2011

Promoting physical activity and motor development among preschool-aged children: The Jump Start pilot randomised controlled trial

Annaleise Riethmuller
University of Wollongong

Recommended Citation
http://ro.uow.edu.au/theses/3399
NOTE

This online version of the thesis may have different page formatting and pagination from the paper copy held in the University of Wollongong Library.

UNIVERSITY OF WOLLONGONG

COPYRIGHT WARNING

You may print or download ONE copy of this document for the purpose of your own research or study. The University does not authorise you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site. You are reminded of the following:

Copyright owners are entitled to take legal action against persons who infringe their copyright. A reproduction of material that is protected by copyright may be a copyright infringement. A court may impose penalties and award damages in relation to offences and infringements relating to copyright material. Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.
Promoting physical activity and motor development among preschool-aged children: The Jump Start pilot randomised controlled trial

A thesis submitted in fulfilment of the requirements for the award of the degree

Doctor of Philosophy

from

The University of Wollongong

by

Annaleise Riethmuller
Bachelor of Education (Early Childhood)(Honours)

Faculty of Education

2011
DECLARATION

I, Annaleise Riethmuller, declare that this thesis is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Signed

Annaleise Riethmuller
ACKNOWLEDGEMENTS

Thank you very much to my supervisors, my colleagues, and my family and friends for their patient support of this research project, and the writing of this thesis. In particular, I wish to acknowledge that particularly important to the completion of this candidature were the professional and/or personal support offered by Associate Professor Tony Okely, Dr. Rachel Jones, Dr. Kylie Hesketh, Dr. Jillian Trezise, Dr. Louisa Peralta, Dr. Lauren Puglisi, Dr. Dylan Cliff, Dr. Marijka Batterham, Jacqueline Kelly, Xanne Jansen, Vicki Riethmuller, Kimberley Baker, Katyana Baker, Rosanne Baker, Emily Travers, Lisa Macgeorge, Clare Travers, Sarah Schachtel, Kate Peters, and my wonderful husband Dan.

I wish to also thank Illawarra Children’s Services for the opportunity to conduct research within their centres, and the participating child care centres’ staff, children and parents, for their willingness and commitment to participating in the research process.

Throughout my candidature I was supported by an Australian Postgraduate Award. The Proof-of-Concept trial and pilot RCT were supported by University of Wollongong Faculty Grants.
PREFACE

This candidate was involved collaboratively with her supervisors in the design of the intervention. The implementation and evaluation of the intervention was overseen by this candidate, with the assistance of her supervisors, data collection personnel and a statistician. Where persons other than this candidate were involved in implementing or evaluating this intervention their involvement is noted throughout this thesis (e.g. where statistical analyses were conducted by a statistician or where data were collected by blinded assessors). Specifically, this candidate’s involvement included: liasing with centres, delivering all professional development content (workshops, demonstration lessons, demonstration unstructured activities, and mentoring), organising all equipment, organising necessary assistance (e.g. data collectors and a second researcher to code interviews), providing training for data collectors, entering data, analysing data, and writing this thesis. Due to time constraints, this candidate did not write the manuscript arising from the pilot randomised controlled trial, reported in this thesis, and was therefore not the first author on the manuscript.
ABSTRACT

The preschool years (3 – 5 years of age) are an important time to influence key health behaviours such as physical activity. Engaging in sufficient physical activity during the preschool years has the potential to decrease the risk of health consequences later in life. However, a large proportion of preschool-aged children do not meet current physical activity recommendations.

Preschool-aged children’s participation in physical activity is influenced by a number of factors, one of which is fundamental movement skill proficiency. Fundamental movement skills are the foundation for physical activity with mastery requiring practice, feedback and encouragement. Australian preschool children currently demonstrate low levels of fundamental movement skill proficiency.

Child care settings are an ideal place to promote physical activity and fundamental movement skill development. Approximately 84% of Australian children are enrolled in formal child care (e.g. long day care centres) the year before starting school, which means that a large proportion of the preschool population could be targeted. Additionally, child care settings are required to support physical development and they generally have the resources to promote physical activity and to support fundamental movement skill development (e.g. space and equipment).

This thesis reports on two trials that informed the development, implementation and evaluation of a fundamental movement skill development intervention (Jump Start), targeting three- to five-year old children enrolled in long day care centres: a Proof-of-Concept trial followed by a pilot Randomised Controlled Trial (pilot RCT). The aim of both studies was to test the feasibility (screening, recruitment and retention and collection of useable data), acceptability (implementation of planned professional development, structured lessons and unstructured activities, and staff acceptability), and potential efficacy (changes in physical activity and fundamental movement skill development) of Jump Start. Physical activity levels and fundamental movement skill proficiency were encouraged through structured lessons and unstructured activities delivered by setting staff in long day care settings. Both trials were underpinned by Social Cognitive Theory, and attempted to influence behaviour change through modifying the child care environment, and targeting cognitive and personal factors (e.g.
teaching that fundamental movement skills are mastered through practice) and behaviour (e.g. practicing fundamental movement skills through regular and enjoyable games).

The Proof-of-Concept trial was a single group design involving 37 three- to five-year old children attending one long day care centre (mean age 4.8y, SD = 0.45). Measures were collected at pre-intervention and at post-intervention (8-weeks). The intervention had three components: professional development (1 day workshop), structured lessons (20min, 3 x per week) and unstructured activities (3 per week). Results showed that the intervention was feasible and acceptable, however a small number of issues were identified for modification for the pilot RCT, including: unsatisfactory implementation of lessons by staff, low return of staff lesson evaluations, and barriers to collection of objective data (such as fear of instruments and regular absences).

The pilot RCT was a 20-week, 2-arm parallel group trial involving 97 three- to five-year old children who were randomly assigned at the centre level to either the intervention (n = 52) or comparison group (n = 45). The intervention comprised three components: 1) Professional development which consisted of 4 x 30 minute workshops delivered in staff meetings, 15 demonstration structured lessons, and 14 demonstration unstructured activities; 2) 43 staff-implemented structured lessons; and 3) 44 staff-implemented unstructured activities. Three structured lessons and three unstructured activities were delivered each week, with five focus skills covered during the intervention period (run, jump, hop, catch, kick).

The pilot RCT confirmed that the Jump Start program was feasible, acceptable, and potentially efficacious. All feasibility and acceptability targets were met with the exception of implementation of unstructured activities. All potential efficacy hypotheses were met, with the exception of physical activity levels at post-intervention. A significantly greater increase for total physical activity was found for the intervention group, compared with the comparison group, during the intervention (adjusted diff = 110.48, 95% CI = 33.62, 187.33, p = 0.01), however this was not maintained at post-intervention. At post-intervention a greater increase was found for all fundamental movement skills in the intervention group compared with the comparison group, with statistically significant differences found for jump (adjusted diff = 1.41, 95% CI = 0.69, 2.13, p < 0.001) and total fundamental movement skill score (adjusted diff = 2.08, 95% CI = 0.76, 3.40, p < 0.001), Additionally a greater decrease was found in the
intervention group, compared with the comparison group, for body mass index (adjusted diff = -0.08, 95% CI = -0.33, 0.17, \(p = 0.53\)).

This study’s findings reinforce the potential that child care settings (e.g. long day care) hold for promoting physical activity and fundamental movement skill proficiency among preschool-aged children. Future efficacy studies that are adequately powered to detect statistically significant differences between groups are now needed to confirm these results.
TABLE OF CONTENTS

1. INTRODUCTION ........................................................................................................................................... 1
   1.1 PURPOSE OF THE STUDY ......................................................................................................................... 3
   1.2 RESEARCH QUESTIONS, TARGETS AND HYPOTHESES ................................................................. 3
       1.2.1 Research Question One and Related Targets .................................................................................... 3
       1.2.2 Research Question Two and Related Targets .................................................................................. 4
       1.2.3 Research Question Three and Hypotheses ....................................................................................... 4
   1.3 OVERVIEW OF METHODOLOGIES USED IN THE STUDY ................................................................... 5
   1.4 SIGNIFICANCE OF THE STUDY .............................................................................................................. 5
   1.5 BACKGROUND TO THE STUDY .............................................................................................................. 6
   1.6 DELIMITATIONS ...................................................................................................................................... 6
   1.7 LIMITATIONS .......................................................................................................................................... 6
   1.8 DEFINITION OF TERMS ............................................................................................................................ 7
   1.9 OVERVIEW OF THESIS ........................................................................................................................... 8

2. LITERATURE REVIEW ....................................................................................................................................... 11
   2.1 HEALTH BENEFITS OF PHYSICAL ACTIVITY ......................................................................................... 11
   2.2 TRACKING OF PHYSICAL ACTIVITY IN PRESCHOOL-AGED CHILDREN ................................................ 12
   2.3 PREVALENCE OF PHYSICAL ACTIVITY IN PRESCHOOL-AGED CHILDREN ........................................ 14
       2.3.1 Prevalence of Habitual Physical Activity ......................................................................................... 15
       2.3.2 Prevalence of Physical Activity During Child Care Hours ............................................................. 20
       2.3.3 Summary ........................................................................................................................................ 21
   2.4 CORRELATES OF PHYSICAL ACTIVITY .................................................................................................. 23
       2.4.1 Evidence of Fundamental Movement Skill Proficiency as a Correlate of Physical Activity ............ 30
   2.5 PROMOTING PHYSICAL ACTIVITY AND FUNDAMENTAL MOVEMENT SKILLS AMONG PRESCHOOL-AGED CHILDREN ........................................................................................................ 33
       2.5.1 Rationale for Targeting Formal Child Care Settings ....................................................................... 33
       2.5.2 Interventions to Promote Physical Activity and/or Fundamental Movement Skills in Child Care Settings ......................................................................................................................... 34
           2.5.2.1 Design and Instruments ............................................................................................................... 42
           2.5.2.2 Methodological Quality ............................................................................................................. 42
           2.5.2.3 Intervention Components ......................................................................................................... 45
           2.5.2.4 Efficacy ..................................................................................................................................... 46
           2.5.2.5 Alignment with CONSORT and TREND Statements ................................................................. 48
           2.5.2.6 Summary ................................................................................................................................ 48
   2.6 CHAPTER SUMMARY AND FURTHER RESEARCH .............................................................................. 49

3. THEORETICAL FRAMEWORK .......................................................................................................................... 52
   3.1 THEORETICAL FRAMEWORKS OF SIMILAR INTERVENTIONS ................................................................ 52
   3.2 SOCIAL COGNITIVE THEORY ................................................................................................................ 55
       3.2.1 How Social Cognitive Theory Informed the Current Intervention .................................................. 56
   3.3 CHAPTER SUMMARY ............................................................................................................................... 61

4. METHODS: PROOF-OF-CONCEPT TRIAL .................................................................................................... 62
   4.1 INTRODUCTION ....................................................................................................................................... 62
   4.2 OBJECTIVES .......................................................................................................................................... 63
   4.3 PARTICIPANTS ........................................................................................................................................ 63
       4.3.1 Recruitment ...................................................................................................................................... 63
       4.3.2 Inclusion and Exclusion Criteria ...................................................................................................... 64
   4.4 TRIAL DESIGN ....................................................................................................................................... 64
       4.4.1 Professional Development .............................................................................................................. 64
       4.4.2 Structured Lessons .......................................................................................................................... 65
       4.4.3 Unstructured Activities ................................................................................................................... 67
       4.4.4 Additional Support for Centre Staff ................................................................................................ 68
   4.5 MEASURES AND PROCEDURES ............................................................................................................. 68
       4.5.1 Primary Outcomes ........................................................................................................................... 68
           4.5.1.1 Objectively Measured Physical Activity .................................................................................. 68

vii
4.5.1.2  Fundamental Movement Skills................................................................. 71
4.5.2  Secondary Outcomes.................................................................................. 73
4.5.2.1  Body Mass Index .................................................................................... 73
4.5.3  Process Data ............................................................................................... 74
4.5.3.1  Attendance .............................................................................................. 74
4.5.3.2  Percentage of Planned Structured Lessons and Unstructured Activities.............................................. 74
4.5.3.3  Staff Confidence and Competence with Teaching Physical Activity.................................................... 75
4.5.3.4  Staff Enjoyment and Appropriateness of Trial Components ................................................................. 75
4.5.3.5  Staff Attitudes Toward Physical Activity .................................................. 76
4.6  DATA ANALYSES.......................................................................................... 77
4.6.1  Data Handling and Management................................................................. 77
4.6.2  Primary Outcomes .................................................................................... 77
4.6.2.1  Objectively Measured Physical Activity .................................................. 77
4.6.2.2  Fundamental Movement Skills ............................................................... 78
4.6.3  Secondary Outcomes ................................................................................ 78
4.6.3.1  Body Mass Index .................................................................................... 78
4.6.4  Process Data ............................................................................................... 79
4.6.4.1  Attendance .............................................................................................. 79
4.6.4.2  Implementation of Planned Structured Lessons ....................................... 79
4.6.4.3  Staff Attitudes ......................................................................................... 79
4.7  CHAPTER SUMMARY.................................................................................... 80
5.  RESULTS: PROOF-OF-CONCEPT TRIAL ...................................................... 81
5.1  INTRODUCTION............................................................................................. 81
5.2  RESEARCH QUESTIONS............................................................................... 81
5.3  RESEARCH TARGETS AND HYPOTHESES............................................... 82
5.3.1  Feasibility ................................................................................................ 82
5.3.2  Acceptability ......................................................................................... 82
5.3.3  Potential Efficacy ................................................................................... 82
5.4  PARTICIPANTS ............................................................................................. 82
5.4.1  Child Participants .................................................................................... 82
5.4.1.1  Pre-Intervention Characteristics ............................................................. 83
5.4.2  Staff Participants ...................................................................................... 84
5.5  IMPLEMENTATION OF TRIAL AND PROCESS OUTCOMES...................... 85
5.5.1  Feasibility ................................................................................................ 85
5.5.1.1  Target One: Screening and Recruitment ............................................... 86
5.5.1.2  Target Two: Retention .......................................................................... 86
5.5.1.3  Target Three: Data Collection ............................................................... 86
5.5.1.4  Process Data Related to Feasibility ....................................................... 87
5.5.2  Acceptability ........................................................................................... 89
5.5.2.1  Target Four: Implementation of Professional Development Content.................... 89
5.5.2.2  Process Data Related to Target Four .................................................... 89
5.5.2.3  Target Five: Implementation of Structured Lessons ................................ 90
5.5.2.4  Process Data Related to Target 5........................................................... 92
5.5.2.4.1  Lesson Appropriateness .................................................................... 92
5.5.2.4.2  Staff Perception of Children’s Enjoyment of Structured Lessons .............. 94
5.5.2.4.3  Staff Confidence and Perceived Competence .................................... 94
5.5.2.5  Target Six: Implementation of Unstructured Activities ............................ 96
5.5.2.6  Process Data Related to Target Six ....................................................... 96
5.5.2.6.1  Facilitation of Unstructured Activities ............................................... 96
5.5.2.6.2  Perceived Children’s Enjoyment of Unstructured Activities ................. 97
5.5.2.7  Target Seven: Children’s Attendance .................................................... 97
5.5.2.8  Process Data Related to Acceptability .................................................. 98
5.5.2.8.1  Additional Support ............................................................................ 98
5.5.3  Potential Efficacy .................................................................................... 99
5.5.3.1  Hypothesis One: Physical Activity Trends.............................................. 100
5.5.3.2  Hypothesis Two: Fundamental Movement Skill Trends ........................ 100
5.5.3.3  Hypothesis Three: Body Mass Index .................................................... 100
5.6  SUMMARY OF RESULTS.......................................................................... 101
5.7  DISCUSSION.................................................................................................. 104
5.7.1  Feasibility ................................................................................................ 104
5.7.1.1  Screening and Recruitment ................................................................. 104
5.7.1.2  Retention .............................................................................................. 104
5.7.1.3  Data Collection .................................................................................... 104
5.7.2 Acceptability .................................................................................................................. 105
5.7.2.1 Implementation of Professional Development .......................................................... 105
5.7.2.2 Implementation of Structured Lessons ....................................................................... 106
5.7.2.3 Implementation of Unstructured Activities .............................................................. 107
5.7.2.4 Children’s Attendance .............................................................................................. 107
5.7.2.5 Process Measures Related to Acceptability ............................................................. 108
5.7.2.5.1 Staff Lesson Evaluations .................................................................................. 108
5.7.2.5.2 Lesson Appropriateness .................................................................................... 108
5.7.2.5.3 Staff Confidence and Perceived Competence ................................................... 109
5.7.2.5.4 Staff Preparation ............................................................................................... 110
5.7.2.5.5 Additional Support ............................................................................................ 111
5.7.3 Potential Efficacy ......................................................................................................... 111
5.7.3.1 Primary Outcomes .................................................................................................. 111
5.7.3.2 Secondary Outcomes ............................................................................................. 113
5.8 CHAPTER SUMMARY ..................................................................................................... 113

6. METHODS: PILOT RANDOMISED CONTROLLED TRIAL ................................................. 114

6.1 INTRODUCTION .............................................................................................................. 114
6.2 OBJECTIVES ..................................................................................................................... 114
6.3 PARTICIPANTS .................................................................................................................. 115

6.3.1 Recruitment .................................................................................................................. 115
6.3.2 Children’s Inclusion and Exclusion Criteria .................................................................. 115
6.3.3 Staff Inclusion and Exclusion Criteria ......................................................................... 115
6.3.4 Randomisation .............................................................................................................. 115

6.4 INTERVENTION DESIGN ................................................................................................ 116

6.4.1 Professional Development ............................................................................................ 116
6.4.2 Structured Lessons ....................................................................................................... 118
6.4.3 Unstructured Activities ............................................................................................... 122
6.4.4 Additional Changes .................................................................................................... 122

6.5 MEASURES AND PROCEDURES ...................................................................................... 123

6.5.1 Centre Similarity ........................................................................................................... 123
6.5.1.1 Family Socio-Economic Status .............................................................................. 123
6.5.1.2 Interviews .............................................................................................................. 124
6.5.1.3 Director Questionnaire ......................................................................................... 124
6.5.1.4 Visual Audit ........................................................................................................... 125
6.5.1.5 Indoor/Outdoor Environment Sketches and Photographs .................................... 126

6.5.2 Primary Outcomes ...................................................................................................... 126
6.5.2.1 Objectively Measured Physical Activity ................................................................. 126
6.5.2.2 Fundamental Movement Skills .............................................................................. 127

6.5.3 Secondary Outcomes .................................................................................................. 127
6.5.3.1 Body Mass Index ................................................................................................... 127
6.5.4 Process Data ................................................................................................................ 128
6.5.4.1 Staff Attitudes ....................................................................................................... 128
6.5.4.2 Structured Lesson Evaluations and Journal Entries ............................................... 128
6.5.4.3 Percentage of Planned Structured Lessons and Unstructured Activities Implemented ................................................................................................................. 129
6.5.4.4 Staff Enjoyment and Perceived Appropriateness ..................................................... 129

6.6 DATA ANALYSES .......................................................................................................... 129

6.6.1 Data Handling and Management .................................................................................... 129
6.6.2 Centre Similarity .......................................................................................................... 129
6.6.2.1 Parent Education .................................................................................................... 129
6.6.2.2 Pre-Intervention Interviews ................................................................................... 130
6.6.2.3 Director Questionnaire ......................................................................................... 130
6.6.2.4 Visual Audit ........................................................................................................... 130
6.6.2.5 Indoor/Outdoor Environment Sketches and Photographs .................................... 131

6.6.3 Primary Outcomes ....................................................................................................... 131
6.6.3.1 Objectively Measured Physical Activity ................................................................. 132
6.6.3.2 Fundamental Movement Skills .............................................................................. 132

6.6.4 Secondary Outcomes .................................................................................................. 133
6.6.4.1 Body Mass Index ................................................................................................... 133

6.6.5 Process Data ................................................................................................................ 133
6.6.5.1 Staff Attitudes ....................................................................................................... 133
6.6.5.2 Implementation of Planned Structured Lessons ...................................................... 133
6.6.5.3 Lesson Evaluations and Journal Entries .................................................................. 133
6.6.5.4 Staff Enjoyment and Perceived Appropriateness ..................................................... 134
6.7 CHAPTER SUMMARY ........................................................................................................134

7. RESULTS: PILOT RANDOMISED CONTROLLED TRIAL ...........................................135

7.1 RESEARCH QUESTIONS ..........................................................................................135

7.2 RESEARCH TARGETS AND HYPOTHESES ..........................................................136

7.2.1 Feasibility ..............................................................................................................136

7.2.2 Acceptability .........................................................................................................136

7.2.3 Potential Efficacy ..................................................................................................136

7.3 PARTICIPANTS AND SETTINGS ..............................................................................137

7.4 SETTING SIMILARITY ............................................................................................137

7.4.1 Child Participants .................................................................................................138

7.4.2 Staff Participants ..................................................................................................139

7.5 IMPLEMENTATION OF TRIAL AND PROCESS OUTCOMES ................................140

7.5.1 Feasibility ..............................................................................................................140

7.5.1.1 Target One: Screening, Recruitment and Randomisation .................................141

7.5.1.2 Target Two: Retention .........................................................................................141

7.5.1.3 Target Three: Data Collection ............................................................................142

7.5.2 Acceptability ..........................................................................................................143

7.5.2.1 Target Four: Delivery of Professional Development ...........................................143

7.5.2.2 Process Data Related to Target Four ................................................................144

7.5.2.3 Target Five: Implementation of Structured Lessons ..........................................145

7.5.2.4 Process Data Related to Target Five ................................................................146

7.5.2.5 Target Six: Staff Assessment of Lesson Appropriateness .................................147

7.5.2.6 Process Data Related to Target Six ..................................................................149

7.5.2.6.1 Lesson Components .......................................................................................149

7.5.2.6.2 Additional factors ............................................................................................151

7.5.2.6.3 Equipment .......................................................................................................151

7.5.2.6.4 Set up/Pack up .................................................................................................152

7.5.2.6.5 Location ..........................................................................................................152

7.5.2.6.6 Length .............................................................................................................152

7.5.2.6.7 Number of Activities .......................................................................................153

7.5.2.6.8 Frequency of Lessons .....................................................................................153

7.5.2.6.9 Children’s Enjoyment and Participation .........................................................154

7.5.2.6.10 Staff Attitudes ...............................................................................................154

7.5.2.7 Target Seven: Implementation of Unstructured Activities ...............................156

7.5.2.8 Process Data Related to Target Seven ..............................................................156

7.5.3 Potential Efficacy ..................................................................................................157

7.5.3.1 Hypothesis One: Physical Activity Trends During-Intervention ........................157

7.5.3.2 Hypothesis Two: Physical Activity Trends Post-Intervention ...........................157

7.5.3.3 Hypothesis Three: Fundamental Movement Skill Trends ................................160

7.5.3.4 Hypothesis Four: Body Mass Index ..................................................................160

7.6 SUMMARY OF RESULTS .......................................................................................162

8. DISCUSSION: PILOT RANDOMISED CONTROLLED TRIAL ..............................165

8.1 RESEARCH QUESTION ONE: FEASIBILITY .........................................................165

8.1.1 Target One: Screening, Recruitment and Randomisation .................................166

8.1.1.1 Summary of Results .........................................................................................166

8.1.1.2 Comparison With Other Studies .......................................................................166

8.1.1.3 Possible Mechanisms and Explanations .........................................................168

8.1.2 Target Two: Retention .........................................................................................169

8.1.2.1 Summary of Results .........................................................................................169

8.1.2.2 Comparison With Other Studies .......................................................................169

8.1.2.3 Possible Mechanisms and Explanations .........................................................171

8.1.3 Target Three: Collection of Useable Data ............................................................172

8.1.3.1 Summary of Results .........................................................................................172

8.1.3.2 Comparison With Other Studies .......................................................................172

8.1.3.3 Possible Mechanisms and Explanations .........................................................175

8.1.4 Feasibility: Limitations .........................................................................................176

8.1.5 Feasibility: Recommendations ............................................................................176

8.2 RESEARCH QUESTION TWO: ACCEPTABILITY .................................................177

8.2.1 Target Four: Delivery of Professional Development ...........................................177

8.2.1.1 Summary of Results .........................................................................................177

8.2.1.2 Comparison With Other Studies .......................................................................178
8.2.1.3 Possible Mechanisms and Explanations ........................................ 186
8.2.2 Target Five: Implementation of Planned Structured Lessons .................. 188
8.2.2.1 Summary of Results ........................................................................ 188
8.2.2.2 Comparison With Other Studies ..................................................... 188
8.2.2.3 Possible Mechanisms and Explanations ........................................... 190
8.2.3 Target Six: Staff Reported Lesson Appropriateness .............................. 191
8.2.3.1 Summary of Results ........................................................................ 191
8.2.3.2 Comparison With Other Studies ..................................................... 191
8.2.3.3 Possible Mechanisms and Explanations ........................................... 193
8.2.4 Target Seven: Implementation of Unstructured Activities ...................... 194
8.2.4.1 Summary of Results ........................................................................ 194
8.2.4.2 Comparison With Other Studies ..................................................... 194
8.2.4.3 Possible Mechanisms and Explanations ........................................... 197
8.2.5 Acceptability: Limitations .................................................................... 197
8.2.6 Acceptability: Recommendations ......................................................... 198
8.3 QUESTION THREE: POTENTIAL EFFICACY ....................................... 199
8.3.1 Hypothesis One: Physical Activity During-Intervention ....................... 199
8.3.1.1 Summary of Results ........................................................................ 199
8.3.1.2 Comparison With Other Studies ..................................................... 199
8.3.1.3 Possible Mechanisms and Explanations ........................................... 200
8.3.2 Hypothesis Two: Physical Activity Post-Intervention ............................ 200
8.3.2.1 Summary of Results ........................................................................ 200
8.3.2.2 Comparison With Other Studies ..................................................... 201
8.3.2.3 Possible Mechanisms and Explanations ........................................... 203
8.3.3 Hypothesis Three: Mastery of Fundamental Movement Skills ............... 203
8.3.3.1 Summary of Results ........................................................................ 203
8.3.3.2 Comparison With Other Studies ..................................................... 204
8.3.3.3 Possible Mechanisms and Explanations ........................................... 207
8.3.4 Hypothesis Four: Changes to Body Mass Index ..................................... 208
8.3.4.1 Summary of Results ........................................................................ 208
8.3.4.2 Comparison With Other Studies ..................................................... 208
8.3.4.3 Possible Mechanisms and Explanations ........................................... 210
8.3.5 Potential Efficacy: Limitations .............................................................. 210
8.3.6 Potential Efficacy: Recommendations .................................................. 210
8.4 STUDY STRENGTHS ............................................................................. 212
8.5 STUDY LIMITATIONS ........................................................................... 213
8.6 SOURCES OF BIAS .............................................................................. 214
8.7 STUDY GENERALISABILITY ................................................................. 215
8.8 SUMMARY, RECOMMENDATIONS AND CONCLUSIONS .................... 215
8.8.1 Summary ............................................................................................ 215
8.8.2 Recommendations ............................................................................. 216
8.8.3 Conclusions ....................................................................................... 216
9. REFERENCES .......................................................................................... 217
10. APPENDICES ......................................................................................... 229

Appendix A: Background Article: Formative Research Study Which Informed the Current Study ................................................................. 230
Appendix B: Systematic Review of Physical Activity and Fundamental Movement Skill Interventions ............................................................... 240
Appendix C: Ethics Approval ....................................................................... 252
Appendix D: Sample Lesson ........................................................................ 254
Appendix E: Proof-of-Concept Trial: Unstructured Activities ....................... 255
Appendix F: Test of Gross Motor Development (2nd Ed.) (Ulrich, 2000) ............ 257
Appendix G: Proof-of-Concept Trial: Staff Confidence and Competence Questionnaire ................................................................. 261
Appendix H: Proof-of-Concept Trial: Professional Development Feedback Questionnaire ................................................................. 270
Appendix I: Proof-of-Concept Trial: Lesson Evaluation Template ................. 275
Appendix J: Proof-of-Concept Trial: Post-Intervention Semi-Structured Interview Questions ................................................................. 276
Appendix K: Proof-of-Concept Trial: Pre-Intervention Staff Attitudes Towards Physical Activity Focus Group Questions .......................... 278
APPENDIX L. PROOF-OF-CONCEPT TRIAL: RESULTS OF STAFF CONFIDENCE AND COMPETENCE QUESTIONNAIRE

APPENDIX M. PILOT RCT: DETAILS OF PROFESSIONAL DEVELOPMENT WORKSHOPS

APPENDIX N. PILOT RCT: ADDITIONAL UNSTRUCTURED ACTIVITIES

APPENDIX O. PILOT RCT: PARTICIPANT CONSENT FORM

APPENDIX P. PILOT RCT: PRE-INTERVENTION INTERVIEW QUESTIONS FOR STAFF

APPENDIX Q. PILOT RCT: DIRECTOR QUESTIONNAIRE

APPENDIX R. PILOT RCT: VISUAL AUDIT OF PHYSICAL ACTIVITY SUPPORTING ENVIRONMENTS

APPENDIX S. PILOT RCT: LESSON EVALUATION TEMPLATE (EXAMPLE)

APPENDIX T. PILOT RCT: POST-INTERVENTION INTERVIEW QUESTIONS

APPENDIX U. PILOT RCT: ACCEPTED MANUSCRIPT

APPENDIX V. PILOT RCT: FLOOR PLAN SKETCHES OF PARTICIPATING CENTRES

APPENDIX W. PILOT RCT: PHOTOGRAPHS OF INDOOR AND OUTDOOR ENVIRONMENTS OF PARTICIPATING CENTRES

APPENDIX X. PILOT RCT: SUMMARY TABLES OF PARTICIPANTS ETHNIC AND SOCIO-ECONOMIC STATUS

APPENDIX Y. PILOT RCT: IMPLEMENTATION FIDELITY

APPENDIX Z. PILOT RCT: LESSON EVALUATION MEAN SCORES BY THIS CANDIDATE (APPROPRIATENESS OF LESSON COMPONENTS)

APPENDIX AA. PILOT RCT: LESSON EVALUATION MEAN SCORES BY THIS CANDIDATE (ADDITIONAL FACTORS)
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2.1</td>
<td>Tracking of physical activity from 0 - 5 years</td>
<td>13</td>
</tr>
<tr>
<td>Table 2.2</td>
<td>Prevalence of habitual physical activity among preschool-aged children (CPM, %SED, %LPA, %MVPA &amp; %VPA)</td>
<td>16</td>
</tr>
<tr>
<td>Table 2.3</td>
<td>Prevalence of physical activity while attending child care among preschool-aged children (CPM, %SED, %LPA, %MVPA &amp; %VPA)</td>
<td>22</td>
</tr>
<tr>
<td>Table 2.4</td>
<td>Correlates of physical activity among preschool-aged children</td>
<td>24</td>
</tr>
<tr>
<td>Table 2.5</td>
<td>Summary of physical activity interventions implemented in formal child care settings (1990 - 2010)</td>
<td>36</td>
</tr>
<tr>
<td>Table 2.6</td>
<td>Summary of fundamental movement skill interventions implemented in formal child care settings (1990-2010)</td>
<td>38</td>
</tr>
<tr>
<td>Table 2.7</td>
<td>Methodological quality of physical activity and fundamental movement skill interventions implemented in formal child care settings (1990 – 2010) (adapted from van Sluijs et al., 2007)</td>
<td>44</td>
</tr>
<tr>
<td>Table 3.1</td>
<td>Processes of Attention, Retention, Production and Motivation as addressed in the Jump Start intervention</td>
<td>59</td>
</tr>
<tr>
<td>Table 4.1</td>
<td>Proof-of-Concept trial: Planned delivery timeline</td>
<td>66</td>
</tr>
<tr>
<td>Table 5.1</td>
<td>Proof-of-Concept trial: Pre-intervention characteristics of participants</td>
<td>84</td>
</tr>
<tr>
<td>Table 5.2</td>
<td>Proof-of-Concept trial: Percentage of useable data collected</td>
<td>87</td>
</tr>
<tr>
<td>Table 5.3</td>
<td>Proof-of-Concept trial: Implementation fidelity</td>
<td>91</td>
</tr>
<tr>
<td>Table 5.4</td>
<td>Proof-of-Concept trial: Changes to primary and secondary outcome measures</td>
<td>99</td>
</tr>
<tr>
<td>Table 5.5</td>
<td>Proof-of-Concept trial: Summary of results</td>
<td>101</td>
</tr>
<tr>
<td>Table 6.1</td>
<td>Pilot RCT: Planned delivery timeline</td>
<td>120</td>
</tr>
<tr>
<td>Table 7.1</td>
<td>Pilot RCT: Pre-intervention characteristics of participants</td>
<td>139</td>
</tr>
<tr>
<td>Table 7.2</td>
<td>Pilot RCT: Percentage of useable data collected</td>
<td>142</td>
</tr>
<tr>
<td>Table 7.3</td>
<td>Pilot RCT: Mean staff scores for appropriateness of lesson components</td>
<td>148</td>
</tr>
<tr>
<td>Table 7.4</td>
<td>Pilot RCT: Mean staff scores for additional lesson factors</td>
<td>150</td>
</tr>
<tr>
<td>Table 7.5</td>
<td>Pilot RCT: Changes to primary (physical activity) outcome measures</td>
<td>159</td>
</tr>
<tr>
<td>Table 7.6</td>
<td>Pilot RCT: Changes to primary (fundamental movement skills) and secondary outcome measures</td>
<td>161</td>
</tr>
<tr>
<td>Table 7.7</td>
<td>Pilot RCT: Summary of results</td>
<td>162</td>
</tr>
<tr>
<td>Table 8.1</td>
<td>Comparison with other studies: Professional development</td>
<td>180</td>
</tr>
<tr>
<td>Table 8.2</td>
<td>Comparison with other studies: Physical activity</td>
<td>202</td>
</tr>
<tr>
<td>Table 8.3</td>
<td>Comparison with other studies: Fundamental movement skills</td>
<td>205</td>
</tr>
<tr>
<td>Table 8.4</td>
<td>Comparison with other studies: Body mass index</td>
<td>209</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

FIGURE 3.1 SOCIAL COGNITIVE THEORY TRIADIC RECIPROCALITY MODEL (BANDURA, 1986, p24) ...... 56
FIGURE 3.2 CORRELATES OF PHYSICAL ACTIVITY ARRANGED ACCORDING TO THE SOCIAL ECOLOGICAL MODEL ................................................................. 58
FIGURE 5.1 PROOF-OF-CONCEPT: FLOW OF PARTICIPANTS THROUGH TRIAL......................... 85
FIGURE 6.1 EXAMPLE PROFESSIONAL DEVELOPMENT WORKSHOP STRUCTURE (WORKSHOP 1) .......... 118
FIGURE 7.1 PILOT RCT: FLOW OF PARTICIPANTS THROUGH TRIAL.............................................. 140
1. INTRODUCTION

The preschool years, defined in this thesis as three- to five-years of age, have been identified as a critical time for the development of health behaviours, such as physical activity (Ward, Vaughn, McWilliams, & Hales, 2010). There are several reasons for promoting physical activity in these preschool years. For example, physical activity is associated with several health benefits for young children such as increased bone mineralization (Janz et al., 2010), reduced presence of cardiovascular risk factors (Sääkslahti et al., 2004), smaller gains in adiposity (Okely, Salmon, Trost, & Hinkley, 2008) and increased self-esteem (Alpert, Field, Goldstein, & Perry, 1990). Such associations are strengthened as age increases, thereby highlighting the importance of physical activity from a young age (Strong et al., 2005; Warburton, Witney Nicol, & Bredin, 2006). Additionally, although the evidence is limited at the moment, physical activity behaviours seem to track moderately from younger children to older children (i.e. a child who is more active during the preschool years is likely to be more active in early primary school) (Pate, Baranowski, Dowda, & Trost, 1996; Sääkslahti et al., 2004). Therefore, the physical activity of a young child may be sustained and so influence their later life.

The physical activity behaviour of a preschool-aged child is influenced by a number of factors such as sex (with boys being more active than girls) and child care practices and policies (such as the presence of a physical activity policy, or the amount of free play time available) (Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008). Moderate evidence also suggests that fundamental movement skill proficiency is related to physical activity in young children (Fisher et al., 2005a; Williams et al., 2008; Cliff, Okely, Smith, & McKeen, 2009a). Fundamental movement skills are referred to as the building blocks for physical activity and encompass locomotor skills (such as running, jumping and leaping) as well as object control skills (such as catching, kicking and striking) (Gallahue & Ozmun, 2002). These skills are learnt through a process of practice, feedback and encouragement (Gallahue, 1996).

Child care settings are a valuable site to promote physical activity and develop fundamental movement skills for a number of reasons. First, with the majority of children attending child care for at least the year before school (AEDI National Report, 2009), child care settings provide the opportunity to reach large numbers of children.
Second, where interventions are delivered at the setting, barriers to participation, such as travel, are reduced (Riethmuller, Jones, & Okely, 2009a). Third, a child care based physical activity and/or fundamental movement skill intervention could be delivered by setting staff, as part of their government mandated responsibility to support physical development, which means that such an intervention would support current practice (Australian Government, 2009; Department of Health and Ageing, 2009) and be potentially sustainable (Riethmuller et al., 2009a). Fourth, child care settings tend to share a level of similarity in staff/child ratios, available space, and policies (as opposed to home environments) which means child care based interventions are potentially generalisable to similar child care settings (Hesketh & Campbell, 2010). Finally, although fundamental movement skills are foundational for physical activity, proficiency in these skills among preschool children is currently low, and does not appear to increase as a result of natural maturation or later schooling. Mastery of fundamental movement skills among Australian four year olds ranges from 6% (girls strike) to 76% (boys run) (Hardy, King, Farrell, Macniven, & Howlett, 2010a), with mastery ranging from 8% (girls kick) to 68% (girls gallop) by the end of high school (Booth et al., 2006) (the highest mastery among boys was found to be 67% mastery for catch).

To date, only 13 physical activity and/or fundamental movement skill interventions implemented in child care centres have been trialled. These interventions varied greatly in sample size (range \( n = 27 \) – 1,050) and duration (range = 4 weeks – 1 year). The majority employed a randomised controlled trial (RCT) design; with four employing a non-randomised controlled trial design. Unfortunately, interventions were limited by a number of weaknesses including: an absence of process measures being reported (such as staff acceptability and program design), which prevents the study from informing the design of future interventions (Stevens, Taber, Murray, & Ward, 2007); insufficient detail to calculate effect sizes, which would allow comparison between studies; absence of recruitment and retention rates; and poor methodological quality, most notably the lack of reporting of statistical analysis methods and the absence of blinded assessors. Furthermore, few interventions were underpinned by a theoretical framework or closely aligned with the Transparent Reporting of Evaluations with Non-randomised Design (TREND) (Des Jarlais, Lyles, Crepaz, Abbasi, & TREND Group, 2004) or Consolidate Standards of Reporting Trials (CONSORT) statements (Moher et al., 2010), which are
designed to guide transparent reporting of trials. Finally, at the time the current study was implemented, there had been no similar (implemented in child care, targeting physical activity and/or fundamental movement skills) Australian-based randomised or controlled trials reported. At the time of writing only one other Australian-based intervention had been reported (Hardy, King, Kelly, Farrell, & Howlett, 2010b). To add to the body of evidence available and to address these shortfalls, a fundamental movement skill development program, called Jump Start, was designed, implemented and evaluated.

1.1 PURPOSE OF THE STUDY

The aim of this study was to assess the feasibility, acceptability and potential efficacy of a fundamental movement skill development program (Jump Start). Jump Start was designed to be implemented by child care staff, and to increase physical activity levels through promoting fundamental movement skill development among three- to five-year old children: A Proof-of-Concept trial and a pilot RCT were implemented.

1.2 RESEARCH QUESTIONS, TARGETS AND HYPOTHESES

The research questions, targets and hypotheses below were derived for the pilot RCT conducted in 2008, and were informed by the findings of the Proof-of-Concept trial. The Proof-of-Concept trial was guided by similar research questions and hypotheses.

1.2.1 Research Question One and Related Targets

Was the Jump Start program feasible, assessed by screening and recruiting a sufficient number of intervention and comparison participants, retaining these participants and collecting a predetermined proportion of useable data at pre-intervention and post-intervention?

It was proposed that the program would be feasible if:

Target One: 60 participants could be screened, recruited and randomised at the centre level to either the comparison group ($n = 30$) or the intervention group ($n = 30$);

Target Two: 80% of intervention and comparison participants could be retained from pre-intervention to post-intervention (20-week period);
Target Three: 100% of pre-intervention and post-intervention measurement data collected would be useable, except for objectively measured physical activity (90% of useable pre-intervention and post-intervention data collected).

1.2.2 Research Question Two and Related Targets

Was the program acceptable, as assessed by all planned professional development sessions being implemented, all planned structured lessons and unstructured activities being implemented, and staff perception of suitability?

It was proposed that the pilot RCT would be acceptable if:

Target Four: 100% of planned professional development sessions (4 x workshops, 15 x demonstration lessons, 14 x unstructured activities) were delivered;

Target Five: 100% of planned structured lessons (43) were implemented;

Target Six: Staff reported 90% of lesson content as appropriate;

Target Seven: 100% of planned unstructured activities (44) were implemented.

1.2.3 Research Question Three and Hypotheses

Was the program potentially efficacious, as assessed by greater increases in physical activity and fundamental movement skill competence, and similar change in body mass index (BMI), in the intervention centre compared with the comparison centre?

It was hypothesised that at during-intervention testing (defined as 18-weeks after pre-intervention testing), compared with participants allocated to the comparison group, participants in the treatment group would show the following trends:

Hypothesis One: Greater increases in physical activity during child care hours, during-intervention.

It was hypothesised that at post-intervention (20-weeks after pre-intervention testing), compared with participants allocated to the comparison group, participants in the treatment intervention program would show the following trends:

Hypothesis Two: Greater increases in physical activity during child care hours;

Hypothesis Three: Greater competence in fundamental movement skills;

Hypothesis Four: Similar change in BMI.
1.3 OVERVIEW OF METHODOLOGIES USED IN THE STUDY

Prior to the pilot RCT, a Proof-of-Concept trial was conducted. The Proof-of-Concept trial assessed the feasibility, acceptability and potential efficacy of the Jump Start program among a single group of 37 preschool-aged children (3 - 5 years) from one long day care centre. The Proof-of-Concept trial was conducted from October to November 2007, with measurements collected at pre-intervention and post-intervention (8 weeks).

The pilot RCT (Jump Start) was a 20-week, intervention with an intervention group (n = 52) and an active comparison group (n = 45). The active comparison group allowed the potential efficacy of Jump Start to be more thoroughly tested. Primary outcomes were physical activity and fundamental movement skills. The secondary outcome was BMI (kg/m²). Primary outcomes were measured objectively using accelerometers and video assessments, respectively. To minimise measurement bias, primary and secondary outcome measures were collected by blinded assessors.

1.4 SIGNIFICANCE OF THE STUDY

There is a dearth of child care based physical activity and fundamental movement skill interventions, and of the interventions that have been conducted there is a tendency for them to be limited by poor methodological quality, an absence of feasibility and acceptability outcomes, the use of different data collection instruments, and the reporting of different measures, limiting the comparison of results (Riethmuller et al., 2009a; Ward et al., 2010).

At the time of implementation, no child care based physical activity or fundamental movement skill intervention, using an objective measure of physical activity or fundamental movement skills, had been trialled in Australian child care settings, and only one other has been reported to date (Hardy et al., 2010b). If physical activity levels and/or fundamental movement skill proficiency of preschool-aged children are not targeted, low levels of physical activity (Reilly, 2010) and low fundamental movement skill proficiency (Hardy et al., 2010a) of preschoolers are likely to continue.

To address the shortfalls of current child care based physical activity and fundamental movement skill interventions, the Jump Start program was designed and trialled. Jump Start focused on fundamental movement skill development. The program comprised;
professional development (implemented by this candidate), in addition to both structured lessons and unstructured activities that were largely delivered by setting staff.

1.5 **BACKGROUND TO THE STUDY**

*Jump Start* was designed following formative research conducted in three distinct formal child care settings (long day care, family day care and preschools) in 2006 (Riethmuller, Okely, McKeen, Bell, & Sanigorski, 2009b). A summary of this research can be found in Appendix A.

1.6 **DELIMITATIONS**

This study was delimited in the following manner:

1. Participants were aged three- to five-years, and were enrolled in the participating long day care settings’ preschool rooms on the days of the intervention.

2. Participating centres were all drawn from and recommended by *Illawarra Children’s Services*. Centres were chosen based on available outdoor space and perceived high staff motivation.

3. Physical activity was assessed by collecting two days of accelerometry data from each participant, during child care hours only. Measures were collected over a two-week period.

4. Fundamental movement skill proficiency was video assessed using the validated instrument, *Test of Gross Motor Development* (2nd ed.) (Ulrich, 2000).

5. Height and weight was assessed and used to calculate BMI.

6. This study focused on increasing physical activity and developing fundamental movement skills through professional development of child care setting staff, and the implementation of structured lessons and unstructured activities.

1.7 **LIMITATIONS**

Although all efforts were made to adhere to standardised research designs and consistent study protocols, uncontrollable circumstances existed that may have influenced the results of the study. These were:

1. The pilot RCT included a wait-list control group (referred to hereafter as the comparison group). The Australian guidelines for child care settings mandate
inclusion of physical activity in child care programs (Australian Government, 2009), therefore the comparison centre, continuing with their normal program, was seen as an appropriate indication of whether the Jump Start intervention influenced increased physical activity and fundamental movement skill proficiency over current programming in child care settings.

2. Measurement reactivity may have influenced results, particularly the self-report measures (lesson evaluations) where staff may have been tempted to report positively due to the presence of the researcher in the centre. Staff were encouraged and reminded to report honestly in an effort to prevent this.

1.8 DEFINITION OF TERMS

The following definitions are provided to guide understanding of themes specific to the study.

- **Body mass index**: Defined as weight in kilograms divided by height in metres squared (weight [kg]/ height [m]$^2$) (Cole, Bellizzi, Flegal, & Dietz, 2000).

- **Emergent curriculum**: The preferred and recommended mode of programming in Australian child care settings prior to the development of a National Early Years Learning Framework and is similar to play-based learning. Planning of learning experiences were informed by individual interests and the child(ren) would direct the learning experience according to their interests and experimentation (Stonehouse, 2001).

- **Jump Start**: This is the title of the fundamental movement skill development program trialled in this study.

- **Light physical activity (LPA)**: Activity requiring approximately less than three times as much activity as rest (1.6 < 3 METs) (Norton, Norton, & Sadgrove, 2010).

- **Long day care**: Formal centre-based child care where care is available for longer hours than a typical school or preschool program (e.g. 7am to 7pm as opposed to 9am to 3pm). Long day care centres tend to program according to play-based learning strategies, and have minimal structured or pre-planned, teacher-directed learning periods (Riethmuller et al., 2009b).
• **Moderate-to-vigorous physical activity (MVPA):** Activity requiring approximately greater than three times as much activity as rest (≥ 3 METs) (Centres for Disease Control and Prevention, 2010).

• **Physical activity:** Bodily movement that is produced by contraction of the skeletal muscle and that substantially increases energy expenditure (Bouchard & Shephard, 1994).

• **Play-based learning:** Child directed learning through active engagement with people, objects and representations. Child care staff facilitate this by encouraging children towards deeper understanding and fostering connections between ideas, concepts and processes (Australian Government, 2009).

• **Preschool-aged children:** Children aged between three- and five-years (not necessarily attending a preschool).

• **Sedentary behaviour:** Activity that usually involves either sitting or lying, and has little or no energy requirements above rest (< 1.6 METs) (Norton et al., 2010).

• **Total physical activity:** Physical activity as recorded by an accelerometer and reported as activity counts per minute (CPM) (Cliff, Reilly, & Okely, 2009b).

• **Vigorous physical activity (VPA):** Activity requiring greater than or equal to six times as much activity as rest (≥ 6 METs) (Centres for Disease Control and Prevention, 2010).

**1.9 OVERVIEW OF THESIS**

This thesis reports the findings of two trials aimed at assessing the feasibility, acceptability and potential efficacy of a child care based fundamental movement skill development program for three- to five-year-old children. The initial study, the Proof-of-Concept trial, focused on evaluating the feasibility, acceptability and potential efficacy aspects of the program to maximise data collection, and acceptability of the pilot RCT conducted the following year.

The first chapter (*Introduction*) outlines the background to the research and describes the purpose of the study. The chapter provides a brief overview of the methods, the significance of the study, delimitations and limitations of the study and a glossary of terms specific to this thesis.
Chapter two (Literature Review) follows a behavioural epidemiology framework to review literature leading to the development of the current study, as well as a review and evaluation of physical activity and fundamental movement skill development interventions.

Chapter three (Theoretical Framework) provides an overview of the theoretical frameworks underpinning similar studies. Social Cognitive Theory is described and its use in the current study is justified.

Chapter four (Methods: Proof-of-Concept) describes the methodology of the Proof-of-Concept trial, which assessed the feasibility, acceptability and potential efficacy of the Jump Start program among three- to five-year-old children attending one long day care setting. Description of the setting, design, delivery, instruments, data collection procedures, data management and analysis are provided. The chapter is reported according to the Transparent Reporting of Evaluations with Non-Randomised Designs (TREND) statement (Des Jarlais et al., 2004).

Chapter five (Results: Proof-of-Concept) reports the findings of the Proof-of-Concept trial. As this trial was not designed to have sufficient statistical power, and has no control group, the value of the findings is predominately in the feasibility and acceptability data, which informed the development of the pilot RCT. As with the previous chapter, these results are presented using the TREND statement (Des Jarlais et al., 2004).

Chapter six (Methods: Pilot RCT) describes the methodology for the pilot RCT, which was similar to the Proof-of-Concept trial, the most notable difference being the use of a comparison group. Descriptions of the modifications to program design following the Proof-of-Concept trial and used in the pilot RCT are provided. This chapter follows the guidelines presented in the CONSORT statement (Moher et al., 2010).

Chapter seven (Results: Pilot RCT) details the findings of the pilot RCT. Again the trial was not adequately powered to detect statistically significant differences between the intervention and comparison groups, however trends are reported and effect sizes are calculated to allow comparison with other studies. Data are presented following the CONSORT statement (Moher et al., 2010).
Chapter eight (*Discussion*) summarises the main findings and compares them with similar studies. Findings are then explained in light of current literature. Recommendations are provided in this chapter for future fundamental movement skill development interventions delivered through long day care settings.
This chapter will follow a behavioural epidemiology framework to review and evaluate the literature on physical activity and fundamental movement skill interventions for child care settings. Evidence pertaining to preschool-aged children (3 – 5 years) will be the focus. This chapter will appraise the evidence of the benefits, prevalence and correlates of physical activity levels that are relevant to this thesis. Correlates of physical activity will be presented using an Ecological Systems Model, which conceptualises the individual’s behaviour as being influenced by the context in which it is embedded; at an individual, family, child care and then wider community level (Birch & Davison, 2001). This chapter will conclude with a review and a critique of child care based interventions that incorporate an objective outcome measure of physical activity or fundamental movement skill development.

2.1 HEALTH BENEFITS OF PHYSICAL ACTIVITY

Physical activity has been linked with strong associations to a number of health benefits in school-aged children (5 - 12 years), adolescents and adults, some of which include reduced risk of cardiovascular disease, diabetes, cancer, and osteoporosis (Warburton et al., 2006), increased aerobic fitness, reduced incidence of mental health issues including anxiety and depression, and increased self-concept in areas of physical, social and academic competence (Strong et al., 2005).

The links between physical activity and health benefits are not hypothesised to be as strong in preschool-aged children as in older children, adolescents and adults, due to the benefits of physical activity being accrued over sustained periods of time. That is, a preschool-aged child usually is ‘healthy’ and free of the risk factors related to physical activity levels (Okely et al., 2008). However, there is still some evidence of an association between physical activity and several health outcomes or benefits in preschool-aged children (Okely et al., 2008). Physical activity in preschool-aged children has been linked to increased bone mineral content (Janz et al., 2001; Specker & Binkley, 2003; Janz et al., 2010), lower scores for cardiovascular disease risk factors, including cholesterol levels and blood pressure (Shea et al., 1994; Sääkslahti et al., 1999; Sääkslahti et al., 2004), lower BMI measures (indicating reduced risk of adiposity...
related health consequences) (Jago, Baranowski, Baranowski, Thompson, & Greaves, 2005a; O’Brien et al., 2007; Monasta et al., 2010a), increased fitness (Alpert et al., 1990), agility (Alpert et al., 1990), higher self-esteem (Alpert et al., 1990) and social competence (Lobo & Winsler, 2006; Griffiths, Dowda, Dezateux, & Pate, 2010) and fewer emotional problems (Griffiths et al., 2010).

Stronger evidence of links between health outcomes and physical activity for older children, adolescents and adults, suggests that establishing physically active habits from a young age may have long term health benefits (Okely et al., 2008). The link between preschool-aged children’s physical activity levels and physical activity levels later in life is best measured longitudinally, and is referred to as tracking of physical activity. Current evidence available regarding tracking of physical activity from early childhood is reviewed in the following section.

### 2.2 TRACKING OF PHYSICAL ACTIVITY IN PRESCHOOL-AGED CHILDREN

Tracking refers to a relationship between the prevalence of a given behaviour (in this case, physical activity) at different time points. If statistical analyses reveals that there is a relationship between the prevalence of a given behaviour at the two, or more, distinct time points it is then surmised that the behaviour has some level of stability or tracks.

This section reviews the evidence for tracking of physical activity among children where the first measure was conducted while participants were aged between three- and five-years. A total of six studies were identified, and are summarised in Table 2.1, below. Of these, the majority used objective measures of physical activity (5/6), including direct observation. Analyses of tracking split between reporting a Spearman Rank Order correlation (3/6) or Pearson Product-Moment correlation (4/6), with one study reporting both (Pate et al., 1996). Data collection periods ranged from one to three years. The majority of studies collected data at 12 month intervals, with one study comparing tracking at one week and 6 months in addition to 12 month time points (Sallis, Berry, Broyles, McKenzie, & Nader, 1995).
Table 2.1  Tracking of physical activity from 0 - 5 years

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample characteristics</th>
<th>Time period</th>
<th>Physical activity measure</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sallis et al. (1995)</td>
<td>( n = 351 ) (( n ) boys not specified), mean age = 4.4y</td>
<td>2y (bi-annual measures)</td>
<td>Direct observation (BEACHES), 60min at home and 30min during school recess, 2d.</td>
<td>Pearson Product-Moment correlations for home based physical activity ranged from ( r = 0.12 - 0.36 ) (18mo and 12mo intervals, respectively). Pearson Product-Moment correlations for school recess physical activity ranged from ( r = 0.03 - 0.20 ) (18mo and 6mo intervals, respectively).</td>
</tr>
<tr>
<td>Pate et al. (1996)</td>
<td>( n = 47 ) (22 boys), mean age = 3.5y</td>
<td>3y (annual measures)</td>
<td>Heart rate monitor (hours between 3 - 6pm used in analyses, minimum of 120min).</td>
<td>Spearman Rank Order correlations between baseline and 2y ( r = 0.66 ), 2y and 3y ( r = 0.61 ), baseline and 3y ( r = 0.57 ). Pearson Product-Moment correlations between baseline and 2y ( r = 0.53 ), 2y and 3y ( r = 0.58 ), and baseline and 3y ( r = 0.63 ).</td>
</tr>
<tr>
<td>Jackson et al. (2003); Kelly et al. (2007)</td>
<td>( n = 60 ) (30 boys), mean age = 3.8y followed up at 1y; 42 (( n ) boys not specified), followed up at 2y</td>
<td>2y</td>
<td>Accelerometers (1min epochs), 3d (inc 1 weekend day, minimum 6h/d) and 7d at 24mo follow-up.</td>
<td>Spearman Rank Order correlations between baseline and 1y for CPM was ( r = 0.40 ) (( p &lt;0.001 )); between baseline and 2y for CPM was ( r = 0.35 ) (( p &lt;0.02 )) and MVPA ( r = 0.37 ) (( p = 0.02 )).</td>
</tr>
<tr>
<td>Metcalf et al. (2004); Voss et al. (2003)</td>
<td>( n = 307 ) (170 boys), mean age 4.9y</td>
<td>1y</td>
<td>Accelerometers (1min epochs), 7d.</td>
<td>Pearson Product-Moment correlations between baseline and 1y were ( r = 0.49 ) (girls) and ( r = 0.55 ) (boys).</td>
</tr>
<tr>
<td>Sääkslahti et al. (2004)</td>
<td>( n = 155 ) (82 boys), mean age 4.9y</td>
<td>3y (bi-annual measures combined to give one measure/year)</td>
<td>Parent report (diary), 2d.</td>
<td>Pearson Product-Moment correlations between baseline and 1y ranged from ( r = 0.20 - 0.62 ) (girls low active playing and boys low active playing, respectively) and between 2y and 3y ranged from ( r = 0.61 - 0.74 ) (girls high active playing and boys high active playing, respectively).</td>
</tr>
<tr>
<td>Taylor et al. (2009)</td>
<td>( n = 241 ) (137 boys), age range = 2.96 – 3.15y</td>
<td>2y (annual measures)</td>
<td>Accelerometers (epoch length not reported), 5d, 24h.</td>
<td>Spearman Rank Order correlations for active time were 1y to 2y ( r = 0.32 ), 2y to 3y ( r = 0.41 ) and 1y to 3y ( r = 0.29 ).</td>
</tr>
</tbody>
</table>

*Correlations are classified as follows: <0.30 = low, 0.3-0.5 = moderate, >0.5 = high; \( y \) = year(s); BEACHES = Behaviors of Eating and Activity for Child Health: Evaluation System; min = minutes; d = days*; mo = months; h = hours; / = per; CPM = Counts per minute; MVPA = Moderate to vigorous physical activity.
Spearman Rank Order correlations ranged from 0.29 to 0.66, and Pearson Product-Moment correlations ranged from 0.03 to 0.74 across studies. Correlations of <0.3, 0.3 - 0.5, >0.5 are generally classed as weak, moderate and strong, respectively (Choudhury, 2009). Two studies reported weak-to-moderate tracking of physical activity (range $r = 0.03 - 0.41$) (Sallis et al., 1995; Taylor et al., 2009), one reported moderate tracking (range $r = 0.35 - 0.40$) (Kelly et al., 2007), one reported moderate-to-strong tracking (range $r = 0.49 - 0.55$) (Metcalf et al., 2004), and two reported strong tracking (range $r = 0.53 - 0.74$) (Pate et al., 1996; Sääkslahti et al., 2004).

These studies indicate that physical activity is likely to track moderately from the preschool years into the early primary school years. These findings suggest that preschool-aged children who participate in low levels of physical activity may be more likely to have lower levels of physical activity participation in later life. Additionally, the evidence physical activity behaviours track from early childhood into primary school, suggests that increasing preschool-aged children’s participation in physical activity may result in health benefits that extend beyond the short-term years of early childhood (see Section 2.1). The current prevalence of physical activity among preschool-aged children will be examined in the following section.

2.3 PREVALENCE OF PHYSICAL ACTIVITY IN PRESCHOOL-AGED CHILDREN

The prevalence of physical activity in preschool-aged children has been reported in a number of studies. Time spent in habitual physical activity (a measure of physical activity across all waking hours) and time spent being physically active while in a child care setting were summarised separately to allow for possible differences to be identified. These studies are summarised in Tables 2.2 (p15) and 2.3 (p21), respectively. Inclusion criteria set a priori were that: All studies would be published in the last 20 years; have a sample size >100; and employ an objective measure of physical activity (including direct observation). To allow comparison between studies, it was later decided that only studies that report physical activity as either counts per minute (CPM), or percentage of time spent in sedentary, light (LPA), moderate (of which there was only one, so the value was not included in the final table), vigorous (VPA) or moderate-to-vigorous (MVPA) physical activity would be reported here, as these were the meaningful values that were most commonly reported in the identified studies. Where
available, data for boys and girls are reported separately. In the absence of separated data for boys and girls a total group value is reported, where possible. On some occasions no total group value was available, and in these instances the simplest group configurations available are reported and noted.

2.3.1 Prevalence of Habitual Physical Activity

Twelve studies were identified that reported a measure of habitual physical activity. As shown in Table 2.2 (p15), all reported that the majority of time was spent in sedentary behaviour (range 55% - 85%). All studies reported that percentage of time spent in LPA ranged from 11% - 33% and minimal percentage of time spent in MVPA. Three studies indicated that children spent between 10% - 14% of their time engaged in MVPA (Specker & Binkley, 2003; Williams et al., 2008; Vale, Silva, Santos, Soares-Miranda, & Mota, 2010), while four studies reported lower levels of percentage of time spent in MVPA (2% - 5%) (Fisher et al., 2005a; Fisher et al., 2005b; Reilly et al., 2006; Hinkley, Salmon, Okely, Crawford, & Hesketh, under review).

The variation reported across studies for percentage of time spent in a given intensity may be partly or entirely explained by the different cut-points used. For example, Williams et al. (2008) classified sedentary behaviour as <37.5 counts per 15 seconds (<150 CPM), while other studies classified sedentary behaviour as <1,100 CPM (Fisher et al., 2005a; Fisher et al., 2005b; Reilly et al., 2006; Vale et al., 2010). Similarly, for the studies reporting participants spent between 10% - 14% of time in MVPA a lower cut-point was reported compared with studies reporting participants spent 2% - 5% of time in MVPA (>1,680 CPM compared with >3,200 CPM) (see Table 2.2, below). Consensus as to which cut-points to employ remains unresolved and the use of different cut-points to quantify the raw data from accelerometers into biologically meaningful outcomes has been recognised as leading to marked differences in results (Reilly et al., 2008; Cliff et al., 2009b). Counts per minute is a presentation of the ‘raw’ data, and therefore isn’t subject to this same variation between studies (Cliff et al., 2009b). Six studies presented CPM data, which ranged from 651 – 809 (boys range = 765 – 852 CPM, girls range = 651 – 794 CPM).
### Table 2.2  
Prevalence of habitual physical activity among preschool-aged children (CPM, %Sed, %LPA, %MVPA & %VPA)

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Measure*</th>
<th>Length</th>
<th>Results</th>
</tr>
</thead>
</table>
| Janz et al.      | USA    | Actigraph Accelerometer, 1min epoch | 4d, (minimum 8h x 2d). No comment on zeroes/sleep times. | (1) 765.75 ±176.38  
|                  | n = 368 (% boys not reported), 4-6y | Cut-points (CPM): VPA = >2972 (Freedson, Melanson, & Sirard, 1998) | (2) 700.89 ±160.37 |
|                  |        | Reported: (1) boys and (2) girls | | |
| Finn, Johannsen  | USA    | Actiwatch Accelerometer, 1min epochs | 48h. Data excluded if it appeared the monitor was removed (no further details). | (1) 5.2 ±0.2  
| & Specker        | n = 214 (106 boys), 3-5y | Cut-points (CPM): 1,000 = VPA (based on unpublished data) | (2) 4.5 ±0.2 |
|                  |        | Reported: (1) boys and (2) girls | | |
| Janz et al.      | USA    | Actigraph Accelerometer, 1min epochs, excluded periods of no movement >60min | 4d (consecutive, including 1 w/end day, minimum 8h x 3d). Periods ≥60min zeroes were removed. | (1) 774 ±207  
|                  | n = 467 (% boys not reported), 4-6y | Cut-points (CPM): MPA = ≥ 615 – 2,972 VPA = ≥ 2972 (Freedson et al., 1997) | (2) 703 |
|                  |        | Reported: (1) boys and (2) girls | | |
| Jackson et al.   | UK     | Actigraph Accelerometer, 1 min epochs | 3d (2 w/day, 1 w/end, minimum 6h x 3d). | (1) 777 ±207  
|                  | n = 104 (52 boys), 3-4y | Used raw output data (CPM) | (2) 651 ±172 |
|                  |        | Reported: (1) boys and (2) girls | | |

*Separate values for boys and girls are reported where available. On some occasions these values were not available and the simplest group configuration available were reported and noted (e.g. Whole sample); CPM = Counts per minute; Sed = sedentary; LPA = Light physical activity; MVPA = Moderate-to-vigorous physical activity; VPA = vigorous physical activity; y = years of age; min = minutes; d = days; h = hours; w/end = weekend; w/day = weekday
<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Measure*</th>
<th>Length</th>
<th>Results</th>
<th>CPM</th>
<th>% Sed</th>
<th>% LPA</th>
<th>% MVPA</th>
<th>% VPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specker &amp; Binkley (2003), USA</td>
<td>n = 239 (94 boys), 3 – 5y</td>
<td>Actiwatch Accelerometer, epoch length unspecified</td>
<td>48h (minimum wear requirement not reported). No comment on zeroes/sleep times.</td>
<td></td>
<td>(1) 12.1 ± 4.0</td>
<td>(1) 4.5 ± 2.2</td>
<td>(2) 12.8 ± 4.6</td>
<td>(3) 12.4 ± 4.7</td>
<td>(4) 14.0 ± 5.4</td>
</tr>
<tr>
<td>Fisher et al. (2005a), UK</td>
<td>n = 394 (% boys not reported), mean 4.2y</td>
<td>Actigraph Accelerometer 1min epoch Cut-points (CPM): Sed = &lt;1100 (Reilly et al., 2003), LPA = 1100-3200, MVPA = &gt;3200 (Puyau, Adolph, Vohra, &amp; Butte, 2002) Reported: Whole sample</td>
<td>6d (minimum 9h x 3d), no comment on zeroes/sleep times.</td>
<td></td>
<td>76.3 ± 6.8±</td>
<td>20.3 ± 5.3±</td>
<td>3.4 ± 2.2±</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher et al. (2005b), UK</td>
<td>n = 209 (101 boys), mean 4.8y</td>
<td>Actigraph Accelerometer, no epoch specified Cut-points (CPM): Sed = &lt;1100 (Reilly et al., 2003), LPA = 1100-3200, MVPA = &gt;3200 (Puyau et al., 2002) Reported: (1) Spring, (2) Summer, (3) Autumn, (4) Winter</td>
<td>3 - 7d (minimum 6h per day). No comment on zeroes/sleep times.</td>
<td></td>
<td>(1) 701 ± 191±</td>
<td>(1) 79.5 ± 6.5-34.0</td>
<td>(1) 17.0 ± 5.5-14.0</td>
<td>(1) 2.7 ± 0.5-8.3</td>
<td>(2) 826 ± 180±</td>
</tr>
<tr>
<td>Heelan &amp; Eisenmann (2006), USA</td>
<td>n = 100 (48 boys), 4 - 7y</td>
<td>Actigraph Accelerometer, 1min epoch Cut-points (CPM): MPA = 615-2971, VPA = &gt;2972 (Janz et al., 2002) Reported: (1) boys and (2) girls separately</td>
<td>7d (minimum 8h x 4d, including 1 w/end day). No comment on zeroes/sleep times.</td>
<td></td>
<td>(1) 852.1 ± 226.9</td>
<td>(2) 731.5 ± 209.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Separate values for boys and girls are reported where available. On some occasions these values were not available and the simplest group configuration available were reported and noted (e.g. Whole sample). CPM = Counts per minute; Sed = sedentary; LPA = Light physical activity; MVPA = Moderate-to-vigorous physical activity; VPA = vigorous physical activity; y = years of age; min = minutes; d = days; w/end = weekend; w/day = weekday; h = hours
Table 2.2 Prevalence of habitual physical activity among preschool aged children (cont.)

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Measure*</th>
<th>Length</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CPM % Sed % LPA % MVPA % VPA</td>
</tr>
<tr>
<td>Reilly et al. (2006), UK</td>
<td>n = 545 (273 boys), mean 4.2y</td>
<td>Actigraph Accelerometer, epoch length not defined Cut-points (CPM): Sed = &lt;1100 (Reilly et al., 2003), MVPA = &gt;3200 (Puyau et al., 2002) Reported: (1) intervention boys, (2) intervention girls, (3) comparison boys, and (4) comparison girls</td>
<td>6d (minimum wear requirement not reported). No comment on zeroes/sleep times.</td>
<td>(1) 773 ± 151 67.6 ± 50.5 - 81.3 0.4-9.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Williams et al. (2008), USA</td>
<td>n = 198 (99 boys), 3 - 4y</td>
<td>Actigraph accelerometer, 15sec epochs Cut-points (Counts per 15 sec): Sed = &lt;37.5, LPA = 38-419, MVPA = &gt;420, VPA = &gt;842 (Pate, Almeida, McIver, Pfeiffer, &amp; Dowda, 2006) Reported: Whole sample</td>
<td>5 w/day, 2 w/end days (minimum 5h x 3d), &gt;60min zeroes removed and w/days the child did not attend preschool.</td>
<td>54.8 ±54.8 32.6 ±4.3 12.6 ±3.6 4.5 ±1.0*</td>
</tr>
<tr>
<td>Vale et al. (2010), Portugal</td>
<td>n = 245 (140 boys), 3.5 – 6y</td>
<td>Actigraph accelerometer, 5sec epochs Cut-points (CPM): Sed = &lt;1100, (Reilly et al., 2003), MPA = &gt;1680, VPA = &gt;3360 (Pate et al., 2006) Reported: (1) w/day boys, (2) w/day girls, (3) w/end day boys and (4) w/end day girls</td>
<td>7d (including 1 w/end day) (minimum 10h per day). Averages of 3 w/days + 1 w/end day or 2 w/end day used to calculate w/day and w/end day activity respectively. Sleep time not included. No comment on zeroes.</td>
<td>(1) 81.6 (2) 84.7 (3) 82.8 (4) 85.3 (± not reported)</td>
</tr>
</tbody>
</table>

*Separate values for boys and girls are reported where available. On some occasions these values were not available and the simplest group configuration available were reported and noted (e.g. Whole sample). CPM = Counts per minute; Sed = sedentary; LPA = Light physical activity; MVPA = Moderate-to-vigorous physical activity; VPA = vigorous physical activity; y = years of age; d = days; sec = seconds; w/day = weekday; w/end = weekend; min = minutes; h = hours
Table 2.2 Prevalence of habitual physical activity among preschool aged children (cont.)

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Measure*</th>
<th>Length</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinkley et al. (under review), Australia</td>
<td>n = 427 (230 boys), 3 – 5y</td>
<td>Actigraph Accelerometers, 15 sec epoch Cut-points (Counts per 15sec): 4y Sed = &lt;364, LPA = 364-811, MPA = 812-1234, VPA = &gt;1234; 5y Sed = &lt;399, LPA = 399-890, MPA = 891-1254, VPA = &gt;1254 (Sirard, Trost, Pfeiffer, Dowda, &amp; Pate, 2005) Report: (1) boys and (2) girls</td>
<td>8d (minimum 50% wake time x 3 w/day + 1 w/end day). Sleep times removed. No comment on zeroes.</td>
<td>CPM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1) 730.10 ± 181.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2) 682.62 ± 179.60</td>
</tr>
</tbody>
</table>

*Separate values for boys and girls are reported where available. On some occasions these values were not available and the simplest group configuration available were reported and noted (e.g. Whole sample); CPM = Counts per minute; Sed = sedentary; LPA = Light physical activity; MVPA = Moderate-to-vigorous physical activity; VPA = vigorous physical activity; y = years of age; sec = seconds; d = days; w/day = weekday; w/end = weekend
Based on the details reported, it is difficult to compare these studies to current physical activity recommendations for preschool-aged children, which are three hours of physical activity per day (Australia) (Department of Health and Ageing, 2009) or two hours of physical activity per day and not sedentary for more than one hour unless sleeping (USA) (National Association for Sport and Physical Education, 2002). One study did include these details. Of a sample of 427 Australian three- to five-year olds, it was reported that 7% of boys and 3% of girls met the Australian physical activity recommendations (64% boys and 47% girls meet USA recommendations) (Hinkley et al., under review). This indicates that the habitual physical activity levels of a large number of Australian preschool-aged children are alarmingly low. Given the similarity of habitual physical activity prevalence data between the study by Hinkley and colleagues (under review), and studies based in the USA and UK (See Table 2.2, p15), it is likely that interventions to increase preschool-aged children’s physical activity levels would be of widespread benefit. The habitual physical activity data presented here will be compared to physical activity levels in child care settings in the following section.

2.3.2 Prevalence of Physical Activity During Child Care Hours

Identifying whether there is a difference between children’s habitual physical activity and physical activity within child care hours is valuable for informing whether a child care based intervention could expect to positively impact on physical activity levels. Five studies were identified that reported physical activity during child care hours, and are summarised in Table 2.3 (p21). Similar to those studies reporting habitual physical activity, the highest percentage of time was spent being sedentary (range 55% - 61%). In contrast, the percentage of time spent in MVPA tended to be higher, with the majority of studies reporting 6% - 12% of time spent in MVPA (compared with 2% - 14% for habitual physical activity). Two studies reported a much higher percentage of time spent in MVPA (range 39% - 48%) due to including LPA as MVPA (McKenzie et al., 1997; Trost, Sirard, Dowda, Pfeiffer, & Pate, 2003). For example, of the three studies that measured physical activity using the direct observation tool OSRAP, Trost and colleagues (2003) defined MVPA as a score of three (slow/easy movement) or higher (maximum five), the other two studies defined MVPA as a score of four (moderate movement) or five only (fast movement) (Dowda et al., 2004; Bower et al., 2008). McKenzie and colleagues reported only sedentary behaviour or MVPA, with all
physical activity being categorised as MVPA (McKenzie et al., 1997). With the exception of studies by McKenzie and colleagues (1997) and Trost and colleagues (2003), where the high levels of MVPA are likely explained by reporting a combined percentage of time spent in LPA and MVPA, the seemingly higher percentage of time spent in physical activity within child care hours may be explained by studies not including sleep times (Dowda et al., 2004) and meal times in their analyses (Bower et al., 2008) or only measuring physical activity during recess periods (outdoor free play) (McKenzie et al., 1997; Cardon, Labarque, Smits, & De Bourdeaudhuij, 2009). One study provided data in the raw form of CPM (Trost et al., 2003). The CPM results of that study were slightly higher than those of studies measuring habitual physical activity, with CPM ranging from 841 - 868 (Trost et al., 2003) compared with a range of 651 – 852 among studies measuring habitual physical activity (see Table 2.2, p15). While limited data are available, physical activity levels in child care settings appear to be similar to habitual physical activity levels. This indicates that the finding of Hinkley and colleagues, that preschool-aged children may not be participating in recommended levels of physical activity, may also be applied to children who are attending child care settings. Therefore, child care settings may provide an opportunity to intervene and support the development of healthy physical activity habits.

2.3.3 Summary

In summary, the available evidence suggests that physical activity tracks throughout the preschool years (see Section 2.2). While little research is available, and the variety of instruments and cut-points used make it difficult to draw conclusions, evidence from studies of both habitual and within child care physical activity levels indicate that the prevalence of physical activity is low among preschool-aged children. Given the links between physical activity and health (see Section 2.1), the long-term implications for psychological, physical and socio-emotional health are concerning. Thus a concerted preventative effort to increase both habitual physical activity and physical activity levels within child care settings is warranted and recommended (Deghan, Akhtar-Danesh, & Merchant, 2005; National Preventative Health Taskforce, 2008).
Table 2.3 Prevalence of physical activity while attending child care among preschool-aged children (CPM, %Sed, %LPA, %MVPA & %VPA)

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Measure*</th>
<th>Length</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CPM</td>
</tr>
<tr>
<td>McKenzie et al. (1997), USA</td>
<td>n = 287, boys, mean 4.4y</td>
<td>Direct observation (BEACHES)</td>
<td>Only observed recess periods, mean 25.9 min ± 5.5.</td>
<td>58.9 (± not reported)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cut-points: % of time observed ‘walking’ to ‘very active’ = MVPA Reported: (1) European-American boys, (2) European-American girls, (3) Mexican-American boys, and (4) Mexican-American girls (reported for %MVPA only, whole sample mean score reported for %Sed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trost et al. (2003), USA</td>
<td>n = 245, male, 3 - 5y</td>
<td>Direct Observation (OSRAP) Actigraph Accelerometer, 15sec epochs</td>
<td>DO: 1h x 3d Acc: mean, 4.4h, 6.6d, min 3d (not meal &amp; rest times).</td>
<td>(1) 841.6 ± 14.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cut-points (accelerometers, counts per 15sec): 3y MPA = &gt; 505, VPA = &gt; 1257, 4y MPA = &gt; 543, VPA = &gt; 1295, 5y MPA = &gt; 580, VPA = &gt; 1332 (Sirard, Trost, Dowda, &amp; Pate, 2001) Cut-points (direct observation): % of time observed at levels 3, 4 or 5 = MVPA Reported: (1) overweight boys, (2) overweight girls, (3) non-overweight boys, (4) non-overweight girls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dowda et al. (2004), USA</td>
<td>n = 266, 3 – 5y</td>
<td>Direct observation (OSRAP)</td>
<td>1h, 2 - 3d, morning and afternoons, not rest times.</td>
<td>(1) 55.4 ± 4.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cut-points: % of time observed at levels 4 or 5 = MVPA Reported: (1) &gt; 90min outside p/day, (2) &lt; 90min outside p/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bower et al. (2008), USA</td>
<td>n (centres) = 20 (% boys not reported, 3 – 5y</td>
<td>Direct observation (OSRAP)</td>
<td>8 x 32min periods over 2d per centre (not meal &amp; rest times), children randomly selected, 4 observed per period.</td>
<td>(1) 50.17 ± 6.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cut-points: % of time observed at levels 4 or 5 = MVPA Reported: (1) high quality, (2) low quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardon et al. (2009), Belgium</td>
<td>n = 583, male, mean 5.3y</td>
<td>Actigraph Accelerometer, 15sec epochs</td>
<td>Recess periods only (mean 42min) number of days unclear.</td>
<td>61.3 ± 11.4</td>
</tr>
</tbody>
</table>

*Separate data for boy and girls are presented where available, otherwise the simplest group configuration is presented and noted; CPM = Counts per minute; Sed = Sedentary; LPA = Light physical activity; MVPA = Moderate-to-vigorous physical activity; VPA = vigorous physical activity; y = years of age; min = minutes; DO = Direct observation; Acc = Accelerometer; h = hours; d = days.
2.4 CORRELATES OF PHYSICAL ACTIVITY

Identifying correlates of physical activity allows interventions to target factors that are most likely to influence increased levels of physical activity. The first review of physical activity correlates among preschool children was published by Hinkley and colleagues (2008), and spanned from 1980 to early 2007. A subsequent review of publications to date (July, 2010) was conducted for this chapter. The collated results are summarised in Table 2.4 (below) using a Social Ecological Model, which posits the individual’s behaviour as being influenced by the context in which they are embedded (individual, family, child care, wider community) (Birch & Davison, 2001), as per Hinkley et al.’s original review (2008). Strong positive correlations are classified as 60% - 100% of four or more studies supporting a given association.

Of correlates related to Demographic and biological variables a strong positive relationship was found for ‘gender (boys)’ while a clear lack of correlation for ‘age’ and ‘socio-economic status’ was found. An inconclusive correlation was found for fundamental movement skills, although all studies (n = 4) reported some positive correlations. Weak negative correlations and inconclusive correlations were found for the remaining correlates, including ‘wheezing’, ‘pre-term birth’, ‘BMI’, and ‘parent education’. Psychological, cognitive and emotional variables, such as ‘Intelligence Quotient’ (IQ) and ‘personality’, were each reported in one study only and were all found to be unrelated. Behavioural variables were similarly covered in only a small number of studies, and the results therefore ought to be interpreted with caution. Only one variable, ‘television viewing and sedentary behaviours’, was covered in more than two studies and results were inconclusive. Of Social and cultural variables a clear lack of correlation was found between ‘parent encouragement’ and physical activity, and the findings regarding ‘parent physical activity and familial interaction’ were inconclusive. Other social and cultural variables were examined by three or less studies, including a weak positive correlation for ‘teacher education’ and a weak no correlation for ‘parental discouragement’. One Physical environment variable, ‘preschool attended’, had a strong positive correlation with physical activity. A further three variables were reported in four or more studies, but results were inconclusive; ‘time outdoors or in play spaces’, ‘availability of toys’, ‘weekdays versus weekends’, and ‘weather (warmer)’. A number of other variables were reported in only one or two studies hence are not summarised here.
Table 2.4  Correlates of physical activity among preschool-aged children

<table>
<thead>
<tr>
<th>Variable</th>
<th>Studies reporting a relationship</th>
<th>+/-</th>
<th>Studies reporting no relationship</th>
<th>n/N* (%)</th>
<th>Summary**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic and biological variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family risk (CVD)</td>
<td>Sallis, Patterson, McKenzie, &amp; Nader (1988)</td>
<td>-</td>
<td></td>
<td>1/1 (100)</td>
<td>-</td>
</tr>
<tr>
<td>Wheezing/asthma</td>
<td>Firrincieli et al. (2005), Brasholt et al. (2010)</td>
<td>-</td>
<td>Eijkemans et al. (2008)</td>
<td>2/3 (67)</td>
<td>-</td>
</tr>
<tr>
<td>Pre-term birth</td>
<td>Finn et al. (2002)</td>
<td>-</td>
<td></td>
<td>1/1 (100)</td>
<td>-</td>
</tr>
</tbody>
</table>

+/- indicates a positive or negative relationship found with a given correlate; * n = number of studies finding a relationship, N = total number of studies; ** Summary codes were assigned in the following way, where percentage of studies supported an association were 0% - 33% = 0, 34% - 59% = ?, 60% - 100% = + or -. Additionally, when four or more studies supported an association it was coded as 00, ++ or --; CVD = cardiovascular disease; yo = year olds
### Table 2.4  Correlates of physical activity among preschool aged children (cont.)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Studies reporting a relationship</th>
<th>+/-</th>
<th>Studies reporting no relationship</th>
<th>n/N* (%)</th>
<th>Summary**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic and biological variables (cont.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity (white/non-migrant)</td>
<td>Sallis et al. (1993), Pate et al. (2004) (independent variables &amp; preschool as dummy variable), Kuepper-Nybelen et al. (2005) (with outdoor play/sport),</td>
<td>+</td>
<td>Baranowski et al. (1993), Pate et al. (2004) (independent variables only), Jago, Baranowski, Thompson et al. (2005b)</td>
<td>3/6 (50)</td>
<td>?</td>
</tr>
<tr>
<td>BMI/relative weight</td>
<td>Klesges et al. (1990), Jackson et al. (2003) Klesges et al. (1986) (with intensity)</td>
<td>+</td>
<td>-</td>
<td>2/12 (17)</td>
<td>0</td>
</tr>
<tr>
<td>Socio-economic status</td>
<td>Sallis et al., (1993), Jackson et al. (2003), Kelly et al. (2006), Cliff, Okely et al. (2009a)</td>
<td></td>
<td></td>
<td>0/4 (0)</td>
<td>00</td>
</tr>
<tr>
<td>Parent education</td>
<td>Pate et al. (2004), Hinkley et al. (2010)</td>
<td></td>
<td></td>
<td>0/2 (0)</td>
<td>0</td>
</tr>
<tr>
<td>Fundamental movement skills</td>
<td>Fisher, Reilly, Kelly et al. (2005a), Williams et al. (2008), Cliff, Okely et al. (2009a) (boys) Sääkslahti et al. (1999) (boys running and throw with high level play) Cliff, Okely et al. (2009a) (girls total score and locomotor)</td>
<td>+</td>
<td>-</td>
<td>4/7 (57)</td>
<td>?</td>
</tr>
<tr>
<td>Parent overweight/obesity/BMI</td>
<td>Sallis et al. (1988) (paternal behaviour), Klesges et al. (1990), Finn et al. (2002) (paternal behaviour)</td>
<td>-</td>
<td></td>
<td>3/5 (50)</td>
<td>?</td>
</tr>
</tbody>
</table>

+/- indicates a positive or negative relationship found with a given correlate; *n = number of studies finding a relationship, N = total number of studies; **Summary codes were assigned in the following way, where percentage of studies supported an association were 0% - 33% = 0, 34% - 59% = ? 60% - 100% = + or - . Additionally, when four or more studies supported an association it was coded as 00, ++ or --.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Studies reporting a relationship</th>
<th>+/-</th>
<th>Studies reporting no relationship</th>
<th>n/N* (%)</th>
<th>Summary**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Psychological, cognitive, and emotional variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type A behaviour</td>
<td>Sallis et al. (1988)</td>
<td></td>
<td></td>
<td>0/1 (0)</td>
<td>0</td>
</tr>
<tr>
<td>IQ</td>
<td>Buss et al. (1980)</td>
<td></td>
<td></td>
<td>0/1 (0)</td>
<td>0</td>
</tr>
<tr>
<td>Personality measures</td>
<td>Buss et al. (1980)</td>
<td></td>
<td></td>
<td>0/1 (0)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Behavioural variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prompts/requests from child</td>
<td>Sallis et al. (1993)</td>
<td>+</td>
<td></td>
<td>1/1 (100)</td>
<td>+</td>
</tr>
<tr>
<td>Computer/TV use at preschool</td>
<td>Dowda et al. (2009)</td>
<td>-</td>
<td>Dowda et al. (2004)</td>
<td>1/2 (50)</td>
<td>?</td>
</tr>
<tr>
<td>Participation in organised sports</td>
<td>Sallis et al. (1993), Finn et al. (2002)</td>
<td></td>
<td></td>
<td>0/2 (0)</td>
<td>0</td>
</tr>
<tr>
<td>TV viewing/sedentary</td>
<td>Burdette et al. (2004), Montgomery et al. (2004), Jago, Baranowski, Thompson et al. (2005b)</td>
<td>-</td>
<td>Sallis et al. (1993), Burdette &amp; Whitaker (2005a)</td>
<td>3/6 (50)</td>
<td>?</td>
</tr>
<tr>
<td><strong>Social and cultural variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent PA/ familial interaction</td>
<td>Sallis et al. (1988) (associated with parents VPA), Moore et al. (1991)</td>
<td>+</td>
<td>Sallis et al. (1993), Klesges et al. (1990), Loprinzi &amp; Trost (2010)</td>
<td>2/5 (40)</td>
<td>?</td>
</tr>
<tr>
<td>Familial interaction x family risk</td>
<td>Klesges et al. (1990)</td>
<td>+</td>
<td></td>
<td>1/1 (100)</td>
<td>+</td>
</tr>
<tr>
<td>Prompts by other adults</td>
<td>Sallis et al. (1993)</td>
<td></td>
<td></td>
<td>1/1 (100)</td>
<td>+</td>
</tr>
</tbody>
</table>

* +/- indicates a positive or negative relationship found with a given correlate; * n = number of studies finding a relationship, N = total number of studies; ** Summary codes were assigned in the following way, where percentage of studies supported an association were 0% - 33% = 0, 34% - 59% = ?, 60% - 100% = + or -. Additionally, when four or more studies supported an association it was coded as 00, ++ or --.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Studies reporting a relationship</th>
<th>+/-</th>
<th>Studies reporting no relationship</th>
<th>n/N (%)</th>
<th>Summary **</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social and cultural variables (cont.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Play rules</td>
<td>Sallis et al. (1993) (outdoors and indoors)</td>
<td>-</td>
<td></td>
<td>1/1 (100)</td>
<td>-</td>
</tr>
<tr>
<td>Parental discouragements</td>
<td></td>
<td></td>
<td>Klesges et al (1986), Klesges et al (1990), Jago, Baranowski, Thompson et al (2005b)</td>
<td>0/3 (0)</td>
<td>0</td>
</tr>
<tr>
<td>Community support at preschool</td>
<td>Dowda et al. (2004)</td>
<td></td>
<td></td>
<td>0/1 (0)</td>
<td>0</td>
</tr>
<tr>
<td>Presence of teachers</td>
<td>Cardon et al. (2008) (girls)</td>
<td>-</td>
<td>Cardon et al. (2008) (boys)</td>
<td>1/2 (50)</td>
<td>?</td>
</tr>
<tr>
<td>Parent perceived competence</td>
<td>Loprinzi &amp; Trost (2010)</td>
<td>+</td>
<td></td>
<td>1/1 (100)</td>
<td>+</td>
</tr>
<tr>
<td><strong>Physical environment variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenient play spaces</td>
<td>Sallis et al. (1993), Boldemann et al. (2006)</td>
<td>+</td>
<td></td>
<td>2/2 (100)</td>
<td>+</td>
</tr>
</tbody>
</table>

+/− indicates a positive or negative relationship found with a given correlate; *n* = number of studies finding a relationship, N = total number of studies; **Summary codes were assigned in the following way, where percentage of studies supported an association were 0% - 33% = 0, 34% - 59% = ?, 60% - 100% = + or -. Additionally, when four or more studies supported an association it was coded as 00, ++ or --
### Table 2.4  Correlates of physical activity among preschool aged children (cont.)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Studies reporting a relationship</th>
<th>+/-</th>
<th>Studies reporting no relationship</th>
<th>n/N* (%)</th>
<th>Summary**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical environment variables (cont.)</td>
<td>Frequency in play spaces</td>
<td>+</td>
<td>Sallis et al. (1993)</td>
<td>1/1 (100)</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Number of preschool field trips (≥4)</td>
<td>+</td>
<td>Dowda et al. (2004)</td>
<td>1/1 (100)</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Preschool quality</td>
<td></td>
<td>Dowda et al. (2004)</td>
<td>0/1 (0)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Preschool class size</td>
<td>+</td>
<td>Cardon et al. (2008) (fewer children p/m2)</td>
<td>1/2 (50)</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Neighbourhood safety</td>
<td></td>
<td>Burdette &amp; Whitaker (2005a)</td>
<td>0/1 (0)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Weekday versus weekend</td>
<td>+</td>
<td>Vale et al. (2010)</td>
<td>1/4 (25)</td>
<td>0</td>
</tr>
</tbody>
</table>

*+/− indicates a positive or negative relationship found with a given correlate; *n = number of studies finding a relationship, N = total number of studies; **Summary codes were assigned in the following way, where percentage of studies supported an association were 0% - 33% = 0, 34% - 59% = ?, 60% - 100% = + or −. Additionally, when four or more studies supported an association it was coded as 00, ++ or −−.*
### Table 2.4  Correlates of physical activity among preschool aged children (cont.)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Studies reporting a relationship</th>
<th>+/-</th>
<th>Studies reporting no relationship</th>
<th>n/N (%)</th>
<th>Summary **</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical environment variables (cont.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of day</td>
<td>Benham-Deal (2005) (comparing evening and afternoon)</td>
<td>-</td>
<td>Benham-Deal (2005) (comparing morning and afternoon)</td>
<td>1/2</td>
<td>?</td>
</tr>
<tr>
<td>Playground markings</td>
<td>Cardon et al. (2009)</td>
<td></td>
<td></td>
<td>0/1</td>
<td>0</td>
</tr>
<tr>
<td>Playground space</td>
<td>Dowda et al. (2009)</td>
<td>+</td>
<td></td>
<td>1/1</td>
<td>+</td>
</tr>
<tr>
<td>Natural surfaces</td>
<td>Sugiyama et al. (2010)</td>
<td>+</td>
<td></td>
<td>1/1</td>
<td>+</td>
</tr>
</tbody>
</table>

*/+/- indicates a positive or negative relationship found with a given correlate; n = number of studies finding a relationship, N = total number of studies; Summary codes were assigned in the following way, where percentage of studies supported an association were 0% - 33% = 0, 34% - 59% = ?, 60% - 100% = + or -. Additionally, when four or more studies supported an association it was coded as 00, ++ or --.*
Given that fundamental movement skills are the building blocks of physical activity (Gallahue & Ozmun, 2002), the focus of the current study is to test a fundamental movement skill development resource designed for child care settings. Therefore, the following section will discuss in detail the available evidence regarding fundamental movement skills as a correlate of physical activity in preschool-aged children.

2.4.1 Evidence of Fundamental Movement Skill Proficiency as a Correlate of Physical Activity

All physical activity is performed using a combination of fundamental movement skills, such as running, hopping or catching (Gallahue & Ozmun, 2002). Given that physical activity cannot be performed without some fundamental movement skill ability, experts suggest that fundamental movement skill proficiency is a likely correlate of physical activity (Gallahue & Ozmun, 2002). Strong correlations between fundamental movement skill proficiency and physical activity have consistently been found in older children and adolescents, however there is less evidence available for preschool-aged children (Lubans, Morgan, Cliff, Barnett, & Okely, 2010). Four studies were identified that examined fundamental movement skill proficiency as a correlate of physical activity among preschool-aged children, with all reporting some positive association. Sääkslahti and colleagues (1999) investigated the relationship between physical activity and fundamental movement skills in 105 three- to five-year-old Finnish children. Physical activity was assessed through a validated two-day parent report diary. Fundamental movement skills were assessed using the validated AMP-Inventory (Numminen, 2005, cited in Sääkslahti et al., 1999). For boys, positive correlations were found between throwing at a target from three metres and time spent in very active indoor time ($r = 0.24$, $p = 0.014$), and between running speed and very active play (combined indoor and outdoor) ($r = -0.21$, $p = 0.037$). No relationship was found between both standing broad jump or agility and very active play (combined indoor and outdoor) (both $r = 0.05$, no $p$ values reported). No statistically significant correlations were found between any fundamental movement skills and girls physical activity. The authors suggest that the low correlations may be due to the young age of the participants, however no reasons are suggested for the differences between boys and girls.
Fisher and colleagues (2005a) investigated the relationship between physical activity and fundamental movement skills in a sample of 394 British children, with a mean age of 4.2 years. Habitual physical activity was assessed objectively (6 days) using an Actigraph accelerometer. One-minute epochs were used and data were analysed using Puyau and colleagues (2002) and Reilly and colleagues (2003) cut-points (sedentary = <1,100CPM, LPA = 1,100 - 3,200CPM, MVPA = >3,200). The validated Movement Assessment Battery was used to measure fundamental movement skills (Croce et al., 2001, cited in Fisher et al., 2005a). Total movement score was significantly related to both total physical activity (CPM) and percentage of time spent in MVPA ($r = 0.01, p = 0.039$ and $r = 0.18, p = <0.001$, respectively). That is, the higher the level of physical activity the more proficient the individual’s fundamental movement skills. Total fundamental movement skill score was not related to percentage of time spent in LPA ($r = 0.02, p = 0.625$). Separate results for boys and girls were not reported, however the authors note that the correlations were similar when analyses were also conducted with boys and girls separately.

Williams and colleagues (2008) investigated the relationship between physical activity and fundamental movement skills in a sample of 198 North American three- to four-year olds. Habitual physical activity was objectively assessed (8 - 10 school days and 1 weekend day) using Actigraph accelerometers. Fifteen second epochs were used and cut-points developed by their own research group were used (sedentary = <150CPM, LPA = 151 - 1,676CPM, MVPA = >1,680CPM, VPA = >3,368CPM). The validated CHAMPS motor skill protocol was used to measure fundamental movement skills (Williams et al., 2008). Significant correlations were reported between total fundamental movement skill score and time spent in MVPA ($r = 0.20$) and VPA ($r = 0.26$) ($p$ values not reported). Relationships between object control skills and MVPA ($r = 0.19$) and VPA ($r = 0.24$), and between locomotor skills and MVPA ($r = 0.16$) and VPA ($r = 0.21$) were also found to be significant ($p$ values not reported). There were no associations between fundamental movement skills and time spent in sedentary behaviour or LPA. Analyses reported were for the total sample. Separate results for boys and girls were not reported or commented on.

Lastly, Cliff and colleagues (2009a) investigated the relationship between physical activity and fundamental movement skills in a sample of 46 Australian three- to five-year olds. Habitual physical activity was objectively assessed (7 days) using Actigraph
accelerometers. Physical activity data were collected in one minute epochs and analysed using cut-points derived by Reilly and colleagues (2003) (sedentary = <1100 CPM) and Sirard and colleagues (2005) (MPA 3y = 2460-4920, 4y = 3248-4936, 5y = 3564-5016, VPA 3y = >4920, 4y = >4936, 5y = >5016). The validated Test of Gross Motor Development (2nd ed.) was used to measure fundamental movement skills (Ulrich, 2000). Among boys, weak relationships were found between locomotor scores and percentage of time in MVPA ($r = 0.34, p = 0.098$), object control scores and percentage of time in MPA ($r = 0.52, p = 0.008$), CPM and MVPA ($r = 0.48, p = 0.015$) and CPM ($r = 0.37, p = 0.070$), and between total fundamental movement skill score and percentage of time in MVPA ($r = 0.38, p = 0.061$), VPA ($r = 0.46, p = 0.020$) and CPM ($r = 0.39, p = 0.056$). Among girls, there was no relationship between object control scores and physical activity levels. Locomotor scores were negatively associated with percentage of time in MPA ($r = -0.52, p = 0.015$) and MVPA ($r = -0.50, p = 0.022$), and total fundamental movement skill score and MPA ($r = -0.44, p = 0.047$) and MVPA ($r = -0.46, p = 0.038$). The authors suggest that the differences between boys and girls may be due to psychosocial or environmental factors having a stronger relationship with girls physical activity levels than fundamental movement skills, or that the Test of Gross Motor Development may test skills that are more predominant in physical activities preferred by boys. The authors suggest that a stronger relationship may have been found between girls’ level of physical activity and balance and rhythm skills. Additionally, the authors note that their limited sample may have affected the results.

Based on the available evidence, there is some positive correlation between physical activity and fundamental movement skill proficiency. In light of this evidence, and the finding that preschool-aged children spend the majority of their time engaged in sedentary behaviour, the value of interventions with a focus on physical activity and/or fundamental movement skill development has been highlighted (Hardy et al., 2010a; Hesketh & Campbell, 2010; Ward et al., 2010). The following section will summarise and compare physical activity and/or fundamental movement skill development interventions, to date (December, 2010).
2.5 **PROMOTING PHYSICAL ACTIVITY AND FUNDAMENTAL MOVEMENT SKILLS AMONG PRESCHOOL-AGED CHILDREN**

2.5.1 *Rationale for Targeting Formal Child Care Settings*

Early childhood has been recommended as a target stage for preventative health interventions (Deghan et al., 2005). As discussed previously preschool-aged children tend to be free of health risk factors (see Section 2.1) and are developing health behaviours, such as physical activity behaviours, that may track into later childhood, adolescence and adulthood (see Section 2.2). Concerningly, studies have shown that children currently spend the majority of their time sedentary, and spend only 6% - 12% of their time engaged in MVPA (see Section 2.3), which potentially increases their risk of disease in later adolescence or adulthood (see Section 2.1).

Therefore, interventions to promote physical activity among preschool-aged children have been recommended (Deghan et al., 2005). There are a number of different settings that are potentially suitable for these interventions, including the home, formal child care (e.g. long day care settings) or consultations with health professionals (such as maternal and child health nurses or General Practitioners). Mixed results from interventions implemented in these various settings have been reported and may be attributed in part to the poor quality methodology in most studies (Riethmuller et al., 2009a; Hesketh & Campbell, 2010), and the limited number of studies building on prior trials (Stevens et al., 2007; Hesketh & Campbell, 2010).

Formal child care has been suggested as a valuable setting for early childhood interventions for a number of reasons. First, it has the potential to provide more consistency and structure than home-based interventions. Early childhood settings tend to be characterised by a series of routines that happen every day and that are similar across centres, as opposed to homes that may bear very little resemblance to each other regarding routines, values, or leadership (Hesketh & Campbell, 2010). Second, it provides the opportunity to recruit large numbers of participants due to the absence of barriers such as the inconvenience of travelling to an intervention site (Guzmán, Richardson, Gesell, & Barkin, 2009; Ward, Vaughn, McWilliams, & Hales, 2009), as well as the opportunity to reach a large percentage of the preschool-aged population, with the majority of preschool-aged children attending formal child care prior to beginning schooling (AEDI National Report, 2009). Third, it offers an opportunity to
implement sustainable interventions due to the setting already tending to own appropriate equipment, and employing staff that may be able to be trained to implement the intervention. Finally, Australian early childhood setting staff recognise physical activity as part of their core responsibilities (Pagnini, Wilkenfeld, King, Booth, & Booth, 2007) as instituted by the National Early Years Learning Framework (Australian Government, 2009) and in line with current government health guidelines (Department of Health and Ageing, 2009), and therefore are likely to already be interested in implementing high quality physical activity programs.

However, while child care staff see physical activity as a core responsibility, additional research indicates that children are not sufficiently active while in child care (see Section 2.3.2) and that child care staff tend to lack the confidence, competence, time, equipment and motivation they need to promote physical activity (Riethmuller et al., 2009b). Limited research also indicates that fundamental movement skills may be an important correlate of physical activity to target (see Section 2.4.1), and that child care staff can implement efficacious fundamental movement skill development interventions (Riethmuller et al., 2009a). Therefore, evidence guided interventions to promote physical activity and/or fundamental movement skill development, which are suitable for child care settings, are needed. The next section reviews interventions conducted, to date, in this area.

2.5.2 Interventions to Promote Physical Activity and/or Fundamental Movement Skills in Child Care Settings

This candidate conducted a systematic review to identify all prior physical activity or fundamental movement skill development interventions delivered in child care settings in the last 20 years (1987 - 2007) (see Appendix B) (Riethmuller et al., 2009a). This review was updated to 2010 for this thesis. Thirteen studies were identified following searches of numerous databases (A+ Education, ERIC (Ovid), Medline (Ovid), Health Reference Centre Academic, Sports Discuss, Current Contents Connect, PUBMED, ISI Web of Science, CINAHL, PsychInfo, Australian Family and Society Plus, Expanded Academic ASAP, Dissertation Abstracts, Ebsco Megafile Premier) and several recent reviews (Reilly & McDowell, 2003; Bluford, Sherry, & Scanlon, 2007; Campbell & Hesketh, 2007; Chau, 2007; Riethmuller et al., 2009a; Ward et al., 2009; Hesketh & Campbell, 2010; Monasta et al., 2010b; Ward et al., 2010). The interventions reported
all met inclusion criteria set *a priori* that the study: be either a controlled trial or randomised controlled trial; be implemented in a formal child care setting; be of four weeks duration or greater; have a minimum of eleven participants; collect an objective measure of physical activity and/or fundamental movement skills; and report both pre- and post-intervention measures. Of the thirteen studies identified, three reported physical activity outcomes only (Specker & Binkley, 2003; Trost, Fees, & Dzewaltowski, 2008; Cardon et al., 2009), nine reported fundamental movement skill outcomes only (Connor-Kuntz & Drummer, 1996; Hamilton, Goodway, & Haubenstricker, 1999; Derri, Tsapakidou, Zachopoulou, & Kioumourtzoglou, 2001; Goodway & Branta, 2003; Venetsanou & Kambas, 2004; Deli, Bakle, & Zachopoulou, 2006; Garza Cedillo, 2006; Hardy et al., 2010b; Klein et al., 2010) and one reported both physical activity and fundamental movement skill outcomes (Reilly et al., 2006).

Studies were implemented in the North America (*n* = 6), Europe (*n* = 5), the United Kingdom (*n* = 1), and Australia (*n* = 1). Interventions with a measure of physical activity are summarised in Table 2.5 (below) and interventions with a measure of fundamental movement skills are summarised in Table 2.6 (p37). The design, methodological quality, intervention components, efficacy and alignment with CONSORT or TREND statements were compared for all studies.

An additional three study protocols of large-scale physical activity and fundamental movement skill development interventions in formal child care settings had been released at the time of writing, but no results were available (Niederer et al., 2009; Finch et al., 2010; Roth et al., 2010).
<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample</th>
<th>Design, Setting, &amp; Length</th>
<th>Intervention Groups</th>
<th>Treatment Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specker &amp; Binkley (2003; 2004), USA</td>
<td>n = 178, male = 94 (53%), age = 3 - 5y</td>
<td>RCT, child care centres, 1y</td>
<td>(1) Fine motor experimental; (2) Fine motor comparison; (3) Gross motor experimental; (4) Gross motor comparison</td>
<td>(1) 30min fine motor 1/d + calcium; (2) 30min fine motor 1/d + placebo; (3) 30min gross motor 1/d + calcium; (4) 30min gross motor 1/d + placebo. Treatment delivered by physical activity specialists.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>48h accelerometer (epoch length not defined)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>During-intervention measures: 6mo; Post-intervention: 12mo; follow-up: 18mo and 24mo</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>During-intervention: (3) + (4) &gt; (1) + (2); Post-intervention: (3) + (4) &gt; (1) + (2); follow-up: (18mo): (3) + (4) &gt; (1) + (2); follow-up (24mo): (3) + (4) = (1) + (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>During-intervention: %MVPA = 0.13, %VPA = 0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Post-intervention: %MVPA = 0.17, %VPA = 0.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Follow-up: can’t calculate (insufficient detail)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reilly et al. (2006), UK</th>
<th>n = 545, males = 273 (50%), mean age = 4.2y</th>
<th>Cluster RCT, nurseries 24wk</th>
<th>(1) Intervention; (2) Comparison</th>
<th>(1) 30min sessions 3/wk + resource pack and two leaflets sent home. Nursery based treatment delivered by setting staff after attending three training sessions, with implementation monitored once; (2) Usual care.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Accelerometer (6d) (epoch length not defined)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Post-intervention: (2) &gt; (1) (sig diff MVPA); follow-up: no relevant measures collected (BMI only)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Post-intervention: %MVPA = -0.07, %Sed = 0.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CPM = -0.07, %MVPA = -0.03, %Sed = 0.03</td>
<td></td>
</tr>
</tbody>
</table>

y = year(s); RCT, randomised controlled trial; min = minutes; / = per; d = day(s); hr = hours; mo = months; (3)+ (4) > (1) +(2), groups (3) and (4) increased at post-intervention testing compared with groups (1) and (2); (1) = (2), no difference between groups (1) and (2) at post-intervention testing; %MVPA = percentage of time spent in moderate to vigorous physical activity; %VPA = percentage of time spent in vigorous activity; wk = weeks; BMI = body mass index; CPM = counts per minute; %Sed = percentage of time spent in sedentary behaviour
Table 2.5  Summary of physical activity interventions implemented in formal child care settings (1990 – 2010) (cont.)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample</th>
<th>Design, Setting, &amp; Length</th>
<th>Intervention Groups</th>
<th>Treatment Content</th>
<th>Relevant Outcomes Measured</th>
<th>Testing time points</th>
<th>Results</th>
<th>Effect size (Cohen's d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trost et al. (2008), USA</td>
<td>$n = 42$, male = 55%, age 3 - 5y</td>
<td>RCT, preschool 8wk</td>
<td>(1), (2) Physical activity intervention (3), (4) Comparison</td>
<td>(1), (2) 10min session 2/d (minimum). Encouraged to integrate physical activity into all areas of curriculum. Setting staff attended 1 x 3h training session prior to delivering the intervention, 1 additional professional development session later added to address observed low implementation quality (no length reported); (3), (4) Usual care</td>
<td>Aclerometers (15sec epoch, 2 x 2.5h/wk) and 15min direct observation (OSRAP)</td>
<td>During-intervention: Aclerometers (1), (2) &gt; (3), (4) (sig diff classroom time weeks 5 + 6, 7 + 8); OSRAP (1), (2) &gt; (3), (4) (sig diff: MVPA during circle time, outdoor free choice time and indoor free choice time)</td>
<td>Can't calculate (SD not reported)</td>
<td></td>
</tr>
<tr>
<td>Cardon et al. (2009), Belgium</td>
<td>$n = 583$, boys = 52%, mean age 5.3y</td>
<td>Cluster RCT, preschool 4 - 6 wk</td>
<td>(1) Equipment (2) Markings (3) Equipment &amp; markings (4) Comparison</td>
<td>(1) Equipment provided, and minimum 1h spent introducing the equipment to the children (2) Markings painted on the ground (3) Equipment provided (with min 1h introduction) and markings painted on the ground (4) No professional development, equipment, markings or formal lessons to be implemented</td>
<td>Accelerometer (15sec epoch), measuring 1 x afternoon recess break</td>
<td>Post-intervention: 4 - 6wk</td>
<td>Post-intervention: no differences</td>
<td>(1) %Sed = 0.17, %LPA = -0.29, %MPA = 0.50, %VPA = 0.16, CPE = 0.08 (2) %Sed = 0.46, %LPA = 0.50, %MPA = -0.48, %VPA = -0.16, CPE = -0.29 (3) %Sed = 0.16, %LPA = -0.32, %MPA = -0.28, %VPA = 0.17, CPE = 0.03</td>
</tr>
</tbody>
</table>

y = year(s); RCT, randomised controlled trial; wk = weeks; min = minutes; / = per; d = days; h = hours; sec = seconds; OSRAP = Observational System for Recording Activity in Preschoolers; (1) (2) > (3) (4) = groups (1) and (2) showed greater increases compared with groups (3) and (4); sig diff = significant difference; MVPA = moderate-to-vigorous physical activity; %Sed = percentage of time spent in sedentary behaviour; %LPA = percentage of time spent in light physical activity; %MVPA = percentage of time spent in moderate-to-vigorous physical activity; %VPA = percentage of time spent in vigorous activity; BMI = body mass index; CPE = Counts per (15 sec) epoch
<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample</th>
<th>Design, Setting &amp; Length</th>
<th>Intervention Groups</th>
<th>Treatment Content</th>
<th>Relevant Outcomes Measured</th>
<th>Testing Time Points</th>
<th>Results</th>
<th>Effect Size (Cohen’s d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connor-Kuntz &amp; Drummer (1996), USA</td>
<td>n = 72, male = 37 (51%), mean age = 3.6y</td>
<td>RCT, preschool (disadvantaged), 8wk</td>
<td>(1) Language enriched motor skill lessons; (2) Motor skill lessons without language enrichment</td>
<td>(1) 30min sessions, 3/wk. Language enriched, with instruction in language concepts and labels within the context of physical activity lessons; (2) 30min sessions, 3/wk. Physical activity lessons without language focus. Programs (1) and (2) both delivered by researcher with assistance from setting staff.</td>
<td>Gross motor proficiency (PMDS-2)</td>
<td>Post-intervention = 8wk; Follow-up = 3mo</td>
<td>Post-intervention: (1) = (2); Follow-up: (1) = (2)</td>
<td>Developmentally delayed children = 0.06; Disadvantaged children = 0.21</td>
</tr>
<tr>
<td>Hamilton et al. (1999), USA</td>
<td>n = 27, male = 16 (59%), mean age = 3.9y</td>
<td>Quasi-experimental design (non-equivalent comparison group), preschool (at risk for developmental delays), 8wk</td>
<td>(1) Parent-led fundamental movement skill lessons; (2) Parents involved in regular movement program (movement song and activities)</td>
<td>(1) 45min sessions, 2/wk. Treatment delivered by parents, who were provided 2 x 45min orientation meetings, prior to the intervention, to familiarise them with the skills to be taught in lessons, and 15min demonstration and question time (led by the researcher) prior to each lesson. Researcher was present at lessons; (2) Usual care (teacher led, parent involvement).</td>
<td>Object control skills (TGMD-2)</td>
<td>Post-intervention = 8wk; No follow-up</td>
<td>Post-intervention: (1) &gt; (2) (sig diff)</td>
<td>Could not be calculated (SD not reported)</td>
</tr>
</tbody>
</table>

y = year(s); RCT = randomised controlled trial; wk = weeks; min = minutes; / = per; PMDS-2 = Peabody Motor Development Skills; mo = months; (1) = (2) = no difference between groups 1 and 2; TGMD or TGMD-2 = Test for Gross Motor Development (1st & 2nd edition); (1) > (2) = group 1 demonstrated greater increases compared with group 2; sig diff = significant differences
Table 2.6  Summary of fundamental movement skill interventions implemented in formal child care settings (1990 – 2010) (cont.)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample</th>
<th>Design, Setting &amp; Length</th>
<th>Intervention Groups</th>
<th>Treatment Content</th>
<th>Relevant Outcomes Measured</th>
<th>Testing Time Points</th>
<th>Results</th>
<th>Effect Size (Cohen's d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derri et al. (2001), Greece</td>
<td>n = 68, male = 35 (51%), mean age = 5.4y</td>
<td>RCT, preschool, 10wk</td>
<td>(1) Music and movement program; (2) Comparison</td>
<td>(1) 35 - 40min, 2/wk. Treatment delivered by a physical education specialist; (2) Free play.</td>
<td>Locomotor skills (TGMD)</td>
<td>Post-intervention = 10wk; No follow-up</td>
<td>Post-intervention: (1) &gt; (2) (sig diff gallop, leap, horizontal jump, skip)</td>
<td>Run = 0.32, Gallop = 0.82, Hop = 0.05, Jump = 0.64, Slide = 0.10, Leap = 1.28, Skip = 0.65</td>
</tr>
<tr>
<td>Goodway &amp; Branta (2003), USA</td>
<td>n = 59, male = 29 (49%), mean age = 4.7y</td>
<td>Quasi-experimental pre-post intervention 12wk</td>
<td>(1) Fundamental movement skill intervention; (2) Comparison</td>
<td>(1) 45min sessions, 24 over 12 wk. Treatment delivered by researcher with assistance from setting staff; (2) Usual care.</td>
<td>Object control and locomotor skills (TGMD-2)</td>
<td>Post-intervention = 12wk; No follow-up</td>
<td>Post-intervention: (1) &gt; (2) (sig diff for both object control and locomotor)</td>
<td>Run = 1.83, Gallop = 0.38, Hop = 2.15, Leap = 1.34, Jump = 2.76, Skip = 1.74, Slide = 2.06, Strike = 2.87, Bounce = 1.67, Catch = 1.23, Kick = 2.90, Throw = 1.57</td>
</tr>
<tr>
<td>Venetsanou &amp; Kambas (2004), Greece</td>
<td>n = 66, males = 36 (55%), mean age = 5y</td>
<td>Controlled trial, kindergarten 20wk</td>
<td>(1) Dance program; (2) Comparison</td>
<td>(1) 45min session, 2/wk. Treatment deliverer unclear.; (2) Usual care.</td>
<td>Gross motor proficiency (MOT 4-6)</td>
<td>Post-intervention = 20wk; No follow-up</td>
<td>Post-intervention: (1) &gt; (2) (sig diff)</td>
<td>Total score = 0.56</td>
</tr>
</tbody>
</table>

y = year(s); RCT = randomised controlled trial; wk = weeks; min = minutes; / = per; TGMD or TGMD-2 = Test for Gross Motor Development (1st & 2nd edition); (1) > (2) = group 1 demonstrated greater increases compared with group 2; sig diff = significant differences; MOT 4-6 = Test for children 4-6 years (Motoriktest für vier-bis sechsjährige Kinder)
<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample</th>
<th>Design, Setting &amp; Length</th>
<th>Intervention Groups</th>
<th>Treatment Content</th>
<th>Relevant Outcomes Measured</th>
<th>Testing Time Points</th>
<th>Results</th>
<th>Effect Size (Cohen's d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deli, Bakle &amp; Zachopoulou (2006), Greece</td>
<td>$n = 75$, male = 36 (48%), mean age = 5.4y</td>
<td>Controlled trial, kindergarten, 10wk</td>
<td>(1) Movement program; (2) Music and movement program; (3) Comparison</td>
<td>(1) 35min, 2/wk, movement lessons only; (2) 35min, 2/wk, movement and music lessons; (3) Free play.</td>
<td>Locomotor skills (TGMD)</td>
<td>Post-intervention = 10wk; No follow-up</td>
<td>Post-intervention: (1) (2) &gt; (3) (sig diff)</td>
<td>Could not be calculated (SD not reported)</td>
</tr>
<tr>
<td>Garza Cedillo (2006), USA</td>
<td>$n = 85$, ages = not reported, age = 3.0 - 3.6y, low socio-economic status</td>
<td>RCT, preschool 10wk, low socio-economic status</td>
<td>(1) Language and fundamental movement skill stimulation program; (2) Comparison</td>
<td>(1) 20min, 4/wk. Treatment delivered by specialist teacher; (2) Usual care.</td>
<td>Combined fine and gross motor skills score (The First Step Screen Test for Evaluating Preschoolers Motor Skills)</td>
<td>Post-intervention = 10wk; No follow-up</td>
<td>Post-intervention: (1) &gt; (2) (sig diff)</td>
<td>Total score = 0.75</td>
</tr>
<tr>
<td>Reilly et al. (2006), UK</td>
<td>$n = 545$, males = 273 (50%), mean age = 4.2y</td>
<td>Cluster RCT, nurseries 24wk</td>
<td>(1) Enhanced physical activity program + home-based health education; (2) Comparison</td>
<td>(1) 30min sessions 3/wk + resource pack and two leaflets. Nursery based treatment delivered by setting staff after attending three training sessions (length not specified), with implementation monitored once; (2) Usual care.</td>
<td>Object control and locomotor skills (MAB)</td>
<td>Post-intervention = 24wk; Follow-up = 12mo (BMI only)</td>
<td>Post-intervention: Total movement score (1) &gt; (2) (sig diff)</td>
<td>Total movement score = 0.25</td>
</tr>
</tbody>
</table>

$y =$ year(s); wk = weeks; min = minutes; / = per; FMS = Fundamental movement skills; min = minutes; TGMD = Test of Gross Motor Development (1st edition); (1) (2) > (3) = Groups 1 and 2 demonstrated greater increases compared with Group 3; sig diff = significant difference; RCT = randomised controlled trial; (1) > (2) = Group 1 demonstrated greater increases compared with group 2; MAB = Movement Assessment Battery, mo = months; BMI = body mass index
Table 2.6  Summary of fundamental movement skill interventions implemented in formal child care settings (1990 – 2010) (cont.)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample</th>
<th>Design, Setting &amp; Length</th>
<th>Intervention Groups</th>
<th>Treatment Content</th>
<th>Relevant Outcomes Measured</th>
<th>Testing Time Points</th>
<th>Results</th>
<th>Effect Size (Cohen’s d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardy et al. (2010b), Australia</td>
<td>n = 430, males = 50%, mean age = 4.4y</td>
<td>RCT, preschool, 5 - 6mo</td>
<td>(1) Healthy weight professional development; (2) Comparison</td>
<td>(1) One staff member attended a one-day professional development workshop. No formal intervention to be implemented, however staff were provided with a resource containing activities, a grant and access to health professionals, to support staff implementation of motor skill development activities,</td>
<td>Object control and locomotor skills (TGMD-2)</td>
<td>Post-intervention = 5 - 6mo: No follow-up</td>
<td>Post-intervention: Object control, Locomotor and Total movement score (1) &gt; (2) (sig diff).</td>
<td>Object control = 0.20, Locomotor = 0.20, Total movement score = 0.24</td>
</tr>
<tr>
<td>Klein et al. (2010), Germany</td>
<td>n = 1050, males = 567 (54%), mean age = 4.8y</td>
<td>RCT, kindergarten, 5 - 6mo</td>
<td>(1) Healthy lifestyle education; (2) Comparison</td>
<td>(1) Parents and two staff members from participating kindergartens were invited to attend a 90 - 120min information session regarding healthy lifestyle; (2) Usual care. No information session.</td>
<td>Gross motor proficiency (KMS 3-6)</td>
<td>Post-intervention = 5-6mo; No follow-up</td>
<td>Post-intervention: One leg stand (2) &gt; (1) (sig diff).</td>
<td>Standing long jump = 0.18, Lateral jumping = 0.03, One leg stand = 0.21</td>
</tr>
</tbody>
</table>

y = years; RCT = Randomised controlled trial; mo = months; TGMD-2 = Test of Gross Motor Development; (1) > (2) = Group 1 demonstrated greater increases compared with group 2; sig diff = significant differences; min = minutes; KMS 3-6 = Karlsruher motor screening for kindergarten children; ‘one leg stand’ was measured as the number of ground contacts during a one leg stand (no more detail provided), therefore a greater increase in the intervention group demonstrates lower proficiency; (2) > (1) = group (2) demonstrated greater increases compared with group (1)
2.5.2.1 Design and Instruments

Nine studies (73%) used a randomised controlled trial (RCT) design, with the remaining four employing a controlled trial design. All RCTs were randomised using existing class groups. Of the four studies that assessed physical activity, two measured habitual physical activity (Specker & Binkley, 2003; Reilly et al., 2006), one measured physical activity only during the preschool day (Trost et al., 2008), and one measured physical activity only during preschool outdoor free play (Cardon et al., 2009). All of these four studies used accelerometers to assess physical activity (Specker & Binkley, 2003; Reilly et al., 2006; Trost et al., 2008; Cardon et al., 2009), with two studies using 15-sec epochs (Trost et al., 2008; Cardon et al., 2009) (the remaining two did not define epoch length). One study employed direct observation (Observational System for Recording Activity in Preschoolers) in conjunction with accelerometers (Trost et al., 2008). In the study by Trost and colleagues (2008), direct observation was performed for 15 minutes, on one occasion, for each participating child at randomly assigned times throughout the intervention (inter-rater agreement ranged from 81% - 100%).

Fundamental movement skill proficiency was assessed using six distinct instruments. The most common instrument was the Test of Gross Motor Development (TGMD) (5/10), though the use of this instrument varied. Two studies measured locomotor skills only (Derri et al., 2001; Deli et al., 2006), one measured object control skills only (Hamilton et al., 1999), one measured some of both locomotor and object control skills (eight of the twelve skills included in the TGMD) (Hardy et al., 2010b) and one measured all of both locomotor and object control skills covered in the TGMD (Goodway & Branta, 2003). Other instruments employed included the Peabody Motor Development Skills, The First Step Screen Test for Evaluating Preschoolers Movement Skills, Karlsruher Motor Screening for Kindergarten Children, Movement Assessment Battery, and Motoriktest für vier-bis sechsjährige (Test for children 4 - 6 years), see Table 2.6 (p37).

2.5.2.2 Methodological Quality

Methodological quality was assessed independently by this candidate and one supervisor according to the 10-point checklist published by van Sluijs and colleagues (2007). Agreement was 93% on the 130 items (13 published papers x 10 items to assess
methodological quality for each paper) (κ = 0.86). Where opinions differed, consensus was reached through discussion. The presence of five items or more in non-randomised controlled trials or six items or more in randomised controlled trials was classed as high methodological quality. Overall, the methodological quality of studies was poor with only three studies classed as high in methodological quality (see Table 2.7, below) (Specker & Binkley, 2003; Reilly et al., 2006; Cardon et al., 2009).

Of the ten items assessed, two were consistently present in all studies: Assessment of outcomes using a validated measure (10/13), and timing of measures comparable between groups (10/13). Approximately half of the interventions reported groups to be comparable at baseline (7/13), accounted for potential confounders in analyses (7/13) and described drop-out (7/13). Two interventions collected follow-up measures at six-months or later (24 and 12 months respectively) (Specker & Binkley, 2003; Reilly et al., 2006). No study analysed data using intention-to-treat principles, only two reported randomisation procedures (Connor-Kuntz & Drummer, 1996; Reilly et al., 2006), four studies reported the use of blinded-assessors (Hamilton et al., 1999; Deli et al., 2006; Reilly et al., 2006; Hardy et al., 2010b) and four used an individual unit of analysis (Specker & Binkley, 2003; Reilly et al., 2006; Trost et al., 2008; Cardon et al., 2009).
Table 2.7 Methodological quality of physical activity and fundamental movement skill interventions implemented in formal child care settings (1990 – 2010) (adapted from van Sluijs et al., 2007)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Connor-Kuntz &amp; Drummer (1996)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Hamilton et al. (1999)</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Derri et al. (2001)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Goodway &amp; Branta (2003)</td>
<td>1</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Specker &amp; Binkley (2003)</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>6*</td>
</tr>
<tr>
<td>Venetsanou &amp; Kambas (2004)</td>
<td>0</td>
<td>N/A</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Deli, Bakle &amp; Zacopoulos (2006)</td>
<td>0</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Garza Cedillo (2006)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Reilly et al. (2006)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>9*</td>
</tr>
<tr>
<td>Trost et al. (2008)</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cardon et al. (2009)</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6*</td>
</tr>
<tr>
<td>Hardy et al. (2010b)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Klein et al. (2010)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

*Indicates studies with high methodological quality (the presence of five or more items in non-randomised controlled trials or six items or more in randomised controlled trials; N/A = these trial were non-randomised controlled trials
2.5.2.3 Intervention Components

Duration of interventions ranged from four weeks to one year. Approximately half the interventions had a duration between eight and twelve weeks (7/13) (Connor-Kuntz & Drummer, 1996; Hamilton et al., 1999; Derri et al., 2001; Goodway & Branta, 2003; Deli et al., 2006; Garza Cedillo, 2006; Trost et al., 2008). Three interventions were 20 weeks or longer (Specker & Binkley, 2003; Venetsanou & Kambas, 2004; Reilly et al., 2006). Sample sizes ranged from 27 to 1,050 participants, with the sample size of five interventions greater than 100 (Specker & Binkley, 2003; Reilly et al., 2006; Cardon et al., 2009; Hardy et al., 2010b; Klein et al., 2010).

Of the four studies that assessed physical activity, the majority had a formal activity component, where either teachers (Reilly et al., 2006; Trost et al., 2008) or physical activity specialists (Specker & Binkley, 2003) led the participating children in planned physical activity sessions. Planned sessions ranged from 90 – 150 minutes per week, with two studies implementing daily planned physical activity sessions (Specker & Binkley, 2003; Trost et al., 2008) and one study implementing three sessions per week (Reilly et al., 2006). Cardon and colleagues (2009) also assessed physical activity but did not implement a formal activity component. Their study assessed whether the provision of equipment and/or playground markings had an impact on children’s level of physical activity. Staff received no training as part of the intervention and were not asked to implement any changes to their current program beyond introducing the equipment to the children (minimum 1 hour) and making the equipment available.

Similar to those interventions that assessed physical activity, most interventions that assessed fundamental movement skills implemented formal/structured lessons. Lessons were delivered by either setting staff (Reilly et al., 2006), research personnel (Connor-Kuntz & Drummer, 1996; Derri et al., 2001; Goodway & Branta, 2003; Garza Cedillo, 2006), parents (Hamilton et al., 1999), a physical activity specialist (Deli et al., 2006), or the deliverer was unspecified (Venetsanou & Kambas, 2004). Instruction time ranged from 70 – 90 minutes per week over 2 - 4 sessions. Two studies, that measured fundamental movement skills, involved an information session or professional development workshop and no other formal intervention requirements (e.g. no requirement to implement lessons or provide equipment) (Hardy et al., 2010b; Klein et al., 2010). Hardy and colleagues (2010b) provided a one-day professional development workshop, which was attended by one staff member from each of the intervention
centres. The workshop covered (in addition to nutrition and small screen recreation) physical activity and incorporating planned and unstructured physical activity into their program. Additionally centres were given a small grant to support staff attendance at the professional development, or to buy equipment, and contact with a health professional who could provide support and advice. Klein and colleagues held an information session (length not defined) at each centre, attended by a minimum of two staff and any interested parents (60% of children had at least one parent attend) (Klein et al., 2010). The information session covered the importance of being physically active, and guidelines for physical activity (2 hours per day) and sedentary behaviour (maximum 30 minutes per day). There were no additional components (e.g. contact with a health professional).

2.5.2.4 Efficacy

Two of the four studies that assessed physical activity reported greater increases in physical activity levels in the intervention group compared with the control groups (Specker & Binkley, 2003; Trost et al., 2008). One study involved three intervention groups and a comparison group, and reported mixed results (Cardon et al., 2009). And the fourth reported significantly greater improvements in the comparison group compared with the intervention group (Reilly et al., 2006). Of the studies reporting positive intervention effects, one of these collected only during-intervention data and reported significant increases (Trost et al., 2008). Effect sizes could not be calculated for this study due to insufficient detail (Trost et al., 2008). The other study reported increases at during-intervention (6 months) (%MVPA Cohen’s $d = 0.13$) and a small-negligible positive effect at post-intervention (12 months) (%MVPA Cohen’s $d = 0.17$). It was also reported that these changes were sustained at 18 month follow-up, but not 24 month follow-up, however insufficient detail was provided to calculate effect sizes (Specker & Binkley, 2003). Cardon and colleagues (2009) study, which reported mixed results, involved three intervention groups, where the first intervention group received equipment only, the second received playground markings only and the third received both equipment and playground markings. A fourth group received no playground markings or equipment and acted as the comparison group. Compared with the comparison group at post-intervention, the equipment only group was found to have a greater increase in total physical activity (counts per 15 second epoch) (negligible effect size, Cohen’s $d = 0.08$), which was reflected in moderate increases in percentage of time
spent in MPA (Cohen’s $d = 0.50$), and small-negligible increases in VPA and sedentary behaviour (Cohen’s $d = 0.16$, 0.17, respectively), as well as small decreases in percentage of time spent in LPA (Cohen’s $d = -0.29$). Similarly, the equipment and playground markings group were found to have increases in total physical activity (counts per 15 second epoch) (negligible effect size, Cohen’s $d = 0.03$), with small-negligible positive effect sizes for percentage of time spent in VPA and sedentary behaviour (Cohen’s $d = 0.17$ and 0.16, respectively), and small negative effect sizes for percentage of time spent in LPA and MPA (Cohen’s $d = -0.32$ and -0.28, respectively).

The third group, playground markings only, were found to have decreased total physical activity (counts per 15 second epoch), which was reflected in a small negative effect size (Cohen’s $d = -0.29$). A small-to-medium positive effect was found for percentage of time spent engaged in sedentary behaviour (Cohen’s $d = 0.46$) and small-to-medium negative effects were found for percentage of time spent in LPA and MPA (Cohen’s $d = -0.50$ and -0.48 respectively).

Of studies measuring changes to fundamental movement skill proficiency, all reported greater increases in fundamental movement skill proficiency in the intervention group compared with the control group, though one reported improvements in the comparison group compared with the intervention group for one skill (one-leg stand, Cohen’s $d = 0.21$) (Klein et al., 2010). Two studies reported insufficient data to calculate effect sizes but reported significantly greater improvements in the intervention group compared with the comparison group ($p = 0.002$ and $p < 0.05$) (Hamilton et al., 1999; Deli et al., 2006). All remaining studies were found to have small to large positive effects for at least one skill (range = 0.18 – 2.87). Results from Goodway and Branta’s (2003) intervention indicated large effect sizes for all skills, with the exception of gallop (range Cohen’s $d = 1.23 – 2.90$). Derri and colleagues (2001) had a large positive effect size for gallop and leap (Cohen’s $d = 0.82$ and 1.28 respectively) and medium positive effect sizes for jump and skip (Cohen’s $d = 0.64$ and 0.65 respectively). Garza Cedillo (2006) and Venetsanou and colleagues (2004) had a medium-large effect on total fundamental movement skill score (Cohen’s $d = 0.75$ and 0.56 respectively). The remaining studies had small positive effects for at least one skill (range Cohen’s $d = 0.18 – 0.32$) (Connor-Kuntz & Drummer, 1996; Reilly et al., 2006; Hardy et al., 2010b; Klein et al., 2010).

These findings suggest that physical activity or fundamental movement skill interventions delivered in child care settings are likely to have a positive impact on
physical activity levels and fundamental movement skill proficiency. From the studies available, it appears interventions targeting fundamental movement skill development have a greater chance of having a positive effect. With experts suggesting that fundamental movement skills are a correlate of physical activity, and some evidence to support this (see Section 2.4.1), fundamental movement skill development may be a valuable focus for promoting physical activity in child care settings. Given the smaller effects in interventions delivered by setting staff, the available research indicates that staff professional development may be a key component of effective, sustainable interventions.

2.5.2.5 Alignment with CONSORT and TREND Statements

To facilitate critical appraisal and interpretation of non-randomised trials and randomised controlled trials, and to eliminate systematic error, the Consolidated Standards of Reporting Trials (CONSORT) (Moher et al., 2010) and Transparent Reporting of Evaluations with Non-randomised Designs (TREND) (Des Jarlais et al., 2004) statements were developed. Few studies aligned closely with the CONSORT and TREND statements. All studies reported the objective, though not necessarily the hypotheses, of the study and a description of the intervention. Ten of the trials reported some information about the statistical methods used (Connor-Kuntz & Drummer, 1996; Goodway & Branta, 2003; Specker & Binkley, 2003; Deli et al., 2006; Garza Cedillo, 2006; Reilly et al., 2006; Trost et al., 2008; Cardon et al., 2009; Hardy et al., 2010b; Klein et al., 2010). Consistently absent were details or explicit mention of inclusion and exclusion criteria, randomisation procedures, justification of sample size, whether assessors were blinded, whether there were any adverse events affecting the trial, or, if any exploratory analyses were conducted.

2.5.2.6 Summary

Very few interventions for child care settings, with a measure of physical activity and/or fundamental movement skills, have currently been tested in controlled or randomised controlled trials. Of the limited number of interventions identified (physical activity n = 4, fundamental movement skills n = 10) two distinct instruments (accelerometers and pedometers) were used to measure physical activity and six distinct instruments to measure fundamental movement skill proficiency (the most common being the Test of
Gross Motor Development, 5/10). Quality of interventions was consistently poor, with few interventions comparing groups at baseline or accounting for potential confounders in analyses (despite randomisation occurring at a group level) and none employing intention-to-treat analysis procedures. The majority of interventions involved a structured physical activity or fundamental movement skill development component (as opposed to an information meeting for staff only, for example) and reported positive results. Three of four physical activity interventions reported greater increases in the intervention group compared with the comparison group and all ten fundamental movement skill interventions reported greater increases in the intervention group (or in some of the intervention groups) compared with the comparison group for some, or all, skills. Review of these interventions indicates that inclusion of regular, planned physical activity and fundamental movement skill activities in early childhood settings is likely to influence increased levels of physical activity and fundamental movement skill proficiency. Though promise was also shown in the low-threshold interventions of Hardy et al. (2010b), Klein et al. (2010) and Cardon et al. (2009). Review of the thirteen studies identified above also suggests that a program delivered by an outside expert may result in greater increases in physical activity levels and/or fundamental movement skill proficiency, though the sustainability of such a model and the probability of higher implementation costs associated with employing specialist teachers is a potential weakness. There has been less attention given to intervention models that might support effective implementation of interventions by setting staff, however the positive effects seen in the interventions implemented by Trost and colleagues (2008) (physical activity) and Reilly and colleagues (2006) (fundamental movement skills) both of which were staff implemented with some form of professional support, indicate that more attention may be warranted in this area. Due to the small number of studies available, variety of instruments used and low methodological quality across the eleven studies identified, it is difficult to draw strong conclusions from this review.

2.6 CHAPTER SUMMARY AND FURTHER RESEARCH

Physical activity has a number of health benefits for preschool-aged children including bone strength (Janz et al., 2010), lower scores for cardiovascular disease risk factors (Sääkslahti et al., 2004), higher self esteem (Alpert et al., 1990) and social competence (Griffiths et al., 2010). As the benefits of physical activity are accrued over sustained periods of time, health benefits are seen more strongly in older groups as has been
indicated in a number of reviews (Strong et al., 2005; Warburton et al., 2006). Additionally, a small number of studies have indicated that physical activity behaviours track across the early years (Pate et al., 1996; Jackson et al., 2003; Sääkslahti et al., 2004; Taylor et al., 2009), indicating that interventions to promote physical activity in preschool-aged children may be able to effect long term health behaviours through supporting the development of active behaviours.

Currently, the prevalence of both habitual physical activity and physical activity during child care hours is concerning, with data indicating that children spend the majority of their time engaged in sedentary behaviours (Cardon et al., 2009; Hinkley et al., 2010; Vale et al., 2010). Physical activity and sedentary behaviours may be influenced by a number of correlates, including parent attitudes, gender (male), and preschool attended (Hinkley et al., 2008). One correlate of interest is fundamental movement skill proficiency. Fundamental movement skill proficiency forms the foundations for physical activity and is therefore seen as a likely positive correlate of physical activity (Gallahue & Ozmun, 2002), which is supported by a small body of evidence in the preschool age group (Sääkslahti et al., 1999; Fisher et al., 2005a; Williams et al., 2008; Cliff et al., 2009a).

Child care settings are recommended as intervention sites for promoting physical activity, including the teaching of fundamental movement skills, due to: physical activity being a core responsibility of child care settings (Australian Government, 2009); child care based interventions being able to reach a large proportion of the target population; and the availability of space and equipment that may be used to facilitate an intervention (Riethmuller et al., 2009a). However, child care settings have received little attention in past literature (Hesketh & Campbell, 2010) and child care staff tend to lack the confidence, competence and motivation they require to promote physical activity and fundamental movement skill development (Riethmuller et al., 2009b). Therefore, there is a need for evidence-guided interventions to support fundamental movement skill development in early childhood settings. The small number of interventions completed to date have employed diverse intervention designs, data collection instrumentation and procedures (see Section 2.5.2.1), and are characterised by poor methodological quality (see Section 2.5.2.2). Interventions have tended to be implemented by experts, which limits the external validity or potential sustainability of the intervention (see Section 2.5.2.3), and lack the sequential development of small
scale trials (Hesketh & Campbell, 2010) that can inform the design of important but traditionally under-reported components such as professional development and implementation of the program as intended (Stevens et al., 2007).

To address current short falls in the literature Jump Start, a fundamental movement skill development program designed to be implemented by setting staff within child care settings was implemented and evaluated. The aim of this study was to assess the feasibility, acceptability and potential efficacy of Jump Start first in a Proof-of-Concept trial, which then informed a pilot RCT. Specific research questions, targets and hypotheses can be found in Section 1.2.

The following chapters will describe the theoretical framework, methodologies and results of the Proof-of-Concept and the pilot RCT, with the final chapter comparing the findings against similar studies and discussing the implications for future interventions.
3. THEORETICAL FRAMEWORK

This chapter will build on the review and critique of physical activity and fundamental movement skill interventions designed for formal child care settings (see Section 2.5.2). It will examine the theoretical frameworks used in similar studies, the theoretical framework underpinning the current study, and demonstrate how the chosen theoretical framework informed the design of the intervention.

3.1 THEORETICAL FRAMEWORKS OF SIMILAR INTERVENTIONS

Of the thirteen physical activity and/or fundamental movement skill interventions identified (see Section 2.5.2), only three explicitly stated that they were underpinned by a theoretical framework (Hamilton et al., 1999; Goodway & Branta, 2003; Klein et al., 2010). All of these were fundamental movement skill interventions. Two reported significant improvements in fundamental movement skill proficiency among the intervention group compared with the comparison group (Hamilton et al., 1999; Goodway & Branta, 2003) and one reported mixed results (Klein et al., 2010). However, it should be noted that all other fundamental movement skill interventions identified (n = 10) reported significantly greater improvements in some or all fundamental movement skills measured, and most (3/4) physical activity interventions reported greater increases in physical activity levels, among the intervention group compared with the comparison group.

Goodway and Branta’s (2003) intervention, targeting disadvantaged preschoolers, was based on Dynamic Systems Theory. Within Dynamic Systems Theory it is postulated that fundamental movement skill development is influenced by a combination of internal and external factors. Internal factors are referred to as subsystems within the learner such as motivation, strength and neurological development. External factors include previous experience and environment (such as play surfaces or available equipment) (Newell 1984, 1986, cited in Goodway & Branta, 2003). Goodway and Branta (2003) hypothesised that disadvantaged children would be influenced by constraints in their environment potentially resulting in retardation of their motor development. Therefore, these authors targeted disadvantaged children in their intervention to identify whether they demonstrated developmental delays in
fundamental movement skill proficiency and whether these delays could be overcome through influencing their internal (increasing strength and motivation through enjoyable participation in physical activity) and external factors (providing fundamental movement skill development experiences). The intervention was of 12 weeks duration, and had 59 participants. Results were positive with effect sizes for all fundamental movement skills ranging from Cohen’s $d = 0.38 – 2.90$.

Hamilton and colleagues’ (1999) parent-assisted intervention was based on the Ecological Systems Perspective. The Ecological Systems Perspective suggests that development is influenced by the dynamic relationships between the individual’s microsystem (e.g. family, school) and their extended community and culture, with family being the most critical ecological system influencing a child’s optimal development (Trout & Foley, 1989, cited by Hamilton et al., 1999). In developing their intervention based on this theoretical perspective, parents played a key role in the eight week fundamental movement skill intervention, attending every session and acting as the key deliverer of lesson content for their child. Parents met with the lead researcher before the intervention for 2 x 45 minute orientation meetings, which covered the five skills to be taught in the intervention. Parents also met with the lead researcher for 15 minutes before each lesson to go over the lesson plan and ask any questions. Parents then taught the lesson to their child. Quality of implementation was monitored by the lead investigator. The intervention was of eight weeks duration and had 27 participants. Effect sizes could not be calculated, as there was no standard deviation reported for post-intervention results. Statistical analyses demonstrated a greater increase among the intervention group compared with the comparison group ($p = 0.002$).

Klein and colleagues’ (2010) intervention was underpinned by a combination of the Precaution Adoption Process Model and the Theory of Planned Behaviour. The Precaution Adoption Process Model asserts that an individual moves through seven distinct stages before adopting and sustaining a new health behaviour. These stages range from being unaware of the need to change (Stage 1), to contemplating behaviour change (Stages 3 – 5), to sustained behaviour change (Stage 7) (Weinstein, Rothman, & Sutton, 1998). The Theory of Planned Behaviour focuses on the independent determinants that shape an individual’s intention towards behaviour change. These include: a person’s attitude to changing the specific behaviour; the perceived social pressure to/not to engage in the behaviour; and the perceived ease/difficulty associated
with performing the new behaviour (Ajzen, 1991). The intervention consisted of a single information meeting for parents and educators only (e.g. no lesson implementation requirements), the aim of which was to enhance child care staff and parents awareness of healthy lifestyle, and to impact related skills and competencies. The information meeting covered the importance of physical activity, consequences of physical inactivity, and physical activity recommendations (e.g. how often to be physically active), in addition to nutrition components. The intervention had an intervention period of between five- and six-months and 1,050 participants. Greater increases in proficiency were seen in the intervention group compared with the comparison group for two movement skills (Cohen’s $d = 0.03$ and $0.18$, lateral jump and long jump, respectively), with a greater increase in proficiency seen in the comparison group compared with the intervention group for one skill (one leg stand, Cohen’s $d = 0.21$).

Although not included in the review of interventions in Section 2.5.2, due to lack of an objective measure of physical activity (physical activity was measured using parent report), a further study underpinned by a theoretical model was identified. This study was entitled *Hip-Hop to Health Jr.* and the child component was informed by both Social Cognitive Theory and Self Determination Theory (Fitzgibbon, Stolley, Dyer, VanHorn, & KauferChristoffel, 2002). Social Cognitive Theory emphasised the social and interpersonal influences on behaviour change, including the role that adult and peer modelling plays. Self Determination Theory distinguishes between actions of choice and actions performed under direction with a lack of choice, with individuals less likely to choose to engage in behaviours they feel they have been forced to engage in (Deci & Ryan, 1991, cited in Fitzgibbon et al., 2002). Based on these theoretical frameworks, Fitzgibbon and colleagues’ (2002) 14-week intervention provided adult and peer role modelling of healthy behaviours and promoted healthy food choices and physical activity, but avoided situations that left participants feel coerced into a choice. *Hip-Hop to Health Jr.* reported greater reductions in their primary outcome, BMI, within the intervention group compared with the control group. Also greater increases in parent reported physical activity levels in the intervention group compared with the comparison group were reported (Fitzgibbon, Stolley, Schiffer, Van Horn, & Kauferchristoffel, 2005). These results were not found in their subsequent trial with predominately Latino participants (Fitzgibbon et al., 2006).
Three of these four trials used theoretical frameworks that emphasised the role of both inter- and intra-personal influences on behaviour (Hamilton et al., 1999; Fitzgibbon et al., 2002; Goodway & Branta, 2003). Each one sought to address one or more key elements of the individuals’ environment to bring about changes in health behaviour, with a focus on the children attending participating child care settings. The fourth trial (Klein, et al. 2010) was based upon a theoretical framework that emphasised participants moving through a sequential process of change. It sought to increase knowledge and skills related to why children should be physically active and how physical activity can be supported. Unlike the other three trials, which targeted children, Klein and colleagues (2010) targeted parents and educators.

The current study was underpinned by Social Cognitive Theory, which is characterised by a tenant of interacting internal and external forces affecting behaviour (described in more detail below), similar to the theories underpinning Fitzgibbon and colleagues (2002), Goodway and Branta (2003), and Hamilton and colleagues (1999). The current study aimed to assess the feasibility, acceptability and potential efficacy of a fundamental movement skill development program for three- to five-year olds in long day care settings (Jump Start). This study incorporated two phases, a Proof-of-Concept trial and a pilot RCT. The aim of the Proof-of-Concept was to identify the suitability of the intervention design based primarily on feasibility and acceptability measures. Potential efficacy data were also collected to indicate trends. The pilot RCT aimed to further build upon the Proof-of-Concept by modifying the intervention design in response to the Proof-of-Concept trial findings, including increased staff autonomy and mentoring, and to further test the potential efficacy of the intervention through the inclusion of a comparison group. The primary outcomes for both trials were objectively measured physical activity and fundamental movement skill proficiency. The use of lower cost, small scale trials, such as a Proof-of-Concept trial followed by a pilot RCT allow experimentation with the intervention design and are valuable for informing the effective design of intervention components of larger scale trials (Stevens et al., 2007).

### 3.2 SOCIAL COGNITIVE THEORY

Social Cognitive Theory proposes that an individual is not influenced simply by either internal or external forces, but that a person’s preferences, thoughts and actions are instead a product of a dynamic interplay between a number of influencing factors.
These factors are summarised in a model of triadic reciprocality, where the triad of influences includes; 1) environmental events, 2) cognitive and personal factors, and, 3) the individual’s behaviour (see Figure 3.1, below) (Bandura, 1986). That is, the environment of an individual influences the individual’s behaviour, but the individual’s behaviour also affects their environment. The cognitive processes within this theory set it apart from other behaviourist theories, as Bandura (1986) proposes that an individual’s preferences, thoughts and actions are affected by what they see happening, what they anticipate will happen, and what actually happens. Therefore, Bandura (1986) identifies modelling as a powerful tool for behaviour change because seeing someone else successfully execute a behaviour and experience the rewards, can influence behaviour change, rather than an individual being limited to learning through their own trial and error.

**Figure 3.1** Social Cognitive Theory Triadic Reciprocality Model (Bandura, 1986, p24)

In line with the triadic reciprocality model contained in the Social Cognitive Theory, *Jump Start* sought to encourage preferences, thoughts and actions regarding physical activity by addressing environmental events, cognitive and personal factors, and individual behaviour. The *Jump Start* intervention comprised professional development, structured lessons and unstructured activities and is described below, according to components of the triadic reciprocality model.

**3.2.1 How Social Cognitive Theory Informed the Current Intervention**

In line with the triadic reciprocality model of Social Cognitive Theory, *Jump Start* attempted to influence behaviour change through modifying elements of all three
components of the model. A number of correlates of physical activity have been identified (see Section 2.4 and Table 2.4, p23) and are presented below using a Social Ecological Model (see Figure 3.2, p57), which shares with Social Cognitive Theory the idea that environmental influences both shape and are shaped by the individual. Therefore, the environment, personal and cognitive, and individual behaviour elements we attempted to influence already had some evidence to indicate that they were correlates of physical activity. First, we attempted to modify the child care environment through equipping staff with the knowledge, confidence, competence and motivation to teach fundamental movement skills through structured and unstructured activities, this was the professional development component of our intervention. Additionally, centres were provided with equipment to support physical activity (e.g. balls). Second, cognitive and personal factors were targeted through the design of structured lessons. These lessons sought to improve participants’ fundamental movement skill proficiency. Lessons contained multiple demonstrations of skills, to encourage children’s ability to learn vicariously, and explicitly focused on the idea that skills have correct skill performance components and are learnt through practice. This may support children’s motivation and persistence with fundamental movement skill based activities by positively engaging their forethought, self-regulatory, and self-reflective capabilities. Third, behaviour was addressed by including a number of enjoyable games in each of the lessons. These provided opportunities to practice the skills, and so improve fundamental movement skill proficiency, but also, according to Social Cognitive Theory, had the potential to positively influence their environment by demonstrating that physical activity is enjoyable and therefore increasing both teacher support and child requests for physical activity opportunities.

Within Bandura’s Social Cognitive Theory, four processes that influence behaviour change have been noted as helpful guide for the development of behaviour change interventions (Robinson & Borzekowski, 2006). These four processes are attention, retention, production, and motivation and were used to guide both the development of the professional development model for setting staff and the structured fundamental movement skill lessons for the children. A summary of how each of the four processes were addressed through the design of the Jump Start intervention is provided following Figure 3.2, in Table 3.1 (p58).
Figure 3.2 Correlates of physical activity arranged according to the Social Ecological Model

Key for Figure 3.2 (as described by Hinkley et al., 2008)

<table>
<thead>
<tr>
<th>Studies supporting association (%)</th>
<th>Summary code</th>
<th>Meaning of coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 33</td>
<td>0</td>
<td>No association</td>
</tr>
<tr>
<td>34 - 59</td>
<td>?</td>
<td>Indeterminate or inconsistent</td>
</tr>
<tr>
<td>60 - 100</td>
<td>+</td>
<td>Positive association</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>Negative association</td>
</tr>
</tbody>
</table>

Note: When four or more studies supported an association or no association it was coded as 00, ++, or --; italicised correlates indicate correlates targeted in Jump Start (positioned on the right hand side of the figure); CVD = Cardiovascular disease; SES = Socio-economic status; IQ = Intelligence Quotient; BMI = Body mass index
Table 3.1  Processes of Attention, Retention, Production and Motivation as addressed in the *Jump Start* intervention

<table>
<thead>
<tr>
<th>Process</th>
<th>Setting Staff Professional Development</th>
<th>Children Structured Lessons</th>
<th>Children Unstructured Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td>• Workshops delivered in staff meetings (e.g. connected with current structures and culture); • Brief workshops (30min); • Simple content; • Variety of delivery methods in every workshop (e.g. power point, brainstorming, demonstrations, activities), including hands on involvement in the learning; • Simple, visually appealing colour formatting of lesson and activity cards.</td>
<td>• Taught/supported staff with behaviour management skills and strategies; • Minimised listening time, with a focus on simple concepts and play-based learning; • Asked age appropriate questions • Variety of activities; • Use of interesting equipment (e.g. balls or scarves).</td>
<td>• Interest based activities (tailored to individual children or common group interests); • Game based; • Fun, age appropriate activities; • Opportunity to use equipment (e.g. balls).</td>
</tr>
<tr>
<td>Retention</td>
<td>• Ongoing professional development allowed ideas to be revisited; • Demonstration lessons and unstructured activities allowed staff to see theory in practice; • Hands on practice and experience. Staff delivered lessons and unstructured activities, and were actively involved in the professional development workshops.</td>
<td>• Inclusion of a review and debrief in every lesson; • Use of cue words; • Provision of posters to be displayed in the yard.</td>
<td>• Opportunity to further practice a particular skill; • Staff used opportunity to remind children of cue words and skill components covered in structured lessons.</td>
</tr>
<tr>
<td>Production</td>
<td>• Staff delivered the majority of planned structured lessons and unstructured activities; • Staff had hands on involvement in the professional development workshops (e.g. brainstorming or playing games from the resource), as well as in the structured lessons and unstructured activities.</td>
<td>• Opportunity to practice skill throughout all components (e.g. Guided Discovery, Review, etc.) of the 20min lesson, particularly in the ‘skill activities’ section.</td>
<td>• Skill based activities (e.g. main component of an unstructured activity will involve using a fundamental movement skill, such as playing Rabbit Tag to practice running).</td>
</tr>
<tr>
<td>Process</td>
<td>Setting Staff</td>
<td>Children Structured Lessons</td>
<td>Children Unstructured Activities</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------</td>
<td>-----------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Motivation</td>
<td>• Demonstration lessons and activities demonstrated that the content was suitable and enjoyed by children; • Director support; • Linked with current values and addressed personal concerns; • Every workshop included a review of the value of physical activity and fundamental movement skills (e.g. health and social benefits); • Lessons were pre-prepared and presented on simple, easy-to-use cards (addressing common barriers of limited time and lack of ideas); • Lesson cards were printed in colour and visually appealing; • Lessons and activities required minimal equipment and preparation; • Regular times and space to implement activities created routine; • Regular implementation of program allowed staff to see children’s skills improve, which reinforced the value of the program.</td>
<td>• Enjoyable developmentally appropriate game-based activities; • No individual, competitive activities, maximising the positive play experience; • High levels of encouragement and support from staff and this candidate.</td>
<td>• Opportunity to work with small groups or individual children to allow for positive attention and encouragement; • Activities are tailored to individual interests and skill level, which may increase enjoyment and therefore interest in participating.</td>
</tr>
</tbody>
</table>
3.3 **CHAPTER SUMMARY**

Current literature recommends the use of theoretical frameworks to underpin studies, however it is also noted that knowledge of the population and environment being targeted is a key component of ensuring the best theoretical framework is selected, and that the framework is applied appropriately (Glanz & Bishop, 2010). With little research available regarding formal child care settings and very few interventions reporting a theoretical framework, it was appropriate therefore that the current study included two phases: 1) a Proof-of-Concept trial, based on Social Cognitive Theory, and 2) a pilot RCT, which was informed by the Proof-of-Concept trial and was therefore based on Social Cognitive Theory, but was also enhanced by the knowledge of the target population and environment that was elicited through the Proof-of-Concept trial. The following chapters will outline the methods of this study, report the results and compare the findings of this study with current literature.
4. METHODS: PROOF-OF-CONCEPT TRIAL

4.1 INTRODUCTION
This chapter describes the methodology of the Jump Start Proof-of-Concept trial, assessing the feasibility, acceptability and potential efficacy of Jump Start, a fundamental movement skills program designed for three- to five-year-olds in long day care settings. The Proof-of-Concept trial was the first phase in a two-phase study. This phase employed a single-group pre-intervention post-intervention design. The feasibility and acceptability of the program was tested through collection of rich process data, including lesson evaluations, interviews, observations, questionnaires, attendance, and percentage of pre-intervention and post-intervention data collected. Potential efficacy was measured through the collection of objectively measured physical activity and fundamental movement skill proficiency collected at pre-intervention and at eight-week post-intervention.

Proof-of-Concept trials have been suggested by Stevens and colleagues (2007) to be a useful and cost effective means of testing and developing trial components such as recruitment and appropriateness of content and delivery prior to implementation of larger adequately-powered randomised controlled trials. Therefore the aim of this trial was to test these components prior to implementation of the pilot RCT and further randomised controlled trials.

The methods of the Proof-of-Concept trial are described using the Transparent Reporting of Evaluations with Non-randomised Designs (TREND) statement (Des Jarlais et al., 2004). These guidelines facilitate critical appraisal and interpretation of non-randomised trials and eliminate systematic error (Des Jarlais et al., 2004).
4.2 OBJECTIVES
The Proof-of-Concept trial aimed to test the: 1) feasibility of *Jump Start* by recruiting a sufficient number of participants and retaining 80% of participants at pre- and post-intervention respectively, and collecting a pre-determined proportion of useable data; 2) acceptability of *Jump Start* according to children and staff by implementing all planned professional development content and structured lessons, facilitating all planned unstructured activities, having participating children attend 80% of lessons, and by staff reporting the trial to be enjoyable and acceptable; 3) potential efficacy of *Jump Start*, by determining whether there were improvements in primary outcomes (children’s objectively measured physical activity and fundamental movement skill proficiency).

4.3 PARTICIPANTS

4.3.1 Recruitment
One long day care centre was recruited through *Illawarra Children’s Services*, a local child care organisation, which oversees 17 community-owned, not-for-profit, long day care centres and preschools. The centre was selected based on perceived high staff motivation and available outdoor space for physical activity. All staff, from the centre’s three- to five-year-old room (\( n = 4 \)) and all children who attended on the designated trial days (\( n = 37 \)) were invited to participate. In addition two support workers were included in the trial three weeks after the pre-intervention testing. These staff members were permanent staff members, but not identified to this candidate by the Director at pre-intervention. They participated in completing lesson evaluations and interviews. As they were support workers, with specific responsibility for children with additional needs, they were not involved in leading structured lessons. All invited participants, staff and children, were provided with information sheets and consent forms. Child care staff distributed the provided the consent forms to parents and answered parents queries regarding the program. This candidate was also available at the participating centre during recruitment, data collection, and throughout the implementation of the intervention to talk to parents. Parents provided consent for their children and all invited staff provided written consent.
4.3.2 Inclusion and Exclusion Criteria

For staff, inclusion criteria were having a permanent position in the three- to five-year-old room. There were no exclusion criteria for staff, thus amount of training or number of days worked did not impact eligibility for the study.

For children, inclusion criteria were that a child regularly attended the centre in the three- to five-year-old room on one or more of the designated trial days (Tuesday and/or Friday). There were no exclusion criteria for children.

4.4 TRIAL DESIGN

The Proof-of-Concept trial was implemented between October and December 2007 in one long day care setting. The trial was granted ethics approval by the University of Wollongong’s Human Research Ethics Committee (HE07/221) (see Appendix C).

The trial comprised three main sections: professional development, fundamental movement skill structured lessons, and unstructured activities. The trial design and delivery was informed through consultation with participating centre staff, which was anticipated to lead to an intervention design suited to the setting as well as fostering a sense of ownership among staff (Curtis et al., 1997). The trial focused on eight fundamental movement skills (jump, catch, run, throw, leap, kick, hop, strike). These eight skills were chosen by the centre Director for a number of reasons: covering a different skill each week (rather than four skills for two weeks each, for example) would expose children to the widest variety of skills as possible, the Director indicated that she thought these skills were valuable, and there was a balance between locomotor and object control skills. The structured lessons and unstructured activities were designed so centre staff, following their involvement in appropriate professional development, could facilitate and deliver them.

4.4.1 Professional Development

The professional development model was designed in consultation with centre staff. Due to time constraints on the project, and also planned staff leave, the professional development was delivered as a one-day workshop. The workshop comprised theoretical and practical components. The theoretical component aimed to increase staff understanding of the value of physical activity, the importance of both structured and unstructured physical activity in early childhood settings, and the importance of fundamental movement skill development. The practical component aimed to increase
staff confidence with using the *Jump Start* program and teaching fundamental movement skill structured lessons by providing opportunities for staff to engage in activities and participate in example lessons that would be used in the trial. In line with Social Cognitive Theory (described in Section 3.2), the professional development was designed to be interactive. Staff participated in brainstorming and in discussion throughout the theoretical component, and physically engaged with the lessons and activities in the practical component. Only two staff members, who were expected to be implementing the lessons, participated in the professional development. Two other participating staff had a job share arrangement. The Director asked that they not to be directly involved in the teaching and professional development as they had limited time available in their work-day. Their involvement was then limited to participating in pre- and post-intervention interviews regarding their experience of the trial and their perception of children’s response to the trial. The additional two support workers were also not involved in the professional development as it occurred during pre-intervention testing, prior to their inclusion in the trial.

### 4.4.2 Structured Lessons

Staff were given the option of running up to five lessons per week, and covering between two and eight skills. Staff chose to implement lessons twice per week covering eight skills. Therefore, the program design was that for each skill the same lesson would be taught twice (two days per week, Tuesday and Friday), with a different skill being taught each week (see Table 4.1, below). Staff initially chose to run all lessons, however, the planned delivery timeline was modified from week two, to support high quality implementation of the lessons. From week two, the first lesson of each skill was taught by this candidate as a demonstration lesson, so that centre staff could observe and participate. A centre staff member then taught the same lesson, on a different day of the week, with a different group of children. Staff were encouraged to adapt activities, if necessary, to suit their group, though were instructed to still follow the lesson outline for that week to ensure trial fidelity. Table 4.1 (below) shows the planned structured lesson delivery. Lessons usually occurred at 10am, except on days that an excursion or incursion was planned when the lesson ran at 2pm instead.
Table 4.1  Proof-of-Concept trial: Planned delivery timeline

<table>
<thead>
<tr>
<th>Week</th>
<th>Skill</th>
<th>Date</th>
<th>Structured Lesson Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jump</td>
<td>05/10/07</td>
<td>Staff member</td>
</tr>
<tr>
<td></td>
<td>Jump</td>
<td>09/10/07</td>
<td>Staff member</td>
</tr>
<tr>
<td>2</td>
<td>Catch</td>
<td>12/10/07</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td>Catch</td>
<td>16/10/07</td>
<td>Staff member</td>
</tr>
<tr>
<td>3</td>
<td>Run</td>
<td>19/10/07</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td>Run</td>
<td>23/10/07</td>
<td>Staff member</td>
</tr>
<tr>
<td>4</td>
<td>Throw</td>
<td>26/10/07</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td>Throw</td>
<td>30/10/07</td>
<td>Staff member</td>
</tr>
<tr>
<td>5</td>
<td>Leap</td>
<td>02/11/07</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td>Leap</td>
<td>06/11/07</td>
<td>Staff member</td>
</tr>
<tr>
<td>6</td>
<td>Kick</td>
<td>09/11/07</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td>Kick</td>
<td>13/11/07</td>
<td>Staff member</td>
</tr>
<tr>
<td>7</td>
<td>Hop</td>
<td>16/11/07</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td>Hop</td>
<td>20/11/07</td>
<td>Staff member</td>
</tr>
<tr>
<td>8</td>
<td>Strike</td>
<td>23/11/07</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td>Strike</td>
<td>27/11/07</td>
<td>Staff member</td>
</tr>
</tbody>
</table>

*All unstructured activities were facilitated by this candidate (see Section 4.4.3)*

Structured lesson duration was approximately 20 minutes and the structure was based on that proposed by Gallahue (1996) and used in a previous fundamental movement skill development intervention (Jones et al., 2007). Each lesson was divided into five sections:

1) Exploration - children were encouraged to explore the focus skill using different movement concepts such as speed (fast/slow), height (high/low), or force (hard/soft) (for example, ‘Throw your object in the air and try to catch it. Try to do three very quick catches. Now try to do three very slow catches.’);

2) Guided Discovery - the correct performance of each fundamental movement skill is made up of mastering a number of components. For example, in a proficient catch a person will be looking at the ball, extend their arms towards the ball, and then absorb the force of the ball as they catch it. Each lesson focused on one component of the skill, for example, looking at the ball. In
Methods: Proof-of-Concept Trial

Guided Discovery, the teacher directed the children to use two or three different methods (correct and incorrect) to achieve the focus skill component, such as look up while trying to catch, look at a friend while trying to catch, and look at the ball while trying to catch. Through trying different methods children were then ‘guided to discover’ the correct way of performing specific skill components;

3) Review - skill components were reinforced by asking children the correct way to perform the skill and to demonstrate the focus skill component(s), e.g. ‘Where should you look when catching?’ or ‘Everyone show me one more catch, remember to look at the ball’;

4) Practical application – children participated in three games, designed to be enjoyable and provide opportunity for them to practice the focus skill;

5) Debrief - children were again asked to identify the focus skill components and to demonstrate them.

An example lesson is provided in Appendix D.

4.4.3 Unstructured Activities

The purpose of unstructured activities was to provide further opportunity for children to use and practice the focus skill (the skill taught in the structured lessons). Potentially the style of unstructured activities would also be more familiar and acceptable to child care staff than the structured lessons. Unstructured activities were inline with the emergent curriculum learning and teaching philosophy of the time (Stonehouse, 2001) and the play-based learning method endorsed at the time of writing (Australian Government, 2009). Unstructured activities complemented the emergent curriculum philosophy of child care settings by; 1) having no compulsory attendance, 2) consideration being given to individual or group interests and individual needs, 3) children being allowed and encouraged to develop and modify activities.

Unstructured activities were run in the afternoons following the structured lessons. Unstructured activities were set up and facilitated by this candidate, from 2:30pm when children were finishing afternoon tea until 4:00pm when staff routinely began to pack up the outdoor equipment. Children were encouraged to participate in the unstructured activities, however participation was not compulsory. Unstructured activities involved creating an environment that encouraged the use of the focus skill, and often the
attention and encouragement of this candidate. The environment was created by displaying posters of the target skill, which showed the skill components, and setting up or providing appropriate equipment (e.g. balls when focusing on catching). In many instances, unstructured activities involved suggesting or explaining a game (e.g. Hopscotch). The unstructured activity time was also used as an opportunity to engage with individual children, and possibly try to interest children who were observed during the lessons to be uninvolved or of lower competence in the focus skill. This candidate recorded a journal entry for each day detailing the children and staff involvement in the unstructured activities. Unstructured activities are described in Appendix E.

4.4.4 Additional Support for Centre Staff

This candidate developed inserts for newsletters and templates for children’s individual portfolios, detailing the skill components and the value of physical activity. Photos were also taken during one structured lesson each week (the one led by centre staff) and during the unstructured time, for staff to use in the children’s developmental folders. A book on correct performance of fundamental movement skills was created using pictures of children from the centre. The newsletter templates, photos and fundamental movement skills book were provided as tools for staff to use at their own discretion. Use and appropriateness of these components was assessed through post-intervention interviews with staff.

4.5 MEASURES AND PROCEDURES

Measures were taken at the centre, during centre hours, at pre-intervention and at post-intervention immediately following the intervention. Process data were collected throughout the study.

4.5.1 Primary Outcomes

Primary outcome measures included objectively measured physical activity and fundamental movement skill proficiency.

4.5.1.1 Objectively Measured Physical Activity

The Manufacturing Technology Inc. (MTI) 7146 Actigraph (MTI Health Services, 2004) accelerometers were used to objectively measure physical activity of participants. The Actigraph is a non-intrusive, comfortable, light-weight instrument worn on the right iliac crest and secured by an elastic waist belt. It is a uniaxial accelerometer designed to
detect vertical accelerations ranging in magnitude from 0.05 to 2.00 g-force with a
frequency response of 0.25 - 2.50 Hertz (Trost et al., 1998). These parameters allow for
the detection of normal human motion and will reject high-frequency vibrations
(encountered during activities such as vigorous shaking). The filtered acceleration
signal is digitised, rectified, and integrated over a user-specified period (Trost, Way, &
Okely, 2006). At the end of each sampling interval or ‘epoch’, the summed value or
‘activity count’ is stored in the memory and downloaded onto a computer for later
analyses, automatically resetting the integrator. Research has shown that 80% of
moderate physical activity and 93% of vigorous physical activity bouts last for less than
10 seconds. Therefore, recommendations for epoch length are for the shortest epoch
length possible in order to assess high levels of physical activity as accurately as
possible (Baquet, Stratton, Van Praagh, & Berthoin, 2007). The instrumentation
available to this research project was unable to measure in epochs lower than 15
seconds. Therefore, the shortest epoch length possible, of 15 seconds, was used in this
study. Research has demonstrated 15 second epochs to provide a valid measure of
physical activity in three- to five year-old children (Sirard et al., 2005).

Accelerometers have been shown to be a valid tool for use with preschoolers (Sirard et
al., 2005; Pate et al., 2006). Pate and colleagues (2006) conducted a validation and
calibration study in two phases. The first phase, to calibrate cut-points, was conducted
with 30 preschoolers (aged 3 – 5 years), in a laboratory setting. Participants fasted for
two hours prior to testing. Each participant wore an Actigraph accelerometer on their
right hip and a calibrated Cosmed portable metabolic system was fitted on each child’s
back with a paediatric face mask to collect expired respiratory gases. Cosmed portable
metabolic systems provide a validated measure of energy expenditure. Participants
performed 10 minutes of resting, and five minutes of either walking or jogging at 3
mph, 4 mph and 5 mph on flat ground. A researcher paced each child, and children
rested between each session of walking or jogging. Cut-points were identified through
visual inspection of the distribution of the expired respiratory gases during rest and the
three speeds of walking or jogging. The second phase, to validate the cut-points,
involved the same 30 participants. Participants were fitted with the same instruments
(Actigraph accelerometer and Cosmed portable metabolic system) and performed 20
minutes of unstructured free play indoors and outdoors at their preschool. After four to
six minutes in each activity, children were instructed to choose a different activity to
ensure participation in a range of activities. Typical indoor activities included playing with blocks, reading and dramatic play, and typical outdoor activities included climbing, swinging, and chasing. Spearman rank order correlations between expired respiratory gases and accelerometer counts was 0.66.

Sirard and colleagues (2005) conducted a validation and calibration study in two phases. The first phase, to calibrate cut-points, was conducted with 16 preschoolers aged between three- and five-years. Participants wore an Actigraph accelerometer, on their right hip and secured with an elastic belt, while performing three minutes of each; sitting and talking, fast walking, sitting and playing, slow walking, and jogging. Both sitting activities were used as a measure of sedentary behaviour, slow walking and was used as a measure of LPA and fast walking and jogging as a measure of MVPA. The second phase then validated these cut-points within a sample of 281 three- to five-year olds from nine child care settings. Children wore Actigraph accelerometers for up to 10 consecutive week days, during preschool hours. Participants’ physical activity was also measured by trained observers using a validated direct observation tool (*Child Activity Rating Scale*). Inter-observer agreement ranged from 0.88 – 0.96 and inter-observer reliability ranged from 0.91 – 0.98. Observations were taken over 15 seconds, with the following 15 seconds used to record observations. These 15-second observations were synchronised with the timing of the epochs being recorded on the accelerometers. Pearson correlations between direct observation and accelerometry were all statistically significant and ranged from 0.46 – 0.70.

Seven days of accelerometer data is recommended for the measurement of habitual physical activity (Rowlands, 2007). However the length of time a child needs to wear an accelerometer to provide a reliable measure of habitual physical activity has been found to be as low as three hours of data on two to three days (Penpraze et al., 2006). Penpraze and colleagues (2006) investigated the number of days and hours required to provide representative measures of physical activity among young children. Seventy-six children (40 male, mean age 5.6y) participated. Participants provided at least seven consecutive days of accelerometry data (epoch length not specified). Data were then analysed using the Spearman-Brown prophecy formula to determine reliability coefficients and 95% confidence intervals. Results indicated that reliability was affected by the number of days of data collected rather than the number of hours of data collected per day. For three days of data reliability was 62%. This did not vary if data
were collected for three hours or for ten. Reliability increased to 69%, 73%, 77%, and 79% for 4, 5, 6 and 7 days respectively. The consistency between the reliability of three hours of data and of ten hours of data on the same day remained for each of these. Recommendations published by Cliff and colleagues (2009b) suggest that this may be even lower for children who are sleeping for long periods of time during the day (e.g. 3 year olds). Additionally, Cliff and colleagues (2009b) suggest that physical activity during centre hours follows a consistent pattern, with little daily variation. Therefore monitoring of physical activity levels while children are in care possibly requires less monitoring time.

In the current study, physical activity was measured whilst children were at the child care centre, from the time the child arrived at the centre until they left at the end of the day. The maximum time period for a child to wear an accelerometer on any one day was therefore from 7am until 6pm (i.e. 11 hours) (average hrs/day = 6.9 hrs/day, range = 3.3 - 9.0 hrs). One day of physical activity data were collected per child at each of pre-intervention and post-intervention. Given the trial nature of this study, one day was seen as an appropriate length to gain insight into potential barriers and provide limited physical activity measures. Variable placement of accelerometers has been suggested to affect the reliability of the instrument. Having a single trained assessor collect the measures ensured consistency in data collection methods (Ward, Evenson, Vaughn, Brown Rodgers, & Troiano, 2005).

4.5.1.2 Fundamental Movement Skills

A review of motor skill assessment tools for preschool children identified only two assessment tools that were designed for use with children aged three- to five-years (Cools, De Martelaer, Samaey, & Andries, 2009). Of these, for the purposes of the current study, the Test of Gross Motor Development (TGMD-2) (Ulrich, 2000) had the most appropriate assessment time (20 minutes compared to 45 minutes) and assessed relevant, common skills such as jumping, hopping, and catching. Therefore, children’s fundamental movement skills were assessed according to the procedures outlined in the TGMD-2 (Ulrich, 2000). The TGMD-2 has specific requirements regarding distances and equipment used, and directions provided during testing. The TGMD-2 was designed to test fundamental movement skills in children aged between three and ten years. The TGMD-2 measures 12 fundamental movement skills. In the current trial children were
assessed for only the eight focus skills taught in the trial (jump, catch, run, throw, leap, kick, hop, strike) (see Section 4.4).

The TGMD-2 has established validity for assessing fundamental movement skill proficiency in three- to ten-year-old children. Validation included an examination of the tools content validity, criterion-prediction validity and construct identification validity (Ulrich, 2000). Content validity was assessed by three content experts. The content experts judged whether the skills covered in the TGMD were frequently taught in preschool and early primary school and were representative of gross motor skills (fundamental movement skills). Items discrimination was assessed using the item-total-score Pearson Product-Moment correlation index. All skills achieved an item discrimination score above $r = 0.38$ (no range included). The criterion-prediction validity of the TGMD was assessed with a sample of 41 primary school children who were assessed using the TGMD-2 and then reassessed two weeks later using the Comprehensive Scales of Student Abilities (CCSA). The correlation between the TGMD-2 subtests, locomotor and object control, and the CCSA were $r = 0.63$ and $r = 0.41$ respectively (no range included). Using a composite score, the correlation between the TGMD-2 and the CCSA was $r = 0.63$ (no range included). Construct-identification validity was examined based on age and group (gender, ethnic and disability) differentiation. Scores demonstrated moderate to high correlation with average scores for each group. A specific discussion of the tool’s validation process can be found in the TGMD-2 Examiner Manual (Ulrich, 2000).

Reliability for the TGMD-2 has also been established from analyses of the tool’s accuracy in replication in the areas of content sampling, time sampling, and inter-score differences (Ulrich, 2000). Internal consistency and reliability were investigated using Cronbach’s coefficient alpha. All reliability coefficient scores exceeded $\alpha = 0.80$, except one (eight year olds, $\alpha = 0.76$). Test-retest reliability was conducted with a sample of 75 American children, between three and ten years of age. All reliability coefficients scores were above $\alpha = 0.91$. Interscorer reliability was tested with two staff members independently scoring 30 randomly selected completed protocols. All reliability coefficient scores exceeded $\alpha = 0.84$. A specific discussion of the tool’s reliability process can be found in the TGMD-2 Examiner Manual (Ulrich, 2000).
In the current study, children performed skills in small groups (2 - 4 children), which were organised ad hoc by setting staff. A trained demonstrator, not this candidate, demonstrated a skill. Children then took it in turns to perform the skill in the same way, as it had been demonstrated, to the best of their ability. If children appeared to not understand directions a second demonstration was given. Children performed each skill twice. All instructions, demonstrations and procedures followed the requirements of the TGMD-2 and were kept consistent between groups of children.

Children were video recorded performing each skill to allow for careful assessment at a later time. All skills were recorded with the long axis at 90° to the direction of the movement pattern. This position allows an accurate visual perspective of the participant’s performance of each of the assessment criteria. Videos were later viewed and analysed by a single trained assessor (the same person who demonstrated skills during data collection), using TGMD-2 assessment sheets (see Appendix F) (Ulrich, 2000).

4.5.2 Secondary Outcomes

Secondary outcomes were BMI. Changes in BMI were not anticipated to affect the potential efficacy of the Proof-of-Concept trial due to the short duration and low intensity (skill development focus and no diet component) of the trial. However, as physical activity is related to adiposity, BMI was included to allow comparison between studies.

4.5.2.1 Body Mass Index

All BMI measures were collected by a single trained assessor, using the International Society for the Advancement of Kinanthropometry (ISAK) procedures (ISAK, 2001).

Children’s height was measured using a portable stadiometer and the stretch stature method. Height was measured to the nearest 0.1cm. Children removed shoes and hats and stood with their head, shoulders, buttocks and heels against the stadiometer. Children’s feet remained flat on the base of the stadiometer, with eyes focused forwards. Children were directed to inhale deeply, at which time the assessor gently applied upward pressure through the mastoid process. The tape was then slid down to rest firmly on the child’s head and the assessor recorded the measurement. The child would then take a few seconds to relax and the process was repeated. The average of the
two measures was used in the calculation of the child’s BMI. Where there was a
difference +/- 5mm a third measure was taken. In the case of three measures being
recorded, the two closest measures were averaged and used in the calculation of the
child’s BMI.

Weight was measured using Tanita BF-681 portable scales and was recorded to the
nearest 0.1kg. Shoes and heavy clothing were removed prior to all measures. Weight
was measured twice for each child and the average of the two measures was used in the
calculation of BMI. Where there was a large significant difference in measures (equal to
or greater than 0.3kg) a third measure was taken, and the two closest measures used.

BMI (kg/m²) was calculated for each child and used to determine weight categories
(non-overweight, overweight and obese) according to the child’s gender, using the
international age specific cut-points developed by the International Obesity Task Force
(Cole et al., 2000).

4.5.3 Process Data

Process data included attendance, percentage of planned structured lessons and
unstructured activities implemented, and staff attitudes (confidence and competence
with teaching lessons, enjoyment and perceived appropriateness, and attitudes towards
physical activity).

4.5.3.1 Attendance

Attendance was collected from the formal rolls completed daily within the centre.
Attendance rolls were collected only for the two days of each week that the trial was
implemented. The number of days a child attended was then calculated by reviewing the
attendance roll.

4.5.3.2 Percentage of Planned Structured Lessons and Unstructured Activities

This candidate attended the centre on each day of the trial (i.e. Tuesday and Friday).
Therefore, this candidate recorded in the lesson observations whether the structured
lesson was implemented, and which components of the lesson were included. This
candidate implemented all unstructured activities and recorded the implementation,
duration and children’s involvement in unstructured activities in daily journal entries.
4.5.3.3 Staff Confidence and Competence with Teaching Physical Activity

Staff confidence and competence was measured using a pre- and post-intervention questionnaire (see Appendix G), and observations collected by this candidate throughout the trial. Insight into staff confidence and competence was also given through incidental staff comments on lesson evaluations (described below, see Section 4.5.3.4).

The staff confidence and competence questionnaire was independently completed at pre- and post-intervention. The questionnaire asked staff to rate their confidence and perceived competence in teaching each of the fundamental movement skills. Responses were marked by the participant on a 90mm continuous rating scale, with each extremity marked either as ‘not at all’ or ‘extremely’. Space was provided for additional comments. The use of self-delivered questionnaires reduces the risk of questioning bias which may occur with interview-based data collection (May, 2001). Limited response options, as provided through the use of the continuous rating scale allows for participants responses to be compared (May, 2001). The use of limited response questions also reduces the amount of time required to complete the questionnaire, which therefore reduces participant burden. Providing a limited number of short answer questions encouraged participants to consider responses, as well as providing more in depth to the data collected (May, 2001).

4.5.3.4 Staff Enjoyment and Appropriateness of Trial Components

Staff enjoyment was measured using a questionnaire completed at the conclusion of the professional development, staff lesson evaluations, researcher lesson evaluations and observations recorded by this candidate, informal interviews throughout the trial and individual post-intervention interviews. Staff enjoyment was collected for the three components of the trial: professional development, structured lessons and unstructured activities.

Feedback on the professional development delivery, content and appropriateness was collected through a short answer questionnaire (see Appendix H). The questionnaire was completed by participants immediately following the professional development workshop. The questionnaire requested information about the strengths and weaknesses of the professional development, their expectations of the trial, and whether there were any areas of their centre’s current physical activity program they believed should be
changed in response to the workshop. The questionnaire also asked participants if they had been involved in any other relevant professional development, to help to control for differences participants level of training and exposure to fundamental movement skills and physical activity education.

Following each structured lesson staff independently completed a lesson evaluation. Initially staff were provided with photocopies of the lesson plan to annotate. A template was introduced in week three to ensure the following areas were covered; participation of children, suitability of activities, organisation (set up, equipment, teaching strategies), possible modifications and strengths of the lesson (see Appendix I). This candidate also independently completed the same lesson evaluations as staff for each lesson. Observations of staff and children were recorded daily as journal entries.

At post-intervention each staff member participated in one individual semi-structured interview (see Appendix J). Staff were asked to share their perception regarding the appropriateness of the trial lessons and unstructured activities, how the trial affected them, how they felt the children responded, whether they had received any comments from parents, whether they had implemented anything additional on the days this candidate wasn’t in the centre, and whether there were changes that they would suggest for the resource folder (containing the lessons and activities) or the professional development.

4.5.3.5 Staff Attitudes Toward Physical Activity

Data on staff attitudes towards physical activity were collected in a pre-intervention interview, and questionnaire. Pre-intervention interviews were conducted by this candidate. Staff members were interviewed in pairs, which were convenience-based, and allocated by the centre Director in response to shift allocations and availability of staff. The pre-intervention interview focused on staff perception of the value of physical activity, aspects of physical activity they personally liked and disliked, and aspects of their centre environment they perceived to be either a barrier or a facilitator of physical activity (see Appendix K). Interviews were recorded and transcribed verbatim.

The staff confidence questionnaire, completed during the pre-intervention testing period (see Section 4.5.3.3) (see Appendix G), included questions about staff attitudes towards physical activity at child care centres. Staff completed the questionnaire individually and indicated responses on a five-point Likert scale, 1 = never, 2 = sometimes, 3 =
regularly, 4 = often, 5 = all the time. Staff indicated their response to questions such as how often they encouraged children to be physically active, how often they included physical activity in their centre program and how often they thought that physical activity should be included in the centre program. By providing limited response questions participant burden was reduced and participants responses could be compared (May, 2001).

4.6 DATA ANALYSES
Primary and secondary outcomes were analysed using SPSS for Mac Version 11 (SPSS Inc, Chicago). Intention-to-treat principles were applied, meaning all participant data were included in analyses irrespective of compliance to treatment or missing data at post-intervention (Hollis & Campbell, 1999). Missing values were imputed by carrying the last observation forward. Descriptive statistics were calculated for each study variable. As the values were approximately normally distributed, an intervention effect was tested for using a paired sample t-test conducted on each of the outcome measures. As this was a single group Proof-of-Concept trial, with a sample of 37, it was not adequately powered to detect statistically significant differences.

4.6.1 Data Handling and Management
Data were recorded on standardised forms, with identification numbers replacing participants’ names. Data records were stored on a password locked computer. Original data sheets were stored in a locked filing cabinet. Raw data were single input entered, checked using frequency and extreme value analyses and cross-checked with original data sheets. All calculated data were checked using frequency and extreme value analyses.

4.6.2 Primary Outcomes
4.6.2.1 Objectively Measured Physical Activity
Data were analysed using KidProg (Trost, personal communication, 2007). KidProg provided summaries of data, containing the accelerometer ID number, total epochs measured, total bouts of zero activity, total movement counts, total steps, minutes in sedentary activity, minutes in light physical activity (LPA), minutes in moderate physical activity (MPA), minutes in vigorous physical activity (VPA), and total minutes in moderate-to-vigorous physical activity (MVPA). Age specific cut-points, developed
Methods: Proof-of-Concept Trial

by Sirard et al. (2005), were used. These cut-points were validated by comparing Actigraph results with direct observation (modified Child Activity Rating Scale) \( (n = 269, 9 \text{ preschools}) \). Light physical activity sensitivity and specificity ranged from 87% - 100% and MVPA from 66% - 100%.

Summaries of data, from this study, were then imported into Excel (Version 11.0). Accelerometer ID numbers were matched with participant codes. Total minutes monitored and counts per minute (CPM) were calculated for each day. Due to children having the accelerometers both fitted and removed for them, bouts of zero were not subtracted from total epochs before calculating total minutes, as it was unlikely that there was any non-wear time collected. This meant that children continued to wear their accelerometer during any nap time they participated in, which is recommended for maximising compliance but compromises the ability of a study which collects nap time to compare with studies that do not (Cliff et al., 2009b). Total minutes of wear time were calculated by dividing total epochs by four \( (4 \times 15 \text{ second epochs} = 60 \text{ seconds}) \). Counts per minute were calculated by dividing total counts by total minutes monitored. The average CPM per day and minutes spent in LPA, MPA and VPA were calculated for pre-intervention and post-intervention data.

4.6.2.2 Fundamental Movement Skills

Each child was assessed according to the methods and standards outlined in TGMD-2, as described earlier (see Section 4.5.1.2) (Ulrich, 2000). Each skill had between three and five components and each skill was performed twice. Children were given a score of one if the component was present and zero if the component was not present. Therefore, if a skill comprises three components the score range is 0 – 6, four components gives a score range of 0 – 8, and five components gives a score range of 0 – 10. To give a total score, individual scores were standardised and summed as per the assessor manual. Children’s scores were recorded in an Excel Spreadsheet.

4.6.3 Secondary Outcomes

4.6.3.1 Body Mass Index

BMI scores were calculated and children were categorised as healthy weight, overweight or obese according to international cut-points (Cole et al., 2000), in an Excel worksheet, as described earlier (see Section 4.5.2.1).
4.6.4 **Process Data**

4.6.4.1 **Attendance**

Children’s attendance was recorded in a spreadsheet, with a ‘1’ indicating they attended child care on trial days and a ‘0’ indicating that they were absent. Attendance was then calculated individually for each child and a percentage of sessions attended calculated. Group attendance was calculated by noting the number of children who attended equal to or more than 80% of sessions on their days of enrolment.

4.6.4.2 **Implementation of Planned Structured Lessons**

Lesson evaluations were compared against the planned timeline to identify the percentage of planned structured lessons implemented. To determine the proportion of lesson components implemented, lesson evaluations were reviewed. Entries for each lesson were coded to identify the presence or absence of each lesson component; 1) exploration, 2) guided discovery, 3) review, 4) skill application 5) debrief. The presence or absence of lesson components were tabulated and a percentage of planned lesson components actually implemented were calculated for each lesson component (e.g. percentage of ‘exploration’ components actually implemented).

4.6.4.3 **Staff Attitudes**

A predetermined facilitation script was used for each interview (see Appendices E & H). Each interview was audio taped and subsequently transcribed verbatim. The interviews were analysed using logico-inductive analysis and major themes and categories were identified (Kervin, Vialle, Herrington, & Okely, 2006). Two researchers (this candidate and one supervisor) read the transcripts, independently identified common themes and selected comments as examples of each theme. There were a small number of occasions where these researchers did not agree on elements of common themes (< 3). In such an instance, transcripts were re-read and discussed further until a consensus was reached.

Staff questionnaires were entered into an Excel spreadsheet. For responses to questions pertaining to staff confidence with performing skills and teaching skills the continuum was measured (mm) from the left to where the participant had marked their response. A total score was calculated for confidence with performing skills, and subtotal scores for
Methods: Proof-of-Concept Trial

confidence with performing locomotor skills, and confidence with performing object control skills. A total score was also calculated for confidence with teaching skills, with subtotal scores for teaching locomotor skills, and teaching object control skills. Scores were compared individually at pre- and post-intervention. Responses to attitudes towards physical activity were also entered into an Excel spreadsheet, with never = 1, sometimes = 2, regularly = 3, often = 4, and, all the time = 5. A total score was calculated for each participant. These were used in triangulation of data regarding staff attitudes towards physical activity.

Formal and informal interviews, lesson evaluations and journal entries, were independently coded by three researchers (this candidate and two supervisors) for themes relating to staff perceived appropriateness, staff attitudes, staff confidence and staff enjoyment.

Formal interview data, questionnaire responses, observations, informal interviews and lesson evaluations were triangulated to develop an understanding of the impact of the trial on staff confidence and perceived competence, staff perceived appropriateness, staff enjoyment, and staff attitudes towards the value of physical activity. Staff attitudes and perceived appropriateness were reported as a narrative.

4.7 CHAPTER SUMMARY

This chapter outlines the methods used in this Proof-of-Concept trial in order to generate valid and reliable data, which was used to support or refute the targets and hypotheses of this trial. In particular the procedures used to collect objective data for the two primary outcomes, physical activity and fundamental movement skill proficiency, were described along with the planned statistical analyses and the use of intention-to-treat principles. This chapter outlined, and justified where appropriate, the study design, the sample, and the intervention components. Chapter 5 will detail the results of this Proof-of-Concept trial, addressing each of the targets and hypotheses, and will make recommendations for future trials on the basis of these findings.
5. RESULTS: PROOF-OF-CONCEPT TRIAL

5.1 INTRODUCTION

A Proof-of-Concept trial was undertaken to examine the feasibility, acceptability and potential efficacy of a fundamental movement skills program (*Jump Start*) for three- to five-year-olds in early childhood settings. The Proof-of-Concept trial was not designed to have sufficient statistical power to detect changes in the primary outcomes (physical activity and fundamental movement skill proficiency). The evaluation of the Proof-of-Concept trial therefore is based on the success of study implementation, intervention process measures and trends in primary and secondary outcomes.

This chapter reports on the feasibility, acceptability and potential efficacy of the Proof-of-Concept trial, incorporating both intervention outcomes and process measures. The chapter concludes with a summary of results in relation to each of the three research questions, and recommendations for future research.

The results of the Proof-of-Concept trial are reported using the Transparent Reporting of Evaluations with Non-randomised Designs (TREND) checklist (Des Jarlais et al., 2004).

5.2 RESEARCH QUESTIONS

The purpose of the Proof-of-Concept trial was to determine if an eight-week intervention was feasible, acceptable, and potentially efficacious. This was assessed through three research questions:

1. Is the program *feasible*, assessed by screening and recruiting a sufficient number of participants, retaining these participants, and collecting a pre-determined proportion of useable measurement data?

2. Is the program *acceptable*, assessed by evaluating the proportion of professional development content delivered, proportion of structured lessons and unstructured activities implemented, proportion of structured lessons attended by children and staff perception of program suitability?

3. Is the program *potentially efficacious*, assessed by greater increases in physical activity and fundamental movement skill competence, and no change in body mass index (BMI)?
5.3 RESEARCH TARGETS AND HYPOTHESES

5.3.1 Feasibility

It was proposed that the Proof-of-Concept trial would be feasible if:

Target One: 20 participants could be screened and recruited;

Target Two: 80% of participants could be retained from pre-intervention to post-intervention testing (8-week intervention period);

Target Three: 100% of data collected would be useable, except for objectively measured physical activity (70% of pre-intervention and post-intervention data would be useable).

5.3.2 Acceptability

It was proposed that the Proof-of-Concept trial would be acceptable if:

Target Four: 100% of professional development content was delivered;

Target Five: 100% of structured lessons were implemented;

Target Six: 100% of unstructured activities were implemented;

Target Seven: Child participants attended 80% of structured lessons;

Target Eight: Staff thought the program was appropriate for their centre.

5.3.3 Potential Efficacy

It was hypothesised that the Proof-of-Concept trial would be potentially efficacious if compared with pre-intervention, children at post-intervention showed:

Hypothesis One: Increased participation in physical activity;

Hypothesis Two: Greater mastery of fundamental movement skills;

Hypothesis Three: No change in BMI.

5.4 PARTICIPANTS

5.4.1 Child Participants

The characteristics of the Proof-of-Concept trial participants and their flow through the study are described using the Transparent Reporting of Evaluations with Non-
randomised Designs (TREND) statement (Des Jarlais et al., 2004). Use of the TREND statement assists authors to eliminate systematic error in the reporting of their non-randomised trials and allows for comparison between studies.

All eligible children had consent provided for their participation in the program by parents. The sample for the Proof-of-Concept trial consisted of 37 preschool children \( (n = 21 \text{ boys, } n = 16 \text{ girls}) \). Intention-to-treat principles were used, therefore all participants with pre-intervention data were included in the analyses of outcomes \( (n = 37) \).

5.4.1.1 Pre-Intervention Characteristics

Pre-intervention descriptive statistics are reported in Table 5.1, below. Of the total sample, the mean age of participants was 4.84yrs (± 0.45), 57% (21/37) of participants were boys and 43% (16/37) were girls, with 75% (28/37) classified as healthy weight, 14% (5/37) classified as overweight, and 11% (4/37) classified as obese (Cole et al., 2000).
Table 5.1  Proof-of-Concept trial: Pre-intervention characteristics of participants

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean [SD])</td>
<td>4.84 (0.45)</td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
</tr>
<tr>
<td>Counts per minute (mean [SD])</td>
<td>918.70 (257.51)</td>
</tr>
<tr>
<td>% Sedentary</td>
<td>78.05</td>
</tr>
<tr>
<td>% Light</td>
<td>14.64</td>
</tr>
<tr>
<td>% Moderate</td>
<td>4.09</td>
</tr>
<tr>
<td>% Vigorous</td>
<td>3.22</td>
</tr>
<tr>
<td>% Moderate–Vigorous</td>
<td>7.31</td>
</tr>
<tr>
<td>Fundamental movement skills (mean [SD])</td>
<td></td>
</tr>
<tr>
<td>Hop (/10)</td>
<td>4.00 (2.45)</td>
</tr>
<tr>
<td>Leap (/6)</td>
<td>3.96 (0.92)</td>
</tr>
<tr>
<td>Jump (/8)</td>
<td>3.48 (1.70)</td>
</tr>
<tr>
<td>Strike (/10)</td>
<td>5.36 (2.16)</td>
</tr>
<tr>
<td>Catch (/6)</td>
<td>3.37 (1.18)</td>
</tr>
<tr>
<td>Kick (/8)</td>
<td>4.81 (1.27)</td>
</tr>
<tr>
<td>Throw (/8)</td>
<td>2.04 (1.61)</td>
</tr>
<tr>
<td>Run (/8)</td>
<td>5.89 (1.34)</td>
</tr>
<tr>
<td>Body mass index (mean [SD])</td>
<td>16.61 (1.80)</td>
</tr>
<tr>
<td>Weight category (mean [%])</td>
<td></td>
</tr>
<tr>
<td>Non-overweight</td>
<td>28 (75)</td>
</tr>
<tr>
<td>Overweight</td>
<td>5 (14)</td>
</tr>
<tr>
<td>Obese</td>
<td>4 (11)</td>
</tr>
</tbody>
</table>

5.4.2 Staff Participants

All eligible staff provided consent to participate. The sample for the Proof-of-Concept trial consisted of six female staff members. At pre-intervention four of the six staff members participated in measures. Data were not collected from two staff members at the pre-intervention as they only became involved in the research part way into the trial (see Section 4.3.1). At post-intervention all staff participated in process measures.
5.5 IMPLEMENTATION OF TRIAL AND PROCESS OUTCOMES

5.5.1 Feasibility

A flow chart for screening, recruitment and retention for the Proof-of-Concept trial is shown in Figure 5.1, below.

![Flow chart diagram](image)

**Figure 5.1** Proof-of-Concept: Flow of participants through trial
5.5.1.1 Target One: Screening and Recruitment

To screen and recruit 20 participants.

All children who attended the centre’s preschool room permanently on a Tuesday and/or a Friday, and were aged three- to five-years , were eligible and invited to participate in the trial (n = 37). Of the 37 invitations, 37 consent forms were returned (100% return rate). This exceeded the target of successfully recruiting 20 children.

5.5.1.2 Target Two: Retention

To retain 80% of participants from pre-intervention to post-intervention testing (8-week intervention period).

Thirty-seven children began the trial (September 2007) and thirty five were retained at 8-week post-intervention testing. Two children left the centre: one immediately following pre-intervention assessments and the other part way through the trial. Therefore the retention rate for the study was 95%, exceeding the target of 80% retention.

5.5.1.3 Target Three: Data Collection

Of data collected, that 100% would be useable, except for physical activity (70% useable pre-intervention and post-intervention data could be collected).

Table 5.2 (below) displays the number and percentage of participants who completed outcome measures (producing useable data) at both pre-intervention and post-intervention testing. Missing data at pre-intervention was due to children refusing to participate on the day of testing (BMI n = 2, physical activity n = 4, fundamental movement skills n = 4) or children being absent on testing days (fundamental movement skills n = 2). One child couldn’t participate in some fundamental movement skill testing at pre-intervention (jump and hop) due to special needs. At post-intervention, two children had left the centre. Remaining missing data at post-intervention were due to children refusing to participate on the day (physical activity n = 2, fundamental movement skills n = 3) or being absent for all days of testing (fundamental movement skills n = 1). The same child who couldn’t participate in some fundamental movement skills testing at pre-intervention due to special needs, couldn’t participate in some fundamental movement skills testing at post-intervention (catch, jump, kick, throw). On
one occasion, at post-intervention, useable physical activity data were not collected for a child due to a malfunction with an accelerometer. When the accelerometers were downloaded one accelerometer had not recorded any epochs. The feasibility of collecting all data was high, with the target of 100% useable data (70% useable physical activity data) being met. A total of 64 days of accelerometer data at pre-test and 67 days of accelerometer data at post-test were included in the analyses.

Table 5.2  Proof-of-Concept trial: Percentage of useable data collected

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data</td>
<td>Useable Data</td>
</tr>
<tr>
<td></td>
<td>Collected</td>
<td>Collected</td>
</tr>
<tr>
<td>Physical activity</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Fundamental movement skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catch</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Hop</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Jump</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Kick</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Leap</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Run</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Strike</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Throw</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Body mass index</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Height</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Weight</td>
<td>35</td>
<td>35</td>
</tr>
</tbody>
</table>

*a* denotes the number of children who participated in the measure, shown in the cell directly left; "*Number of children who consented to participate in the study and were enrolled in the centre at post-intervention. Intention-to-treat principles were used in analyses.

5.5.1.4  Process Data Related to Feasibility

A number of barriers to data collection were identified. The limited timeframe for collection of pre-intervention data (1 week) resulted in 8/37 participants not providing data. Reasons included children being absent from the centre (n = 5) or the child refusing to be involved in data collection procedures (n = 3). In response this large amount of missing data, it was decided to collect additional data the following week. Due to time constraints, the professional development and intervention continued as per
the planned timeline, meaning that some pre-intervention data were collected during the first week of the intervention.

Fear and/or uncertainty seemed to prevent a small number of children from participating in data collection, with five children having one or more item of data missing which are attributed to fear of the instrument (based on observations recorded in journals). In addition to this small number, a much larger number of children (no record kept) initially refused to have their height and weight measured at baseline, but were willing after seeing the data collection procedure demonstrated on peers and teachers. One child had a fear-like unwillingness to participate in fundamental movement skill testing due to the presence of the male tester, but was happy to participate once the male tester was no longer present.

A small number \((n = 3)\) of children exhibited an unwillingness to be involved in data collection that appeared to be caused by preference (to play with friends or simply to choose not to) rather than fear.

A number of strategies were employed to overcome fear, uncertainty and unwillingness. Setting staff were asked to be, and were at all times, enthusiastic and encouraging of children’s participation in data collection. As mentioned earlier this also included setting staff increasing children’s familiarity and confidence with the stadiometer. A trained female tester (this candidate) collected fundamental movement skill data where the presence of a male tester posed a barrier \((n = 1)\). Finally, children were given stickers as incentives to participate in the height and weight measurements and to put on an accelerometer. Children were then given an additional sticker at the end of the day, which was designed to act as an incentive to wear the accelerometer all day.

Following the staff directed ‘play-time’ with the stadiometer, BMI data were successfully collected for most of the children who had initially refused to be measured. Process data suggests that many children enjoyed receiving the stickers, but may have been happy to wear the accelerometers without an incentive. A small number of children wouldn’t wear an accelerometer despite the incentive \((n = 2)\) (see Section 5.5.1.3). For a small number of children each day (2 or 3) the ‘end of day’ sticker played an important role in encouraging them to keep wearing their accelerometer. There were less refusals by children to participate in measures at post-intervention
compared to pre-intervention, suggesting that both familiarity and incentives may play an important role in collecting data for as many participants as possible.

5.5.2 Acceptability

5.5.2.1 Target Four: Implementation of Professional Development Content

Deliver 100% of planned professional development content.

All professional development content was delivered as planned in the one-day workshop. For detail regarding the design of the professional development please see Section 4.4.1.

5.5.2.2 Process Data Related to Target Four

Staff deemed the content of the professional development workshop appropriate, commenting that the content was ‘simple to understand’, that they valued being ‘active participants’. Additionally they valued the theory and practical elements. However, the timing of the professional development workshop was noted as a weakness. Despite being designed in consultation with staff, staff reported that it was difficult to attend for the whole day and that they felt that it was a bit rushed to have it completed before the start of the program.

Staff suggested that the inclusion of the demonstration lessons in the structured lessons increased their confidence in teaching the lessons.

‘...I think that if you just gave us the book and said here you go, I think that staff would lack a lot more confidence and probably, maybe, a bit of motivation to do it’. (Post-intervention interview)

‘[Having not watched the demonstration lesson] I felt that I didn’t know the games and felt uncomfortable teaching them to the children. I had to keep referring to my notes’. (Lesson evaluation, 23/10/07)

However, staff found it difficult to attend these demonstration lessons. Twice the Director scheduled staff to use this time for programming (while the children were occupied with the lesson), once the staff members forgot (were doing other things) and
once both permanent staff members were absent. Initially staff reported that they were not aware that the lessons led by this candidate were demonstration lessons that they were expected to watch (staff comments during program). To address this, from the second week of demonstration lessons (the third week of the intervention) this candidate actively reminded staff prior to each demonstration lesson and encouraged them to observe and participate. The instances where both participating staff members were absent and where the staff member forgot to come out for the lesson (described above) occurred after week three of the demonstration lessons.

5.5.2.3 Target Five: Implementation of Structured Lessons

*Implement 100% of planned structured lessons.*

All planned structured lessons within the intervention were successfully implemented (16/16) (see Table 5.3, p90). However, not all lessons were implemented as planned. One lesson was rescheduled due to a public holiday, and twice this candidate ran lessons that were planned to be implemented by setting staff (catch and kick) due to either, no staff member observed the first demonstration lesson, or, because the staff member who had observed the demonstration lesson was then unavailable to facilitate the following lesson.

Additionally, implementation fidelity was monitored by this candidate, and of the 16 lessons, 13 lessons (81%) were implemented according to the lesson plan. Each lesson component was included in the lessons the majority of time (exploration 16/16, guided discovery 14/16, review 16/16, activity 1 16/16, activity 2 15/16, activity 3 14/16, debrief 16/16). Reasons for missing components included, staff directing children to practice the correct skill component only in guided discovery (rather than children attempting variations and recognising the correct way to perform the skill) \((n = 2)\) or staff forgetting to implement some activities \((n = 3)\) (see Section 4.4.2 for an explanation of lesson components such as guided discovery).
Table 5.3 Proof-of-Concept trial: Implementation fidelity

<table>
<thead>
<tr>
<th>Week</th>
<th>Skill</th>
<th>Date</th>
<th>Exploration</th>
<th>Guided Discovery</th>
<th>Review</th>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Debrief</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jump</td>
<td>05/10/07**</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>09/10/07**</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Catch</td>
<td>12/10/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16/10/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Run</td>
<td>19/10/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>23/10/07**</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Throw</td>
<td>26/10/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30/10/07**</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Leap</td>
<td>02/11/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>06/11/07**</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Kick</td>
<td>09/11/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13/11/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Hop</td>
<td>16/11/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20/11/07**</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Strike</td>
<td>23/11/07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>04/12/07***</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Implementation fidelity (%)  

<table>
<thead>
<tr>
<th>28/09/07 – 09/10/07</th>
<th>Data collection</th>
<th>28/09/07 – 09/10/07</th>
<th>Data collection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Pre-intervention testing overlapped with the intervention due to higher numbers of children being absent at pre-intervention testing than anticipated; ** Indicates lessons taught by setting staff; † This lesson was planned to be implemented on a day that was a public holiday, it was rescheduled during the intervention, causing the post-intervention testing to overlap with the intervention.
5.5.2.4 Process Data Related to Target 5

5.5.2.4.1 Lesson Appropriateness

Staff were asked to provide their perception of the appropriateness of the structured lessons through lesson evaluations and in post-intervention interviews (see Section 4.5.3.4). Evaluations were completed for 11/16 (69%) lessons. Staff were not asked to give a reason for not completing evaluations. All participating staff completed post-intervention interviews.

Several themes were identified through lesson evaluations and post-intervention interviews. These themes are described below.

1) Lesson Components

Staff involved in the implementation of the lessons suggested that the exploration and guided discovery components were too detailed and lengthy and possibly difficult for children to understand. They recommended that the exploration and guided discovery sections be shortened to allow more time for activities and games.

‘I’m thinking that maybe that was a bit long and in depth and that’s maybe where we lost some of the kids, whereas maybe if we got stuck into some of the games a little bit earlier then that might engage them a little bit better and sort of maintain their attention.’ (Post-intervention interview)

‘I think for preschool kids that was a little bit tricky for them to understand the meaning of doing it all different ways, and some of them struggled just to strike a ball. (Post-intervention interview)

2) Activities

Individual staff suggested that some of the activities were inappropriate for the age group \(n = 1\), ‘Captain’s Coming’) or difficult for the children to understand \(n = 2\), ‘End Ball’, ‘Rabbit Tag’). However, other staff commented positively on the same activities and reported that children requested these activities later (either in free play or other structured lessons), suggesting either that they were not as inappropriate as staff had thought, or that they were suitable for some, but not all, children. Additionally, one staff member suggested that the equipment was not appropriate for one activity because
it was difficult to use (balloons in the strike lesson, due to it being difficult to anticipate which direction the balloon will move in).

3) Participation

While no formal participation record was kept, qualitative data (journal entries and lesson evaluations) suggest that in each lesson a small number of children (< 4) chose not to participate in either the whole lesson or sections of the lesson. In the first jump lesson approximately half the children chose not to participate, possibly due to the difficulty of the games or due to it being the first week of the trial (see Table 5.3, p90). Reasons for non-participation throughout the trial were recorded by this candidate and included, heat, children being upset about something that had happened prior to the lesson, children thought that they would not be able to do the activity (specifically the jump or hop), children were tired, distracted or bored. Overall staff were not surprised about some children not participating

‘As per our normal experiences, some children responded well. Others became disinterested.’ (Lesson evaluation, 05/10/07)

‘Sometimes I was a bit disappointed in the kids participation, but I guess you’re going to get that with any group of children.’ (Post-intervention interview)

4) Lesson Evaluations

Staff completion of lesson evaluations was low, with only 69% (11/16) of lessons having at least one lesson evaluation. Where lesson evaluations were completed, the information provided was of limited value for determining the acceptability of the program. For example, on three occasions staff reported what was done in the lesson rather than evaluating the lesson.

5) Preplanning for Lessons

Regarding the appropriateness of preparation time required for each lesson, staff did little preplanning for the lessons. Of the seven lessons run by centre staff members, on six occasions staff had not looked through the provided lesson plan beforehand. Additionally, staff came to five of the seven lessons without a lesson plan. When asked in post-intervention interviews, the Director expressed a belief that it was difficult to
find time in a day to look over a lesson plan, however staff might do this if time were allocated for them to do so.

5.5.2.4.2 **Staff Perception of Children’s Enjoyment of Structured Lessons**

Although some activities were deemed inappropriate by staff and some participants chose not to participate in the structured lessons, staff evaluations and journal entries written by this candidate suggested that children enjoyed the lessons, irrespective of the skill. As the trial progressed, and children became familiar with the routine of having the structured fundamental movement skill lessons, children began to make positive comments in anticipation of the lesson.

Lesson evaluations support the finding that children enjoyed the lessons, with staff including the following comments;

‘*All the children really enjoyed this session. You had their attention all the way through it. Lots of happy smiling faces.*’ (Catch Lesson)

‘*Children really enjoyed it. Element of excitement. Children worked hard to throw things over the net.*’ (Throw Lesson)

‘*I think they all enjoyed it and I think even the ones that were a little bit reserved about it came around towards the end of the lesson.*’ (Post-Interview)

5.5.2.4.3 **Staff Confidence and Perceived Competence**

Prior to implementing the program, staff appeared to be confident about implementing movement lessons and their ability to support movement skill development. In pre-intervention interviews, one staff member suggested that she would be surprised if the trial taught her anything new.

‘*It’ll be interesting to see whether you are going to teach me anything different to what I already know ...*’ (Pre-intervention interview)

Staff suggested that the Jump Start program would overcome a major barrier to implementing physical activity in long day care centres, a lack of ideas, rather than improving their own confidence in teaching fundamental movement skills.

‘*...There are) people who would think ‘I couldn’t think of something like that’ you know and so they just try to avoid it, but having a stash of cards*
like that or any type of thing it’s just, ok let’s follow that’. (Pre-intervention interview)

At pre-intervention, most staff (3/4) were confident in their ability to teach structured lessons and to teach each of the fundamental movement skills (3/4 or 4/4) with the exception of the skip (2/4). One staff member indicated low confidence with teaching six skills. However, only half of the staff were confident in their ability to identify the correct performance of a given movement skill (2/4) or to correct and/or advise children’s performance of fundamental movement skills (2/4). Additional detail can be found in Appendix L.

Staff suggested that the professional development workshop further increased their confidence in teaching the fundamental movement skill structured lessons and identifying and correcting the specific fundamental movement skill components. One wrote on their post-professional development questionnaire, ‘I feel confident about implementing the program. I wasn’t at first, but now with the activity cards I feel this is achievable.’ The other staff member wrote, ‘I’m really looking forward to it (implementing the program)...Resources we have to use are presented professionally. Although I only briefly taught a lesson... I found it to be comfortable and relatively easy to progress through.’ Following the professional development staff elected to begin running lessons immediately, rather than having this candidate run initial lessons as a demonstration (see Sections 4.4.2 and 5.5.2.3), which also demonstrates their confidence and perceived competence regarding the structured lesson content.

At post-intervention, staff confidence with teaching movement skills had decreased (they reported lower scores on the confidence rating scale). At post-intervention all staff (4/4) indicated they were confident in teaching the jump only, compared with pre-intervention where all staff (4/4) were confident in teaching six skills (balance, strike, kick, side-gallop, gallop, and jump). At post-intervention only two staff felt confident with teaching skip, hop, side-gallop and gallop and only one staff member indicated confidence with teaching the leap. Similarly, at post-intervention mean confidence ratings with identifying correct fundamental movement skill performance also decreased. There appeared to be no consistency in changes to self-rated confidence between staff who participated in implementing intervention compared to the two staff members who did not (see Appendix L).
Staff members involved in lesson facilitation suggested that it was helpful and reassuring having this candidate present in the lessons, with one commenting, ‘I think I did alright with your (this candidate) support. You were always there so I could say, ‘Am I doing it right?’ ’ and the other, ‘Having you actually here, and even being there in the lessons, like if we forgot something, that was good’.

5.5.2.5 Target Six: Implementation of Unstructured Activities

Implement 100% of planned unstructured activities.

All planned unstructured activity sessions were successfully implemented (16:16). Details of activities can be found in Appendix E.

5.5.2.6 Process Data Related to Target Six

5.5.2.6.1 Facilitation of Unstructured Activities

The support teachers were not asked to comment on the unstructured activities in the post-intervention interviews, as the provision of activities is not part of their role at the centre. Therefore the following comments are from the four permanent teachers. All four staff reported that they thought that the unstructured activities were worthwhile. However, all suggested that the unstructured activities were difficult to initiate as they had competing tasks during that time, for example, talking with parents, unsettled children, changing nappies and organising drinks for children. They suggested that it would be difficult to run unstructured activities consistently.

‘...We’re all trying to talk to parents and get children in and out of nappies and we don’t seem to have time to do that (unstructured)....’
(Post-intervention interviews)

‘Time constraints in the afternoons, with routines and stuff might make it hard for someone to stand there and do it with them.’ (Post-intervention interviews)

Although staff believed they would find it difficult to initiate the unstructured activities, they indicated that it was important to facilitate activities, similar to the ones demonstrated in the unstructured component of Jump Start. Staff recognised that for the unstructured activities to be successful and worthwhile that staff would need to commit to facilitating them in much the same way that they have committed to supervising
trampoline use (the trampoline is stored away except on occasions when an adult is prepared to provide constant supervision, a commitment of time that staff have accommodated). Further, staff expressed that they understood that their involvement in such activities would be an encouragement to children to be engaged in physical activity.

5.5.2.6.2 Perceived Children’s Enjoyment of Unstructured Activities

Three of the four staff said they thought that the unstructured activities were valuable and engaging for the children. Staff commented that, ‘I think that they enjoyed it’, ‘We always noticed that you had stacks of kids around you’, and, ‘We’ve noticed a big change in the kids of an afternoon when you’re here’.

Children demonstrated excitement regarding the unstructured activities, with children asking what ‘games’ had been brought and requesting activities. The presence of an adult who was willing to engage with the children appeared to encourage participation and enjoyment, although children often would continue to engage with activities without the presence of the facilitator or another adult. Further, although participation data were not routinely collected, on occasions the unstructured activities attracted children who had chosen not to participate in the structured lessons.

On a small number of occasions (3/16) children were injured while participating in the unstructured activities. These injuries were minor, such as grazed knees.

5.5.2.7 Target Seven: Children’s Attendance

Child participants will attend 80% of structured lessons.

While lesson attendance or participation was not collected, it was assumed that children participated in lessons on the days they were in attendance. Therefore, 86% (30:35) of children attended 80% or more of the structured fundamental movement skill lessons, which exceeds the target of 80% of participants attending 80% of lessons. However, the actual attendance based on participation in the lesson is likely to be slightly lower due as it is reported in lesson evaluations that on occasions a small number of children in attendance would refuse to participate in some or all of a structured lesson (see Section 5.5.2.4.1).
5.5.2.8 Process Data Related to Acceptability

5.5.2.8.1 Additional Support

None of the additional support was used. In post-intervention interviews one staff member involved in running the lessons reported:

‘I didn’t use them (photographs), but I loved looking back at them ... we just haven’t got the time to do it. Even though all the photos are there because you’d taken them... This time of the year is really busy ... we’re all trying to get our portfolios ready and to be given out and it’s really busy.’

This may also be related to the possibly low priority given to the program, or low perceived benefit of the program, as indicated by staff rarely being prepared for lessons or bringing the lesson plan to lessons, and low completion lesson evaluations (see Section 5.5.2.4.1) and that staff needed reminders to attend the demonstration lessons (see Section 5.5.2.2).
### 5.5.3 Potential Efficacy

Table 5.4 (below) describes primary and secondary outcome measures, as related to the potential efficacy of the Proof-of-Concept trial.

**Table 5.4** Proof-of-Concept trial: Changes to primary and secondary outcome measures

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pre-intervention Mean (SD)</th>
<th>Post-intervention Mean (SD)</th>
<th>Pre -Post Difference</th>
<th>95% CI of diff Lower</th>
<th>Upper</th>
<th>t Value</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counts per minute</td>
<td>918.70 (257.51)</td>
<td>973.00 (277.94)</td>
<td>54.27</td>
<td>-7.94</td>
<td>116.49</td>
<td>1.78</td>
<td>0.09</td>
</tr>
<tr>
<td>% Sedentary</td>
<td>78.05</td>
<td>75.75</td>
<td>-2.30</td>
<td>-4.92</td>
<td>0.32</td>
<td>-1.79</td>
<td>0.08</td>
</tr>
<tr>
<td>% Light</td>
<td>14.64</td>
<td>16.07</td>
<td>1.43</td>
<td>-0.16</td>
<td>3.03</td>
<td>1.82</td>
<td>0.08</td>
</tr>
<tr>
<td>% Moderate</td>
<td>4.09</td>
<td>4.70</td>
<td>0.61</td>
<td>-0.21</td>
<td>1.43</td>
<td>1.50</td>
<td>0.14</td>
</tr>
<tr>
<td>% Vigorous</td>
<td>3.22</td>
<td>3.48</td>
<td>0.26</td>
<td>-0.24</td>
<td>0.77</td>
<td>1.07</td>
<td>0.29</td>
</tr>
<tr>
<td>% Moderate-to-vigorous</td>
<td>7.31</td>
<td>8.18</td>
<td>0.87</td>
<td>-0.30</td>
<td>2.04</td>
<td>1.51</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Fundamental movement skills</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catch (/6)</td>
<td>3.33 (0.21)</td>
<td>3.39 (1.22)</td>
<td>0.06</td>
<td>-0.47</td>
<td>0.59</td>
<td>0.23</td>
<td>0.82</td>
</tr>
<tr>
<td>Hop (/10)</td>
<td>4.27 (2.62)</td>
<td>4.82 (2.31)</td>
<td>0.55</td>
<td>-0.23</td>
<td>1.32</td>
<td>1.43</td>
<td>0.16</td>
</tr>
<tr>
<td>Jump (/8)</td>
<td>3.56 (1.81)</td>
<td>3.72 (1.80)</td>
<td>0.16</td>
<td>-0.54</td>
<td>0.85</td>
<td>0.46</td>
<td>0.65</td>
</tr>
<tr>
<td>Kick (/8)</td>
<td>4.91 (1.38)</td>
<td>4.94 (1.60)</td>
<td>0.03</td>
<td>-0.52</td>
<td>0.58</td>
<td>0.11</td>
<td>0.91</td>
</tr>
<tr>
<td>Leap (/6)</td>
<td>4.09 (0.95)</td>
<td>4.21 (0.93)</td>
<td>0.12</td>
<td>-0.22</td>
<td>0.46</td>
<td>0.73</td>
<td>0.47</td>
</tr>
<tr>
<td>Run (/8)</td>
<td>6.00 (1.30)</td>
<td>5.70 (1.45)</td>
<td>-0.30</td>
<td>-0.72</td>
<td>0.12</td>
<td>-1.47</td>
<td>0.15</td>
</tr>
<tr>
<td>Strike (/10)</td>
<td>5.36 (2.18)</td>
<td>6.45 (2.05)</td>
<td>1.09</td>
<td>0.27</td>
<td>1.91</td>
<td>2.73</td>
<td>0.01</td>
</tr>
<tr>
<td>Throw (/8)</td>
<td>1.97 (1.55)</td>
<td>2.55 (2.05)</td>
<td>0.58</td>
<td>0.02</td>
<td>1.14</td>
<td>2.09</td>
<td>0.05</td>
</tr>
<tr>
<td>Body mass index</td>
<td>16.61 (1.80)</td>
<td>16.69 (1.69)</td>
<td>0.08</td>
<td>-0.08</td>
<td>0.24</td>
<td>0.98</td>
<td>0.34</td>
</tr>
</tbody>
</table>
5.5.3.1  Hypothesis One: Physical Activity Trends

*Compared with pre-intervention testing, children will participate in increased levels of physical activity.*

Participants demonstrated non-significant increases in their levels of physical activity during child care hours from pre-intervention to post-intervention. Overall physical activity (counts per minute : CPM) increased non-significantly by 54 CPM (95% CI = -7.94 – 116.49, \( p = 0.09 \)). Non-significant increases were seen in all other physical activity variables with the largest non-significant increase being a 1.43% (95% CI = -0.16, 3.03, \( p = 0.08 \)) increase in percentage of time spent in light physical activity (LPA). Mean sedentary activity non-significantly decreased by 2.30% (95% CI = -4.92, 0.32, \( p = 0.08 \)). While not powered to detect significant changes in physical activity, these findings support the potential efficacy of this intervention.

5.5.3.2  Hypothesis Two: Fundamental Movement Skill Trends

*Compared with pre-intervention testing, children will demonstrate a greater mastery of fundamental movement skills.*

At post-intervention, participants demonstrated increased skill proficiency in all skills with the exception of the run. The greatest increase was seen in the strike with a significant increase of 1.09 components (95% CI = 0.27, 1.91, \( p = 0.01 \)) on a scale of 0 - 10, followed by the throw with a significant increase of 0.58 components (95% CI = 0.02, 1.14, \( p = 0.05 \)) on a scale of 0-8, and hop with a non-significant increase of 0.55 components (95% CI = -0.23, 1.32, \( p = 0.16 \)) on a scale of 0 - 10. While not powered to detect significant changes in fundamental movement skill proficiency, these findings support the potential efficacy of this intervention.

5.5.3.3  Hypothesis Three: Body Mass Index

*Compared with pre-intervention testing, children will demonstrate no change in BMI.*

Given the low intensity and short duration of the intervention it was hypothesised that BMI would not change from pre-intervention to post-intervention (see Section 4.5.2). Average BMI at post-intervention was the same as at pre-intervention, that is, no change was reported.
5.6 SUMMARY OF RESULTS

This study aimed to determine the feasibility, acceptability and potential efficacy of a fundamental movement skill development program (*Jump Start*) for three- to five-year-olds in early childhood settings. Data were collected from 37 children (*n* = 21 boys, *n* = 16 girls) attending a long day care centre on the South Coast of New South Wales. The main results obtained from the data, as they relate to the three research questions, are summarised in Table 5.5 (below).

Table 5.5  Proof-of-Concept trial: Summary of results

<table>
<thead>
<tr>
<th>Research Question 1</th>
<th>Results</th>
</tr>
</thead>
</table>
| Is the program *feasible*, assessed by screening and recruiting a sufficient number of participants, retaining these participants, and collecting a pre-determined proportion of useable measurement data? | **Recruitment**: Through a local child care organisation (*Illawarra Children’s Services*), 1 long day care centre, *n* = 37.  
**Retention**: Two children unenrolled from participating centre at post-intervention. 95% (35/37).  
**Measurements collected**:  
• **Physical activity**: 89% (33/37) pre-intervention, 94% (32/35) post-intervention,  
• **Fundamental movement skills**: 81% (30/37) pre-intervention, 86% (30/35) post-intervention,  
• **BMI**: 95% (35/37) pre-intervention, 100% (35/35) post-intervention,  
• **Reasons for missing data**: Refusal, absent on all days of data collection, special needs restricting involvement, instrument malfunction. |
<table>
<thead>
<tr>
<th>Research Question 1 (cont.)</th>
<th>Results (cont.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the program <strong>feasible</strong>, assessed by screening and recruiting a sufficient number of participants, retaining these participants, and collecting a pre-determined proportion of useable measurement data?</td>
<td><strong>Useable data:</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>Physical activity:</strong> 100% of pre-intervention, 97% post intervention (due to accelerometer malfunction),</td>
</tr>
<tr>
<td></td>
<td>• <strong>Fundamental movement skills:</strong> 100% of pre- and post-intervention,</td>
</tr>
<tr>
<td></td>
<td>• <strong>BMI:</strong> 100% pre- and post-intervention.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Research Question 2</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the program <strong>acceptable,</strong> assessed by evaluating the proportion of professional development content delivered, proportion of structured lessons and unstructured activities implemented, proportion of structured lessons attended by children and staff perception of program suitability?</td>
<td>• <strong>Professional Development:</strong> 100% planned content implemented.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Structured sessions:</strong> 100% of planned structured lessons implemented (fidelity 81%, 13/16).</td>
</tr>
<tr>
<td></td>
<td>• <strong>Unstructured activities:</strong> 100% of unstructured physical activity sessions implemented.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Attendance:</strong> 86% (30/35) of children attended over 80% (≥7/8 days) of the structured sessions.</td>
</tr>
</tbody>
</table>
Table 5.5 Proof-of-Concept trial: Summary of results (cont.)

<table>
<thead>
<tr>
<th>Research Question 3</th>
<th>Results</th>
</tr>
</thead>
</table>
| Is the program *potentially efficacious*, assessed by greater increases in physical activity and fundamental movement skill competence, and no change in BMI? | • **Physical activity:** Reduction in mean time spent in sedentary activity and increase in mean counts per minute, and mean time spent in light, moderate and vigorous activity. None were statistically significant.  
• **Fundamental movement skill proficiency:** Improvements in 7/8 skills, with these statistically significant for the strike (pre - post difference = 1.09, 95% CI = 0.27, 1.91, \( p = 0.01 \)) and approaching statistical significance for the throw (pre - post difference = 0.58, 95% CI = 0.02, 1.41, \( p = 0.05 \)).  
• **BMI:** No change in BMI. |
5.7 DISCUSSION

5.7.1 Feasibility

5.7.1.1 Screening and Recruitment

Recruitment exceeded targets. This was possibly due to the high motivation and involvement of centre staff, including their willingness to talk to parents and promote the program (see Section 4.3.1).

In response to the findings in the Proof-of-Concept trial recommendations for future studies include:

1) Setting higher recruitment targets. These recruitment findings suggest that the majority of invited participants will consent to participate in a non-threatening intervention that is perceived as beneficial to their child, has the support of setting staff and is delivered at their child’s child care setting, during normal hours;

2) Actively involve setting staff in promoting interventions to parents and following up consent.

5.7.1.2 Retention

Retention from pre-to post-intervention exceeded 80%. No participants’ parents withdrew consent.

In response to the findings in the Proof-of-Concept trial recommendations for future studies include:

1) That minimum retention rates of 80% are a feasible target.

5.7.1.3 Data Collection

At pre-intervention, all data collected were useable. At post-intervention, almost all data collected were useable (97% physical activity, 100% fundamental movement skills, 100% BMI). However not all data were able to be collected from all participants.

The high percentage of useable data collected may have been due to data being collected by trained assessors and children only wearing accelerometers for the hours they were at preschool (see Sections 4.5.1.1, 4.5.1.2, and 4.5.2.1).
In response to findings in the Proof-of-Concept trial, recommendations for future studies include:

1) Always having a female assessor. Children seemed to be less apprehensive about assessments when a female assessor was present, possibly because all centre staff were female;

2) Providing centres with a stadiometer a week prior to the commencement of data collection to allow children an opportunity to use the apparatus and become familiar with its presence and function;

3) A buffer week before the intervention begins to allow for children who are absent in the official data collection period to be assessed;

4) Where accelerometers are being worn only during centre hours there is less likelihood of data loss. Therefore percentage of useable data collection targets potentially could be set higher than 70%.

5.7.2 **Acceptability**

5.7.2.1 **Implementation of Professional Development**

All planned professional development content was delivered. This was probably due to the use of a one day workshop format, designed in consultation with centre staff (see Section 4.4.1). However this approach was chosen due to time constraints and was not ideal because of the demand on time and its limited ability to influence behavioural change (see Sections 5.5.2.2). Demonstration lessons were offered to staff, however, staff initially suggested that they were not needed as they felt confident that they could deliver the program without the additional support. Early in the intervention this candidate observed that implementation quality was poor and staff showed limited lesson preparation and understanding of activities, therefore demonstration lessons were incorporated into the delivery timeline.

Even though the professional development workshop and demonstration lessons were successfully delivered, only staff that participated in the professional development and the implementation of the program were willing to continue to facilitate the program. Staff not involved in the program (as they were part-time or teaching in the younger children’s room at the time) perceived that the program was “…Too much work…”. This
was of concern as a complete change of staff was occurring the following year (meaning preschool teachers were moving to the infants rooms and infants teachers would be moving to teach in the preschool room).

In response to the findings in the Proof-of-Concept trial recommendations for future studies include:

1) That implementation of professional development be ongoing and in short blocks of time;

2) That professional development workshops have theoretical and practical components;

3) That demonstration lessons be part of the planned professional development model (e.g. a formal component), to build confidence and competence of staff, and to encourage high implementation quality of lessons;

4) That all centre staff be involved in the professional development with the aim of enhancing sustainability and accommodating staffing changes in future years.

5.7.2.2 Implementation of Structured Lessons

All structured lessons were implemented, however not strictly according to the planned timetable (see Table 4.1, p65 for planned delivery and Table 5.3, p90). One lesson was rescheduled due to a public holiday and this candidate ran some lessons that were planned to be implemented by setting staff.

Additionally, staff rarely did preparation that would support high quality implementation of the lesson (such as perusing the lesson plan prior to the lesson or having the lesson plan on hand for the lesson).

In response to the findings in the Proof-of-Concept trial recommendations for future studies include:

1) Include public holidays in delivery schedule. Avoid rescheduling lessons that fall on a public holiday to keep the schedule simple and predictable;

2) Provide staff with a timeline for the intervention, prior to starting the intervention and clearly outline implementation expectations;

3) Use professional development workshops as an opportunity to remind staff of expectations and to familiarise them with the implementation program. Also encourage staff to raise concerns at this time;
4) Have a project manager to provide generous implementation support such as reminders and follow-up;

5) Include demonstration lessons in the original professional development design, as opposed to offering demonstration lessons as an optional addition, to support confidence and competence in lesson delivery.

5.7.2.3 Implementation of Unstructured Activities

All unstructured activities were facilitated as planned. This candidate facilitated all unstructured activities, thus ensuring all were implemented. However, post-intervention interviews indicated that while staff believed the unstructured activities were valuable, they saw them as time consuming and had some reservations about their ability to continue to implement similar activities (see Section 5.5.2.6.1).

In response to the findings in the Proof-of-Concept trial recommendations for future studies include:

1) Giving setting staff responsibility for implementing unstructured activities, to reduce the risk that they may have an inaccurate perception of the time and effort involved;

2) Provide some demonstration unstructured activities to support high quality implementation of unstructured activities;

3) As recommended for the structured lessons above (see Section 5.7.2.2), provide generous implementation support in the form of reminders and follow-up;

4) Provide simple ideas that can either be used or act to stimulate setting staff’s development of appropriate unstructured activities.

5.7.2.4 Children’s Attendance

Over 80% of children attended at least 80% or more of the structured lessons by virtue of their attendance at preschool. Upon reflection it is suggested that children of this age have little influence on their preschool attendance and therefore attendance may not be an appropriate measure of acceptability within this age group.

In response to the findings in the Proof-of-Concept trial, recommendations for future studies include:

1) Attendance may not be an appropriate measure of acceptability within this age group.
5.7.2.5 Process Measures Related to Acceptability

5.7.2.5.1 Staff Lesson Evaluations

Staff completion of lesson evaluations was low (11/16) and the information contained in lesson evaluations was of limited value for informing the future design of the Jump Start program.

In response to the findings in the Proof-of-Concept trial, recommendations for future studies include:

1) Providing standardised lesson evaluation forms, which include Likert scales for each item being assessed. This will minimise participant burden and provide empirical data which will allow comparison of responses (Burns, 1998). Also include space on the lesson evaluation forms for short answer responses. These short answer responses provide an opportunity for valuable insight into participant opinions and experience through providing opportunity for participants to provide a more detailed response (Burns, 1998);

2) Integrate evaluations into the routine of the intervention. Introduce evaluations at the beginning of the intervention, provide a simple system so that participants know where to find blank evaluation forms and what to do with completed evaluations;

3) Keep a record of completed evaluations and follow up participants if they appear to have forgotten to complete an evaluation for a given lesson. Remind participants regularly (formally, such as in professional development workshops, and informally) of the need to complete evaluations and the value of the evaluations.

5.7.2.5.2 Lesson Appropriateness

Overall, staff deemed Jump Start to be appropriate, however individual staff members deemed a small number of activities in the structured lessons not appropriate and some staff commented that less time should be allocated to the exploration and guided discovery components and with more time on the games.

The overall positive response is possibly due to the formative research Jump Start was based upon (see Section 1.5 or Appendix A), which may have strengthened the suitability of the program for a long day care setting. Having a small number of activities that were not as well suited to the setting or the children’s stage of
development may have been due to this being the first implementation of the lessons. The staff perception that there should be less theory and more of a focus on games may indicate that this element of the intervention needs to receive more attention during the professional development (e.g. explaining the value of these components clearly and supporting delivery of high quality lessons).

In response to the findings in the Proof-of-Concept trial, recommendations for future studies include:

1) Include Proof-of-Concept trials in initial testing of interventions to allow the intervention to be refined in anticipation of implementing larger scale interventions with an optimum program design;

2) Appreciate that the value of explicitly teaching of fundamental movement skill components does not seem to be quickly accepted by early childhood staff (i.e. multiple suggestions to ‘just play the games’) and so should be addressed thoroughly and regularly to ensure staff understand the value of the lesson design and the underpinning theory;

3) Also through professional development and implementation support, provide direction on implementing lessons and behaviour management strategies to optimise lesson enjoyment, and therefore participation, which will subsequently support staff perception of lesson appropriateness. This includes strategies such as reading over lessons before hand and considering how to minimise waiting time for children.

5.7.2.5.3 Staff Confidence and Perceived Competence

Process measures (pre- and post-intervention interviews, observations and confidence questionnaire) suggested that staff believed that the Jump Start program would enable them to implement physical activity structured lessons that would support fundamental movement skill development. Process measures also indicated that staff found the presence of this candidate and the demonstration lessons helpful for teaching physical activity lessons. However results of the confidence questionnaire were not consistent, with both increased and decreased confidence across skills and general teaching questions, as well as inconsistent changes in confidence when comparing staff involved in the intervention (2/4) with staff not involved (2/4) (e.g. for ‘run’, ‘throw’, and ‘hop’ 1/2 staff members involved in the intervention and 1/2 staff members not involved report higher confidence) (see Section 5.5.2.4.3 and Appendix L). Self-reported
Results: Proof-of-Concept Trial

confidence may have been affected by staff not being familiar with what was involved in teaching fundamental movement skills at pre-intervention. For example, reduced confidence at post-intervention may have been caused by an increased familiarity with fundamental movement skills following the intervention and therefore an awareness of knowledge gaps (Glajchen & Bookbinder, 2001). Lack of clear findings may also have been due to the small number of staff participating in the measure: only four staff completed the confidence questionnaire, and of these, only two participants were involved in the professional development and lesson delivery. Finally, given participants knew the purpose of the intervention, questionnaire results may have also been influenced by participant bias (May, 2001).

To address the findings of the Proof-of-Concept trial, recommendations for future studies include:

1) Cover lesson content, related games and skill components explicitly within the professional development content. Involve staff practically in demonstrations of structured lessons, unstructured activities and observing fundamental movement skill performance throughout the professional development to support knowledge acquisition (Porter, Garet, Desimone, & Birman, 2003);

2) Consider not collecting quantitative data regarding confidence, unless a robust tool is available.

5.7.2.5.4 Staff Preparation

Staff did little preplanning for lessons, with six out of seven lessons being run without the teaching staff member looking over the lesson plan first. Generally this was attributed to staff forgetting or being unaware of where to access the lesson plans. This is possibly due to the lesson implementation not being a habitual part of the child care settings day, a low understanding among staff of the importance of well prepared structured lessons, and/or the trial being implemented at the end of the school year, which is typically a busy time in child care.

In response to the findings in the Proof-of-Concept trial, recommendations for future studies include:

1) Develop norms (such as storage locations and expectations) early and in consultation with the setting staff (through the Director). Ensure all staff are aware of these practices.
Have all resources prepared and delivered to the centre in advance of the program commencing;

2) Include reminders of the value of lesson preparation within the ongoing professional development;

3) Plan interventions so that they are implemented well in advance (two months) of the end of the year and therefore reduce one area of conflicting priorities.

5.7.2.5.5 Additional Support

None of the modes of additional support were utilised by setting staff. Post-intervention interviews suggest that this is due to competing interests for staff time. Particularly interesting are staff comments that they didn’t have time to include the movement skills covered in Jump Start in the developmental portfolios because, ‘they are concentrating getting the school readiness stuff in there’, which may be an example of lower parent and/or staff value for physical development compared with academic achievement. It is possibly also due to staff not being familiar with the additional support, both knowing what was available and therefore being familiar with use it.

In response to the findings in the Proof-of-Concept trial, recommendations for future studies include:

1) Incorporating a formal home component in line with recommendations in current literature (such as home activities or parent newsletters) (Riethmuller et al., 2009a; Hesketh & Campbell, 2010), with appropriate structures such as planned implementation, and implementation fidelity and acceptability measures;

2) Addressing barriers staff face in using ‘additional support’ components of an intervention, such as familiarity and perceived value, possibly as part of professional development.

5.7.3 Potential Efficacy

5.7.3.1 Primary Outcomes

Trends towards improvements were seen in all primary outcomes. There was a decrease in objectively measured sedentary time and an increase in CPM, LPA, and moderate and vigorous physical activity (MPA and VPA, respectively). This may be due to children increasing their fundamental movement skill proficiency, learning games,
social skills and ideas for using equipment that influenced their free play choices. Alternatively, changes in physical activity levels may be the result of post-intervention data being collected in late Spring when possibly the weather was more conducive to outdoor active play (Baranowski et al., 1993). This is difficult to confirm in the absence of a comparison group.

Trends towards improvements were seen in all fundamental movement skills, with the exception of the run. Lack of increases in run proficiency may be due to run scores being high at pre-intervention, and therefore some regression to the mean occurring at post-intervention testing. Due to the small sample size, the results are more prone to extreme values. Statistically significant increases were found for the strike (pre – post-difference = 1.09, 95% CI = 0.27, 1.91, \( p = 0.01 \)) and improvements approaching statistical significance were found for the throw (pre- post-difference = 0.58, 95% CI = 0.02, 1.41, \( p = 0.05 \)). Again, the presence of a control group would further test the potential efficacy of this intervention.

In response to the findings in the Proof-of-Concept trial, recommendations for future studies include:

1) Collecting more than one day of accelerometer data for each participant to improve the accuracy of the measure of physical activity during child care hours;

2) Limit the number of fundamental movement skills addressed in an intervention to increase the dosage for each skill and allow adequate time to see improvements over the period of the intervention;

3) Choose skills based on those best supported by the provided program (which lessons have been trialled in a Proof-of-Concept, with positive responses from staff and children), which skills do setting staff already value and which skills are likely to demonstrate improvements beyond maturation;

4) As this was a Proof-of-Concept trial, it was appropriate to have an intervention group only for the purpose of testing feasibility and acceptability targets. For studies aiming to determine potential efficacy, and to control for threats to internal validity of the study, trial designs should include comparison groups.
5.7.3.2 Secondary Outcomes

There was no change to BMI. This was possibly due to the short duration of the intervention (8-weeks), and participants tending to be a healthy weight. Affecting BMI was not the focus of this intervention, though it is anticipated that increasing physical activity and fundamental movement skills in this age group may have long term benefits for maintaining healthy weight. Therefore, BMI was included in the current study to allow comparison with other health interventions conducted in this age group.

In response to the findings of the Proof-of-Concept trial, recommendations for future studies include:

1) That a control group be employed in trials seeking to measure the impact of an intervention on BMI.

5.8 Chapter Summary

This chapter has described the results of the Proof-of-Concept trial, the first phase of a two-phase project to test the feasibility, acceptability and potential efficacy of a fundamental movement skill development resource, *Jump Start*. In addition to the promising results of statistical analyses conducted on primary and secondary outcomes (physical activity, fundamental movement skills, BMI), this chapter has also reported rich process data. These data were then used to make recommendations for future studies, based upon the feasibility, acceptability and potential efficacy findings of this Proof-of-Concept trial. The following chapter, Chapter 6, will describe changes made to the study design and intervention components, and outline methodology specific to the second-phase of the research project, the pilot RCT.
6. METHODS: PILOT RANDOMISED CONTROLLED TRIAL

6.1 INTRODUCTION

This chapter describes the methodology of the Jump Start pilot randomised controlled trial (RCT), assessing the feasibility, acceptability and potential efficacy of a fundamental movement skills program designed for three- to five-year-old children attending long day care settings. This pilot RCT was the second phase of a two-phase research project. The methods and results of the first phase, a Proof-of-Concept trial, are described in Chapters 4 and 5, respectively. The feasibility and acceptability of the Jump Start program was tested through collection of rich process data, including lesson evaluations, interviews, observations, and questionnaires. Potential efficacy was tested through collection of objectively measured physical activity, fundamental movement skill proficiency, and height and weight (used to calculate body mass index: BMI), collected at pre- and post-intervention (20 weeks).

The methods of the pilot RCT are described using the revised Consolidated Standards of Reporting Trials (CONSORT) statement (Moher et al., 2010). These guidelines facilitate critical appraisal and interpretation of RCTs by providing guidance to authors about how to improve the reporting of their trials to eliminate systematic error (Moher et al., 2010).

6.2 OBJECTIVES

The pilot RCT aimed to test the: 1) feasibility of the Jump Start program by determining whether it was possible to recruit 30 children (60 total) from the three- to five-year-old room at two long day care centres, retain 80% of participants from pre- to post-intervention, and to collect 100% useable data of measures collected at pre- and post-intervention; 2) acceptability of Jump Start by determining whether it was possible to implement and facilitate all planned professional development content, structured lessons, unstructured activities, and whether staff found the program to be enjoyable and acceptable; 3) potential efficacy of Jump Start by determining whether children at the intervention centre showed greater improvements in primary outcomes (objectively
measured physical activity levels and fundamental movement skill proficiency) compared with the comparison group.

6.3 PARTICIPANTS

6.3.1 Recruitment

Long day care centres were recruited through Illawarra Children’s Services. Similar to the Proof-of-Concept trial (see Section 4.3.1), Illawarra Children’s Services identified two long day care centres in the Illawarra region (population ~ 0.4M), which were similar in size (including outdoor space), enrolled children from similar socio-economic environments, and had similar levels of high staff motivation. Directors from each of the identified centres attended an information session, which outlined the content and expectations associated with the pilot RCT. Centre Directors were given the opportunity to ask questions about the project. Both Centre Directors agreed to participate in the pilot RCT following the information session.

6.3.2 Children’s Inclusion and Exclusion Criteria

Children were included in the study if they were three- to five-years of age and enrolled in the three- to five-year-old room on a permanent basis for a minimum of one day: either Monday, Tuesday or Friday. Both centres indicated that Monday, Tuesday and Friday, were the most appropriate days for the Jump Start program to be implemented. There were no exclusion criteria.

6.3.3 Staff Inclusion and Exclusion Criteria

Staff were included in the study if they were employed in a permanent position (full- or part-time) in the three- to five-year-old room. There were no exclusion criteria: staff were not excluded based on the number of hours employed at the centre or their level of training.

6.3.4 Randomisation

Centres were randomised at the conclusion of pre-intervention testing. The words ‘intervention’ and ‘comparison’ were placed in one hat and the name of each centre on separate pieces of paper in another hat. An independent person then drew either the word ‘intervention’ or ‘comparison’ out of the first hat and the name of the corresponding centre from the second hat. Following randomisation, the Jump Start
program was implemented in the intervention centre whilst the comparison centre continued with their normal child care program. The comparison centre received the *Jump Start* program in 2009, after the completion of post-intervention testing. Both centres had only one preschool room or group. Different children attended on different days of the week, based on parent preferences and child care availability, however these enrolment variations did not form formal class groupings (i.e. one child may be enrolled in the preschool room at long day care for two days per week, while another may be enrolled for five days per week, as opposed to child care settings that might run distinct two- and three-day programs).

**6.4 INTERVENTION DESIGN**

Like the Proof-of-Concept trial (see Section 4.4), the *Jump Start* program pilot RCT comprised three sections: professional development, fundamental movement skill structured lessons, and unstructured activities. Although parent involvement in interventions is recommended (Hesketh & Campbell, 2010), it was decided that the time and cost of implementing and assessing a robust parent component was beyond the scope of this pilot RCT. Therefore the additional support component reported in the Proof-of-Concept trial (newsletter inserts, portfolio templates, etc) was removed from the design of the pilot RCT and no other parent or home-based component was added. As the design of the pilot RCT is similar to the Proof-of-Concept trial (described in detail in Chapter 4), only variations made to the design for the pilot RCT will be described in this chapter.

The pilot RCT was implemented from May to October 2008 in two long day care centres (one intervention centre and one comparison centre). The trial was granted ethics approval by the University of Wollongong’s Human Research Ethics Committee (HE07/221) (see Appendix C).

**6.4.1 Professional Development**

The professional development model comprised four workshops, fifteen demonstration lessons, and fourteen demonstration unstructured activities. Each workshop ran for between 30 to 40 minutes and was implemented during staff meetings. All centre staff were invited to participate in the workshops to prevent loss of knowledge when staff changed rooms (i.e. staff from the three- to five-year-old room and staff from the infants room), and also to keep all staff informed of changes at a centre level that might occur
as a result of *Jump Start*. The following content was covered during the workshops: 1) benefits of *Jump Start* in centres, 2) value of physical activity and fundamental movement skills, 3) components of the structured lessons, 4) the importance of observing children performing fundamental movement skills, and how to observe and identify correct/incorrect performance of skills, 5) practical experience in facilitating the lessons and associated games, 6) overcoming implementation difficulties, and 7) alternate equipment, for example using balloons when insufficient balls are available (see Appendix M for the structure and content of each workshop). The model of ongoing professional development was employed to support knowledge acquisition and behaviour change (Porter et al., 2003) and in response to the Proof-of-Concept trial where the one day workshop was found to be unsuccessful. An example workshop structure is shown in Figure 6.1, below. All components of all workshops were facilitated by this candidate.

Demonstration structured lessons (structured lessons facilitated by this candidate, see Section 6.4.2, below) and unstructured activities (see Section 6.4.3, below) were included in the professional development model, based on recommendations made at the conclusion of the Proof-of-Concept trial. They were facilitated by this candidate and aimed to increase staff knowledge, competence and confidence with teaching the lesson content. This model of mentoring and active learning has strong support in current professional development literature (Porter et al., 2003; Rudd, Lambert, Satterwhite, & Smith, 2009). Fifteen structured lesson demonstrations were included: nine during the first three weeks of the program (weeks 1 - 3), and one each week for the following seven weeks (weeks 4 - 10). Staff were participant observers during the demonstration lessons. Between weeks 11 - 20, staff implemented all structured lessons, with this candidate acting as a participant observer.

Fourteen unstructured demonstration activities were included in the professional development model. For the first half of the program (weeks 1 - 10), this candidate facilitated the unstructured activities for the first week of each skill and the centre staff facilitated the unstructured activities for the second week of each skill. From Week 11 staff facilitated all unstructured activities (see Section 6.4.3, below). Table 6.1, in the following section (Section 6.4.2, p119) shows a timeline for planned delivery of structured lesson and unstructured activities.
Methods: Pilot Randomised Controlled Trial

<table>
<thead>
<tr>
<th>Time</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 minute</td>
<td>Benefits of <em>Jump Start</em> – based on research and findings from the Proof-of-Concept trial.</td>
</tr>
<tr>
<td>5 minutes</td>
<td>Observations</td>
</tr>
<tr>
<td></td>
<td>(Practical) Identify components of ‘Run’ being performed incorrectly</td>
</tr>
<tr>
<td>2 minutes</td>
<td>Lesson design and teaching structured lessons</td>
</tr>
<tr>
<td>2 minutes</td>
<td>Expectations for the intervention</td>
</tr>
<tr>
<td>15 minutes</td>
<td>(Practical) Staff involvement in games and lessons</td>
</tr>
</tbody>
</table>

**Figure 6.1**  Example professional development workshop structure (Workshop 1)

### 6.4.2 Structured Lessons

A detailed explanation of the structured lessons’ content can be found in Section 4.4.2. Some changes were made for the pilot RCT, including the number of lessons taught and the number of skills covered. In brief, structured fundamental movement skill lessons were implemented three times per week for the duration of the intervention (20 weeks). It was planned that there would be no catch up sessions for public holidays. Therefore, a total of 58 structured lessons were planned, with 43 to be implemented by staff and 15 by this candidate as a part of the professional development (see Table 6.1, p119). Five skills were taught in the pilot RCT, (compared with eight in the Proof-of-Concept trial) and included run, catch, jump, kick and hop. The number of skills was reduced so that there was a sufficient amount of time spent on each skill to potentially measure change in skill proficiency. These skills were chosen to encompass both locomotor and object control skills, and inclusion was based on process data from the Proof-of-Concept trial which indicated that these skills were valued by staff, had effective unstructured options, and high participation in structured lessons. Also, in the instance of hop, the skill was unlikely to be developed outside of focused support in this age group.
Each structured lesson in the pilot RCT focused on one skill for two consecutive weeks. The *Jump Start* resource folder contained two lessons for each skill (e.g. Run Lesson 1 and Run Lesson 2) Unlike the Proof-of-Concept trial, which trialled only Lesson 1 (see Section 4.4.2), the pilot RCT involved both Lesson 1 and Lesson 2. In the pilot RCT, Lesson 1 was implemented for all three days in the first week and Lesson 2 was implemented for all three days in the following week (see Table 6.1, p119). Therefore, after 10 weeks, Lesson 1 and 2 of the five focus skills had been implemented. The cycle was repeated in the subsequent 10 weeks. This structure was chosen so that children would have enough opportunity to improve their skills, from repeated practice, but not be focused on the one skill for so long that they became disinterested or frustrated. This allowed the pilot RCT to better test the potential efficacy of the *Jump Start* program.

Two public holidays occurred on planned implementation days but were identified prior to the commencement of the program and included in the implementation schedule (see Table 6.1, p119). It was decided prior to implementation of the program that these days would not be caught up and nor would any subsequent days that might be lost due to unforeseen reasons. This decision was made to ensure that the implementation schedule remained as consistent and as simple as possible to support staff confidence and independence with implementation.
Table 6.1  Pilot RCT: Planned delivery timeline

<table>
<thead>
<tr>
<th>Week</th>
<th>Lesson</th>
<th>Date</th>
<th>Structured Lesson Facilitator</th>
<th>Unstructured Activity Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Run 1</td>
<td>26/05/08</td>
<td>This candidate</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27/05/08</td>
<td>This candidate</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30/05/08</td>
<td>This candidate</td>
<td>This candidate</td>
</tr>
<tr>
<td>2</td>
<td>Run 2</td>
<td>02/06/08</td>
<td>This candidate</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>03/06/08</td>
<td>This candidate</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>06/06/08</td>
<td>This candidate</td>
<td>Staff</td>
</tr>
<tr>
<td>3</td>
<td>Catch 1</td>
<td>09/06/08</td>
<td>Pre-intervention testing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10/06/08</td>
<td>This candidate</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13/06/08</td>
<td>This candidate</td>
<td>This candidate</td>
</tr>
<tr>
<td>4</td>
<td>Catch 2</td>
<td>16/06/08</td>
<td>This candidate</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17/06/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20/06/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>5</td>
<td>Jump 1</td>
<td>23/06/08</td>
<td>This candidate</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24/06/08</td>
<td>Staff</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27/06/08</td>
<td>Staff</td>
<td>This candidate</td>
</tr>
<tr>
<td>6</td>
<td>Jump 2</td>
<td>30/06/08</td>
<td>This candidate</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>01/07/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>04/07/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>7</td>
<td>Kick 1</td>
<td>07/07/08</td>
<td>This candidate</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>08/07/08</td>
<td>Staff</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11/07/08</td>
<td>Staff</td>
<td>This candidate</td>
</tr>
<tr>
<td>8</td>
<td>Kick 2</td>
<td>14/07/08</td>
<td>This candidate</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15/07/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18/07/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>9</td>
<td>Hop 1</td>
<td>21/07/08</td>
<td>This candidate</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22/07/08</td>
<td>Staff</td>
<td>This candidate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25/07/08</td>
<td>Staff</td>
<td>This candidate</td>
</tr>
<tr>
<td>10</td>
<td>Hop 2</td>
<td>28/07/08</td>
<td>This candidate</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29/07/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>01/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
</tbody>
</table>

*Lessons and unstructured activities were not replaced at a later date, as recommended following the Proof-of-Concept trial.
Table 6.1 Pilot RCT: Planned delivery timeline (cont.)

<table>
<thead>
<tr>
<th>Week</th>
<th>Lesson</th>
<th>Date</th>
<th>Structured Lesson Facilitator</th>
<th>Unstructured Activity Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Run 1</td>
<td>04/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>05/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>08/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>12</td>
<td>Run 2</td>
<td>11/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>13</td>
<td>Catch 1</td>
<td>18/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>14</td>
<td>Catch 2</td>
<td>25/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29/08/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>15</td>
<td>Jump 1</td>
<td>01/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>02/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>05/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>16</td>
<td>Jump 2</td>
<td>08/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>09/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>17</td>
<td>Kick 1</td>
<td>15/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td>18</td>
<td>Kick 2</td>
<td>22/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26/09/08</td>
<td>Staff</td>
<td>Staff</td>
</tr>
</tbody>
</table>

22/09/08**, 29/09/08 – 10/10/08  
*Mid-intervention testing*

| 19   | Hop 1 | 29/09/08  | Staff                         | Staff                            |
|      |       | 30/09/08  | Staff                         | Staff                            |
|      |       | 03/10/08  | Staff                         | Staff                            |

20   | Hop 2 | 06/10/08  | Public Holiday               | Staff                            |
|      |       | 07/10/08  | Staff                         | Staff                            |
|      |       | 10/10/08  | Staff                         | Staff                            |

13/10/08 – 31/10/08  
*Post-intervention testing*

---

*Lessons and unstructured activities were not replaced at a later date, as recommended following the Proof-of-Concept trial;**

**Mid-intervention testing also conducted on this date due to a public holiday on the 06/10/08
6.4.3 **Unstructured Activities**

As in the unstructured component of the Proof-of-Concept trial (see Section 4.4.3), unstructured activities in the pilot RCT focused on the same skill taught in the structured lesson and were implemented on the same days as structured lessons. For the purpose of trialling their staff acceptability (see Section 5.7.2.3), unlike the Proof-of-Concept trial, setting staff were responsible for implementing the majority of unstructured activities (44/58) (see Table 6.1, p119). Unstructured activities used in the pilot RCT were similar to those in the Proof-of-Concept trial (see Appendix E). Details of activities that were added in the pilot RCT are provided in Appendix N. For the unstructured activities staff were given the freedom to choose the activities, with the only direction being that the activity should involve practice of the week’s target skill. Staff could then initiate activities that were influenced by children’s interests, in line with their emergent curriculum method of programming (see Section 4.4.3). Staff were not restricted to implementing the same activities as demonstrated by this candidate. A small number of activities used in unstructured time, such as ‘Duck, Duck, Goose’ did not allow continuous practice of the skill for all children participating in the activity, however they were relevant to the focus skill. This candidate provided ongoing support for unstructured activities in the form of reminders, and mentoring where appropriate, to support the ongoing quality of implemented activities.

6.4.4 **Additional Changes**

In addition to the changes discussed above, and in response to the results of the Proof-of-Concept trial (reported in Chapter 5 and discussed in Section 5.7), the following modifications were made to the Jump Start program prior to the pilot RCT;

1) Additional time was allowed for meeting with centres and planning the program delivery, to ensure that data collection, the provision of information and the delivery of the program ran as smoothly as possible.

2) Stadiometers and accelerometers were left at the centre for one week prior to pre-intervention data collection commencing, to allow children to become familiar with them and to reduce the risk of loss of data due to children’s fear of the instruments.
3) Activities that did not work well, or were deemed inappropriate for the target age group and/or long day care settings in the Proof-of-Concept trial, were replaced with more appropriate activities.

4) The posters, provided as part of the Jump Start resource, displaying skill components, were printed on laminated A3 sheets as opposed to the A4 size used in the Proof-of-Concept trial.

5) The Jump Start resource was printed, laminated and cropped professionally. Due to budget constraints this was not possible for the Proof-of-Concept trial.

6.5 MEASURES AND PROCEDURES

As the measures and procedures of the pilot RCT are similar to the Proof-of-Concept trial (described in detail in Chapter 4), only variations made to the design for the pilot RCT will be described in this chapter.

Unlike the Proof-of-Concept trial, multiple assessors were involved in pre- and post intervention testing (with the exception of the fundamental movement skills demonstrator). Thorough training in procedures for all assessors ensured that data collection procedures were consistent. Training was given to each trainee-assessor in a 1:1 session. Each data collection procedure was first modelled for the trainee-assessor. Each trainee-assessor then performed the assessment a minimum of two times or to the satisfaction of the trainer.

6.5.1 Centre Similarity

Centre similarity measures were completed at pre-intervention to assess the degree of similarity between the centres. Centres were randomised after pre-intervention testing. Several measures were used to assess the similarities of the two centres in terms of family socio-economic status, staff training, experience and attitudes, and the centre’s physical activity policies, practices and resources.

6.5.1.1 Family Socio-Economic Status

Family socio-economic status was determined from parents’ education level, which was self-reported on consent forms (see Appendix O). This information was optional, to reduce the risk of non-consent based on a reluctance to divulge parent education information. Parent/guardians were asked to indicate for one or two parents, depending
on their family structure (where families have more than two key parent/guardians they were asked to select two), parent gender and the highest level of education completed by this parent/guardian.

6.5.1.2 Interviews

To control for staff differences in attitudes towards physical activity, all staff working in the three- to five-year-old room, at both the intervention and control centres were interviewed individually. Interviews followed a predetermined facilitation script. Staff were asked about their: 1) training and number of years they had been working in the early childhood sector; 2) experience of, and attitude towards physical activity as a child; 3) current physical activity habits and attitude towards physical activity; 4) opinions about the place of physical activity in long day care centres; 5) confidence with running structured physical activity lessons; and 6) feelings about the possibility of having Jump Start running in their centre (see Appendix P).

6.5.1.3 Director Questionnaire

The Director from each centre completed a questionnaire that requested information regarding the centre’s physical activity practices and policies (see Appendix Q). The Director Questionnaire was based on the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC), which has previously been validated in the United States of America (Benjamin et al., 2007). The validity study for NAP SACC involved five trained field observers and 69 child care centres. Field observers completed an observation-based instrument that was compared with Directors’ responses on the NAP SACC questionnaire. Moderate agreement was reported for 43% (6/14) of the physical activity questions for validity ($\kappa > 0.40$) (Landis & Koch, cited in Benjamin et al., 2007). Reliability was tested with a sample of 168 child care staff who completed the questionnaire independently and concurrently. In the same study, test-retest reliability was assessed with a sub-sample of 38 Directors completing the questionnaire three weeks after the initial testing. Of the physical activity questions, moderate agreement or higher was found for 28% (5/18) for test-retest reliability and 100% (18/18) for inter-rater reliability. The authors of the reliability and validity study concluded that the questionnaire is stable and suitable for use in interventions, though
not robust enough to measure intervention impact (Benjamin et al., 2007). As such, it was appropriate for use in this project.

In the current study, the NAP SACC questionnaire was modified by this candidate and her supervisors, to make it more appropriate for the Australian child care setting. Modifications were minimal and included removing questions pertaining to nutrition policies (questions N1 - N9) and practices and references not relevant to Australian long day care settings (parentheses in question PA1b and reference to ‘NAP SACC areas’, PA6a).

In addition to completing the modified NAP SACC questionnaire, Directors were asked questions about the number of staff working in the centre as a whole, and in the three- to five-year-old room, the number of children attending the centre, and enrolled in the three- to five-year-old room, the number of children enrolled in the three- to five-year-old room who spoke English as a second language, or had special needs (ADHD, Autism, Developmental Delays, and other), and the breakdown of enrolled family wage brackets.

6.5.1.4 Visual Audit

A visual audit was conducted to determine the resources in each centre (e.g. posters and books supporting physical activity) (see Appendix R). The visual audit of the physical activity environment was modified from the Environmental Policy Assessment and Observation Measure (EPAO) (Ward et al., 2008). The EPAO was developed for the evaluation of NAP SACC. The EPAO was tested in nine child care settings, in the United States of America, with 17 observer pairs. Mean agreement was 87% between pairs, with lowest agreement being for staff behaviour and policy classification (Ward et al., 2008). Like the NAP SACC questionnaire, minor modifications were made to ensure that it was appropriate for the Australian setting. For example, questions 12, 13, and 14 were completed at four set times during the day (9am, 10am, 3pm, 4pm) to accommodate for possible changes to the outdoor environment as opposed to solely reporting if these were present or absent, based on this candidates observations of common child care practice.

A visual audit was completed for both indoor and outdoor environments. For each room (three- to five-year-olds, babies room, foyer, staff room, sleep room) either this candidate or a supervisor recorded the number of 1) books on display ($n = 0, 1 - 5, 6 -$
15, 16+); 2) physical activity related books on display ($n = 0, 1, 2 - 5, 6+$); 3) posters displayed ($n = 0, 1 - 2, 3 - 5, 6+$); 4) physical activity posters on display ($n = 0, 1 - 2, 3 - 5, 6+$); 5) physical activity brochures displayed ($n = 0, 1, 2, 3+$); 6) computers visible ($n = 0, 1 - 2, 3 - 5, 6+$); and 7) television visibility (none visible, visible but in state of storage, visible and set up in room, in use). For the outdoor environment the presence of equipment (fixed or portable), running space, yard markings, shaded areas, bike tracks and staff engaging in physical activity were recorded as being present or absent (yes or no).

6.5.1.5 Indoor/Outdoor Environment Sketches and Photographs

A floor plan was obtained from each centre. Additionally this candidate took photographs of the indoor and outdoor areas and completed a sketch of the indoor and outdoor environments of each centre. Sketches included the size of the area, and the layout of furniture/equipment. Photographs were taken at times when no children were in the area.

6.5.2 Primary Outcomes

Primary outcome measures included objectively measured physical activity and fundamental movement skill proficiency. Unlike the Proof-of-Concept trial, multiple assessors ($n = 9$) were involved in pre- and post-intervention testing (with the exception of a single fundamental movement skills demonstrator and a single fundamental movement skills video-assessor). Thorough training in procedures for all assessors ensured that data collection procedures were consistent. Training was given to each trainee-assessor in a 1:1 session. Each data collection procedure was first modelled for the trainee-assessor. Each trainee-assessor then performed the assessment a minimum of two times or to the satisfaction of the trainer. All primary outcome measures were taken at pre- and post-intervention (20-weeks), during centre hours by trained assessors who were blind to group allocation. No inter- or intra-rater reliability measures were collected.

6.5.2.1 Objectively Measured Physical Activity

Physical activity levels were measured objectively using accelerometers as described in Section 4.5.1.1. Physical activity data were collected during centre hours for two days for each child (average hours/day = 3.5, range = 2.9 - 9.4), compared with a single day
Methods: Pilot Randomised Controlled Trial

in the Proof-of-Concept trial. In addition to these pre- and post-intervention measures, physical activity levels were monitored during the last two weeks of the intervention (during-intervention) to identify the impact of the study running as planned compared with at post-intervention (when the mandated structure had ended) (average hours/day = 7.1, range = 5.0 – 9.4). During-intervention physical activity measures were collected only for the intervention group, according to the same procedures used for pre- and post-intervention testing. The collection of these measures were to identify the impact of the intervention being implemented by staff as opposed to measures collected at post-intervention when setting staff were not required to implement content from the Jump Start program. The intervention group was participating in hop lessons and unstructured activities when during-intervention physical activity measures were taken.

6.5.2.2 Fundamental Movement Skills

Fundamental movement skills were assessed using the TGMD-2 (Ulrich, 2000). The data collection procedures are described in Section 4.5.1.2. As in the Proof-of-Concept trial, only the skills covered in the intervention were assessed (run, catch, jump, kick, hop).

6.5.3 Secondary Outcomes

Secondary outcomes were height and weight, used to calculate children’s BMI. As in the Proof-of-Concept trial, it was not expected that Jump Start would impact of weight status, due to the young age of the children, most children being a healthy weight, the relatively short duration of the intervention and the intervention having no diet or parental component (as parents are the main gate keepers for food choices). Therefore, it was not anticipated that the pilot RCT would impact participants’ BMI. As physical activity is related to adiposity, BMI measures were included to enable comparison between studies. Secondary outcome measures (height and weight) were taken at pre- and post-intervention (20-weeks), during centre hours by trained assessors who were blind to group allocation. Training of assessors is described above in Section 6.5.2.

6.5.3.1 Body Mass Index

Height and weight were measured, with BMI and weight status calculated, using the same protocols used in the Proof-of-Concept trial (see Section 4.5.2.1).
6.5.4 Process Data

Process data included staff interviews, staff and researcher (this candidate) completed structured lesson evaluations and researcher (this candidate) completed journal entries. This data collection was designed to provide insight regarding staff attitudes such as their confidence and competence with testing fundamental movement skills, and their perceived appropriateness and enjoyment of the Jump Start intervention components. This data also provided an implementation record, and some indication of child participant enjoyment. Some of the process data collected was also used to compare centres (e.g. staff interviews, see Section 6.5.1.2).

6.5.4.1 Staff Attitudes

As in the Proof-of-Concept trial (see Section 4.5.3.5), staff participated in semi-structured interviews prior to the commencement of the pilot RCT trial. Unlike the Proof-of-Concept trial, staff were interviewed individually. This reduced the likelihood of participants’ responses being influenced by other staff and allowed a more accurate picture of each participants’ attitudes to physical activity to be created. Staff were asked questions about their confidence and competence with teaching fundamental movement skills, and their enjoyment of physical activity (see Appendix P and Section 6.5.1.2). Questions in these interviews were modified from the Proof-of-Concept trial (see Appendix K).

6.5.4.2 Structured Lesson Evaluations and Journal Entries

Staff completed lesson evaluations at the conclusion of each structured lesson (for an example see Appendix S). Staff were asked to score each component of the lesson (exploration, guided discovery, and the three skill activities), and an additional six categories (length of lesson, time of lesson, number of activities, location of activities, time required to set up, and equipment needed) on a Likert Scale ('1' = highly inappropriate, '2' = a little inappropriate, '3' = neither inappropriate nor appropriate, '4' = appropriate, '5' = highly appropriate). Additional space allowed participants to elaborate on their responses or to provide additional comments and suggestions for modification.

This candidate also completed identical lesson evaluations. Where a component wasn’t covered this candidate noted this instead of giving the component a score on the Likert
scale. Additionally this candidate wrote a detailed summary (journal entries) of the implementation of the structured lesson and unstructured activities, including staff comments, staff preparation (where known), and individual children’s responses to the lessons and activities.

6.5.4.3 Percentage of Planned Structured Lessons and Unstructured Activities Implemented

This candidate attended the centre and observed structured lessons and outdoor free play time every day throughout implementation (i.e. 3 days per week). A record of implemented structured lessons and unstructured activities were kept. Also, a record of lesson components implemented was kept as part of this candidate’s completion of lesson evaluations (see Section 6.5.4.2).

6.5.4.4 Staff Enjoyment and Perceived Appropriateness

At post-intervention, staff from the intervention centre participated in individual interviews. Staff were asked to discuss: 1) suitability of structured lessons for their centre, 2) suitability of structured lesson content, 3) children’s enjoyment of structured lessons, 4) feasibility of unstructured activities, 5) children’s enjoyment of unstructured activities, 6) self-confidence with teaching structured lessons, 7) appropriateness of professional development content and implementation (See Appendix T).

6.6 DATA ANALYSES

6.6.1 Data Handling and Management

Data handling was the same in the pilot RCT as for the Proof-of-Concept trial (see Section 4.6.1). Data were recorded on standardised forms, and stored in a locked filing cabinet and on a password protected computer. Raw data were single input entered and checked visually using extreme value analysis.

6.6.2 Centre Similarity

6.6.2.1 Parent Education

Parent education responses (data collection described in Section 6.5.1.1) were entered into a MS Excel (Version 11.0) spreadsheet. A ‘1’ was allocated for a male parent or guardian and a ‘2’ was allocated for a female parent or guardian. Responses were then
given a ‘1’ for ‘never attended school’, through to ‘9’ for ‘University’. The percentages for each were then recorded.

6.6.2.2 Pre-Intervention Interviews

Pre-interviews (described in Section 6.5.1.2) were recorded and transcribed verbatim. Interviews were then independently coded by two researchers (this candidate and one supervisor) using logico-inductive analysis (Kervin et al., 2006). Themes within each question were identified. Where there were differences in codes and themes between the two researchers, the transcripts were re-read until the researchers agreed upon themes. The themes were compared between the centres.

6.6.2.3 Director Questionnaire

Responses from the Directors questionnaires (described in Section 6.5.1.3) were coded from ‘1’ - ‘4’, with ‘1’ indicating the least optimum response and a ‘4’ indicating the most optimum response. Scores of ‘1’ or ‘2’ and ‘3’ or ‘4’ were then combined to form a dichotomous scale indicating positive or negative physical activity practices.

6.6.2.4 Visual Audit

Each option, for the visual audit of rooms (described in Section 6.5.1.4), was given a value of ‘1’ to ‘4’. For example, possible responses for ‘Television’ included: 1) none visible, 2) visible but in a state of storage, 3) visible and set up, 4) in use. For questions regarding the presence of posters, books or brochures related to physical activity a ‘4’ was the most optimum response. For questions related to the presence of televisions and computers a ‘1’ was the most optimum response. Two researchers (this candidate and one supervisor) reviewed the results of the indoor audit and compared similarities and differences between centres.

Outdoor equipment was assessed every hour, and allocated a ‘1’ if present and a ‘0’ if not present. Data were entered into a MS Excel (Version 11.0) spreadsheet and tallied for both equipment present at a given hour, and how often particular equipment was present. Values were then compared between centres.
6.6.2.5 *Indoor/Outdoor Environment Sketches and Photographs*

Two researchers (this candidate and one supervisor) visually compared the sketches and photographs of each centre’s indoor and outdoor environments. Sketches and photographs were examined subjectively for similarities and differences in available indoor and outdoor space between the two centres. Particular considerations included: Potential space available for gross motor activities during wet weather, fixed equipment, and whether the layout was conducive (e.g. bike tracks) or posed a hindrance to physical activity (e.g. terraced gardens).

6.6.3 *Primary Outcomes*

Primary and secondary data were analysed by a consultant statistician using SPSS Version 11 (SPSS Inc, Chicago). Intention-to-treat principles were used, with missing values imputed by carrying the last observation forward. As the values were approximately normatively distributed, an intervention effect was tested for using analysis of covariance (ANCOVA), with the post-intervention score as the dependant variable, the centre as the independent variable and the pre-intervention value as the covariate (Vickers & Altman, 2001).

A post hoc analysis was performed to adjust the significance tests for the clustered nature of the data. The adjustment was conducted using the approach of Hedges (Hedges, 2007) which involves a correction to the t-test using a multiplicative factor (c) which is calculated as $c = \sqrt{\frac{(N-2)-2(n-1)\rho}{(N-2)[1+(n-1)\rho]}}$ where N is the total sample size, n is the cluster size and ρ is the intraclass correlation coefficient. The corrected t statistic (ct) has a Students’ t distribution with a reduced degrees of freedom (h) calculated as

$$h = \frac{[(N-2)-2(n-1)\rho]^2}{(N-2)(1-\rho)^2 + n(N-2n)\rho^2 + 2(N-2n)\rho(1-\rho)}.$$ 

In the absence of a value of ρ from the sample studied, an external estimate is employed from the literature (Varnell, Murray, & Baker, 2001). In this case the values were obtained from the work of Murray and colleagues (2004). The study data for the variables of interest were converted to a change score (post-intervention – pre-intervention) that were then compared using an independent sample t-test for the difference between treatment and control. The main analysis was presented as an ANCOVA however the computationally simpler approach using a t-test has been used.
Methods: Pilot Randomised Controlled Trial

in the adjustment and relies on the relationship between the t and F statistic when it is a
two group comparison, \( t^2 = F \). Varnell and colleagues (2001) propose that if an
adjustment approach relying on external estimates of \( \rho \) is used a range of adjusted
values representing a liberal and conservative estimates should be presented. Hence
values are presented for \( \rho \) of 0.01 and 0.05.

As a pilot study, this RCT was not adequately powered to detect statistically significant
differences between groups. To demonstrate effects and trends and to allow comparison
of results across studies using different measures, the standardised effect size (Cohen’s
d) was calculated for primary and secondary outcomes. Standardised effect size was
calculated as the adjusted difference between the treatment and control groups divided
by the pooled within group standard deviation. Effect sizes of approximately 0.2, 0.5
and 0.8 are generally considered small, medium and large effects, respectively (Cohen,
1988).

6.6.3.1 Objectively Measured Physical Activity

Similar to the Proof-of-Concept trial (see Section 4.6.2.1) data were analysed using
KidProg (Trost, personal communication, 2007), with summaries being imported into
Excel (Version 11.0). Accelerometer ID numbers were matched with participant codes.
Total minutes monitored were calculated for each day by dividing the number of epochs
by four (as data were measured in 15 second epochs). Counts per minute (CPM) were
then calculated by dividing total counts by number of minutes recorded. Average CPM,
and percentage of time spent in light, moderate, vigorous and moderate-to-vigorous
activity were calculated for pre- and post-intervention data. Bouts of zero were not
subtracted as children had their accelerometers fitted and removed for them by trained
researchers each day. See Section 4.6.2.1 for more detail. Data were then analysed as
described above in Section 6.6.3.

6.6.3.2 Fundamental Movement Skills

Similar to the Proof-of-Concept trial (see Section 4.6.2.2) fundamental movement skills
were video-assessed using the Test of Gross Motor Development (TGMD-2) (Ulrich,
2000), by a single blinded assessor. Total raw scores for each individual skill were
calculated and entered into an Excel spreadsheet. Individual skills were compared using
these raw scores. Due to individual skills having different quantities of skill components
and therefore differing high scores (e.g. performing all components of the catch proficiently gives a score of 6 and performing all components of the hopping proficiently gives a score of 10), individual skill scores were standardised to account for variation. Standardised skill scores were combined for each participant to give a total score. Data were then analysed as described above in Section 6.6.3.

### 6.6.4 Secondary Outcomes

#### 6.6.4.1 Body Mass Index

BMI scores were calculated and categorised in the same way as outlined for the Proof-of-Concept trial (see Section 4.6.3.1).

#### 6.6.5 Process Data

##### 6.6.5.1 Staff Attitudes

Similarly to analysis of staff attitudes in the Proof-of-Concept trial, two researchers (this candidate and one supervisor) independently identified themes and categories within the pre-intervention interviews using logico-inductive analyses (Kervin et al., 2006) (see Section 4.6.4.3). Findings were compared and differences were discussed until a consensus was reached.

##### 6.6.5.2 Implementation of Planned Structured Lessons

Similarly to the Proof-of-Concept trial (see Section 4.6.4.2) the percent of planned structured lessons implemented was calculated by comparing the lessons implemented (recorded as described in Section 6.5.4.2) with the planned implementation timeline (see Table 6.1, p119). Implementation fidelity was calculated for both lessons implemented in their entirety and for individual lesson components (e.g. how often was the lesson component ‘Exploration’ left out of a lesson).

##### 6.6.5.3 Lesson Evaluations and Journal Entries

Staff and this candidate’s responses for lesson evaluations were entered into a MS Excel (Version 11.0) spreadsheet. A mean score was then calculated for each component, lesson and skill. An overall mean was also calculated.
6.6.5.4 Staff Enjoyment and Perceived Appropriateness

Two researchers (this candidate and one supervisor) coded post-intervention interviews independently using logico-inductive analysis (Kervin et al., 2006), as described in Section 4.6.4.3. These were triangulated with staff and this candidate’s lesson evaluations (see Section 6.5.4.2), lesson evaluation means (see Section 6.6.5.3).

6.7 CHAPTER SUMMARY

This chapter outlined the specific methods used in the Jump Start pilot RCT in order to generate valid and reliable data to support or refute the specific target and hypotheses set for this study. In particular, this chapter outlined changes to the methodology and intervention design, which are specific to this second phase of the current research project compared with the phase-one Proof-of-Concept trial reported in Chapters 4 and 5. Chapter 7 will detail the results of the process data and statistical analyses of the Jump Start pilot RCT, addressing each of the feasibility and acceptability targets, and the potential efficacy hypotheses of this study.
7. RESULTS: PILOT RANDOMISED CONTROLLED TRIAL

The pilot RCT was not designed to have sufficient statistical power to determine changes in primary outcomes (physical activity and fundamental movement skills) or secondary outcomes (body mass index: BMI). The evaluation of the pilot RCT was based on testing the feasibility and acceptability targets, and potential efficacy hypotheses that were developed following the analysis of the Proof-of-Concept trial. What distinguishes the pilot RCT from the Proof-of-Concept trial is the inclusion of a comparison group that allows the potential efficacy of the intervention to be tested. Additionally, the pilot RCT was longer in duration, was implemented three times a week instead of twice a week, had increased staff involvement and autonomy, and focused on fewer skills. Design of the pilot RCT was informed by the Proof-of-Concept trial. Conducting a pilot RCT is a valuable, cost effective means of testing and developing trial components (Stevens et al., 2007). Stevens and colleagues (2007) recommend that attention to design issues in early, low cost, small-scale trials will ultimately support the design and implementation of successful, cost-effective, adequately powered, randomised controlled trials.

The results of the pilot RCT are described using the revised Consolidated Standards of Reporting Trials (CONSORT) statement (Moher et al., 2010). The paper reporting on these results is currently ‘in press’ with the journal *Pediatric Exercise Science* (accepted 29th May, 2011). A copy of the accepted manuscript can be found in Appendix U.

7.1 RESEARCH QUESTIONS

The purpose of the pilot RCT was to further test the feasibility, acceptability and potential efficacy of a fundamental movement skill development program (*Jump Start*). The design and implementation of the intervention was modified from the Proof-of-Concept trial (see Sections 6.4 and 6.5). Similar research questions as used for the Proof-of-Concept, were employed to assess the feasibility, acceptability and potential efficacy of the pilot RCT. The research questions included:

1. Is the program *feasible*, assessed by screening and recruiting a sufficient number of intervention and comparison participants, retaining these participants and
collecting a pre-determined proportion of useable data at pre-intervention and post-intervention testing?

2. Is the program acceptable, as assessed by all planned professional development sessions, all planned structured lessons and the planned number of unstructured activities being implemented, and staff perception of suitability?

3. Is the program potentially efficacious, assessed by greater increases in physical activity and fundamental movement skill competence, and similar change in BMI, in the intervention centre compared with the comparison centre?

7.2 RESEARCH TARGETS AND HYPOTHESES

7.2.1 Feasibility
It was proposed that the pilot RCT would be feasible if:

Target One: 60 participants could be screened, recruited and randomised at the centre level to either the comparison group \((n = 30)\) or the intervention group \((n = 30)\);

Target Two: 80% of intervention and comparison participants could be retained from pre-intervention to post-intervention (20-week period);

Target Three: 100% of pre-intervention and post-intervention measurement data collected would be useable, except for objectively measured physical activity (90% of useable pre-intervention and post-intervention data collected).

7.2.2 Acceptability
It was proposed that the pilot RCT would be acceptable if:

Target Four: 100% of planned professional development sessions (4 workshops, 15 demonstration lessons, 14 unstructured activities) were delivered;

Target Five: 100% of planned structured lessons (43) were implemented;

Target Six: Staff reported 90% of lesson content as appropriate;

Target Seven: 100% of planned unstructured activities (44) were implemented.

7.2.3 Potential Efficacy
It was hypothesised that during the intervention (defined as 18-weeks after pre-intervention testing), compared with participants allocated to the comparison group, participants in the treatment group would show the following trend:
Hypothesis One: Greater increases in physical activity during child care hours.

It was hypothesised that at post-intervention (20-weeks after pre-intervention testing), compared with participants allocated to the comparison group, participants in the treatment intervention program would show the following trends:

Hypothesis Two: Greater increases in physical activity during child care hours;

Hypothesis Three: Greater competence in fundamental movement skills;

Hypothesis Four: Similar change in BMI.

7.3 PARTICIPANTS AND SETTINGS

7.4 Setting Similarity

Centres were deemed similar by the Illawarra Children’s Services in the following aspects: child care policies, adoption of emergent curriculum approach (a method of fostering learning through child directed activities) (Stonehouse, 2001), implementation of an indoor/outdoor program and motivation of staff. Further, staff teaching experience, training and attitudes towards physical activity in long day care centres were similar. Both centres employed staff with a few (intervention n = 2, comparison n = 1) or many years (<12 years) experience (intervention n = 5, comparison n = 4). All staff at both centres valued physical activity highly and saw physical activity as an important part of long day care. Further, all staff were enthusiastic about the possibility of implementing the intervention.

Both centres had very similar practices around physical activity as reported in the Director Questionnaire (see Section 6.5.1.3, Appendix Q). Centres gave identical responses on 14/17 items. Additionally, policies were identical as a result of being mandated by the overarching organisation. Differences in responses were due to; 1) one Director indicating that some children may on occasion remain seated for more than 30 minutes over lunch, 2) one centre having fixed play equipment, and 3) one centre reporting safety checks once per year while the other reported once per week. Responses were not discussed with the Directors.

The visual audit (see Section 6.5.1.4, Appendix R) also showed that available equipment and space at each centre were similar. Floor plan sketches and photographs have been included in the Appendix (see Appendices V and W, respectively). Two main differences were identified: the intervention centre had an extra small room which could
be used for rest times and indoor activities and the intervention centre had separate
yards for the infants and the three- to five-year-old children, where the comparison
centre had one shared yard.

Family demographics were similar across centres. At both centres, more than half of
responding parents indicated that they had completed tertiary education (intervention = 59%, comparison = 62%) and the majority of families were in the middle to high-income wage brackets (intervention = 93%, comparison = 85%). The number of
children with special needs was also similar across centres. Approximately 10% of the
children enrolled in each of the participating three- to five-year-old rooms had special
needs (including speech delays) (intervention = 8%, comparison = 13%). The
comparison centre had a higher percentage of children from Non-English speaking
backgrounds compared with the intervention centre (intervention = 9%, comparison = 17%). Summary tables can be found in Appendix X.

7.4.1 Child Participants
The sample consisted of 97 children, aged three to five years. Fifty-two attended the
intervention centre (boys \(n = 31\), girls \(n = 21\)) and 45 attended the comparison centre
(boys \(n = 23\), girls \(n = 22\)). Six children (12%) from the intervention centre and five
children (11%) from the comparison centre were not retained at post-intervention. All
children not retained at post-intervention had left the centre, except for one child from
the comparison centre who was absent on all nine days of post-intervention testing. As
in the Proof-of-Concept trial (see Section 4.6), intention-to-treat principles were used
for analysis. Therefore, all children with pre-intervention data \(n = 97\) were included in
primary analyses (see Figure 7.1, p139).

7.4.1.1 Pre-Intervention Characteristics
Pre-intervention descriptive statistics for the intervention and comparison groups are
reported in Table 7.1, below. For the total sample, the mean age was 4.13 ± 0.59 years,
with a mean BMI of 16.69 ± 1.62. The total sample included 54 boys (56%) and 43 girls
(44%). Additionally, 71% (69/97) of participants were considered normal weight, 22%
(21/97) overweight, 7% (7/97) obese. Physical activity and fundamental movement skill
competence at pre-intervention were similar for the intervention and comparison groups
(see Table 7.1, below).
### 7.4.2 Staff Participants

Fourteen staff participated in pre-intervention interviews (intervention $n = 8$, comparison $n = 6$). Of the eight staff working at the intervention centre, six were present for the entire intervention and participated in post-intervention interviews. One staff member moved into the infants room and one staff member ceased employment with the centre (both before the commencement of the program). Additionally, one staff member joined the three- to five-year-old room at the intervention centre part way through the program. This staff member consented to be involved in the pilot RCT and was subsequently included in process data and post-intervention interviews. There were no staff changes at the comparison centre.

#### Table 7.1 Pilot RCT: Pre-intervention characteristics of participants

<table>
<thead>
<tr>
<th>Pre-intervention Characteristics</th>
<th>Intervention Group ($n = 52$)</th>
<th>Comparison Group ($n = 45$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Mean [SD])</td>
<td>(Mean [SD])</td>
</tr>
<tr>
<td>Boys n (%)</td>
<td>31 (60)</td>
<td>23 (51)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>4.18 (0.55)</td>
<td>4.07 (0.62)</td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counts per minute</td>
<td>745.47 (241.45)</td>
<td>795.69 (222.07)</td>
</tr>
<tr>
<td>% Sedentary</td>
<td>82.20 (9.33)</td>
<td>80.94 (8.83)</td>
</tr>
<tr>
<td>% Light</td>
<td>10.84 (4.12)</td>
<td>12.04 (3.24)</td>
</tr>
<tr>
<td>% Moderate</td>
<td>2.91 (1.50)</td>
<td>3.30 (1.66)</td>
</tr>
<tr>
<td>% Vigorous</td>
<td>4.05 (7.98)</td>
<td>3.72 (8.17)</td>
</tr>
<tr>
<td>% Moderate-to-vigorous</td>
<td>6.96 (8.15)</td>
<td>7.02 (8.42)</td>
</tr>
<tr>
<td>Fundamental movement skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hop (/10)</td>
<td>2.53 (2.13)</td>
<td>2.00 (2.16)</td>
</tr>
<tr>
<td>Jump (/8)</td>
<td>2.61 (1.71)</td>
<td>2.62 (1.57)</td>
</tr>
<tr>
<td>Run (/8)</td>
<td>5.55 (1.87)</td>
<td>5.67 (1.88)</td>
</tr>
<tr>
<td>Catch (/6)</td>
<td>2.29 (1.19)</td>
<td>2.36 (1.48)</td>
</tr>
<tr>
<td>Kick (/8)</td>
<td>3.65 (1.95)</td>
<td>3.51 (1.75)</td>
</tr>
<tr>
<td>Body mass index (kg/m$^2$)</td>
<td>16.80 (1.74)</td>
<td>16.57 (1.47)</td>
</tr>
<tr>
<td>Weight category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-overweight n (%)</td>
<td>35 (67)</td>
<td>34 (76)</td>
</tr>
<tr>
<td>Overweight n (%)</td>
<td>13 (25)</td>
<td>8 (18)</td>
</tr>
<tr>
<td>Obese n (%)</td>
<td>4 (8)</td>
<td>3 (7)</td>
</tr>
</tbody>
</table>

*Do not equal 100% due to rounding of values
7.5 IMPLEMENTATION OF TRIAL AND PROCESS OUTCOMES

7.5.1 Feasibility

The flow of participants throughout the pilot RCT is shown in Figure 7.1, below.

![Flowchart of Pilot RCT: Flow of participants through trial](image)

**Figure 7.1** Pilot RCT: Flow of participants through trial
7.5.1.1 Target One: Screening, Recruitment and Randomisation

To screen and recruit 60 children, and to randomise children at a centre level into intervention group (n = 30) or comparison group (n = 30).

As with the Proof-of-Concept trial (see Section 4.3.1), centres were recruited through a local child care organisation, Illawarra Children’s Services (see Section 6.3.1). Children were invited to participate in the study if they attended a participating centre on one or more of the intervention days (Monday, Tuesday, Friday) and were aged between three and five years (see Section 6.3.2).

Consent was provided for 97 children across the two centres: 52 from the intervention centre and 45 from the control centre. These numbers exceeded the target of recruiting 30 children from each centre.

7.5.1.2 Target Two: Retention

To retain 80% of participants from pre-intervention to post-intervention (20-week post-intervention).

In the Proof-of-Concept trial participants were lost to post-intervention as a result of ceasing their enrolment at the centre (see Section 5.5.1.2). It was hypothesised that this would also be the case for the pilot RCT. Additionally, the pilot RCT was planned to run for 12 weeks longer than the Proof-of-Concept trial, in which time it might be expected that more participants might leave a centre. Therefore, a retention rate of 80% was set *a priori* for the pilot RCT.

Of the 52 participants in the intervention group, 46 were followed-up (87%). Six participants left the intervention centre during the course of the study. Of the 45 participants in the comparison group, 40 were followed-up (89%). Four participants left the centre during the study and one was absent for all days of data collection (overall retention rate = 89%). Therefore, the target of retaining 80% of participants was surpassed.
7.5.1.3 Target Three: Data Collection

That 100% of pre-intervention and post-intervention measures collected would be useable, except for objectively measured physical activity data (90% useable pre-intervention and post-intervention data to be collected).

Collection of useable data is summarised in Table 7.2, below. Of the data collected at pre-intervention, 100% of fundamental movement skill and BMI measures collected were useable and 96% (81/84) of physical activity data were useable. Missing data were due to children being absent from the child care setting for multiple days of data collection (physical activity n = 9, fundamental movement skills testing n = 5, height/weight n = 3), and in a small number of instances, children refusing to wear an accelerometer (n = 1), participate in either some (n = 1) or all (n = 1) of the fundamental movement skill testing, have their height measured (n = 1), or have their weight measured (n = 1). Physical activity data were not useable on three occasions due to an error with the accelerometers and no physical activity data being recorded. Missing data were from different children. A total of 218 days of accelerometer data at pre-test and 179 days of accelerometer data at post-test were included in the analyses.

Table 7.2 Pilot RCT: Percentage of useable data collected

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data collected</td>
<td>Useable*</td>
</tr>
<tr>
<td></td>
<td>/97 (%)</td>
<td>/x (%)</td>
</tr>
<tr>
<td>Physical activity</td>
<td>84 (87)</td>
<td>81 (96)</td>
</tr>
<tr>
<td>Fundamental movement skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hop</td>
<td>90 (92)</td>
<td>90 (100)</td>
</tr>
<tr>
<td>Jump</td>
<td>91 (94)</td>
<td>91 (100)</td>
</tr>
<tr>
<td>Run</td>
<td>91 (94)</td>
<td>91 (100)</td>
</tr>
<tr>
<td>Catch</td>
<td>91 (94)</td>
<td>91 (100)</td>
</tr>
<tr>
<td>Kick</td>
<td>91 (94)</td>
<td>91 (100)</td>
</tr>
<tr>
<td>Body mass index</td>
<td>92 (95)</td>
<td>92 (100)</td>
</tr>
<tr>
<td>Height</td>
<td>93 (96)</td>
<td>93 (100)</td>
</tr>
<tr>
<td>Weight</td>
<td>93 (96)</td>
<td>93 (100)</td>
</tr>
</tbody>
</table>

*Denominator (x) is taken from the number of participants from whom data were collected. This changes for each measure, hence is represented as ‘x’. "Denominator reflects number of participants enrolled in the study at the time of data collection. However intention-to-treat principles were used in analyses."
Of the data collected at post-intervention, 100% of primary and secondary measures collected were useable. Similar to pre-intervention, missing data were mainly due to children being absent for multiple days of post-intervention testing (physical activity \( n = 11 \), fundamental movement skills testing \( n = 9 \), height/weight \( n = 5 \)). Additionally, a small number of children refused to wear an accelerometer \( (n = 3) \) or participate in some \( (n = 1, \) hop) or all \( (n = 1) \) of the fundamental movement skill testing.

Physical activity data collected in the last two weeks of the program (during-intervention physical activity data) were able to be collected from 34 participants from the intervention group \( (34/46, 74\%) \). Non-useable data for one child on one day was due to an accelerometer malfunction (useable data = 33/34, 97%). Missing data were due to children being absent on all days of data collection \( (n = 12) \).

On occasions only one day of accelerometer data were collected. On these occasions, this day was used as the average. At pre-intervention, only one day of physical activity data were collected for 16% \( (16/97) \) of participants. Three of these were due to accelerometer malfunction on one day of data collection, one due to the child refusing to wear the accelerometer on one day, and the remaining participants were absent on one or more days allowing only one day of physical activity data to be collected. At post-intervention only one day of physical activity data were collected for 13% \( (11/84) \) of participants: one due to accelerometer malfunction, and the remainder were caused by children being absent from child care during data collection. For the physical activity data collected during-intervention, one day of data only were collected for 24% \( (11/46) \) of participants. Of these, one was due to accelerometer malfunction and the remainder were caused by children being absent from child care during the data collection period.

Therefore the target of collecting 100% useable data, with the exception of a 90% useable data target for physical activity measures, was achieved.

### 7.5.2 Acceptability

#### 7.5.2.1 Target Four: Delivery of Professional Development

Deliver 100% of planned professional development sessions (4 workshops, 15 demonstration lessons, 14 unstructured activities).

All professional development sessions were implemented as planned. All professional development workshops were delivered as planned \( (4/4) \).
workshops were delivered monthly in staff meetings. All staff from both the infants room and the three- to five-year-old room attended the workshops as planned. Specific attendance records were not made, however the inclusion of professional development in compulsory staff meetings meant that staff prioritised attendance. Demonstration structured lessons were delivered as planned (15/15). However, due to centre regulations two lessons were delivered each day, so that there were not more than 20 children in each lesson. Therefore, a total of 30 demonstration lessons were taught. All demonstration unstructured activities were delivered as planned (14/14).

7.5.2.2  Process Data Related to Target Four

A number of reasons contributed to the successful implementation of all of the professional development workshops. First, the Director supported the professional development workshops and ensured that time was allocated for delivering them at their regular staff meetings. Second, staff reported the professional development workshops to be highly relevant, practical and valued the opportunity to practice the lessons before teaching them, hence were happy to have them included in their staff meetings (8/8). This was suggested during post-intervention interviews where staff gave the following responses:

‘I thought that it was good that she (this candidate) not only explained what we were doing in the Jump Start program, but why we were doing it. I think that was what was most important because it sort of opened our eyes up that little bit more as well to say this is really important and we should be doing it. It was very relevant, everything that she was teaching us, and the way that she taught it was good as well because it sort of involved us a lot more.’

‘It showed you how to do it (fundamental movement skills) properly even though you might think you can kick properly, you might not, so you think, ‘Oh right is that the proper way to do it’.

Third, staff (8/8) reported that the structure of the professional development workshops was appropriate and that they perceived the structure to be the most practical and effective way of conducting the professional development. Lastly, two staff members specifically commented that having all staff involved in the professional development
workshops was beneficial for equipping all staff in knowledge and skills so that they could support each other during implementation.

All staff (8/8) saw the demonstration lessons delivered by this candidate as highly beneficial. Four staff members specifically commented that having the demonstration lessons reduced their apprehension with teaching the structured lessons.

‘I think it was like a godsend to us, because even though it is very easy when you look at it, but at the beginning of Jump Start we were like, oh my gosh what if I do it wrong so it was really good having ... (this candidate) ... run it and we could take what she had taught us and add our own little things because we know the children so well and could adapt.’

Staff post-intervention interviews did not include a question relating to the value of the demonstration unstructured activities that were run as part of the professional development model. Staff perceived value of the unstructured activity component of the intervention is discussed later in this chapter (Section 7.5.2.7), however, specifically requesting staff to report on the acceptability of the professional development related to the unstructured activities was overlooked in the interviews.

7.5.2.3 Target Five: Implementation of Structured Lessons

100% of planned structured lessons will be implemented.

All structured lessons were implemented as intended (43/43). Three lessons were implemented per week (Monday, Tuesday and Friday), for 20 weeks. Therefore, the target of implementing 100% of planned structured lessons was met.

It was anticipated that each lesson would be implemented once per day on Monday, Tuesday and Fridays, however lessons were implemented twice per day. This was due to the intervention centre having a large group of children in the three- to five-year-old room \((n = 30)\) in attendance each day and their centre policy was not to run structured activities with the whole group at one time. A total of 115 structured lessons were taught over the course of the intervention (on one occasion the group was not split due to less children being in attendance than normal), with 29 of these taught by this candidate as part of the professional development and 86 taught by child care staff.
Implementation fidelity was high, with 88% (76/86) of staff-taught lessons implemented according to the lesson plan (implementing all five lesson components) (see Section 4.4.2). A total of 12 individual components were omitted, across 10 different lessons. Each lesson is made up of five components, therefore 3% (12/430) of planned components were not implemented. On nine occasions a staff member did not include the ‘Exploration’ component in the lesson (reasons: forgot = 1/9, no reason known = 8/9). On two occasions a staff member did not include one of the activities in the lesson due to timing (1/2) (the lesson was started late and needed to be finished in time for lunch) and weather (1/2) (the lesson was implemented inside and the staff member felt there was not enough space). A table detailing the implementation fidelity of lesson components has been included as Appendix Y.

The intervention centre also consistently expressed an intention to implement additional lessons on non-implementation days (Wednesday and Thursday). This was discussed early in the intervention with this candidate who encouraged them to do so, but requested that staff inform her of when this had occurred. Throughout the 20 weeks of the intervention four additional lessons were implemented. Two of these lessons were for Kick 1, one for Kick 2, and one for Jump 1.

7.5.2.4 Process Data Related to Target Five

Staff suggested a number of reasons for the high level of planned implementation. These reasons included; the intervention being a formal part of their program routine (6/8); the presence of this candidate in the centre (2/8); and because staff and children enjoyed the program (2/8).

Early in the delivery of the intervention (week 3), staff delivery of lessons (and unstructured activities) was aligned with shifts. The staff member rostered on for the early shift (the first shift of the day, 7am arrival) taught the first lesson of the day, and the staff member on the second shift (8:30am arrival) taught the second lesson. Additionally, the staff member on late shift (10am arrival) would run the unstructured activity. All staff believed that this system was very effective. Five staff attributed the high implementation of the program to this system. Three staff commented that this system allowed them to know what they were doing and when they were doing it. One staff member commented that the system helped to share the responsibility for Jump Start across the staff team.
'It was perfect because then you don’t have to think you just know oh I’m on early shift, I’m doing Jump Start. It’s good to have a system in place like that because then there’s no issues, everyone just knows what they’re doing and it just works.'

7.5.2.5 Target Six: Staff Assessment of Lesson Appropriateness

Staff will report 90% of lesson content as appropriate.

Table 7.3 (below) shows the mean scores given by staff for each of the five lesson components for each lesson (exploration, guided discovery, and three activities, see Section 4.4.2 for a description of each lesson component, see Appendix D for a lesson sample, or Appendix S for a lesson evaluation sample). Staff were asked to give each lesson component a score from ‘1’ (highly inappropriate) to ‘5’ (highly appropriate) based upon how appropriate they felt the component was for the children involved in the lesson (described in Section 6.5.4.2). The first round (weeks 1 - 10), where staff were given additional support, is reported separately to the second round (weeks 11 - 20). Almost all staff lesson evaluations were completed (114/115). There is no record explaining the one missing evaluation.

Mean scores range from 4.1 – 5.0, demonstrating that staff reported the majority of lesson content as either appropriate or highly appropriate. Comparison of the mean scores from the first 10 weeks of the intervention (where this candidate taught 29 demonstration lessons) and weeks 11 - 20 (where staff taught all lessons) indicate that staff perception of the appropriateness of the lesson content was not affected by who was facilitating the lesson.

On a number of occasions (21/115), a lesson component had a mean score of 5.0 indicating that component was scored as ‘highly appropriate’ by all staff for all lessons. A score of ‘neither appropriate nor inappropriate’ (a score of 3/5) was given to 10 individual components, across four lessons. Reasons were not explicitly given for these scores, however comments written by staff, in staff evaluations, implied that lower scores may have been given because staff felt that the lesson was too long for some children’s attention span (6/10) or that the activity was inappropriate for some children (4/10). No lesson component was reported by staff as being ‘inappropriate’ or as being ‘highly inappropriate’. This candidate also evaluated the lessons, resulting in similar mean scores as those completed by the staff (see Appendix Z).
Therefore, the target of 90% of lesson content being reported as appropriate was exceeded, with 97% (111/115) of lessons having all components scored as ‘appropriate’ or ‘highly appropriate’ by all staff, and, 100% of lesson components obtaining a mean score of ‘appropriate’ to ‘highly appropriate’.

Table 7.3  
Pilot RCT: Mean staff scores for appropriateness of lesson components

<table>
<thead>
<tr>
<th>Week</th>
<th>Lesson</th>
<th>Exploration (*/5)</th>
<th>Guided Discovery (*/5)</th>
<th>Activity 1 (*/5)</th>
<th>Activity 2 (*/5)</th>
<th>Activity 3 (*/5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Run Lesson 1</td>
<td>4.2*</td>
<td>4.5</td>
<td>4.7</td>
<td>4.7*</td>
<td>4.8</td>
</tr>
<tr>
<td>2</td>
<td>Run Lesson 2</td>
<td>4.7</td>
<td>4.8</td>
<td>4.8</td>
<td>4.7*</td>
<td>4.4*</td>
</tr>
<tr>
<td>3</td>
<td>Catch Lesson 1</td>
<td>4.5</td>
<td>4.8</td>
<td>4.5</td>
<td>4.5</td>
<td>5.0</td>
</tr>
<tr>
<td>4</td>
<td>Catch Lesson 2</td>
<td>4.3</td>
<td>4.7</td>
<td>4.7</td>
<td>4.7</td>
<td>4.7</td>
</tr>
<tr>
<td>5</td>
<td>Jump Lesson 1</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>6</td>
<td>Jump Lesson 2</td>
<td>4.4*</td>
<td>4.5*</td>
<td>4.5*</td>
<td>4.5*</td>
<td>4.7*</td>
</tr>
<tr>
<td>7</td>
<td>Kick Lesson 1</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>8</td>
<td>Kick Lesson 2</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>9</td>
<td>Hop Lesson 1</td>
<td>4.7</td>
<td>4.7</td>
<td>4.7</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>10</td>
<td>Hop Lesson 2</td>
<td>4.8</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Total Mean (weeks 1 – 10)</strong></td>
<td><strong>4.6</strong></td>
<td><strong>4.7</strong></td>
<td><strong>4.8</strong></td>
<td><strong>4.8</strong></td>
<td><strong>4.8</strong></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Run Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>4.8</td>
<td>4.8</td>
<td>5.0</td>
</tr>
<tr>
<td>12</td>
<td>Run Lesson 2</td>
<td>4.5</td>
<td>4.8</td>
<td>4.8</td>
<td>5.0</td>
<td>4.8</td>
</tr>
<tr>
<td>13</td>
<td>Catch Lesson 1</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>14</td>
<td>Catch Lesson 2</td>
<td>4.7</td>
<td>4.2*</td>
<td>4.8</td>
<td>4.8</td>
<td>4.3</td>
</tr>
<tr>
<td>15</td>
<td>Jump Lesson 1</td>
<td>5.0</td>
<td>4.8</td>
<td>5.0</td>
<td>4.8</td>
<td>5.0</td>
</tr>
<tr>
<td>16</td>
<td>Jump Lesson 2</td>
<td>4.7</td>
<td>4.7</td>
<td>4.8</td>
<td>4.8</td>
<td>4.7</td>
</tr>
<tr>
<td>17</td>
<td>Kick Lesson 1</td>
<td>4.7</td>
<td>4.7</td>
<td>4.3</td>
<td>4.3</td>
<td>4.7</td>
</tr>
<tr>
<td>18</td>
<td>Kick Lesson 2</td>
<td>4.8</td>
<td>4.8</td>
<td>4.7</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>19</td>
<td>Hop Lesson 1</td>
<td>4.5</td>
<td>4.8</td>
<td>4.8</td>
<td>4.7</td>
<td>5.0</td>
</tr>
<tr>
<td>20</td>
<td>Hop Lesson 2</td>
<td>4.5</td>
<td>4.5</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Total Mean (weeks 11 – 20)</strong></td>
<td><strong>4.7</strong></td>
<td><strong>4.7</strong></td>
<td><strong>4.8</strong></td>
<td><strong>4.8</strong></td>
<td><strong>4.8</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Indicates component was scored ‘neither appropriate nor inappropriate’ in one evaluation (a score of 3/5);  
†Weeks 1-10 included the 15 demonstration lessons delivered by this candidate, in weeks 11 – 20 all lessons were delivered by setting staff.

Staff were also asked to comment on additional lesson factors. These included the length of the lesson, the time of day the lesson was run, the number of activities in the lesson, the location of the lesson, the amount of time required to set up the lesson and the quantity and type of equipment required for the lesson. Additional lesson factors
were assessed to provide insight into external factors that may have influenced the appropriateness of the lesson design. Table 7.4 (below) shows the mean scores given by staff for each of the additional lesson factors for each lesson. As for Table 7.3 (p147), a score of ‘1’ (highly inappropriate) to ‘5’ (highly appropriate) was given for each element, based on how appropriate the item was for the lesson. The first 10 weeks, where this candidate taught demonstration lessons as part of the professional development, is reported separately to weeks 11 - 20.

Mean scores for additional factors indicate that all items were scored highly in staff evaluations. The lowest mean score, and only mean score below four (‘appropriate’), was recorded for Round 1 Run Lesson 2. The score of 3.9 occurred for ‘location’. Due to wet weather two of the three Round 1 Run Lesson 2 lessons were run indoors. Staff comments on evaluations for these lessons indicated that they compared the indoor location with outdoors when assessing its appropriateness and they felt the lesson would have worked better outside. On a number of occasions (50/115), additional components had a mean score of 5.0 indicating they were scored as ‘highly appropriate’ by all staff for all lessons. This candidate also evaluated the additional factors; mean scores were similar to those reported by staff (see Appendix AA).

7.5.2.6 Process Data Related to Target Six

7.5.2.6.1 Lesson Components

The high ratings of the evaluations were supported by comments made by staff in the post-intervention interviews. When asked to give a verbal numerical score (with 5 being the highest) all but one staff member gave lesson ‘content’ a 5, with the remaining staff member scoring ‘content’ as 4. Staff reported that they saw the strengths of the lesson content as explicitly learning fundamental movement skills, the variety of activities, and the opportunity for children to learn and practice skills in a fun environment.

‘It was good that you had the Guided Discovery bit and then you had the fun games so the children could have fun and not realise that they were really working hard at refining those skills.’

‘They were varied, it wasn’t the same activity, it was the same skill but done differently, so that was fun, made it interesting.’
Table 7.4  Pilot RCT: Mean staff scores for additional lesson factors

<table>
<thead>
<tr>
<th>Week</th>
<th>Length (5)</th>
<th>Time (5)</th>
<th>Number of Activities (5)</th>
<th>Location (5)</th>
<th>Set-up (5)</th>
<th>Equipment (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Run Lesson 1</td>
<td>4.7</td>
<td>4.8</td>
<td>4.7</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>2</td>
<td>Run Lesson 2</td>
<td>4.6</td>
<td>4.6</td>
<td>4.7</td>
<td>3.9</td>
<td>4.6</td>
</tr>
<tr>
<td>3</td>
<td>Catch Lesson 1</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>4</td>
<td>Catch Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>4.8</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>5</td>
<td>Jump Lesson 1</td>
<td>4.7</td>
<td>4.7</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>6</td>
<td>Jump Lesson 2</td>
<td>4.7</td>
<td>5.0</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>7</td>
<td>Kick Lesson 1</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
<td>4.8</td>
<td>5.0</td>
</tr>
<tr>
<td>8</td>
<td>Kick Lesson 2</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>9</td>
<td>Hop Lesson 1</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>10</td>
<td>Hop Lesson 2</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td><strong>Total Mean (weeks 1 - 10)</strong></td>
<td><strong>4.8</strong></td>
<td><strong>4.9</strong></td>
<td><strong>4.9</strong></td>
<td><strong>4.7</strong></td>
<td><strong>4.9</strong></td>
</tr>
<tr>
<td>11</td>
<td>Run Lesson 1</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>12</td>
<td>Run Lesson 2</td>
<td>4.7</td>
<td>4.7</td>
<td>5.0</td>
<td>4.8</td>
<td>5.0</td>
</tr>
<tr>
<td>13</td>
<td>Catch Lesson 1</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>14</td>
<td>Catch Lesson 2</td>
<td>4.5</td>
<td>4.7</td>
<td>4.5</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>15</td>
<td>Jump Lesson 1</td>
<td>4.7</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>16</td>
<td>Jump Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>17</td>
<td>Kick Lesson 1</td>
<td>4.7</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>18</td>
<td>Kick Lesson 2</td>
<td>4.7</td>
<td>4.8</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>19</td>
<td>Hop Lesson 1</td>
<td>4.5</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>20</td>
<td>Hop Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td><strong>Total Mean (weeks 11 - 20)</strong></td>
<td><strong>4.7</strong></td>
<td><strong>4.8</strong></td>
<td><strong>4.8</strong></td>
<td><strong>4.9</strong></td>
<td><strong>4.9</strong></td>
</tr>
</tbody>
</table>

Although the content was reported to be appropriate, a few minor limitations were reported in post-intervention interviews and on lesson evaluations. These included children becoming too familiar with the Guided Discovery answers, and children with more mature skills feeling frustrated when playing with children of less mature ability. One staff member reported that they thought some children struggled with the structure of the lessons, as they were ‘not a structured centre’ (a reference to their emergent curriculum method of programming, see Section 1.8 for definition of emergent curriculum), when asked about their perception of the suitability of the structured...
lessons for their setting (all other staff responded to the same question that the lessons were highly suitable [7/8]).

‘(Guided Discovery) was very repetitive though, which was kind of boring, like again I guess it gives them practice and they understand it more but a lot of the older ones were yeah, yeah, we already know that one, sort of thing.’

‘There were so many different skill levels and while within the lessons the five-year-olds were fantastic and could do everything the three-year-olds weren’t so good. So when you were playing team games like ‘End Ball’ the older children would get a bit frustrated because the younger ones weren’t playing it appropriately.’

7.5.2.6.2 Additional factors

In post-intervention interviews, staff were asked to give a verbal numerical score to all of the additional factors reported in Table 7.4 (p149) (equipment, set up/pack up, location, length, and number of activities) and also regarding the ‘frequency of lessons’. The same scoring system used in lesson evaluations was used in the interview (‘1’ = “highly inappropriate” through to ‘5’ = “highly appropriate”). Post-intervention interviews support the data shown in staff evaluations. All staff members (8/8) scored ‘frequency of lessons’ either ‘4’ or ‘5’. For all other components, all but one staff member (7/8) gave a numerical score of either ‘4’ or ‘5’ for all areas, with the exception of lesson ‘location’ which two (1/8) staff members scored ‘3’. The reasons given for lower scores for ‘location’ was due to implementing lessons inside in wet weather, as described in the previous section. Explanations provided by staff for their ratings of each of the additional factors are given below.

7.5.2.6.3 Equipment

Equipment was described positively as ‘very basic’, easily adapted for each of the activities (such as using balloons instead of balls) and was easily accessed from the centre’s storage shed. Additionally, staff suggested that the equipment provided at the beginning of the intervention was helpful and meant that equipment wasn’t a problem.

‘Really suitable, they were very basic equipment. We had I suppose most of it in the centre and ... there were things you could use in place of it.’
7.5.2.6.4 Set up/Pack up

Staff reported that it was easy to get all the equipment ready for a lesson, especially once they initiated a routine of one person collecting the necessary equipment at the beginning of each week. The most difficult part of set up and pack up reported was clearing an area for the lesson, however staff encouraged children to help with this task. Two staff members said having the lessons in the morning affected what they set up in the mornings for free play as it seemed a waste of time to set up something that would need to be moved or packed up soon after.

7.5.2.6.5 Location

Staff were happy with the outdoor space available for lessons, though packing away free play equipment (discussed above in section 7.5.2.6.4) to make room for the lesson was a consideration. Moving equipment and running lessons inside were both mentioned as potential barriers to running the lessons, as described earlier.

‘When you’re inside in the little room and you’re doing kicking and they want to use those big muscles you can only guess how much fun that was.’

7.5.2.6.6 Length

Despite lesson length consistently receiving high numerical score ratings, as for the other areas, four staff members commented that some lessons were too long. Staff reported that lessons should be no longer than 20 minutes (lessons were anticipated to run for 20 minutes, see Section 4.4.2. No process data regarding lesson length was consistently collected) and that appropriate lesson length depended on how co-operative children were being.

‘Sometimes I felt they dragged along and other times I … (thought) … that just went so quick and I suppose that depended on the children’s interest in the particular lesson as well.’
7.5.2.6.7  Number of Activities

Staff believed there was good variety of activities, and the number of activities allowed children to spend time practicing the skill while maintaining their interest. One staff member commented on an early lesson evaluation and then again in the post-intervention interviews that the first run lesson had a number of similar activities that could have been confusing for the children especially as they were just beginning. Again, children’s behaviour influenced how staff felt about the number of activities on individual days.

‘...It was perfect, it was enough to keep them busy and not bored on the same activity, there was a variety so it was good.’

‘I suppose it depended on the children as well as to how they responded to all the activities, but there wasn’t that many activities in it to sort of for them to lose interest so I think that the number of activities was quite suited.’

7.5.2.6.8  Frequency of Lessons

All staff (8/8) thought the frequency of the lessons was appropriate. Additionally, four staff members were interested in increasing the frequency of lessons (to five days per week), as they believed that the children enjoyed the lessons, that running Jump Start lessons helped staff to support physical activity more than they would in their normal program, and that they could see improvements in children’s confidence and fundamental movement skills. Two part-time staff believed that the program was implemented five days per week (and were happy with the frequency of lessons).

7.5.2.6.9  Children’s Enjoyment and Participation

All staff (8/8) reported in post-intervention interviews that they believed that children enjoyed the structured lessons. Where children did not participate in lessons, staff expressed a belief that this was their normal behaviour. Two staff members expressed surprise at how well children responded to the lessons given that the centre routine usually is very unstructured.
‘We’re a very unstructured centre so this is sort of the first structured thing that we’ve done and we were a bit worried about how they would respond to that, but they really soaked it up and loved it.’

‘I thought that they would really struggle with the structured side of it because we don’t do a lot of structured here normally, so I thought they responded a lot better than I had, like I know we had the odd kid that wasn’t going to participate but yeah the majority of them found it really good.’

This was also supported in lesson evaluations where staff regularly included comments, such as:

‘The children responded positively while participating in this experience, this was evident through their enthusiasm. I also enjoyed this lesson!!!’

‘These games are a huge hit. Children really listen and are enthusiastic about this particular session.’

### 7.5.2.6.10 Staff Attitudes

Prior to implementation all staff expressed confidence with running structured lessons in general, and enthusiasm for running the intervention. In post-intervention interviews staff described their experience of teaching the lessons as enjoyable and that they gained confidence as they continued with the program, although their experience of running lessons varied depending on the mix of children in the lesson.

‘Challenging at times (laughs) like when children don’t want to listen it’s really hard to stay excited plus to let them know, like to get them back to join in, to try and get their attention at times, that was a little bit hard, other than that, I quite enjoyed it.’

‘My experience was positive and I have never really experienced anything like this, I’ve never really done sport before and I think that I, you know, gained a lot of confidence and learnt a lot about holding a lesson and trying to get their attention. I learnt that I had to be motivated and enthusiastic about the lesson myself to get their, you know, a more positive response out of them. So yeah I did learn a lot.’
In post-intervention interviews some staff (3/8) reported that they had been nervous at pre-intervention about their ability to run the lessons but the professional development workshops and having this candidate in the centre increased their confidence with running the structured lessons.

‘I wasn’t real sure about doing it or being involved. I didn’t want to do them, but the more I did them the more confident I got with them.’

Staff appeared to be highly motivated, often commenting that they had adapted a lesson upon reflection. They also demonstrated a willingness to overcome barriers (such as organising children into different lessons and arranging to leave equipment for the week’s lesson in a designated spot) and to be present to support a lesson being taught by another teacher.

‘Most of the time it was really, really great. There was a few children that didn’t mix so well so that was something we had to iron out pretty quickly, just with the mixture of children, but um, but it was good with the fact that we were running it every day throughout the week, so if something didn’t work one day we could alter that for the next day, so overall I thought it was a fantastic experience but yeah I think its just working out what children mix well together and respond well together and what children don’t.’

Staff unanimously responded that they thought that Jump Start was a program that their centre should and would continue to implement.

‘Definitely, should. The kids are constantly talking about it and you can see the difference in the kids already.’

‘I think so, because its something, I don’t know you don’t always think physical activity, you just go ok lets go and do this, you never actually think that they need to learn how to throw a ball properly. You just go, yeah, they can throw, it its all good sort of thing. So, no, I think it is important for them to learn those skills.’
7.5.2.7 Target Seven: Implementation of Unstructured Activities

100% of planned unstructured activity sessions will be implemented.

Forty-four unstructured activities were planned, with implementation to occur on the afternoon of each structured lesson (see Section 6.4.3). An additional 14 unstructured activities were implemented by this candidate as part of the professional development. One unstructured activity was not implemented by staff as planned. On this occasion, the staff member who was rostered to implement the unstructured activity was engaged in a task that took longer than expected and had not arranged for anyone to implement an unstructured activity in her absence. Therefore, implementation of unstructured activities was just below the target of 100% planned implementation, at 98% (43/44).

7.5.2.8 Process Data Related to Target Seven

Staff reported positively on the unstructured activities in the post-intervention interviews. All staff believed that the unstructured activities were highly suitable for the setting, were very simple to implement, were something that had value for the children, and that the children enjoyed them.

Despite unstructured activities being more closely aligned with the centre’s philosophy of early childhood education (see Section 4.4.3) than the structured lessons, staff still reported the unstructured component of Jump Start as having value for encouraging physical activity over and above their regular program. Staff comments included that the unstructured component encouraged them to think about outdoor free play time more and to consider how they could increase physical activity opportunities.

‘I think most of the time we just put the games side of things out, like the hoops or we played ‘What’s the Time’ in the unstructured or even got bubbles out and stuff and I think that’s probably more than what we’d normally do to, it forced us to sort of think of something to play with them and do something more than sort of stand around the yard and watch them play. It got us more involved in the afternoon too.’

‘(The children) ... really liked it, and I think that a lot of it is the fact that after 3 o’clock when we all go outside it’s just a bit of free play and they get a bit bored at times and the staff can sort of be a bit oh well we’ll just hang around and chat to the parents when they come so it
actually put that other activity into the afternoon keep the kids busy and then they often... took it on themselves and continued it on.'

7.5.3 Potential Efficacy

The pilot RCT design was not sufficiently powered to detect statistical significance. Results indicate trends, and calculated standardised effect sizes (Cohen’s $d$) are included to allow comparison between studies. Effect sizes of approximately 0.2, 0.5 and 0.8 are generally considered small, medium and large effects, respectively (Cohen, 1988).

7.5.3.1 Hypothesis One: Physical Activity Trends During-Intervention

At 18-weeks (during-intervention), compared with participants allocated to the comparison group, participants in the treatment intervention program would show a greater increase in physical activity during the hours they are in child care.

Changes to physical activity during-intervention are reported in Table 7.5 (below). During the intervention, a significant positive effect was found for total physical activity (counts per minute : CPM) in the intervention group, compared with the comparison group (adjusted diff = 110.48, 95% CI = 33.62, 187.33, Cohen’s $d$ = 0.40). Compared with the comparison group, the intervention group also had a slightly greater non-significant increase in percentage of time spent in vigorous (adjusted diff = 0.56, 95% CI = -0.90, 2.02, Cohen’s $d$ = 0.15), and a non-significantly greater decrease in percentage of time spent in sedentary behaviour (adjusted diff = -0.97, 95% CI = -5.76, 3.82, Cohen’s $d$ = -0.08). There were no differences between groups in the proportion of time spent in light physical activity (LPA) (adjusted diff = 0.06, 95% CI = -3.15, 3.02, Cohen’s $d$ = - 0.01).

7.5.3.2 Hypothesis Two: Physical Activity Trends Post-Intervention

At post-intervention, compared with participants allocated to the comparison group, participants in the treatment intervention program would show a greater increase in physical activity during the hours they are in child care.

Changes to physical activity post-intervention are reported in Table 7.5 (below). Changes found during-intervention were not sustained at post-intervention. At post-intervention, the comparison centre, compared with the intervention group showed
greater non-significant increases in total physical activity (CPM) (adjusted diff = -38.31, 95% CI = -104.39, 27.78, Cohen’s d = -0.16), and non-significant decreases in the percentage of time spent in sedentary behaviour (adjusted diff = 4.16, 95% CI = -0.68, 8.99, Cohen’s d = 0.34) and in moderate-to-vigorous physical activity (adjusted diff = -1.86, 95% CI = -3.89, 0.18, Cohen’s d = -0.38). Time spent in LPA also increased non-significantly in the comparison centre compared with the intervention centre (adjusted diff = -2.01, 95% CI = -5.02, 1.00, Cohen’s d = -0.27).
### Table 7.5  Pilot RCT: Changes to primary (physical activity) outcome measures

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline Intervention (Mean [SD] n = 52)</th>
<th>Baseline Comparison (Mean [SD] n = 45)</th>
<th>Follow-up Intervention (Mean [SD] n = 52)</th>
<th>Follow-up Comparison (Mean [SD] n = 45)</th>
<th>Adjusted I-C Difference (95% CI)</th>
<th>p value</th>
<th>p value Adjusted for ICC (0.01, 0.05)*</th>
<th>Effect size (Cohen’s d)**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical activity measures taken during-intervention (18 weeks)</strong>†</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counts per minute</td>
<td>745.4 (241.45)</td>
<td>796.2 (221.58)</td>
<td>894.2 (308.98)</td>
<td>829.5 (246.51)</td>
<td>110.48 (-33.62, 187.33)</td>
<td>0.01</td>
<td>0.03, 0.16</td>
<td>0.40</td>
</tr>
<tr>
<td>% Sedentary</td>
<td>82.20 (9.33)</td>
<td>80.92 (8.83)</td>
<td>78.62 (11.00)</td>
<td>78.24 (14.30)</td>
<td>-0.97 (-5.76, 3.82)</td>
<td>0.69</td>
<td>0.81, 0.88</td>
<td>-0.08</td>
</tr>
<tr>
<td>% Light</td>
<td>10.83 (4.12)</td>
<td>12.04 (3.23)</td>
<td>14.15 (6.59)</td>
<td>14.83 (8.87)</td>
<td>-0.06 (-3.15, 3.02)</td>
<td>0.97</td>
<td>0.92, 0.95</td>
<td>-0.01</td>
</tr>
<tr>
<td>% Moderate</td>
<td>2.91 (1.51)</td>
<td>3.31 (1.67)</td>
<td>3.85 (2.72)</td>
<td>4.21 (4.32)</td>
<td>-0.24 (-1.68, 1.21)</td>
<td>0.74</td>
<td>0.88, 0.92</td>
<td>-0.07</td>
</tr>
<tr>
<td>% Vigorous</td>
<td>4.05 (7.98)</td>
<td>3.72 (8.18)</td>
<td>3.37 (4.15)</td>
<td>2.76 (3.27)</td>
<td>0.56 (-0.90, 2.02)</td>
<td>0.16</td>
<td>0.07, 0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>% Moderate-vigorous</td>
<td>6.96 (8.14)</td>
<td>7.03 (8.42)</td>
<td>7.22 (5.64)</td>
<td>6.97 (6.24)</td>
<td>0.26 (-2.07, 2.60)</td>
<td>0.82</td>
<td>0.69, 0.80</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Physical activity measures taken post-intervention (20 weeks)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counts per minute</td>
<td>745.4 (241.45)</td>
<td>796.2 (221.58)</td>
<td>753.2 (229.87)</td>
<td>829.5 (246.51)</td>
<td>-38.31 (-104.39, 27.78)</td>
<td>0.25</td>
<td>0.55, 0.84</td>
<td>-0.16</td>
</tr>
<tr>
<td>% Sedentary</td>
<td>82.20 (9.33)</td>
<td>80.92 (8.83)</td>
<td>82.64 (9.56)</td>
<td>78.24 (14.30)</td>
<td>4.16 (-0.68, 8.99)</td>
<td>0.09</td>
<td>0.36, 0.55</td>
<td>0.35</td>
</tr>
<tr>
<td>% Light</td>
<td>10.83 (4.12)</td>
<td>12.04 (3.23)</td>
<td>12.25 (6.13)</td>
<td>14.83 (8.87)</td>
<td>-2.01 (-5.02, 1.00)</td>
<td>0.19</td>
<td>0.37, 0.57</td>
<td>-0.27</td>
</tr>
<tr>
<td>% Moderate</td>
<td>2.91 (1.51)</td>
<td>3.31 (1.67)</td>
<td>3.06 (2.43)</td>
<td>4.21 (4.32)</td>
<td>-1.06 (-2.47, 0.34)</td>
<td>0.14</td>
<td>0.32, 0.52</td>
<td>-0.31</td>
</tr>
<tr>
<td>% Vigorous</td>
<td>4.05 (7.98)</td>
<td>3.72 (8.18)</td>
<td>2.05 (1.35)</td>
<td>2.76 (3.27)</td>
<td>-0.71 (-1.70, 0.28)</td>
<td>0.16</td>
<td>0.68, 0.79</td>
<td>-0.31</td>
</tr>
<tr>
<td>% Moderate-vigorous</td>
<td>6.96 (8.14)</td>
<td>7.03 (8.42)</td>
<td>5.10 (3.65)</td>
<td>6.97 (6.24)</td>
<td>-1.86 (-3.89, 0.18)</td>
<td>0.73</td>
<td>0.36, 0.55</td>
<td>-0.38</td>
</tr>
</tbody>
</table>

†p values adjusted using methods of Hedges (2007) as outlines in the methods; **Standardised effect size (Cohen’s d) expressed in standard deviation multiples to allow comparisons of effect sizes across different measures and studies, calculated as the adjusted difference between treatment and comparison groups divided by the pooled within group standard deviation; †No 18-week data were collected for the comparison group. The comparison group’s 20-week post-intervention data is used for these analyses.
7.5.3.3 Hypothesis Three: Fundamental Movement Skill Trends

At post-intervention, compared with participants allocated to the comparison group, participants in the treatment intervention program would show greater competence in fundamental movement skills.

Changes in fundamental movement skill competence are reported in Table 7.6 (below). Greater improvements were demonstrated for all skills within the intervention group compared with the comparison group, as shown by the adjusted I-C differences. A significant positive effect was found for jump (adjusted diff = 1.41, 95% CI = 0.69, 2.13, Cohen’s $d = 0.61$) and total movement score (adjusted diff = 2.08, 95% CI = 0.76, 3.40, Cohen’s $d = 0.47$).

7.5.3.4 Hypothesis Four: Body Mass Index

At post-intervention, compared with participants allocated to the comparison group, participants in the treatment intervention program would show similar change in BMI.

Changes in BMI are reported in Table 7.6 (below). While no impact was hypothesised for BMI (due to the young age of participants and low intensity of the intervention, see Section 4.5.2), a slightly greater non-significant decrease in BMI was reported in the intervention group compared with the comparison group (adjusted diff = -0.08, 95% CI = -0.33, 0.17, Cohen’s $d = -0.05$).
Table 7.6  Pilot RCT: Changes to primary (fundamental movement skills) and secondary outcome measures

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>20-week differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervention (Mean [SD])</td>
<td>Comparison (Mean [SD])</td>
<td>Intervention (Mean [SD])</td>
</tr>
<tr>
<td>Fundamental movement skills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Run (range 0 - 8)</td>
<td>5.55 (1.87)</td>
<td>5.93 (1.45)</td>
<td>6.22 (1.74)</td>
</tr>
<tr>
<td>Hop (range 0 - 10)</td>
<td>2.53 (2.13)</td>
<td>2.09 (2.17)</td>
<td>3.88 (2.66)</td>
</tr>
<tr>
<td>Jump (range 0 - 8)</td>
<td>2.61 (1.71)</td>
<td>2.74 (1.50)</td>
<td>4.06 (2.21)</td>
</tr>
<tr>
<td>Catch (range 0 - 6)</td>
<td>2.29 (1.19)</td>
<td>2.47 (1.42)</td>
<td>2.92 (1.20)</td>
</tr>
<tr>
<td>Kick (range 0 - 8)</td>
<td>3.65 (1.95)</td>
<td>3.67 (1.61)</td>
<td>4.73 (1.83)</td>
</tr>
<tr>
<td>Total movement score</td>
<td>12.66 (4.43)</td>
<td>12.98 (4.17)</td>
<td>16.50 (4.57)</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>16.80 (1.74)</td>
<td>16.57 (1.47)</td>
<td>16.70 (1.84)</td>
</tr>
</tbody>
</table>

*p values adjusted using methods of Hedges (2007) as outlines in the methods; **Standardised effect size (Cohen’s d) expressed in standard deviation multiples to allow comparisons of effect sizes across different measures and studies, calculated as the adjusted difference between treatment and comparison groups divided by the pooled within group standard deviation.
7.6 SUMMARY OF RESULTS

The results of this Pilot RCT are summarised in Table 7.7 (below).

Table 7.7 Pilot RCT: Summary of results

<table>
<thead>
<tr>
<th>Research Question 1</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the program feasible, assessed by screening and recruiting a sufficient number of intervention and comparison participants, retaining these participants and collecting a predetermined proportion of useable data at pre-intervention and post-intervention testing?</td>
<td>Screening: All children aged 3- to five-years and permanently enrolled in the three- to five-year-old room were eligible.</td>
</tr>
<tr>
<td></td>
<td>Recruitment: Through local child care organisation (Illawarra Children’s Services).</td>
</tr>
<tr>
<td></td>
<td>Randomisation: 97 children randomised at centre level into either intervention or comparison:</td>
</tr>
<tr>
<td></td>
<td>• 52 participants enrolled in intervention centre,</td>
</tr>
<tr>
<td></td>
<td>• 45 participants enrolled at comparison centre.</td>
</tr>
<tr>
<td></td>
<td>Retention: 86 of 97 participants retained:</td>
</tr>
<tr>
<td></td>
<td>• 10 children unenrolled from participating centres,</td>
</tr>
<tr>
<td></td>
<td>• 1 child absent all days of testing.</td>
</tr>
<tr>
<td></td>
<td>Useable data (of data collected):</td>
</tr>
<tr>
<td></td>
<td>• Physical activity: 96% (81/84) pre-intervention, 100% (72/72) post-intervention.</td>
</tr>
<tr>
<td></td>
<td>• Fundamental movement skill: 100% (90/90) pre-and (76/76) post-intervention.</td>
</tr>
<tr>
<td></td>
<td>• BMI: 100% (92/92) pre- and (82/82) post-intervention.</td>
</tr>
<tr>
<td></td>
<td>Collection of measures:</td>
</tr>
<tr>
<td></td>
<td>• Physical activity: 87% (84/97) pre-intervention, 84% (72/86) post-intervention.</td>
</tr>
<tr>
<td></td>
<td>• Fundamental movement skill: 92% (90/97) pre-intervention, 88% (76/86) post-intervention.</td>
</tr>
<tr>
<td></td>
<td>• BMI: 95% (92/97) pre- and (82/86) post-intervention.</td>
</tr>
</tbody>
</table>
**Results: Pilot Randomised Controlled Trial**

### Research Question 2

Is the program **acceptable**, as assessed by all planned professional development sessions, all planned structured lessons and the planned number of unstructured activities being implemented, and staff perception of suitability?

<table>
<thead>
<tr>
<th>Implementation</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Professional development</strong>: 100% (4/4) professional development workshops, demonstration lessons (15/15) and demonstration unstructured activities (14/14) implemented.</td>
<td><strong>Staff perception of lesson suitability</strong>: Mean scores indicate 100% of lesson content as appropriate (from staff evaluations).</td>
</tr>
<tr>
<td><strong>Structured lessons</strong>: 100% (43/43) staff-taught structured lessons implemented as planned.</td>
<td></td>
</tr>
<tr>
<td><strong>Unstructured activities</strong>: 98% (43/44) staff-led unstructured activities implemented as planned.</td>
<td></td>
</tr>
</tbody>
</table>

### Research Question 3

Is the program **potentially efficacious**, assessed by greater increases in physical activity, greater increases fundamental movement skill competence, and similar change in BMI?

<table>
<thead>
<tr>
<th>Physical activity levels:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>During-intervention</strong>: Greater increases in physical activity (CPM, %VPA, %MVPA) were seen in the intervention group compared with the comparison group, with this increase statistically significant for CPM (adjusted diff = 110.48, 95% CI = 33.62, 187.33, p = 0.01).</td>
</tr>
<tr>
<td><strong>Post-intervention</strong>: The significant difference between groups, seen during the intervention, were not sustained when assessed at post-intervention for any of the outcomes: CPM (adjusted diff = -38.31, 95% CI = -104.39, 27.78, p = 0.25); %Sedentary (adjusted diff = 4.16, 95% CI = -0.68, 8.99, p = 0.09); %LPA (adjusted diff = -2.01, 95% CI = -5.02, 1.00, p = 0.19); %MVPA (adjusted diff = -1.86, 95% CI = -3.89, 0.18, p = 0.73).</td>
</tr>
</tbody>
</table>
Table 7.7 Pilot RCT: Summary of Results (cont.)

<table>
<thead>
<tr>
<th>Research Question 3 (cont.)</th>
<th>Results (cont.)</th>
</tr>
</thead>
</table>
| Is the program potentially efficacious, assessed by greater increases in physical activity, greater increases fundamental movement skill competence, and similar change in BMI? | **Fundamental movement skill competence:**  
- Compared with the comparison group, there were greater increases in all skills among the intervention group with these increases statistically significant for Jump (adjusted diff = 1.41, 95% CI = 0.69, 2.13, \( p < 0.001 \)) and Total movement score (adjusted diff = 2.08, 95% CI = 0.76, 3.40, \( p = < 0.001 \)).  

**BMI:**  
- A slightly greater but non-significant decrease was reported in the intervention group compared with the comparison group (adjusted diff = -0.08, 95% CI = -0.33, 0.17, \( p = 0.53 \)). |
8. DISCUSSION: PILOT RANDOMISED CONTROLLED TRIAL

The findings from the pilot randomised controlled trial (RCT) demonstrate the feasibility, acceptability and potential efficacy of a fundamental movement skills program (*Jump Start*) designed for use in long day care settings with three- to five-year-olds. *Jump Start* was designed to increase children’s level of physical activity and improve fundamental movement skill competency through supporting setting staff in their provision of structured and unstructured movement activities. A Proof-of-Concept trial, conducted prior to the pilot RCT (reported in Chapters 4 & 5), identified strategies and modifications that improved the design, implementation and measurement of the pilot RCT (summarised in Section 5.7).

The pilot RCT was designed to maximise internal validity and determine potential generalisability in order to inform future full-scale efficacy trials. Additionally, the findings of this pilot RCT may be useful to other researchers and professionals within the early childhood sector to challenge or support current thinking around physical activity and fundamental movement skill development in child care settings.

This chapter summarises key findings from the pilot RCT, compares the findings with similar studies, and discusses the findings against the backdrop of current literature. Additionally, this chapter includes recommendations to inform future studies based within long day care settings or interventions with young children. This chapter follows the CONSORT statement to ensure transparent reporting of the trial (Moher et al., 2010).

8.1 RESEARCH QUESTION ONE: FEASIBILITY

It was proposed that the pilot RCT would be feasible if:

*Target One*: 60 participants could be screened, recruited and randomised at the centre level into a comparison group (*n* = 30) and an intervention group (*n* = 30),

*Target Two*: 80% of intervention and comparison participants could be retained from pre- to post-intervention (20-week period),
**Discussion**

**Target Three:** 100% pre- and post-intervention measurement data would be useable, except for objectively measured physical activity (90% of pre- and post-intervention data collected would be useable).

**8.1.1 Target One: Screening, Recruitment and Randomisation**

To screen and recruit 60 children, and to randomise children at a centre level into intervention group (n = 30) or comparison group (n = 30).

**8.1.1.1 Summary of Results**

The pilot RCT used the same screening procedures as the Proof-of-Concept trial (see Sections 4.3 and 6.3). All children aged between three- and five-years, who attended on one or more of the designated intervention days (Mon, Tues, Fri) were invited to participate in the pilot RCT (see Section 6.3.2).

One hundred children met the eligibility criteria and were invited to participate. Ninety-seven children were recruited and randomised at the centre level, with 52 and 45 children participating at the intervention and comparison centre, respectively (97%) (see Figure 7.1, p139). The screening and recruitment targets were surpassed and therefore support the feasibility of screening and recruiting preschool-aged children in child care settings for interventions using these procedures.

**8.1.1.2 Comparison With Other Studies**

The recruitment rates reported in this study can be compared with five similar physical activity and/or fundamental movement skill development interventions implemented in preschool or long day care settings, one of which was of high methodological quality (Reilly et al., 2006). Reilly and colleagues (2006), conducted a cluster RCT in Scottish nurseries with outcomes including body mass index (BMI), objectively measured physical activity and fundamental movement skills. Similar to the current study, all children attending the participating centres (36 centres participated) were invited to participate. However, less than 50% (545/1162) of children consented to participate in the study. Hannon and Brown (2008) conducted an intervention (no comparison group) in one university research-oriented preschool. The intervention aimed to measure the impact of activity friendly equipment (e.g. balance beams and balls) on physical activity levels.
Physical activity was measured using accelerometers over a five-day period at pre-intervention and post-intervention testing. Consent was provided for 76/98 (76%) enrolled children.

Trost and colleagues’ (2008) conducted an RCT in four North American preschool classes. The aim of the intervention was to increase physical activity through the integration of movement activities. Physical activity, measured by accelerometry and direct observation, was the primary outcome. All children from four class groups within the one centre were invited to participate. The recruitment rate was 88% (42/48).

Hardy and colleagues (2010b) conducted an RCT in 29 Australian preschools. The aim of their intervention was to increase staff confidence and competence, and to influence practices around healthy eating and physical activity. Outcomes included a lunch box audit and fundamental movement skill competence. Consent was provided for 430/796 (54%) eligible children.

Roth and colleagues (2010) conducted a cluster RCT in 41 German kindergartens. The aim of their intervention was to increase physical activity and fundamental movement skill competence, and to reduce sedentary behaviours through daily lessons and homework cards. Outcomes included objectively measured physical activity and fundamental movement skills. All children aged between 4 – 6 years were invited to participate, with consent and baseline measures collected for 709/979 (72%).

While recruitment rates of the current study are considerably higher than those reported in the studies above (at 97%), with the exception of the study by Trost and colleagues (2008) and Hannon and Brown (2008), the sample size of the current study was also considerably smaller (n = 97, 2 participating centres) which may have provided opportunity to employ more intensive recruitment methods.

A further four studies did not explicitly detail recruitment rates, however the number of participants recruited were comparable with the current study. For example, Venetsanou and Kambas (2004) recruited two classes of students totalling 66 for their controlled trial testing the efficacy of a dance program. Wang (2004) recruited 60 children into their RCT of a creative movement dance program. Derri, Tsapakidou & Zachopoulo (2001) recruited 68 children to their controlled trial of a music and movement program and Deli and colleagues (2006) recruited three kindergarten classes, totalling 83 participants, for their controlled trial that compared two distinct movement programs to
a free play condition. In contrast to the current study, all of these studies recruited children from a single setting. These studies support the finding of the current study that it is feasible to recruit 30 children per child care centre to a physical activity and/or fundamental movement skill development intervention.

8.1.1.3 Possible Mechanisms and Explanations

There are a number of possible mechanisms that may explain why the recruitment targets of the current study were surpassed. First, recruiting children through formal child care means that rapport between staff and parents is already established, as are the communication channels between parents and staff (Berger, Begun, & Otto-Salaj, 2009). In this study, staff actively encouraged parents to consent to their child participating by regularly following up outstanding consent forms and answering parents’ questions about the intervention. The willingness of staff to advocate for the program may have been positively influenced by the formative work conducted in the Proof-of-Concept trial (see Chapters 4 & 5), consultation with centres prior to the implementation of the pilot RCT (see Section 6.3.1), and staff involvement in program implementation. Additionally, staff believed that the program would be beneficial in preparing children for school and were therefore happy to promote the program to parents. Second, recruiting and collecting data at established centres, as well as implementing the intervention on site during child care hours, means that common barriers to consent, such as time and travel are overcome (Guzmán et al., 2009). Third, some parents believed that the program would be beneficial for their child by encouraging physical activity and improving their movement skills, and that it would not cause harm to their child, as was indicated by informal parent comment to this candidate and child care staff (reported in post-intervention interviews). Parents may also have shared the belief held by centre staff that the program would be beneficial for their child’s school readiness, and were possibly also comfortable with the program as the program was delivered by child care staff.
8.1.2 Target Two: Retention

To retain 80% of participants from pre- to post-intervention (20-week intervention period).

8.1.2.1 Summary of Results

No participants withdrew their consent from the pilot RCT. Six participants at the intervention centre, and four from the comparison centre, left the centre during the course of the study, which meant they were unable to participate in post-intervention testing. In addition, one participant from the comparison centre was absent for all days of post-intervention testing. Therefore, the retention rate was 89% (86/97), which exceeded the retention target and further supports the feasibility of these procedures.

8.1.2.2 Comparison With Other Studies

Of the eight studies, which identified retention rates at post-intervention, all were similar to those reported in this study (i.e. above or close to 80%). Two of these were classified as being of high methodological quality (Reilly et al., 2006; Cardon et al., 2009). Boucher (1990) conducted a controlled trial in one university based child care centre, within two half-day programs. The intervention group participated in a sensory-motor curriculum (20 - 30min, 4 days/week) while the control group participated in their normal program. Thirty-nine participants (3 – 5 years) were recruited and 79% (31/39) were retained at 20-week post-intervention. The eight non-retained children ceased enrolment at the preschool program following pre-intervention testing.

Connor-Kuntz and Drummer (1996) implemented a group RCT, with three intervention groups participating in a language enriched motor program and two control groups participating in the same motor skill program, without the language enrichment. They recruited 69 participants from five existing preschool classes (4 – 6 years of age), and retained 100% at post-intervention (8 weeks) and 83% at three-month follow-up (57/69). No reason was given for participants lost to follow-up.

Fitzgibbon and colleagues group RCTs targeting 409 African-American preschoolers (2005) and 401 Latino preschoolers (2006) (3 – 5 years), both interventions involved 12 preschools (6 intervention, 6 control). In both RCTs, the intervention groups participated in a 14-week diet and physical activity intervention delivered by trained professionals and the comparison groups participated in general health lessons (such as
seat belt safety and dental health). Data were collected at 14-weeks post-intervention, and 1- and 2-year follow-ups. Retention rates (defined as collecting a measure of BMI) for each of these studies were, 89% (362/409) and 96% (383/401) at 14-week post-intervention, 71% (289/409) and 84% (336/401) at 1-year, and 73% (300/409) and 83% (331/401) at 2-year follow-ups for the African American (2005) and Latino (2006) preschoolers, respectively. No reason was given for participants lost to follow-up.

Deli and colleagues (2006) implemented a controlled trial involving three kindergarten classes, and 83 participants. There were two intervention conditions, the first group participated in a movement skill program, and the second group participated in a music-based movement skill program, while the comparison group participated in free play. Data were collected at 10-weeks post-intervention, with a retention rate of 90% (75/83). No reason was given for participants lost to follow-up.

Reilly and colleagues (2006) conducted a group RCT, which involved 36 nurseries and 545 participants. The intervention involved implementing nursery-based physical activity and fundamental movement skill development, and disseminating home-based health information. Eighty-eight percent of participants were retained at six-month post-intervention (481/545), and 92% (504/545) at twelve-month follow-up (defined as being able to collect a measure of BMI). No reason was given for participants lost to follow-up.

Hannon and Brown’s (2008) experimental intervention (no comparison group), was implemented in one university based preschool. The intervention measured the impact of activity friendly equipment (such as balance beams and balls) on physical activity levels using accelerometers and involved no formal implementation requirements (e.g. structured lessons). The total study period was ten consecutive days (5 days of pre-intervention data collection followed immediately by 5 days of post-intervention data collection), with participants excluded from analysis if they did not provide physical activity data for all 10 days. Retention was 84% (64/76), with reasons for lost data including not wearing the accelerometer or being absent on testing days.

Cardon and colleagues (Cardon et al., 2009) conducted an RCT involving 40 preschools and 636 participants. There were three intervention conditions involving either, 1) playground markings only, 2) provision of activity friendly equipment only (e.g. balls and bean bags), or 3) both playground markings and activity friendly equipment. Post-intervention testing was conducted four- to six-weeks after implementation of the
Discussion

intervention conditions. Ninety-two percent (583/636) of participants were retained at post-intervention testing. Reasons for participants being lost to follow-up were that participants were no longer enrolled at the setting or were absent on data collection days.

Hardy and colleagues (2010b) conducted a group RCT involving 29 preschools and 430 participants. The intervention group had one staff member from each preschool attend a one-day professional development workshop, which aimed to develop the confidence and competence of staff in order to improve practices and policies in the centres regarding healthy eating and physical activity. There were no implementation requirements (e.g. structured lessons). Eight three percent (359/430) of participants were retained at five- to six-month post-intervention testing. Primary reasons for participants being lost to follow-up were that participants were no longer at the preschool or participants were absent on the day of data collection.

Approximately half of the studies had a much larger sample size, yet all studies identified had retention rates of over 80% at post-intervention testing, with the exception of Boucher (1990) at 79%. Half of the studies reported reasons for participants being lost to post-intervention testing (Boucher, 1990; Hannon & Brown, 2008; Cardon et al., 2009; Hardy et al., 2010b). As in the current study, retention rates were affected by children leaving the participating centre or being absent on the day of data collection. The studies cited above support the findings of this study that an 80% retention rate is a feasible goal at post-intervention testing for studies in child care settings. They also highlight that to obtain higher retention rates, studies may need to consider following up participants in a different setting (e.g. home or the participants new child care settings or school).

8.1.2.3 Possible Mechanisms and Explanations

Our intervention was low-risk, and used non-invasive data collection methods. It was implemented entirely within child care hours, thus it posed no inconvenience to parents: as such, it was unlikely that parents would withdraw consent (Guzmán et al., 2009). Where participants could not be followed up, parents had withdrawn their child(ren) from the centre due to family circumstances (e.g. moving to a new region or change of employment). Their withdrawal from the centre was not a result of the program. However this finding does suggest that to maximise post-intervention data collection
future studies may need to consider conducting testing in homes or non-participating child care settings. Finally, staff support for the program may have positively influenced retention rates by promoting children’s enjoyment of the program and consequently alleviating any concerns parents may otherwise have had regarding the program.

8.1.3 Target Three: Collection of Useable Data

That 100% of pre- and post-intervention measurement data collected would be usable, except for objectively measured physical activity (90% of pre- and post-intervention data collected would be usable).

8.1.3.1 Summary of Results

Of the physical activity data collected, over 90% were useable: 96% (81/84) at pre-intervention and 100% (72/72) at post-intervention. Ninety seven percent (34/35) of the physical activity data collected in the last two weeks of the program were useable. Non-useable physical activity data were due, on all occasions, to accelerometer malfunction (no epochs recorded). One hundred percent of fundamental movement skill and BMI data collected at pre-intervention and post-intervention were useable. Therefore, the targets of collecting 90% useable physical activity data, and 100% useable fundamental movement skill and BMI data were achieved.

While targets for percentage of data collected that were useable were met, the amount of data not able to be collected (missing data) is also reported and is valuable to include in this discussion. Missing data, at pre- and post-intervention testing, ranged from 13% - 16% for physical activity, 6% - 12% for fundamental movement skills and 4% - 5% for BMI measures. The majority of data across all data collection time points was missing due to children being absent at time of data collection (range 3% - 13%), though a small amount of missing data was also due to refusal to participate (range 1% - 4%).

8.1.3.2 Comparison With Other Studies

Few physical activity and/or fundamental movement skill studies in preschoolers report feasibility measures such as the amount of data collected or the amount of useable data collected. In relation to objectively measured physical activity, five studies were identified which include some report of the amount of data collected, three of which also report the percentage of useable data collected. One of these was classified as being
of high methodological quality (Reilly et al., 2006). No studies reported strategies used to maximise data collection (e.g. incentives). Pate and colleagues (2006) conducted a calibration and cross-validation study involving 30 preschool-aged children. Collection of accelerometer data was only explicitly reported for the calibration study, which possibly implies no data were lost during the cross-validation trial. During the calibration study children were asked to wear an accelerometer for approximately 30 minutes while performing tasks (e.g. rest or walking at 3mph). Useable data were collected for the majority of participants: one accelerometer malfunctioned (1/30, 3%).

In Reilly and colleagues (2006) large RCT, described earlier (see Sections 8.1.1.2 and 8.1.2.2), 88% (424/482) of physical activity data (6-days) were collected at pre-intervention. At post-intervention (6-months) physical activity data were collected only from participants with pre-intervention data and of these only 355 were available. Eighty percent (285/355) of physical activity data were successfully collected at post-intervention. No reasons details regarding missing data or the percentage of useable data collected were reported.

Alhassan, Sirard and Robinson (2007) conducted a pilot RCT in one preschool, which ran for four days. For the first two days children wore accelerometers and participated in their normal program. Children were then randomised into a control and an intervention group, with the intervention group participating in an additional 60 minutes of unstructured outdoor free-play for two days. Data were collected for the majority of participants: two children refused to wear the accelerometer (2/35, 6%) and one accelerometer malfunctioned (1/35, 3%).

Trost and colleagues (2008) implemented an 8-week RCT involving 42 preschool children from a single child care setting. Similarly to the current study, physical activity was measured objectively during the preschool day using accelerometers. Trost and colleagues measured physical activity at pre-intervention and then for two days of every week of the intervention. Of the possible 840 accelerometer assessments (calculated by the number of participants x weeks of intervention x 2), 21 (3%) were missing due to children being absent and 50 (6%) were missing due to accelerometer malfunction.

Loprinzi and Trost (2010) collected physical activity data, using accelerometers, over one week in thirteen child care centres. They collected a minimum of two days of physical activity data from 268/357 (75%) of the participating children. No details regarding useable data or reasons for missing data were reported.
The amount of useable physical activity data collected as reported by Pate and colleagues (2006), Alhassan and colleagues (2007), and Trost and colleagues (2008) were similar to the current study (97%, 97%, 94% and 96%, respectively). Missing physical activity data were slightly lower in the studies reported by Pate and colleagues (2006), Alhassan and colleagues (2007) and Trost and colleagues (100%, 94% and 97%, respectively), compared with Reilly and colleagues (2006), Loprinzi & Trost (2010), and the current study (88%, 75% and 84% respectively). Reasons for missing or non-useable data were consistent across studies and were due to participants being absent, refusing to wear the monitor, or monitor malfunction. These were barriers also faced in the current study and therefore may be barriers faced by other studies that intend to collect objectively measured physical activity data in this age group. To address common barriers to data collection, future studies may want to consider strategies to overcome barriers of non-compliance (e.g. incentives such as stickers, as used in the current study), as well as planning generous data collection periods, given children being absent from their child care setting for multiple consecutive days was a barrier faced in multiple studies.

Two studies were identified that reported the amount of fundamental movement skill data collected, one of which was of high methodological quality (Reilly et al., 2006). Hardy et al. (2010a) collected fundamental movement skill data from 425 Australian preschoolers, across 29 preschools, with the aim of reporting movement skill proficiency (i.e. cross sectional). A small percentage of children refused to participate in fundamental movement skill assessment (13/425, 3%). In Reilly et al.’s (2006) large RCT (see Sections 8.1.1.2 and 8.1.2.2 and above), 90% (489/545) of fundamental movement skill data were collected at pre-intervention testing and 86% (420/489) at post-intervention for participants with a pre-intervention fundamental movement skill measure. No reasons were given for missing data.

The percentage of fundamental movement skill data collected at pre-intervention were similar between the current study, Reilly et al. (2006), and Hardy et al. (2010a) (92%, 90%, and 97% respectively), and for post-intervention between the current study and Reilly et al. (2006) (88% and 86% respectively). Reilly et al. (2006) provide no reason for missing data, however reasons for missing data reported by Hardy and colleagues (2010a) and this study are similar: participants absent on testing days and participants refusing to participate.
Only three studies were identified that report the percentage of BMI data collected (Fitzgibbon et al., 2005; Fitzgibbon et al., 2006; Reilly et al., 2006). One of these was of high methodological quality (Reilly et al., 2006). The current study had a much smaller sample size than the studies conducted by Fitzgibbon and colleagues (2005; 2006) and Reilly and colleagues (2006) \( (n = 97, 409, 401 \text{ and } 545, \text{ respectively}) \) and collected a similar percentage of BMI data at post-intervention \( (82/86, 95\%; 362/409, 81\%; 481/545, 92\%, \text{ respectively}) \). Of the studies conducted by Fitzgibbon and colleagues (2005; 2006) and Reilly and colleagues (2006), all excluded participants at pre-intervention if no measure of BMI were collected, therefore it is not possible to compare collection of BMI at pre-intervention. No reasons were given for missing data. Reasons for missing data in this study were the same as for fundamental movement skills: participants absent on testing days and participants refusing to participate.

### 8.1.3.3 Possible Mechanisms and Explanations

Compliance may have been positively influenced by data being collected only in centre hours, with staff support for data collection. The procedures used were non-invasive and the centre environment was familiar and non-threatening to participants, reducing the likelihood of children refusing to participate in measures due to fear. The use of incentives in this study (stickers and balloons) may have also supported participant cooperation in data collection procedures. A study of four-year-olds has shown that children are more motivated to engage in a task where incentives are offered (O'Sullivan, 1993). No discussion of incentives was found in the papers discussed above. However incentives are regularly used to improve data collection and retention rates in primary school aged participants (Baranowski et al., 2003; Story et al., 2003; Cliff et al., 2011).

Possible reasons why objective physical activity data may have been more difficult to collect than other outcome data (such as movement skills and BMI measures) include requiring multiple days of attendance by the child to collect sufficient data, and/or also requiring extended periods of co-operation from each participating child. Young children may find wearing an accelerometer uncomfortable over long periods of time, or initial compliance may have been due to an element of excitement or novelty, which was not sustained over the long hours and multiple days required for data collection. The young age of participants may also mean that they do not understand the
importance of wearing the accelerometer, and may not remember to put it back on if it is removed, or remember to wear the accelerometer correctly (in the right position, with no interference such as shaking, for example). Future studies may benefit from considering strategies to maximise compliance, such as asking staff to check placement of accelerometers throughout the day.

8.1.4 **Feasibility: Limitations**

The limitations of this study, that relate to feasibility include;

1. Support from child care centre staff has been suggested as a key influence in recruitment, retention, and the collection of data. Centre staff enthusiasm for the project may have in turn been influenced by the small scale of the intervention allowing regular, on going researcher support (by this candidate) that may not be replicable in a larger scale RCT across many centres unless large resources are available.

2. Similarly, settings were chosen partly for the high motivation of staff. Therefore, it could not be assumed that other centres would also have staff who would actively promote recruitment and support data collection to the same extent.

3. Only two days of physical activity data within child care hours were collected, therefore limiting the generalisability of useable accelerometer data collection results. In larger scale studies, aiming to collect three hours on three days and up to seven days would increase the reliability of the measure (Penpraze et al., 2006). Additionally, collecting whole days of physical activity data would provide a more accurate representation of the interventions effect on physical activity, but may lead to a lower percentage of useable data being collected. Multiple weeks of data collection would need to be allowed for.

8.1.5 **Feasibility: Recommendations**

The findings of this study, and consideration of the study limitations related to feasibility, highlight a number of recommendations for future interventions, including;

1. Controlled trials or randomised controlled trials should report findings using the TREND (Des Jarlais et al., 2004) or CONSORT (Moher et al., 2010) statements to allow better comparisons across studies.
2. Studies should include details regarding recruitment and retention strategies used, and the amount of data collected at each collection point. This recommendation has also been made by Stevens et al. (2007), who suggests that this information is useful for informing future intervention design.

3. Recruiting through formal child care settings, where appropriate, is likely to increase recruitment and retention rates and compliance with data collection.

4. Several weeks of data collection should be allocated to accommodate for children being absent or children not wishing to participate in data collection on a particular day.

5. Changes in family situations are likely to affect retention rates by children changing child care providers. Large scale studies should consider allowing for home visits to increase data collection where children have changed child care provider.

8.2 RESEARCH QUESTION TWO: ACCEPTABILITY

It was proposed that the pilot RCT would be acceptable if:

**Target Four:** 100% of professional development sessions (4 workshops, 15 demonstration lessons, 14 demonstration unstructured activities) were delivered;

**Target Five:** 100% of planned structured lessons (43 lessons) were implemented;

**Target Six:** Staff reported 90% of lesson content as appropriate.

**Target Seven:** 100% of planned unstructured activities (44 sessions) were implemented.

8.2.1 Target Four: Delivery of Professional Development

One hundred percent of planned professional development sessions (4 workshops, 15 demonstration lessons, 14 unstructured activities) were delivered.

8.2.1.1 Summary of Results

All professional development sessions were delivered as planned (4/4 workshops; 15/15 structured lessons, 14/14 unstructured activities). This meets the target set for professional development delivery and supports the acceptability of these procedures.
8.2.1.2 Comparison With Other Studies

Few physical activity and/or fundamental movement skill interventions targeting preschool children have reported including a professional development component. Seven studies were identified, one of which was of high methodological quality (Reilly et al., 2006), and of these minimal detail is provided about the implementation of the professional development (Goodway & Branta, 2003; Goodway, Crowe, & Ward, 2003; Reilly et al., 2006; Trost et al., 2008; Williams, Carter, Kibbe, & Dennison, 2009; Hardy et al., 2010b; Klein et al., 2010). No study was identified that explicitly reported the percentage of planned professional development content, or sessions, delivered. Studies with a professional development component for child care staff are summarised in Table 8.1 (below).

Goodway and Branta (2003) implemented a 12-week (2 x 45min sessions per week) fundamental movement skill intervention, implemented in one preschool class, with an additional class as a control. The primary researcher facilitated the intervention, with the assistance of the two classroom teachers. Professional development was minimal and involved the researcher meeting with staff before each lesson to explain key points, and after each lesson to review the lesson and to make recommendations for the next lesson. Large positive effects were found for all skills (range Cohen’s $d = 0.5 - 2.18$) with the exception of gallop (Cohen’s $d = 0.16$). A similar professional development design was used by Goodway and colleagues (2003) in their 9-week (2 x 35min sessions per week) fundamental movement skill intervention. Large positive effects were found for all fundamental movement skills (range Cohen’s $d = 1.23 - 2.90$).

Reilly and colleagues (2006) implemented a 6-month RCT, in 36 nurseries (18 control, 18 intervention). The intervention comprised a nursery-based physical activity program (3 x 30min sessions per week, 24 weeks) and a home-based physical activity and sedentary activity component (disseminated as two resource packs containing relevant guidance, information and ideas). The nursery component was implemented entirely by nursery staff. Professional development involved two staff members from each intervention nursery attending three training sessions. No detail is provided regarding length, content, location or period of time between the training sessions. Small positive effects were found for fundamental movement skills and no effect was found for total physical activity (counts per minute : CPM) (Cohen’s $d = 0.25$ and -0.07, respectively).
Trost and colleagues (2008) implemented an eight-week physical activity intervention in four half-day preschool classes (2.5 hours) run at the one centre. The intervention involved staff implementing two 10-minute integrated activities (i.e. maths and physical activity) in each half-day program, each day. Prior to implementation, setting staff participated in one three-hour training session and during the intervention staff met weekly with a researcher to receive feedback and discuss implementation.
Table 8.1. Comparison with other studies: Professional Development

<table>
<thead>
<tr>
<th>Reference</th>
<th>Brief Summary of Intervention</th>
<th>Professional Development Model</th>
<th>Implementation Fidelity of Intervention</th>
<th>Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goodway &amp; Branta</td>
<td>*n = 59 children, 3 schools, 4 pre-kindergarten classes, 12wk, mean age = 4.7y, Intervention: 25min, 2/wk, researcher led fundamental movement skill lessons with support of 2 class teachers. Outcomes (Measure): Fundamental movement skills (TGMD), Implementation fidelity not reported. Comparison: Usual care.</td>
<td>Met with staff before and after each lesson.</td>
<td>Before lessons: Discussed key points of the lesson (e.g. key words). After lessons: Review lesson and discuss recommendations for future lessons.</td>
<td>Yes</td>
</tr>
<tr>
<td>(2003)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goodway et al.</td>
<td>*n = 63 children, 1 school, 4 pre-kindergarten classes, 9wk, mean age = 4.9y (intervention), 5.0y (comparison), Intervention: 35min fundamental movement skill lessons, 2/wk, researcher led lessons with support of 2 class teachers. Outcomes (Measure): Fundamental movement skills (TGMD), Implementation fidelity not reported. Comparison: Usual care.</td>
<td>Met with staff before and after each lesson.</td>
<td>Before lessons: Discussed key points of the lesson (e.g. key words). After lessons: Review lesson and discuss recommendations for future lessons.</td>
<td>Yes</td>
</tr>
<tr>
<td>(2003)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Yes = Professional development delivered throughout the intervention, No = Professional development delivered before the intervention only, Unclear = Professional development model unclear;”No intervention reported the implementation fidelity of their professional development model; wk = weeks; y = years; min = minutes; / = per; TGMD = Test of Gross Motor Development; I > C = Intervention demonstrated greater improvements compared with the comparison group.
Table 8.1 Comparison with other studies: Professional Development (cont.)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Brief Summary of Intervention</th>
<th>Professional Development Model</th>
<th>Implementation Fidelity of Intervention</th>
<th>Efficacy</th>
</tr>
</thead>
</table>
| Reilly et al. (2006) | *n = 545 children, 36 nurseries (number of classes not specified), 24wk, mean age = 4.2y.  
Intervention: 30min fundamental movement skill lessons 3/wk, home health information, Teacher implemented.  
Outcomes (Measure): Physical activity (accelerometers), fundamental movement skills (MAB). Implementation fidelity = Delivery of planned lessons (Staff self-report & 1 monitoring visit conducted by an unblinded researcher).  
Comparison: Usual care. | 3 training sessions of undefined length, attended by 2 staff members from each intervention nursery.  
Content: Undefined  
Ongoing*: Unclear | 83% of lessons were delivered as planned  
**Statistically significant improvements for MVPA (C > I), Cohen’s d = -0.03, no effect for CPM (Cohen’s d = -0.07)  
Statistically significant improvements for Total movement score (I > C), Cohen’s d = 0.25 | |
| Williams et al. (2008) | *n = 270 children, 9 preschools, 16 classes, 10wk, mean age = 4.6y  
Intervention: 10min, 4 or 5/wk fundamental movement skill lessons (both 4d and 5d programs involved in trial). Teacher implemented.  
Outcomes (Measure): No measure of physical activity or fundamental movement skills, Implementation fidelity = Length of lesson (Staff self-report).  
Comparison: No comparison group | 1 x 1.5h training session, conducted prior to the intervention, and attended by all classroom teachers.  
Content: Curriculum overview, role-playing of activities, preschool motor competence, importance of structured physical activity, and study evaluation requirements.  
Ongoing: No | Mean number of activities implemented /wk = 4.12 (range 3 - 5), mean duration = 11.4min (range 8.9 – 16.3)  
Not reported. | |

*Yes = Professional development delivered throughout the intervention, No = Professional development delivered before the intervention only, Unclear = Professional development model unclear.  
**No intervention reported the implementation fidelity of their professional development model; wk = weeks; y = years; min = minutes; / = per; MAB = Movement Assessment Battery; MVPA = Moderate-to-vigorous physical activity; CPM = counts per minute; C > I = Comparison group demonstrated greater improvements compared with the intervention group; I > C = Intervention group demonstrated greater improvements compared with the comparison group; d = day; h = hours
<table>
<thead>
<tr>
<th>Reference</th>
<th>Brief Summary of Intervention</th>
<th>Professional Development Model</th>
<th>Implementation Fidelity of Intervention</th>
<th>Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trost et al.</td>
<td><em>n</em> = 42 children, 1 preschool, 4 classes, 8wk, aged 3 – 5y. Intervention: Minimum 10min, 2/d integrated physical activity (e.g. literacy and physical activity), Teacher implemented. Outcomes (Measure): Physical activity (Accelerometers &amp; Direct observation, assessed weekly throughout intervention), Implementation fidelity = Implementation of planned lessons and lessons meeting the 10min minimum (Staff self-report) Comparison: Usual care</td>
<td>3h training session prior to the intervention attended by teachers and staff. Unplanned booster session delivered at 4wk to class teachers (no length specified). Brief weekly meetings between teachers and staff and the researchers. Training session covered curriculum objectives and demonstration and practice of curriculum activities. The booster session at 4wks covered the same content. Brief weekly meetings provided opportunity for feedback and to discuss any problems. Yes Planned lessons implemented = 93% (82/88); Lessons meeting the 10min minimum = 72% (absolute numbers not provided).</td>
<td>Mostly null findings for wks 1 – 4. Significant differences for MVPA and VPA (<em>I &gt; C</em>) during weeks 5 – 8 for both ‘Indoor’ and ‘Combined Indoor and Outdoor’ MVPA and VPA. Cohen’s d could not be calculated (± not presented).</td>
<td></td>
</tr>
<tr>
<td>Hardy et al.</td>
<td><em>n</em> = 430 children, 29 preschools (number of classes not specified), 4 – 5mo, mean age 4.4y. Intervention: Resource provided, including fundamental movement skill activities, and access to health professionals provided, but no intervention requirements. Outcomes (Measures): Fundamental movement skills (TGMD-2). Implementation fidelity not applicable. Comparison: Unrelated health information (e.g. road safety).</td>
<td>1d professional development workshop attended by 1 staff member from each preschool, access to health professionals. Incorporating regular physical activity, providing unstructured physical activity opportunities, and developing and implementing physical activity fundraising policies. No Not applicable</td>
<td>No statistically significant differences. Cohen’s d = Locomotor = 0.20, Object control = 0.20, Total movement score = 0.24</td>
<td></td>
</tr>
</tbody>
</table>

*Yes = Professional development delivered throughout the intervention, No = Professional development delivered before the intervention only, Unclear = Professional development model unclear; **No intervention reported the implementation fidelity of their professional development model; wk = weeks; y = years; min = minutes; / = per; d = day; h = hours; MVPA = Moderate-to-vigorous physical activity; VPA = vigorous physical activity; I > C = Intervention group demonstrated greater improvements compared with the comparison group; TGMD-2 = Test of Gross Motor Development (2nd ed.)*
<table>
<thead>
<tr>
<th>Reference</th>
<th>Brief Summary of Intervention</th>
<th>Professional Development Model</th>
<th>Implementation Fidelity of Intervention</th>
<th>Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klein et al. (2010)</td>
<td>$n = 1050$, 27 kindergartens (number of classes not specified), 5 – 6mo, mean age 4.7y. Intervention: Professional development only, no implementation requirements or support. Outcomes (Measures): Adiposity (BMI), fundamental movement skills (KMS 3-6). Implementation fidelity not applicable. Comparison group: Usual care.</td>
<td>1 information meeting (length unspecified), attended by staff and parents (unclear how many staff per centre attended, 60% of children had at least one parent attend). Increasing parent and educators awareness of healthy lifestyle, and parents skills and competencies with nutrition, importance of physical activity and consequences of physical inactivity, and presented children’s results from baseline testing.</td>
<td>No</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Jump Start</td>
<td>$n = 97$ children, 2 long day care centres, 2 classes, 20wk, mean age $= 4.1y$ Intervention: 20min fundamental movement skill lessons, 3/wk. Teacher implemented. Outcomes (Measure): Physical activity (Accelerometers), fundamental movement skills (TGMD-2), Implementation fidelity = Percentage of planned lessons implemented, percentage of lessons implemented according to lesson plan and percentage of unstructured activities implemented (Observations by this candidate) Comparison: Usual care</td>
<td>4 x 30 - 40min workshops delivered in staff meetings, 15 x 20min demo lessons, 14 x demo unstructured activities (no required length). Value of physical activity and fundamental movement skills, rationale for including regular planned physical activity and fundamental movement skills experiences, curriculum overview, practical experience of lessons and activities, and overcoming difficulties (e.g. behaviour management strategies).</td>
<td>Yes</td>
<td>Planned lessons $= 100%$ (86/86) Lesson delivered according to lesson plan $= 88%$ (76/86) Planned unstructured activities $= 98%$ (43/44)</td>
</tr>
</tbody>
</table>

*Yes = Professional development delivered throughout the intervention, No = Professional development delivered before the intervention only, Unclear = Professional development model unclear; *No intervention reported the implementation fidelity of their professional development model; mo = months; y = years; KMS 3 = Karlsruher motor screening for kindergarten children; C > I = comparison group demonstrated greater improvements than the intervention group; I > C = Intervention group demonstrated greater improvements compared with the comparison group; *'was measured as 'number of ground contacts' (no further detail provided), therefore a greater decrease in score indicates greater increases in mastery; wk = weeks; min = minutes; / = per; TGMD-2 = Test of Gross Motor Development (2nd ed.); CPM = counts per minute; MVPA = moderate-to-vigorous physical activity
Trost and colleagues (2008) held an additional, unplanned professional development session following week four, due to observations of low implementation quality. During this professional development, setting staff met with the researchers and discussed the program requirements, and the components and concepts of the program that were covered in the initial professional development training (length undefined). Although the authors refer to a single-group training session professional development model, the incorporation of weekly meetings between the staff and researchers, and the professional development session added at week four indicate a model of ongoing professional development not reported in other studies. Prior to the during-intervention professional development (weeks 1-4), there were no increases in physical activity levels among the intervention group compared with the comparison. However, following the during-intervention professional development, significant improvements were reported for physical activity level in the intervention group compared with the comparison group (weeks 5-8) (there was insufficient detail provided to calculate effect sizes). This suggests the additional professional development session during-intervention was beneficial.

Williams and colleagues (2009) conducted a pilot study (no control), involving 16 preschool classrooms, across 9 centres. Setting staff were asked to implement at least one 10 minute gross motor activity, from the curriculum provided to each classroom, each day for 10 weeks. Staff attended a ninety minute workshop prior to the commencement of the program. The purpose of the intervention was to assess teacher use of the resource. No measure of physical activity was collected, however based on teacher reported implementation rates, participating children participated in a mean of 47 minutes of physical activity as a result of being involved in the program (the study aimed to increase physical activity by 50 minutes).

Hardy and colleagues (2010b) conducted an RCT involving 29 preschools. The intervention was low-intensity and as such there were no formal implementation requirements (e.g. lessons) for staff at participating centres. Each centre nominated one staff member who attended a one-day professional development workshop. The professional development workshop was designed to increase staff confidence and competence in areas of healthy eating and physical activity, and so influence policy and practices in the participating centres. Small positive effects were found for fundamental
movement skills at five- to six-month post-intervention testing (range Cohen’s $d = 0.20 - 0.24$).

Similarly, Klein and colleagues (2010) also implemented a low-intensity intervention, which involved one information session only for staff (parents were also invited). The information session aimed to increase knowledge regarding healthy eating and physical activity, and included the value of physical activity and consequence of inactivity, and recommendations around physical activity (e.g. be active for 2 hours per day). The length of the session was unspecified. Mixed results were reported at five- to six-month post-intervention testing, with greater improvements seen in the intervention group compared with the comparison group for two skills (lateral jump and long jump, Cohen’s $d = 0.03$ and $0.18$, respectively), and greater improvements in the comparison group compared with the intervention group for one skill, one-leg stand (Cohen’s $d = 0.21$).

Presumably the professional development of each of these studies was delivered as planned, though none explicitly address this. Approximately half of the interventions employed some form of ongoing professional development (Goodway & Branta, 2003; Goodway et al., 2003; Trost et al., 2008). Three had professional development at the beginning of the intervention only, of 90 minutes, one day, and an undefined length respectively (Williams et al., 2009; Hardy et al., 2010b; Klein et al., 2010) and one had three workshops, though the length and timing of these was not reported (Reilly, et al., 2006). It is unclear, for three of the seven studies, whether the staff members who attended the professional development had sole responsibility for implementing the intervention within their class, or child care setting, or whether select staff were to attend the professional development and then disseminate the information at their child care setting (Reilly et al., 2006; Trost et al., 2008; Williams et al., 2009). Due to the small number of studies and limited details provided, it is difficult to note similarities or draw conclusions based upon the professional development models used. All of these studies reported some improvements in the intervention group, compared with the comparison group, which indicates that all the professional development models used hold some promise. However, none of the studies reported that their professional development model was evidence based. An acceptable professional development model will be a key component of any sustainable physical activity intervention (Ward et al., 2009). Also, child care staff report that professional development commonly has
Discussion

associated problems such as a loss of information, quality and motivation due to a small number of staff needing to disseminate information to the centre or due to lack of support following attendance at a one-day workshop (Riethmuller et al., 2009b). Therefore, the professional development model used in an intervention ought to be given serious attention and reported carefully in order to inform future interventions. One strength of the current study is that it recognises the value of the professional development component for the acceptability and sustainability of the intervention. Therefore, the professional development model of the current study was designed with the explicit aim to up skill and mobilise staff to implement high quality physical activity and fundamental movement skill experiences with confidence and competence. It is based on formative research, and the fidelity and staff acceptability is included in the planned evaluation of the intervention. The positive acceptability and potential efficacy findings of this intervention support the use of similar professional development models.

8.2.1.3 Possible Mechanisms and Explanations

Implementing effective professional development in early childhood settings requires overcoming a number of barriers including: time constraints (Bellows, Anderson, Martin Gould, & Auld, 2008; Karagiorgi & Symeou, 2008; Riethmuller et al., 2009b); lack of motivation to change current practices (Flogaitis, Daskolia, & Liarakou, 2005; Bellows et al., 2008; Keengwe & Onchwari, 2009); lack of resources (Bellows et al., 2008; Keengwe & Onchwari, 2009); and lack of confidence (Flogaitis et al., 2005; Mohler, Yun, Carter, & Kasak, 2009).

The successful implementation of all planned professional development for this intervention was possibly due to each of the barriers associated with attending professional development being actively addressed in the professional development design. Time constraints were accommodated by running brief (30 minute) workshops in existing, regular, and compulsory staff meetings. This also negated the need for travel which has been identified as a barrier (Karagiorgi & Symeou, 2008). The professional development model had the support of the Director and was endorsed by senior management of the overarching child care organisation. Leadership support has been reported as a key influence in the success of professional development (Karagiorgi & Symeou, 2008). The professional development model addressed issues of motivation by
ensuring that content was highly relevant to staff, addressing concerns, individual issues - including the provision of ‘compelling reasons’ to change current practices (Karagiorgi & Symeou, 2008; Brown, Knoche, Edwards, & Sheridan, 2009; Keengwe & Onchwari, 2009) - and having a practical, hands-on focus (Riethmuller et al., 2009b). Motivation may have been less of a barrier due to the participating centres being chosen by Illawarra Children’s Services (an overarching child care organisation, see Sections 4.3.1 and 6.3.1) based on their perception that centres were run by highly motivated staff. Lack of physical activity equipment (such as balls and bean bags) was addressed through the provision of equipment as part of the study grant ($500 worth), as well as inexpensive suggestions for modification of physical activity equipment, used in the Jump Start resource, being addressed as part of the professional development content (for example, using balloons instead of balls). The possibility that staff might feel concerned about their lack of knowledge was addressed by the professional development _a priori_ assuming no knowledge, the inclusion of demonstration lessons to clearly show implementation and management suggestions, and the presence of this candidate in teacher led lessons to provide support, encouragement and advice if requested or needed. Given the pilot nature of this study, this model of involvement was deemed to be suitable as it allowed for a richer understanding of the setting, creating a thorough background on which to base further modifications to the intervention prior to larger scale testing (Stevens et al., 2007).

Additionally, the professional development was attended by all staff who worked at the centre (as opposed to only the staff implementing the intervention), which is suggested to support the value of professional development content by allowing discussion and collaboration between staff outside of the formal professional development setting (Porter et al., 2003; Karagiorgi & Symeou, 2008). Finally, staff may have personally valued the content of the professional development, as health and development are seen as core responsibilities among Australian child care staff (Pagnini et al., 2007), which may then have supported their attendance and co-operation with the professional development model (Copeland, Sherman, Kendeigh, Saelens, & Kalkwarf, 2009).
8.2.2 Target Five: Implementation of Planned Structured Lessons

One hundred percent of planned structured lessons (43) were implemented.

8.2.2.1 Summary of Results

All planned structured lessons were implemented (43/43), though two lessons were run on each intervention day, rather than one, to accommodate the large number of children enrolled at the centre (see Section 7.5.2.3). Implementation fidelity was high, with 88% (76/86) of lessons implemented according to the lesson plan. This meets the target set for the implementation of structured lessons and supports the acceptability of these procedures.

8.2.2.2 Comparison With Other Studies

Four similar studies that included some report of implementation of planned structured lessons were identified, one of which was of high methodological quality (Reilly et al., 2006). Reilly et al.’s (2006) RCT involved 36 nurseries and a total of 545 participants (summarised in Table 2.5, p35). Setting staff were asked to deliver 3 x 30-minute physical activity sessions per week, over 24 weeks. Program implementation was assessed through staff records of session delivery and through one monitoring visit conducted by a researcher. Eighty-three percent of planned sessions were implemented (absolute numbers not provided).

Trost and colleagues (2008) conducted a small RCT, involving four class groups and a total of 48 participants (summarised in Table 2.5, p35). Setting staff were asked to deliver 10 minute activities twice per day, for eight weeks. Based on teacher reports, lesson implementation was 93% (82/88), though of these only 72% of activities were reported to run for the required 10 minute minimum (absolute numbers not provided). Although this appears to be high implementation of planned sessions, these results must be interpreted with caution as self-reported implementation is known to contain recall bias (Pate, O’Neill, & Mitchell, 2010), as was found in the study by Trost and colleagues (2008). In the first four weeks staff reported high implementation quality, however classroom observations by researchers found teachers were not meeting project requirements. Therefore, actual implementation may have been lower than reported in this and other studies relying on self-report of implementation.
Williams and colleagues (2009) conducted a pilot (no control) involving 16 early childhood classrooms, across nine Head Start centres (average class had 17 students, evaluation of intervention was based on teacher reported implementation and satisfaction). Teachers were provided with a motor skills program, containing ten units. Each unit focused on a different skill and contained six ten-minute activities designed to develop the focus skill. Teachers were asked to implement a minimum of one ten-minute motor skill development activity, from the provided program, per day and to complete a review of the unit completed in the given week. Only the reviews completed by teachers with a 100% reporting record (n =12) were used in the analysis of the program. The mean number of activities implemented per week was 4.12 (range 3 to 5), and mean duration was 11.4 minutes (range 8.9 to 16.3 minutes). Four of the nine participating centres (number of classes not specified) operated a four-day school week. No additional details regarding implementation were given. Therefore the percentage of centres that implemented a minimum of one 10-minute activity per day cannot be calculated. It appears that acceptability of planned implementation was high, with the majority of centres implementing the target number of lessons (1 x 10 minute activity per day), however additional detail is needed to confirm these assumptions.

Connor-Kuntz and Drummer (1996), implemented a movement skills intervention involving 72 preschool children across five intact class groups. The intervention was facilitated by the researcher and supported by the class teachers (two per class). The intervention was implemented three times per week (30 min sessions), for eight weeks. Implementation fidelity was assessed by audio recording every lesson, and video recording a single lesson. The video recorded lesson and one audio-recorded lesson, selected at random, were compared with the lesson plan. The audio-recordings indicated that 100% of all lessons were implemented as planned.

In summary, high program implementation and fidelity of early childhood fundamental movement skill programs is consistently reported in these four studies, supporting the implementation rates and program fidelity of the current study. One study involved both researchers and teachers implementing the lessons and reported an implementation rate of 100% of lessons and lesson components (Connor-Kuntz & Drummer, 1996). The other three studies identified were implemented by setting staff, following some form of professional development. These studies all had slightly lower implementation rates (range 83% - 93%) of planned lessons and no report of implementation fidelity,
indicating that high, but slightly lower than planned, implementation is common when setting staff implement an intervention (Reilly et al., 2006; Trost et al., 2008; Williams et al., 2009). The current study, where the majority of lessons were implemented by setting staff, had high implementation of planned structured lessons at 100% and implementation of lessons according to the lesson plan (implementation fidelity) of 88% (see Section 7.5.2.3). This may have been due to the smaller scale of the current study and the higher intensity of support that was possible.

**8.2.2.3 Possible Mechanisms and Explanations**

The high implementation rates in this study may have been a result of the size of the intervention. Two long day care centres were involved in the study (one intervention and one comparison), which allowed this candidate to be present at the intervention centre consistently throughout implementation. The continual presence of this candidate may have prompted staff to continue implementation and awareness that monitoring of implementation was occurring may also have been an influencing factor in the high implementation of planned structured lessons. The ongoing professional development workshops may also have contributed to the higher implementation rates (see Section 6.4.1 for a description of the professional development workshops). During these workshops, setting staff were reminded of project requirements, including the rationale, and provided with opportunities for trouble shooting (e.g. creating an implementation roster, see Section 7.5.2.4). Similarly, the demonstration lessons may have aided assimilation of the intervention into the centre program by reducing initial burden and supporting staff acquisition of knowledge and confidence. Further, this candidate regularly provided positive feedback during the workshops and encouraged staff to continue with implementation of the program as planned, which is likely to have acted as a prompt to continue with the structure of the program (3 x lessons and 3 x unstructured activities per week) and supported increasing staff confidence with implementing the program. However the intensity of support provided by this candidate in the current study is unlikely to be feasible in larger scale studies, which may impact implementation rates.

Additionally, the high implementation rates may have been influenced by the motivation of the setting staff (Lieber et al., 2009). All staff agreed to be involved in the study and believed it would be beneficial to the children and to the centre as a whole.
Required resources posed no barrier, as equipment was supplied at the beginning of the intervention and step-by-step lesson plans were provided. Furthermore, aspects of the intervention were negotiated with the participating centre. For example, the implementation of three lessons per week had been chosen and approved by the participating centre, which suggests that the intervention was not a time burden, and implementation of lessons was incorporated into the daily program, which meant the implementation of lessons caused no disruptions and was part of the day-to-day routine.

Finally, the Jump Start resource (lessons and activities contained in a folder) had been carefully designed in response to formative research and based on expert recommendations (see Section 1.5 and Appendix A), therefore it was durable, easy to use, attractive and suitable to hold in one hand while implementing a lesson. This meant that barriers to implementation of lessons, such as lack of knowledge, or time to peruse a lesson or navigate a suitable resource, were addressed in the Jump Start design.

8.2.3 Target Six: Staff Reported Lesson Appropriateness

Staff reported 90% of lesson content as appropriate.

8.2.3.1 Summary of Results

All components in all lessons (e.g. ‘Exploration’, see Section 4.4.2 for a description of the structured lessons) were given a mean score of ‘appropriate’ (‘4’) or ‘highly appropriate’ (‘5’), on a scale of ‘1’ (not at all appropriate) to ‘5’ (highly appropriate) by staff (range 4.2 – 5.0) (see Section 7.5.2.5). This exceeds the target set for staff reporting 90% of content as appropriate and supports the acceptability of these procedures.

8.2.3.2 Comparison With Other Studies

Similar to other feasibility and acceptability targets reported in this study, very few studies based in early childhood settings were identified that reported setting staff’s perception of the intervention’s appropriateness for their setting. As has been mentioned earlier, staff perception of the value of an intervention will directly affect whether staff will accommodate recommended changes to their current practice (Karagiorgi & Symeou, 2008; Brown et al., 2009; Keengwe & Onchwari, 2009). While literature searching and was not limited to a similar focus on physical activity or fundamental movement skill development, only the three interventions (none of which were of high
methodological quality) were identified that reported staff perceptions of intervention appropriateness (Boucher, 1990; Trost et al., 2008; Williams et al., 2009). These are described below.

The first study was a 10-week pilot, aiming to increase physical activity levels in sixteen preschool classes (Williams et al., 2009) (described in Section 8.2.2.2). Staff perception of appropriateness of the intervention was assessed using a five-point Likert scale (5 = strongly agree, 1 = strongly disagree). Appropriateness of the intervention was judged based on whether setting staff would recommend the program to other teachers. Mean scores indicated that participating teachers would recommend the program to other teachers (4.2/5) and felt the program effectively integrated physical activity with learning concepts (4.2/5).

The second study was implemented by Trost and colleagues (2008) and has been described earlier (see Section 8.2.1.2 and Tables 2.5, p35 & 8.1, p178). Teachers reported acceptability by indicating after each lesson on a five-point Likert scale (with 5 being highest) their perspective of children’s attentiveness, enthusiasm, persistence, physical self-regulation and verbal self-regulation. Reported mean scores were high (range 4.4 - 4.6) with staff reporting children were enthusiastic and attentive in the lessons, and were attentive, persistent and self-regulated in their work following the lessons.

The third study was a controlled trial, implemented in two distinct half-day classes (2.5 hours) run within one university-based child care setting (Boucher, 1990). The intervention group participated in a sensory-motor curriculum: 20 - 30min sessions, four days per week for 20 weeks. The comparison group participated in indoor free play and were provided with books, puzzles, and other similar equipment. Both the intervention and comparison treatments were facilitated by a class head teacher and an assistant teacher (with an additional two to six student teachers per lesson). Prior to implementation, intervention and comparison teachers were briefed on specifics of the intervention, such as rationale, teaching strategies, and curriculum orientation (no length specified). During the intervention, teachers implementing the intervention met with the lead researcher before the implementation of each lesson plan (no further details were provided). Student teachers changed throughout the study, dependant on course requirements, and were not involved in implementing the program. However, they assisted in managing the children and were given a brief orientation to the study.
Discussion

(no further details were provided). Following the intervention the four staff \((n = 2\) intervention, 2 comparison) completed an evaluation survey (a five-point Likert scale, with 1 = strongly agree and 5 = strongly disagree). While staff indicated agreement that the theoretical basis was explained in understandable terms (mean 1.2), that they felt confident using the curriculum (mean 1.3), and that they were comfortable making changes to the lessons (mean 1.3), ‘mixed attitudes’ (no further detail provided, but presumably some staff agreeing and some disagreeing) were reported for the remaining questions relating to the value and appropriateness of the intervention for the setting.

In summary, of the three identified studies that report staff perceived appropriateness of a given intervention two reported high staff perceived appropriateness, while staff involved in the third study reported mixed responses in regard to program appropriateness. The mixed responses reported in the third study are possibly due to the early pilot nature of the study or the small number of staff involved \((n = 4)\), of which only two were involved in implementing the intervention.

8.2.3.3 Possible Mechanisms and Explanations

The current study was preceded by formative research and a pilot study. This may have contributed to higher reporting of appropriateness by setting staff, due to procedures being refined in earlier smaller scale studies (Stevens et al., 2007).

Particular elements of the professional development model used in this study may also have contributed to staff’s high perception of lesson appropriateness. As described in Section 8.2.1.3, this professional development model actively addressed a number of common barriers such as time (Bellows et al., 2008; Karagiorgi & Symeou, 2008; Riethmuller et al., 2009b) and motivation (Bellows et al., 2008; Keengwe & Onchwari, 2009), and actively attempted to help staff appreciate the value of the intervention for the wellbeing of the children in their care (Pagnini et al., 2007; Copeland et al., 2009) and their own professional practice (Garet, Porter, Desimone, Birman, & Yoon, 2001; Flogaitis et al., 2005; Karagiorgi & Symeou, 2008). The model was ongoing, offering a motivational, intellectual and practical refresher to staff throughout the intervention (Garet et al., 2001; Karagiorgi & Symeou, 2008). Furthermore, the professional development was hands-on (Garet et al., 2001; Karagiorgi & Symeou, 2008), practical and thoroughly contextualised in their work place and related to high quality implementation of the structured lessons (Ertmer, 2005; Flogaitis et al., 2005;
Karagiorgi & Symeou, 2008; Keengwe & Onchwari, 2009). Having all staff complete the professional development workshops together supported the development of a community and shared knowledge, which allowed them to support each other in structured lesson implementation (Porter et al., 2003; Ertmer, 2005; Lieber et al., 2009). The model also supported staff by including on-going mentoring, that was provided to the setting staff initially through the lesson demonstrations given by this candidate, and then by this candidate acting as an active observer in lessons and as a mentor (Landry, Swank, Smith, Assel, & Gunnewig, 2006; McLaren, Hall, & Fox, 2009; Rudd et al., 2009). The presence of structures (such as which lesson was to be implemented, where the Jump Start resource folder could be found, and a system for organising who would implement the lesson on a given day) may have also influenced the ability of early childhood setting staff to adopt new practices (Morris, Chrispeels, & Burke, 2003) and therefore report high acceptability of the lesson content. Finally, the simple design of the Jump Start resource folder may have reduced the time burden normally associated with preparing lessons (Karagiorgi & Symeou, 2008; Brown et al., 2009), which, again, may have influenced staff perception of the acceptability of the structured lessons.

8.2.4 Target Seven: Implementation of Unstructured Activities

100% of planned unstructured activities (44) were implemented.

8.2.4.1 Summary of Results

Ninety-eight percent (43/44) of planned unstructured activities were implemented. On one occasion the staff member who was scheduled to implement the activity was engaged in a task that took longer than expected and subsequently had no opportunity to organise someone else to facilitate the unstructured activity. This falls slightly below the a priori target of 100% of planned unstructured activities being implemented.

At post-intervention, setting staff unanimously reported the unstructured activity component of the intervention as highly appropriate.

8.2.4.2 Comparison With Other Studies

To the best of the candidate’s knowledge no other study has included unstructured fundamental movement skill development activities, although the combination of unstructured and structured movement activities is recommended (National Association for Sport and Physical Education, 2002) and the unstructured activity component was in
line with the early childhood education philosophy of emergent curriculum, as recommended in the NSW Curriculum Framework (Stonehouse, 2001) at the time the intervention was developed. At the time of writing this framework had been updated to a national framework, which also recommends child-directed play-based learning in child care settings (Australian Government, 2009).

The study designs of Trost and colleagues (2008) and Williams and colleagues (2009) (neither of which were classed as being of high methodological quality) resembled an unstructured component most closely. Staff were given the flexibility to choose which activity they would implement, and Trost and colleagues specifically note that activities were to be chosen ‘based on children’s interests’. Similar to the current study, both Trost et al. (2008) and Williams et al. (2009) specified the number of times staff were expected to implement the activities. However, unlike this study, Trost and colleagues (2008) and Williams and colleagues (2009) specified a program of suitable activities for staff to choose from, a minimum (Trost et al., 2008) or a target (Williams et al., 2009) length that the activities were to run for, and the activities were designed to involve the whole class group. For these reasons, the studies by Trost et al. (2008) and Williams et al. (2009) were both reported in Section 8.2.2.2, where they were compared to the structured lesson component of the current study. Briefly, Trost and colleagues report implementation of 82 of 88 planned lessons, and Williams and colleagues report a mean of 4.2 activities being implemented each week where some centres were to implement five and some four, lessons per week (see Section 8.2.2.2). Further details were not provided in either study to allow comparison.

While it may be ideal for children to receive 1:1 feedback and encouragement while practicing fundamental movement skills, it is impractical to recommend this method to formal child care settings due to their staff-child ratios and time constraints. Therefore, while the structured lessons allowed all children to receive some encouragement, feedback and practice time, incorporating the unstructured component in the intervention allowed setting staff to initiate additional practice time with children, particularly those who were uninterested, uncooperative, or had difficulty in the structured lessons. Unstructured activities also acted as an opportunity for staff to encourage children to adapt concepts and skills from structured lessons to their free play time, potentially encouraging children to habitually engage in or choose active pursuits in their free play time (Burdette & Whitaker, 2005b). Given that fundamental
movement skills develop as a result of practice (Gallahue & Ozmun, 2002) and setting staff influence children’s level of physical activity within child care hours more than the child’s home environment (Pate et al., 2004; Loprinzi & Trost, 2010) the inclusion of an ‘unstructured activities’ component in the intervention design also had the potential to effect the habitual practice of setting staff, and encourage setting staff to be mindful of providing physical activity opportunities during free play time. That this occurred, in this study, was specifically commented on by participating staff in post-intervention interviews (see Section 7.5.2.8). Therefore, including regular unstructured activities in the intervention design has value for increasing staff confidence, competence and motivation to provide movement skill development opportunities during free play times, potentially influencing the long term sustainability of increasing physical activity levels and motor development through child care settings.

Finally, the inclusion of unstructured activities, which closely resembled current early childhood philosophy, are more likely to be found to be acceptable by child care staff and indicate respect of the professional perspectives child care staff. Although important, the suggestion that structured lessons be implemented has the implication that the child care centre significantly adjust their current practice, and as mentioned above even their philosophy. Therefore, the inclusion of the unstructured activities within the intervention design demonstrated to participating staff that the researchers (this candidate and supervisors) had some understanding of their setting and that there was consideration in the research design of their preferences and current recommended practice. The inclusion of both structured lessons and unstructured activities also allowed this pilot to compare staff attitudes towards the two components, which is valuable for informing the development of future interventions. With limited research currently available regarding child care based interventions (Riethmuller et al., 2009a; Hesketh & Campbell, 2010; Ward et al., 2010) and very few studies reporting a measure of acceptability (see Section 8.2), an indication of how staff perceived both modifying the familiar practice (unstructured activities) and incorporating a foreign, but recommended practice (structured lessons) indicates whether future studies should only focus on supporting physical activity and fundamental movement skill development through play-based learning, or whether it is possible for the outside expert recommendation of structured lessons to be implemented in a manner that is acceptable
and appropriate within child care settings. Therefore, the inclusion of both structured lessons and unstructured activities is valuable for informing future studies.

8.2.4.3 Possible Mechanisms and Explanations

Very high implementation of unstructured activities was recorded in this study. Possible reasons for this are similar to those proposed in Section 8.2.2.3, regarding the high implementation of structured lessons and include; the presence of this candidate encouraging implementation, by acting as a reminder and providing opportunity for individual feedback and support (Trost et al., 2008; Potestio et al., 2009); the presence of in-centre structures to promote and support implementation (such as the support of the Director, and implementation being linked to shifts) (Morris et al., 2003); having access to formal and informal discussion with colleagues and opportunities for staff to witness successful implementation, both of which help staff to change practices and beliefs (Ertmer, 2005), and subsequently overcome barriers of fear and uncertainty (Mohler et al., 2009); and the ongoing professional development workshops acting as a reminder and a support (Karagiorgi & Symeou, 2008). Finally, high implementation of unstructured activities may also have occurred due to the design closely resembling their practice of emergent curriculum (Stonehouse, 2001).

8.2.5 Acceptability: Limitations

This study included a number of areas that limit the generalisability of these acceptability findings. The limitations of this study, regarding acceptability, include;

1. The small scale of this study (i.e. only one intervention centre) allowed greater face-to-face contact between this candidate and the intervention centre staff, which in turn may have encouraged high program compliance. In larger studies, it is unlikely that the intensity of contact between this candidate and the intervention centre could be replicated.

2. Only one centre engaged with the Jump Start program (comprising the resource folder, implementing lessons and unstructured activities and the professional development model). Therefore, caution should be used in drawing conclusions regarding how well suited the program design may be for long day care centres in general.
3. There were no parameters set around how soon after the lesson was implemented that a lesson evaluation needed to be completed. Therefore, some lesson evaluations were completed on a different day to the implementation of the lesson being reported. This increases the likelihood of recall error.

4. The close relationship that was able to be developed between this candidate and intervention centre staff, due to the small size of the intervention, may have implications for how centre staff reported the acceptability of intervention components and is unlikely to be reproducible in larger scale studies.

8.2.6 Acceptability: Recommendations

The findings of this study and consideration of the study limitations highlight a number of recommendations for future interventions, including:

1. That implementation targets be set lower than 100% for large scale RCTs. Implementation of above 80% is recommended as appropriate. High implementation targets were believed to be achievable for this intervention due to the small scale of the intervention and the optimum status of involved settings (particularly the high motivation of setting staff, but also large outdoor space available) but are unlikely to be replicable in larger scale studies.

2. That intervention designs include ongoing implementation support, such as ongoing professional development in order to promote high quality implementation of the intervention. This is in line with current professional development literature which reports that professional development models that employ an ongoing model of delivery support knowledge acquisition and behaviour change (Porter et al., 2003).

3. That intervention designs include multiple implementation monitoring components, such as evaluations and observations to ensure accurate reporting of implementation fidelity and quality. Also, that implementation monitoring be conducted by someone other than the staff implementing the intervention to prevent recall bias, although this is likely to increase the cost of the intervention.

4. That additional pilot studies be conducted which include details of the professional development model, planned and actual implementation,
implementation fidelity and acceptability of the program so that, as Stevens and colleagues (2007) recommend, subsequent intervention designs can be informed.

8.3 QUESTION THREE: POTENTIAL EFFICACY

It was hypothesised that at during-intervention testing (18-weeks after pre-intervention testing), compared with participants allocated to the comparison group, participants in the treatment group would show the following trend:

_Hypothesis One:_ Greater increases in physical activity during child care hours.

It was hypothesised that at post-intervention (20-weeks after randomisation), compared with participants allocated to the comparison group, participants in the treatment intervention program would show the following trends:

_Hypothesis Two:_ Greater increases in physical activity during child care hours;

_Hypothesis Three:_ Greater competence in fundamental movement skills;

_Hypothesis Four:_ Similar change in BMI.

8.3.1 Hypothesis One: Physical Activity During-Intervention

_Compared with the comparison group, the intervention group would demonstrate a trend towards greater increases in physical activity during child care hours during the intervention (18-weeks)._ 

8.3.1.1 Summary of Results

When physical activity was assessed during the last two weeks of the intervention (during-intervention), the intervention group, compared with the comparison group, showed a greater increase in their total physical activity (CPM), which translated to a small-to-medium effect size (Cohen’s $d = 0.40$). A negligible positive effect was also found for percentage of time spent in vigorous physical activity (%VPA) (Cohen’s $d = 0.15$).

8.3.1.2 Comparison With Other Studies

Two similar studies were identified that used objective measures (accelerometers) to collect during-intervention physical activity data (Specker & Binkley, 2003; Trost et al., 2008). One of these were of high methodological quality (Specker & Binkley, 2003). Both of these studies are summarised in Table 8.2 (p200) and were also described
previously in Table 2.5 (p35). Trost and colleagues (2008) implemented an eight-week physical activity intervention and collected physical activity data each week throughout the intervention period. Similar to the current study, physical activity increased in the intervention group compared with the comparison group during the intervention period. Insufficient data were provided to calculate effect sizes. Specker and Binkley (2003) implemented an intervention for one year, and collected during-intervention data at six-months. They found negligible effects for the percentage of time spent in MVPA during the intervention (6-months) (Cohen’s $d = 0.13$). Similar to the findings from the current study, the studies discussed here indicate that a physical activity intervention may increase levels of physical activity during the intervention.

### 8.3.1.3 Possible Mechanisms and Explanations

The finding of a greater increase in physical activity in the intervention centre during the intervention, is likely to be largely due to children’s involvement in the structured and unstructured components of the Jump Start program. This indicates that changes to child care physical activity practices, namely the provision of structured and unstructured activity, has the potential to increase the amount of physical activity children engage in during child care hours.

### 8.3.2 Hypothesis Two: Physical Activity Post-Intervention

*Compared with the comparison group, the intervention group would demonstrate a trend towards greater increases in physical activity during child care hours at post-intervention (20-weeks).*

#### 8.3.2.1 Summary of Results

Promising effects on physical activity were found for during-intervention physical activity levels, however these were not sustained at post-intervention testing. At post-intervention testing, negligible negative effect sizes were found for the intervention group compared with the comparison group for total physical activity (CPM) (Cohen’s $d = -0.16$), and small negative effects were found for percentage of time spent in LPA (Cohen’s $d = -0.27$), MPA (Cohen’s $d = -0.31$), VPA (Cohen’s $d = -0.31$), and MVPA (Cohen’s $d = -0.38$). The intervention group also showed a greater increase in the percentage of time spent in sedentary behaviour, demonstrated by a small positive effect (Cohen’s $d = 0.35$). Further analysis of the results revealed that the reason for this was
that the intervention group had greater decreases in physical activity levels compared with the comparison group at the conclusion of the intervention when Jump Start was no longer being implemented at the centre.

8.3.2.2 Comparison With Other Studies

The physical activity results from this study can be compared with two similar studies that collected objectively measured physical activity data at post-intervention using accelerometry, both of which were of high methodological quality (Specker & Binkley, 2003; Reilly et al., 2006). These studies are summarised in Table 8.2 (below) and are also described in Table 2.5 (p35).

Reilly and colleagues (2006) measured physical activity immediately post-intervention (6-months). Similar to the current study, a negligible negative effect was seen in the intervention group’s total physical activity (CPM) compared with the comparison group (Cohen’s $d = -0.07$). Specker and Binkley (2003; 2004) measured physical activity immediately at post-intervention (12-months). Unlike the current study, Specker & Binkley found small positive effects for total physical activity (CPM) were sustained at post-intervention (Cohen’s $d = 0.17$). Therefore, varying results were found for whether changes in physical activity levels following a physical activity intervention are sustained at post-intervention, and given the limited evidence, conclusions are difficult to draw.
Table 8.2. Comparison with other studies: Physical activity

<table>
<thead>
<tr>
<th>Reference</th>
<th>Brief Summary</th>
<th>Outcome</th>
<th>Mean I-C. Difference</th>
<th>p Value</th>
<th>Cohen’s d**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specker &amp; Binkley (2003; 2004)</td>
<td>n = 239, 38 - 58wk, aged 3 – 5y Intervention: 30min 1/d gross motor activities, implemented by research personnel. Comparison: 30min 1/d fine motor activities, implemented by research personnel. Measure: Accelerometers (48h, no epoch length specified).</td>
<td>% MVPA during-intervention (6mo)</td>
<td>0.06</td>
<td>Not reported</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% MVPA post-intervention (12mo)</td>
<td>0.06</td>
<td></td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% VPA during-intervention (6mo)</td>
<td>0.01</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>% VPA post-intervention (12mo)</td>
<td>0.20</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>% VPA 18mo follow-up</td>
<td>0.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>% VPA 24mo follow-up</td>
<td>-0.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reilly et al. (2006)</td>
<td>n = 545, 24wk, mean age = 4.2y Intervention: 30min 3/wk fundamental movement skill activities, home health information. Teacher implemented. Comparison: Usual care. Measure: Accelerometers (6d, epoch length not defined).</td>
<td>Total physical activity (log CPM)</td>
<td>-13.00</td>
<td>0.18</td>
<td>-0.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% Sedentary</td>
<td>1.70</td>
<td>0.08</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% MVPA</td>
<td>-0.20</td>
<td>0.05</td>
<td>-0.03</td>
</tr>
<tr>
<td>Trost et al. (2008)</td>
<td>n = 42, 8wk, aged 3 – 5y Intervention: minimum 10min 2/d integrated physical activity (e.g. literacy and physical activity). Teacher implemented. Physical activity assessed weekly throughout intervention. Comparison: Usual care. Measure: Accelerometers (2 x 2.5h x 8wk,15sec epoch) and direct observation (1 x 15min, OSRAP)</td>
<td>Minutes of MVPA during-intervention (Classroom) (wk 5-6, 7-8)</td>
<td>1.50</td>
<td>&lt;0.05</td>
<td>Could not be calculated (SD not presented)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minutes of MVPA during-intervention (Classroom &amp; Outside) (wk 7-8)</td>
<td>1.00</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minutes of VPA during-intervention (Classroom) (wk 5-6, 7-8)</td>
<td>2.00</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minutes of VPA during-intervention (Classroom &amp; Outside) (wk 7-8)</td>
<td>3.00</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>Jump Start</td>
<td>n = 97, 20wk, mean age = 4.1y Intervention: 20min fundamental movement skill lessons, 3/wk. Teacher implemented. Comparison: Usual care. Measure: Accelerometers (2d, 15sec epoch).</td>
<td>Total physical activity (CPM) during-intervention</td>
<td>115.50</td>
<td>0.01</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% MVPA during intervention</td>
<td>-4.10</td>
<td>0.82</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total physical activity (CPM) post-intervention</td>
<td>-25.50</td>
<td>0.25</td>
<td>-0.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% MVPA post-intervention</td>
<td>-1.80</td>
<td>0.73</td>
<td>-0.38</td>
</tr>
</tbody>
</table>

*Calculated as (intervention post-intervention – intervention pre-intervention) - (comparison post-intervention – comparison pre-intervention); **Standardised effect size (Cohen’s d) expressed in standard deviation multiples to allow comparisons of effect sizes across different measures and studies, calculated as the adjusted difference between treatment and comparison groups divided by the pooled within group standard deviation; *Four groups were reported (fine motor and gross motor placebo and calcium supplement groups). Results for the placebo fine motor and placebo gross motor groups were used in these calculations; wk = weeks; y = years; min = minutes; / = per; d = day(s); h = hours; MVPA = Moderate-to-vigorous physical activity; mo = months; VPA = vigorous physical activity; CPM = Counts per minute; sec = seconds; OSRAP = Observational System for Recording Activity in Preschoolers
8.3.2.3 Possible Mechanisms and Explanations

Similar to Reilly et al. (2006), the findings showed that the changes in physical activity levels were not sustained at post-intervention. This was likely due to staff not continuing with the program once the formal requirements ceased (based on informal observations made during post-intervention testing). This may be due to staff no longer having the structural support that they required (Morris et al., 2003). While the structure of who would run the lessons and the time the lessons were to be implemented were all still able to remain in place, the design of the Jump Start intervention had not included directions about which lessons to implement and an order of lesson implementation, once the intervention timeline ceased, which may be a valuable component to include in future studies. This potential gap in the program design was unforeseen. Another likely reason may be that the end of the intervention coincided with the end of the school year, a typically busy time of year for child care settings, and staff may have decided to focus on other priorities temporarily. This is particularly pertinent as post-intervention data were collected in the two weeks immediately following the final lesson and no further follow-up data were collected. Given that staff unanimously reported high acceptability for the Jump Start program (see Section 7.5.2.5), a belief that the program both should and would continue in their centre (see Section 7.5.2.6.10), these two possibilities seem plausible.

Another possibility is that an intervention of longer duration may allow a stronger physical activity habits to be formed. Both the current study and the intervention implemented by Reilly and colleagues (2006) had a duration of close to six months, unlike the intervention implemented by Specker and Binkley (2003), which had a duration of one year.

8.3.3 Hypothesis Three: Mastery of Fundamental Movement Skills

Compared with the comparison group, the intervention group would demonstrate a trend towards greater competence in fundamental movement skills at post-intervention.

8.3.3.1 Summary of Results

Greater improvements were reported for all five fundamental movement skills for the intervention group compared with the comparison group at post-intervention (see Table 7.6, p160). Small effect sizes were reported for the hop and kick (Cohen’s $d = 0.26$ and
0.23 respectively), a small-to-medium effect size for total movement score (Cohen’s $d = 0.47$), and a medium effect size for the jump (Cohen’s $d = 0.61$).

8.3.3.2 Comparison With Other Studies

Five similar studies, where staff played a key role in providing motor skill development opportunities, were identified and are summarised in Table 8.3 (Goodway & Branta, 2003; Goodway et al., 2003; Reilly et al., 2006; Hardy et al., 2010b; Klein et al., 2010), one of which was of high methodological quality (Reilly et al., 2006). These studies were also summarised in Table 2.5. All report an increase in fundamental movement skill proficiency in the intervention group compared with the control group, for some or all skills. The two interventions implemented by Goodway and colleagues were of 12- and 9-weeks duration, respectively, and were facilitated by the lead researcher with staff support (staff were provided with some professional development and had a teaching role in the lessons) (Goodway & Branta, 2003; Goodway et al., 2003). Both of these interventions reported large positive effect sizes for all skills (range Cohen’s $d = 1.23 - 2.87$), with the exception of a positive small-to-medium effect for the gallop (Cohen’s $d = 0.38$) in the study conducted by Goodway and Branta (2003). Reilly et al. (2006) found a small positive effect size for total movement score as a result of a six-month teacher-led intervention (Cohen’s $d = 0.25$). Hardy and colleagues (2010b) implemented a low-intensity intervention, with no lesson or activity requirements (staff attended a 1-day professional development workshop). Small positive effects were reported for all skills (range Cohen’s $d = 0.20 – 0.24$) at post-intervention (5 – 6 months after the professional development workshop). Klein and colleagues (2010), implemented a similar low-intensity intervention, with a single professional development session for staff only (no lesson or activity implementation requirements). Results at five- to six-month post-intervention testing were mixed with greater improvements seen in the intervention group for two (3) movement skills (lateral jump and long jump, Cohen’s $d = 0.03, 0.18$, respectively). Although there are limited data available, these studies support the findings of the current study that a teacher-led fundamental movement skill intervention may increase the fundamental movement skills of participating children compared with children participating in their normal preschool program.
## Table 8.3. Comparison with other studies: Fundamental movement skills

<table>
<thead>
<tr>
<th>Reference</th>
<th>Brief Summary</th>
<th>Outcome</th>
<th>Mean I-C Difference*</th>
<th>p Value</th>
<th>Cohen’s d**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gallop</td>
<td>0.16</td>
<td></td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hop</td>
<td>1.13</td>
<td></td>
<td>2.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leap</td>
<td>0.75</td>
<td></td>
<td>1.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jump</td>
<td>1.45</td>
<td></td>
<td>2.76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skip</td>
<td>1.39</td>
<td></td>
<td>1.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slide</td>
<td>1.34</td>
<td></td>
<td>2.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strike</td>
<td>2.18</td>
<td></td>
<td>2.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bounce</td>
<td>1.49</td>
<td></td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Catch</td>
<td>0.96</td>
<td></td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kick</td>
<td>1.32</td>
<td></td>
<td>2.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Throw</td>
<td>1.44</td>
<td></td>
<td>1.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Locomotor total</td>
<td>Not reported</td>
<td>&lt;0.001</td>
<td>Could not be calculated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Object control</td>
<td>Not reported</td>
<td>&lt;0.001</td>
<td>Could not be calculated</td>
</tr>
<tr>
<td>Goodway et al. (2003)</td>
<td>*n = 63, 9wk, mean age = 4.9y (intervention), 5.0y (comparison). Intervention: 35min fundamental movement skill lessons, 2/wk, researcher led lessons with support of 2 class teachers. Comparison: Usual care. Measure: Object control and locomotor skills (TGMD).</td>
<td>Locomotor raw score</td>
<td>7.47</td>
<td>&lt;0.001</td>
<td>2.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Object control raw score</td>
<td>5.76</td>
<td>&lt;0.001</td>
<td>1.97</td>
</tr>
</tbody>
</table>

*Calculated as (intervention post-intervention – intervention pre-intervention) - (comparison post-intervention – comparison pre-intervention); **Standardised effect size (Cohen’s d) expressed in standard deviation multiples to allow comparisons of effect sizes across different measures and studies, calculated as the adjusted difference between treatment and comparison groups divided by the pooled within group standard deviation; wk = weeks; y = years; min = minutes; / = per; TGMD and TGMD-2 = Test of Gross Motor Development
Table 8.3 Comparison with other studies: Fundamental movement skills (cont.)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Brief Summary</th>
<th>Outcome</th>
<th>Mean I-C Difference*</th>
<th>p Value</th>
<th>Cohen’s d**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reilly et al. (2006)</td>
<td>n = 545, 24wk, mean age 4.2y. Intervention: 30min fundamental movement skill lessons, 3/wk, home health information, Teacher implemented. Comparison: Usual care. Measure: Object control and locomotor skills (MAB).</td>
<td>Total movement score</td>
<td>0.60</td>
<td>Not reported</td>
<td>0.25</td>
</tr>
<tr>
<td>Hardy et al. (2010b)</td>
<td>n = 430, 4 – 5mo, mean age 4.4y. Intervention: 1d professional development workshop, fundamental movement skill activities resource and contact with health professionals (but no intervention requirements). Comparison: Unrelated health information (e.g. road safety). Measure: Object control and locomotor skills (TGMD-2).</td>
<td>Locomotor score</td>
<td>1.30</td>
<td>0.01</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Object control score</td>
<td>1.10</td>
<td>0.003</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total movement score</td>
<td>2.40</td>
<td>0.003</td>
<td>0.24</td>
</tr>
<tr>
<td>Klein et al. (2010)</td>
<td>n = 1050, 5 – 6mo, mean age 4.7y Intervention: 1 professional development session for parents and educators, including children’s baseline testing results (classified from 'mega super' to ‘a bit super’ (no further detail regarding length or number of educators required to attend). Comparison group: Usual care. Measure: Locomotor skills (KMS 3-6)</td>
<td>Long jump</td>
<td>3.5</td>
<td>&gt;0.05</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lateral jump</td>
<td>0.3</td>
<td>&gt;0.05</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One leg stand (measured as the number of ground contacts)</td>
<td>1.5</td>
<td>&lt;0.001</td>
<td>0.21†</td>
</tr>
<tr>
<td>Jump Start</td>
<td>n = 97, 20wk, mean age = 4.1y Intervention: 20min fundamental movement skill lessons, 3/wk. Teacher implemented, ongoing professional development. Comparison: Usual care. Measure: Fundamental movement skills (TGMD-2).</td>
<td>Run</td>
<td>0.20</td>
<td>0.94</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hop</td>
<td>0.52</td>
<td>0.09</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jump</td>
<td>1.50</td>
<td>&lt;0.001</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Catch</td>
<td>0.26</td>
<td>0.52</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kick</td>
<td>0.46</td>
<td>0.17</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total score</td>
<td>2.18</td>
<td>&lt;0.001</td>
<td>0.47</td>
</tr>
</tbody>
</table>

*Calculated as (intervention post-intervention – intervention pre-intervention) - (comparison post-intervention – comparison pre-intervention); ** Standardised effect size (Cohen’s d) expressed in standard deviation multiples to allow comparisons of effect sizes across different measures and studies, calculated as the adjusted difference between treatment and comparison groups divided by the pooled within group standard deviation; mo = months; y = years; d = days; MAB = Movement Assessment Battery; TGMD-2 = Test of Gross Motor Development (2nd ed.); KMS 3-6 = Karlsruher motor screening for kindergarten children; †A greater decrease indicates competence for this skill; wk = week; min = minutes; / = per
8.3.3.3 *Possible Mechanisms and Explanations*

The greater increase in mastery of fundamental movement skills in the intervention group, compared with the comparison group, is most likely due to increased encouragement, direct instruction, specific feedback and opportunities for practice (Gallahue & Ozmun, 2002). Between 240 - 600 minutes of instruction and practice are proposed to be required for mastering a given fundamental movement skill (Department of Education Victoria, 1996). In this study children participated in between 80 – 240 minutes of instruction per skill, depending on the number of days they attended the long day care centre (20 min lessons x ≤3 lessons per week x 4 weeks per skill). Additionally, specific aspects unique to this intervention may have also contributed to these increases in fundamental movement skill proficiency. For example, the children were young, and therefore were in the initial or elementary stages of developing their fundamental movement skills (Gallahue & Ozmun, 2002), which meant that they had greater room for improvement than older children. The lessons were also designed according to recommended structure (Gallahue, 1996; Jones et al., 2007) and based on the advice of an expert group comprised of researchers, physical education specialists and early childhood teachers (see Section 1.5, Section 4.4.2, and Appendix A), which meant that the design of lessons was informed by an understanding of children’s learning styles and interests; each skill was taught for four weeks and only five skills were covered to maximise instruction and practice time; and lastly, teachers were enthusiastic and valued the intervention which may have influenced children’s involvement and the quality of the lessons (Sallis et al., 1993; O'Connor & Temple, 2005). Given all reviewed studies indicate improvements in fundamental movement skills (see Section 8.3.3.2, above) and fundamental movement skills have been shown to be a correlate of physical activity (see Section 2.4.1), fundamental movement skill development may be an area that can be successfully targeted in interventions to increase physical activity levels in young children (Hardy et al., 2010a). Furthermore, physical development is a government mandated component of child care curriculum (Australian Government, 2009), yet child care staff currently tend to avoid physical activity due to barriers of confidence, competence and motivation (Riethmuller et al., 2009b). This adds further importance to the development of feasible, acceptable and potentially efficacious fundamental movement skill development programs for child care settings.
8.3.4 Hypothesis Four: Changes to Body Mass Index

Compared with the comparison group, the intervention group would demonstrate a similar change in BMI at post-intervention.

8.3.4.1 Summary of Results

A similar change in BMI between groups was hypothesised, with a small non-significantly greater reduction found in the intervention group compared with the comparison group. The effect size was negligible (Cohen’s $d = -0.05$).

8.3.4.2 Comparison With Other Studies

Five similar physical activity and/or fundamental movement skill development interventions were identified that included a report of BMI measures (Fitzgibbon et al., 2005; Fitzgibbon et al., 2006; Reilly et al., 2006; Eliakim, Nemet, Balakirski, & Epstein, 2007; Klein et al., 2010). Reilly and colleagues (2006) report a negligible effect on BMI at six-months (Cohen’s $d = 0.05$), and no effect at 12-month follow-up (Cohen’s $d = 0.00$). Similarly, Klein and colleagues (2010) report a negligible effect on BMI at six-weeks (Cohen’s $d = -0.13$) (no follow-up data collected). Eliakim and colleagues (2007) and Fitzgibbon and colleagues (2005) both reported a large negative effect on BMI with the intervention group showing smaller increases compared with the comparison group (Cohen’s $d = -1.20$, and $-1.80$, respectively). Fitzgibbon and colleagues (2005) reported that these effects were sustained at one- and two-year follow-ups (Cohen’s $d = -5.64$, $-4.64$ respectively). In a second study, Fitzgibbon and colleagues (2006) report a small negative effect on BMI at post-intervention (Cohen’s $d = 0.22$), and large negative effects at one- and two-year follow-ups (Cohen’s $d = -1.30$, $-1.43$ respectively). All three studies that reported large negative effects on BMI had a nutrition component in their intervention that may have contributed to the effect on BMI (Fitzgibbon et al., 2005; Fitzgibbon et al., 2006; Eliakim et al., 2007).
Table 8.4. Comparison with other studies: Body mass index

<table>
<thead>
<tr>
<th>Reference</th>
<th>Brief Summary</th>
<th>Outcome</th>
<th>Mean I-C. Difference</th>
<th>p Value</th>
<th>Cohen’s d*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitzgibbon et al. (2005)</td>
<td>$n = 409$, 14 wk, mean age = 4.1y Intervention: 45min diet and physical activity lessons 3/wk, parent weekly newsletters and homework assignments. Specialist implemented. Comparison: 20min general health lessons (e.g. dental health, no diet or physical activity information), 1/wk.</td>
<td>BMI (Post-intervention)</td>
<td>-0.09</td>
<td>0.234</td>
<td>-1.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMI (1y follow-up)</td>
<td>-0.62</td>
<td>0.002</td>
<td>-5.64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMI (2y follow-up)</td>
<td>-0.65</td>
<td>0.008</td>
<td>-4.64</td>
</tr>
<tr>
<td>Fitzgibbon et al. (2006)</td>
<td>$n = 401$, 14wk, mean age = 4.2y Intervention: 45min diet and physical activity lessons, 3/wk, parent weekly newsletters and homework assignments. Specialist implemented. Comparison: 20min general health lessons (e.g. dental health, no diet or physical activity information) 1/wk, and related weekly parent newsletters (no homework).</td>
<td>BMI (Post-intervention)</td>
<td>-0.02</td>
<td>0.89</td>
<td>-0.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMI (1y follow-up)</td>
<td>-0.15</td>
<td>0.46</td>
<td>-1.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMI (2y follow-up)</td>
<td>-0.25</td>
<td>0.34</td>
<td>-1.43</td>
</tr>
<tr>
<td>Reilly et al. (2006)</td>
<td>$n = 545$, 24wk, mean age = 4.2y Intervention: 30min fundamental movement skill lessons 3/wk, home health information. Teacher implemented. Comparison: Usual care.</td>
<td>BMI SD (Post-intervention)</td>
<td>0.05</td>
<td>Not reported</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMI SD (12mo follow-up)</td>
<td>0</td>
<td>Not reported</td>
<td>0</td>
</tr>
<tr>
<td>Eliakim et al. (2007)</td>
<td>$n = 101$, 14wk, mean age = 5.5y (intervention), 5.6y (comparison) Intervention: 45min diet and physical activity lessons 6/wk. Teacher and expert implemented. Comparison: Usual care.</td>
<td>BMI (Post-intervention)</td>
<td>-0.3</td>
<td>Not reported</td>
<td>-1.20</td>
</tr>
<tr>
<td>Klein et al. (2010)</td>
<td>$n = 1050$, 4 – 6wk, mean age = 4.7y Intervention: 1 professional development session for educators and parents, covering nutrition and physical activity (no details of length or number of educators from each centre required to attend). Comparison: Usual care.</td>
<td>BMI (Post-intervention)</td>
<td>-0.2</td>
<td>&lt;0.001</td>
<td>-0.13</td>
</tr>
<tr>
<td>Jump Start</td>
<td>$n = 97$, 20wk, mean age = 4.1y Intervention: 20min fundamental movement skill lessons, 3/wk. Teacher implemented. Comparison: Usual care.</td>
<td>BMI (Post-intervention)</td>
<td>-0.08</td>
<td>0.53</td>
<td>-0.05</td>
</tr>
</tbody>
</table>

*Calculated as (intervention post-intervention – intervention pre-intervention) - (comparison post-intervention – comparison pre-intervention); **Standardised effect size (Cohen’s d) expressed in standard deviation multiples to allow comparisons of effect sizes across different measures and studies, calculated as the adjusted difference between treatment and comparison groups divided by the pooled within group standard deviation; wk = weeks; y = years; min = minutes; / = per; BMI = Body mass index, calculated as kg/m²
8.3.4.3 **Possible Mechanisms and Explanations**

The similar change in BMI between groups is expected given the short duration of the intervention, as there was no nutrition component, and due to the majority of the sample being classified as non-overweight at pre-intervention.

8.3.5 **Potential Efficacy: Limitations**

This study included a number of areas that limit the generalisability of these potential efficacy findings. The limitations of this study, regarding potential efficacy, include:

1. The sample size was insufficiently powered to detect a statistical significance. Effect sizes were reported to allow results to be compared with other studies.
2. Only one centre was in each of the intervention and comparison groups, causing reduced within group variation and potentially confounding the results (Murray, 1998).
3. There were no medium or long-term follow-up measures taken, so changes reported within the intervention cannot be assessed for sustainability.
4. Only two days of accelerometer data were collected. Due to the routine nature of child care settings, the young age of participants (Cliff et al., 2009b), and the pilot study nature of this trial, this was deemed to be appropriate measure.
5. Physical activity data were only collected within centre hours, which meant the intervention effect on home activity was not measured. Therefore, it cannot be assumed that any gains in physical activity during child care hours did not lead to displacement of physical activity outside of child care hours. Collecting data during centre hours only was deemed appropriate for this small scale pilot study and was preferable as it ensured accelerometers were fitted properly, avoided missing data as a result of guardians forgetting to fit the accelerometer, and placed less burden on primary guardians to fit and remove accelerometers.

8.3.6 **Potential Efficacy: Recommendations**

The findings of this study and consideration of the study limitations highlight a number of recommendations for future interventions, including:

1. The collection of medium- or long-term follow-up data to allow the sustainability of the intervention to be assessed.
2. The collection of outcome measures, specifically objectively measured physical activity, while the intervention is in progress, to identify differences between the impact during the intervention and the impact sustained at post-intervention.

3. The collection of nap times for individual children to allow these periods to be both included and removed from analyses. This would have required either more personnel during data collection or a larger burden to be placed on setting staff. Collecting nap time data was therefore seen as beyond the scope of the current project.

4. Providing an implementation timeline, or structure, that extends beyond the intervention period may be beneficial for sustaining implementation of physical activity experiences, given that time and motivation are a barrier to implementing high quality physical activity experiences in child care settings. The intervention centre was only provided with a structure for implementing lessons for five skills over 20 weeks. At the conclusion of the intervention, the centre was not given directions regarding how to continue implementing the lessons and activities covered in the Jump Start resource folder.

5. Using an ongoing professional development model to support knowledge acquisition, behaviour change and implementation quality.

6. Future large-scale interventions should consider collecting a minimum of three days of preschool physical activity data to potentially increase the reliability of the data collected. It has been shown in a study of habitual physical activity among preschoolers, that a minimum of three days is required to reliably capture overall physical activity levels in this age group (Penpraze et al., 2006). Collecting more than two days of accelerometer data was beyond the scope of this study.

7. Future larger-scale trials should consider collecting whole days of physical activity data so that both physical activity within centre hours and whole day physical activity can be analysed.

8. Implementing large-scale RCTs that are adequately powered to detect significant differences.


### 8.4 STUDY STRENGTHS

There are a number of strengths of this study:

A true pilot RCT design was used, with a focus on feasibility and acceptability components, allowing the design of future studies to be informed, as recommended by Stevens and colleagues (2007). The intervention design was evidence-based, as it was informed by formative research and a Proof-of-Concept trial, and was underpinned by a theoretical framework. Primary outcomes were assessed using objective measures of physical activity and fundamental movement skills, and analysed according to intention-to-treat principles. Post-hoc analyses were conducted to adjust for the clustered nature of the data (Hedges, 2007) and $p$ values of both 0.01 and 0.05 were reported as recommended by Varnell and colleagues (Varnell et al., 2001) for single group per condition trials. This study was reported following the TREND (Des Jarlais et al., 2004) and CONSORT (Moher et al., 2010) statements to allow critical appraisal and comparison between studies and therefore addressed many of the aspects of high methodological quality recommended by van Sluijs et al. (2007) and missing in previous interventions (Riethmuller et al., 2009a) including describing randomisation procedures, using an individual unit of analyses and intention-to-treat principles, using validated tools to measure primary outcomes, describing drop-out, and using blinded assessors.

Setting staff implemented the intervention with appropriate support, which was provided through mentoring and an ongoing professional development model. Therefore, the model being tested is a ‘real-world’ model that is potentially cost-effective and sustainable and could be transferred to community contexts, unlike the majority of similar interventions reported in recent literature, which were implemented by specialists (see Section 2.5.2.3). Additionally, the intervention model involved three integrated components, supporting the knowledge and confidence of staff through professional development, and supporting the knowledge and skill acquisition of children through structured lessons and unstructured skill development activities.

This study makes a valuable contribution to the current body of research regarding physical activity interventions in early childhood settings. The strengths of this study, as discussed above, address many of the weaknesses identified in other physical activity interventions targeting preschool-aged children (Riethmuller et al., 2009a; Hesketh & Campbell, 2010) and follow methodological quality recommendations made by van
Sluijs and colleagues (2007). This study was reported following the guidelines provided in the CONSORT, therefore ensuring transparent reporting of the trial (Moher et al., 2010). To the best of this candidate’s knowledge, there were no other Australian fundamental movement skill development interventions designed for early childhood settings and using objective measures to assess changes reported at the time of implementation. Since implementation only one other Australian study had been reported at the time of writing (Hardy et al., 2010b). The current study adds to a limited body of international research available in this national health priority area (National Preventative Health Taskforce, 2008).

8.5 STUDY LIMITATIONS

Although this study design was informed by previous research, and with an attempt to limit weaknesses, a number of limitations should be considered when drawing conclusions from the reported results. Specific limitations related to each of the targets and hypotheses have been outlined in Sections 8.1.4, 8.2.5 and 8.3.5. In summary:

1. The sample size was not adequately powered to detect statistical significance. As this was a pilot RCT, a larger sample size was not warranted. The purpose of a pilot RCT is to allow the study procedures to be refined before implementing a more expensive and time consuming fully powered RCT (Stevens et al., 2007). However, future large scale RCTs should employ a larger sample to enable the identification of important statistical differences between groups, to eliminate the potential for bias and to assess the transferability of the intervention design to less ‘ideal’ or less highly motivated centres (see Section 6.3.1).

2. No medium to long-term follow-up measures were conducted, which is appropriate for a pilot RCT not powered to detect statistical differences between groups. Therefore any sustained impact of the intervention was not measured. Future large-scale interventions should plan to include longer follow-up measures to enable the impact of the intervention, and in particular the sustainability of any outcomes, to be more fully understood (Jones et al., Accepted March 13th 2011).

3. Recent reviews, published after the implementation of both the Proof-of-Concept and pilot RCT, recommend that interventions include a component targeting parents to ensure knowledge is transferred into home environments
(Riethmuller et al., 2009a; Hesketh & Campbell, 2010). Larger scale projects should plan to include components targeting parents, as recommended. These may take the form of newsletters, face-to-face workshops or online programs. The inclusion of a robust parent component (including appropriate implementation support and evaluation) was beyond the scope of this pilot RCT, due to time and financial constraints.

8.6 SOURCES OF BIAS

As with study limitations, sources of bias specific to each of the targets and hypotheses have already been discussed in Sections 8.1.4, 8.2.5, and 8.3.5. In summary:

1. With only two centres participating, both a part of an overarching network and within the same extended community, there is potential that there was cross contamination between the groups. Centres were aware of the importance of not sharing content from the intervention during the intervention period, and were in agreement with this, as was the overarching organisation (Illawarra Children’s Services). Therefore, Jump Start was not discussed at regular meetings of Directors or included in newsletters. Also, the comparison centre was to receive the Jump Start program at the conclusion of post-intervention, which may have acted as an additional incentive to delay changes to their provision of physical activity experiences. However, it cannot be assumed that cross contamination did not occur.

2. Similarly, both centres were aware of the nature of the intervention at randomisation (an important component of seeking preliminary consent to participate), were interested in participating as the intervention centre, and were already committed to providing a high quality program. Therefore, the control centre may have subconsciously compensated for their group allocation by providing increased physical activity experiences and encouragement.

3. Results may have been affected by the small scale of the project, which allowed close support from this candidate, which may have led the intervention centre to implement a higher percentage of the planned intervention or implement the intervention at higher quality, than may occur in a larger scale RCT.
8.7 STUDY GENERALISABILITY

The current study has a number of components that strengthen its generalisability. These strengths include; detailed collection of internal validity data, the use of setting staff to implement the intervention, and the use of a transferable professional development model. Furthermore, preceding this intervention with formative research and a Proof-of-Concept trial also supports its generalisability.

Components of the study that limit the generalisability, include the small number of centres involved which means the current results don’t, for example, indicate the potential efficacy of the intervention in different socio-economic areas. Additionally, centres perceived to be ‘optimum’ were selected for the trial, due to the early pilot stage of the testing. This limits the generalisability to other centres as it is expected that other centres may not have such motivated staff, as much Director support, or as much outdoor space.

8.8 SUMMARY, RECOMMENDATIONS AND CONCLUSIONS

8.8.1 Summary

The pilot RCT aimed to test the feasibility, acceptability and potential efficacy of a program (Jump Start) designed to increased fundamental movement skill competence among three- to five-year-olds attending long day care centres, through providing appropriate support (knowledge, confidence and tools) for setting staff. The primary outcomes of the pilot RCT were objectively measured physical activity and fundamental movement skills, with BMI as a secondary outcome.

The pilot RCT demonstrated that Jump Start was feasible, acceptable and potential efficacious, within the participating long day care centre. All feasibility and acceptability targets were met, with the exception of implementing 100% of unstructured activities (98% of unstructured activities were implemented). Potential efficacy hypotheses were met, with the exception of hypothesised increases in physical activity levels at post-intervention testing. Children at the intervention centre demonstrated greater increases in physical activity during the intervention, greater increases in fundamental movement skill competence, and similar change in BMI at post-intervention, compared with the comparison centre.
8.8.2 Recommendations

In light of the study findings and the identified limitations and sources of bias (see Sections 8.5 and 8.6, respectively), strengths (see Section 8.4) and the specific recommendations for feasibility (see Section 8.1.5), acceptability (see Section 8.2.6) and potential efficacy (see Section 8.3.6), the following broad recommendations are made for future child care based physical activity and fundamental movement skill development interventions

1. This pilot RCT was not powered to detect statistically significant changes in primary and secondary outcome measures. Standardised effect sizes were calculated to compensate for this. Continuing this practice in other pilot studies would enable meta-analyses to be conducted between studies.

2. Future studies should follow the reporting guidelines published in the CONSORT statement (Moher et al., 2010).

3. This pilot RCT included internal validity details and staff perception of intervention appropriateness. The results were unable to be compared due to very limited attention given in other studies to these important components. It is recommended that future studies include a measure of internal validity and acceptability in their design and report these measures.

8.8.3 Conclusions

This pilot RCT found that Jump Start was feasible, acceptable and potentially efficacious. Targets for screening, recruitment, retention, and collection of useable data, implementation, and staff satisfaction were all met. Potential efficacy findings reported a moderate effect on physical activity levels during the intervention, including trends towards statistical significance for total physical activity, though these effects were not sustained at post-intervention (possibly due to the intervention not being continued to be implemented). There was a medium effect for total movement score, hop and kick, and a large effect for jump, of which jump and total movement score showed trends towards statistical significance.

This study’s findings reinforce that early childhood settings have the potential for increasing physical activity levels and fundamental movement skill proficiency in young children. Future studies are required to examine the effect of Jump Start in large-scale fully-powered efficacy studies.
9. REFERENCES


Binkley, T., & Specker, B. (2004). Increased periosteal circumference remains present 12 months after an exercise intervention in preschool children. *Bone, 35*(6), 1383-1388.


Brasholt, M., Baty, F., & Bisgaard, H. (2010). Physical activity in young children is reduced with increasing bronchial responsiveness. *Journal of Allergy and Clinical Immunology, 125*(5), 1007-1012.


219


Hesketh, K., & Campbell, K. J. (2010). Interventions to prevent obesity in 0-5 year olds: An updated systematic review of the literature. *Obesity, 18*(S1), s27-s35.


10. APPENDICES
Appendix A. BACKGROUND ARTICLE: FORMATIVE RESEARCH STUDY WHICH INFORMED THE CURRENT STUDY


Please see print copy for article on page 230-239
Appendix B. SYSTEMATIC REVIEW OF PHYSICAL ACTIVITY AND FUNDAMENTAL MOVEMENT SKILL INTERVENTIONS

Efficacy of Interventions to Improve Motor Development in Young Children: A Systematic Review
Annaliese M. Rietmuller, Rachel A. Jones and Anthony D. Okely
Pediatrics published online Sep 7, 2009;
DOI: 10.1542/peds.2009-0333

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://www.pediatrics.org

Please see print copy for article on page 241-251
Appendix C. ETHICS APPROVAL

INITIAL APPLICATION APPROVAL
In reply please quote: HE07/221
Further Enquiries Phone: 4221 4457

13 August 2007

Ms Annaiese Riehmuller
Child Obesity Research Centre
University of Wollongong

Dear Ms Riehmuller,

Thank you for your response of 3 August 2007 to the HREC review letter dated 1 August 2007. I am pleased to advise that the application has been approved.

Please be more specific regarding the location of the data storage ie whose office will it be stored in?

Ethics Number: HE07/221
Project Title: Evaluation of an active play resource for long day care settings.
Researchers: Ms Annaiese Riehmuller, Dr Anthony Okely, Dr Jillian Trezise, Dr Rachel Jones
Approval Date: 9 August 2007
Expiry Date: 8 August 2008

The University of Wollongong SESIAHS Health and Medical HREC is constituted and functions in accordance with the NHMRC National Statement on the Ethical Conduct in Research Involving Humans. The HREC has reviewed the research proposal for compliance with the National Statement and approval of this project is conditional upon your continuing compliance with this document. As evidence of continuing compliance, the Human Research Ethics Committee requires that researchers immediately report:

- proposed changes to the protocol including changes to investigators involved
- serious or unexpected adverse effects on participants
- unforeseen events that might affect continued ethical acceptability of the project.

You are also required to complete monitoring reports annually and at the end of your project. These reports are sent out approximately 6 weeks prior to the date your ethics approval expires. The reports must be completed, signed by the appropriate Head of School, and returned to the Research Services Office prior to the expiry date.

Yours Sincerely,

A/Professor Barry Mullan
Chairperson
Human Research Ethics Committee

cc: Dr Tony Okely, Faculty of Education
21 July 2008

Ms Annaliese Riethmuller
Child Obesity Research Centre
University of Wollongong

Dear Ms Riethmuller,

I am pleased to advise that renewal of the following Human Research Ethics application has been approved. This certificate relates to the research protocol submitted in your original application and all approved amendments to date.

Ethics Number: HE07/221
Project Title: Evaluation of an active play resource for long day care settings.
Name of Researchers: Ms Annaliese Riethmuller, Dr Anthony Okely, Dr Jillian Trezise, Dr Rachel Jones
Approval Date: 9 August 2008
Expiry Date: 8 August 2009

Please remember that in addition to completing an annual report the Human Research Ethics Committee requires that researchers immediately report:
• proposed changes to the protocol including changes to investigators involved
• serious or unexpected adverse effects on participants
• unforeseen events that might affect continued ethical acceptability of the project.

You are also required to complete a monitoring report at the end of your project. This report will be sent out approximately 6 weeks prior to the date your ethics approval expires. The report must be completed, signed by the appropriate Head of School, and returned to the Research Services Office.

Yours sincerely

A/Professor Steven Roodenrys
Chair, Human Research Ethics Committee

cc: Dr Tony Okely, Faculty of Education
Dr Jillian Trezise, Dr Rachel Jones
Appendix D. SAMPLE LESSON

FRONT

Lesson 1

Exploration
Have children begin by practicing hopping on the spot (some children may need to rest their non-support foot on the ground for balance - this is fine). Encourage children to swap legs. Allow children to explore their ability to hop while moving around a defined space (fast/slow, big/small).

Guided Discovery
Direct children to try hopping as they hold their non-support foot:
- out to the side
- behind their body
Discuss, "Which one felt best?"

Review
Review correct skill components (one foot up and back, eyes forward).
Either teacher or a student demonstrates correct technique.
All students copy.

Equipment
Music for Hokey Pokey (Hokey Pokey)
3-4 Objects (Eyes to Nose)

BACK

Skills Activities

Eyes to Me
Hop while children line up facing an adult.
As children attempt to hop towards the teacher, the teacher holds up different coloured blocks.
Skill hopping, children call out the colour.
Could also use objects of different numbers of fingers, etc.

Hokey Pokey
Say it as Hokey Pokey together.
When you get to "hop around," have children hop around limits.

What's the Time?
One person stands with their back to everyone at the end of an area.
Everyone calls out, "What's the time?" (1 o'clock) and the person responds with an audible "1 o'clock.
Everyone then hops that number of times (up & down). When the person calls out changing time, everyone runs for the nearest time (e.g. not to get caught, as last one shows the next timekeeper.

Debrief
Discuss where you should look when you are hopping (forward)
Where you should place your hand (fast up and down)
## Appendix E. PROOF-OF-CONCEPT TRIAL: UNSTRUCTURED ACTIVITIES

<table>
<thead>
<tr>
<th>Skill</th>
<th>Unstructured activity</th>
<th>Equipment</th>
<th>Unstructured activity description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jump</td>
<td>Jumping obstacle course</td>
<td>Objects, chalk</td>
<td>Objects were set up as obstacles with chalk markings showing directions (e.g. arrows). Children were encouraged to jump their way around the course.</td>
</tr>
<tr>
<td></td>
<td>Challenge V</td>
<td>Chalk</td>
<td>Two lines were drawn to make a ‘V’ shape. Children tried to jump over the space between the two lines. Children were encouraged to move along the V to increasingly challenge themselves with greater distances to jump.</td>
</tr>
<tr>
<td>Catch</td>
<td>Catching balls</td>
<td>Balls</td>
<td>Children were encouraged to catch and throw with each other, or with an adult.</td>
</tr>
<tr>
<td>Run</td>
<td>Agility ladder</td>
<td>Agility ladder</td>
<td>An agility ladder was laid out. Children were encouraged to run up and down the ladder placing one foot in each space between rungs.</td>
</tr>
<tr>
<td></td>
<td>Streamers</td>
<td>Streamers</td>
<td>Streamers were tied around the yard to fly in the wind to encourage excitement and running.</td>
</tr>
<tr>
<td></td>
<td>Rabbit tag</td>
<td>Scarves</td>
<td>Children tucked a scarf into their waistband. Children then chased each other to take the scarf from other people. When a child lost their scarf they would collect a new scarf from the bag. When a child caught a scarf they brought it back to the bag of scarves.</td>
</tr>
<tr>
<td>Throw</td>
<td>Velcro targets</td>
<td>Velcro targets, balls</td>
<td>Velcro targets were hung up. Children took turns throwing a ball at the target.</td>
</tr>
<tr>
<td></td>
<td>Hanging targets</td>
<td>Targets, string, balls</td>
<td>Squares of metallic card were hung from support beams. Children were encouraged to try to hit them by throwing balls.</td>
</tr>
<tr>
<td></td>
<td>Hoops</td>
<td>Hoops, beanbags</td>
<td>Hoops were laid out and children were encouraged to throw bean bags into them.</td>
</tr>
</tbody>
</table>
### Appendix E. Proof-of-Concept trial unstructured activities (cont.)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Unstructured activity</th>
<th>Equipment</th>
<th>Unstructured activity description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leap</td>
<td>Challenge V</td>
<td>Chalk</td>
<td>As previously described (in ‘Jump’ section, above), two lines were drawn to make a ‘V’ shape. Children were encouraged to try to leap from one side to the other and were able to challenge themselves by choosing the distance they leapt.</td>
</tr>
<tr>
<td>Fly</td>
<td>Hoops</td>
<td></td>
<td>Children were encouraged to lay out hoops and try to leap between them. If they could move easily between hoops they were encouraged to increase the distance between hoops.</td>
</tr>
<tr>
<td>Leap the creek</td>
<td>Rope</td>
<td></td>
<td>A rope was tied to a pole the other end was held by this candidate and wiggled. Children were encouraged to try to leap over it without touching the rope.</td>
</tr>
<tr>
<td>Kick</td>
<td>Squeakers</td>
<td>Soccer balls, squeakers</td>
<td>Children were assisted in attaching the squeakers (gadgets that go over shoes and squeak when a ball is kicked correctly) to their shoe. Children were encouraged to kick balls and try to get a noise out of the squeakers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Goals, balls</td>
<td>Children were encouraged to practice kicking towards the goals.</td>
</tr>
<tr>
<td>Hop</td>
<td>Hopscotch</td>
<td>Chalk</td>
<td>A hopscotch court was drawn. Children were encouraged to hop through the squares.</td>
</tr>
<tr>
<td></td>
<td>Footprint paths</td>
<td>Laminated footprints</td>
<td>Children laid out a line of footprints in any shape they choose. They then tried to hop the path they had made.</td>
</tr>
<tr>
<td>Strike</td>
<td>Crazy golf</td>
<td>Rolled newspaper sticks, scrunched newspaper balls, markers, chalk</td>
<td>Markers were set up and chalk arrows drawn indicating a path. Children were encouraged to hit their ball around the markers.</td>
</tr>
<tr>
<td></td>
<td>Goals</td>
<td>Rolled newspaper sticks, scrunched newspaper balls, chairs</td>
<td>Chairs were set up as goals. Children were encouraged to hit their newspaper balls through the chairs.</td>
</tr>
</tbody>
</table>
Appendix F. TEST OF GROSS MOTOR DEVELOPMENT (2nd Ed.) (Ulrich, 2000)
## Appendix F: Performance Record

### Locomotor Subtest

<table>
<thead>
<tr>
<th>Skill</th>
<th>Materials</th>
<th>Directions</th>
<th>Performance Criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Run</td>
<td>60 feet of clear space, and two cones</td>
<td>Place two cones 50 feet apart. Make sure there is at least 8 to 10 feet of space beyond the second cone for a safe stopping distance. Tell the child to run as fast as he or she can from one cone to the other when you say “Go.” Repeat a second trial.</td>
<td>1. Arms move in opposition to legs, elbows bent 2. Brief period where both feet are off the ground 3. Narrow foot placement landing on heel or toe (i.e., not flat footed) 4. Nonsupport leg bent approximately 90 degrees (i.e., close to buttocks)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Gallop</td>
<td>25 feet of clear space, and tape or two cones</td>
<td>Mark off a distance of 25 feet with two cones or tape. Tell the child to gallop from one cone to the other. Repeat a second trial by galloping back to the original cone.</td>
<td>1. Arms bent and lifted to waist level at takeoff 2. A step forward with the lead foot followed by a step with the trailing foot to a position adjacent to or behind the lead foot 3. Brief period when both feet are off the floor 4. Maintains a rhythmic pattern for four consecutive gallops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Hop</td>
<td>A minimum of 15 feet of clear space</td>
<td>Tell the child to hop three times on his or her preferred foot (established before testing) and then three times on the other foot. Repeat a second trial.</td>
<td>1. Nonsupport leg swings forward in pendular fashion to produce force 2. Foot of nonsupport leg remains behind body 3. Arches flexed and swing forward to produce force 4. Takes off and lands three consecutive times on preferred foot 5. Takes off and lands three consecutive times on nonpreferred foot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Leap</td>
<td>A minimum of 20 feet of clear space, a beanbag, and tape</td>
<td>Place a beanbag on the floor. Attach a piece of tape on the floor so it is parallel to and 10 feet away from the beanbag. Have the child stand on the tape and run up and hop over the beanbag. Repeat a second trial.</td>
<td>1. Take off on one foot and land on the opposite foot 2. A period where both feet are off the ground longer than running 3. Forward reach with the arm opposite the lead foot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill</td>
<td>Directions</td>
<td>Performance Criteria</td>
<td>Total 1</td>
<td>Total 2</td>
<td>Skill Score</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>---------------------</td>
<td>--------</td>
<td>--------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>5. Vertical Jump</td>
<td>Max off start line on the floor. Have the ball down behind the lines, and back. Repeat a second trial.</td>
<td>1. Body jumps off arms in front of both feet. 2. Arms extended forward, and down. 3. Take off and land on both feet simultaneously.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Agility</td>
<td>A minimum of 25 feet of clear floor.</td>
<td>1. Body jumps off a line, both feet. 2. Body jumps to the right. 3. Both feet off floor at one time. 4. Stand back to back, in the left and right, 3 times.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object Control Subtest</td>
<td>1. Ball: a lightweight, and a bat.</td>
<td>1. Catches ball with one hand at about waist level. 2. Catches ball with both hands at waist level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill</td>
<td>Materials</td>
<td>Performance Criteria</td>
<td>Total 1</td>
<td>Total 2</td>
<td>Skill Score</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>---------------------</td>
<td>--------</td>
<td>--------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ball</td>
<td>1. Catches ball with one hand at about waist level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bat</td>
<td>2. Catches ball with both hands at waist level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ball</td>
<td>3. Catches ball with one hand at about waist level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bat</td>
<td>4. Catches ball with both hands at waist level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill</td>
<td>Materials</td>
<td>Directions</td>
<td>Performance Criteria</td>
<td>Trial 1</td>
<td>Trial 2</td>
<td>Score</td>
</tr>
<tr>
<td>-------</td>
<td>-----------</td>
<td>------------</td>
<td>----------------------</td>
<td>---------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>3. Catch</td>
<td>A 4-inch plastic ball, 15 feet of clear space, and tape</td>
<td>Mark off two lines 15 feet apart. The child stands on one line and the tosser on the other. Trip the ball underhand directly to the child with a slight arc aiming for his or her chest. Tell the child to catch the ball with both hands. Only count those tosses that are between the child's shoulders and belt. Repeat a second trial.</td>
<td>1. Preparation phase where hands are in front of the body and elbows are flexed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Arms underhand while reaching for the ball as it arrives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Ball is caught by hands only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Kick</td>
<td>An 8-10-inch plastic, playground, or soccer ball, a beanbag, 30 feet of clear space, and tape</td>
<td>Mark off one line 30 feet away from a wall and another line 20 feet from the wall. Place the ball on top of the beanbag on the line nearest the wall. Tell the child to stand on the other line. Tell the child to run up and kick the ball hard toward the wall. Repeat a second trial.</td>
<td>1. Rapid continuous approach to the ball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. An elongated stride or leap immediately prior to ball contact</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Nonlocking foot placed even with or slightly in back of the ball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Kicks ball with instep of preferred foot (shoe) or toe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Overhand Threw</td>
<td>A tennis ball, a wall, tape, and 20 feet of clear space</td>
<td>Attach a piece of tape on the floor 20 feet from a wall. Have the child stand behind the 20-foot line facing the wall. Tell the child to throw the ball hard at the wall. Repeat a second trial.</td>
<td>1. Windup is initiated with downward movement of hand/arm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Rotates hips and shoulders to a point where the nonthrowing side faces the wall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Weight is transferred by stepping with the foot opposite the throwing hand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Followthrough beyond ball release diagonally across the body toward the nonpreferred side</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Underhand Threw</td>
<td>A tennis ball for children ages 3 to 6; a softball for children ages 6 to 16; two cones, tape, and 25 feet of clear space</td>
<td>Place the two cones against a wall so they are 4 feet apart. Attach a piece of tape on the floor 20 feet from the wall. Tell the child to roll the ball hard so that it goes between the cones. Repeat a second trial.</td>
<td>1. Preferred hand swings down and back, reaching behind the trunk while chest faces cones</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Strikes forward with foot opposite the preferred hand toward the cones</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Bends knees to lower body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Releases ball close to the floor so ball does not bounce more than 4 inches high</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Object Control Subtest Raw Score (sum of the 6 skill scores)
Appendix G. PROOF-OF-CONCEPT TRIAL: STAFF CONFIDENCE AND COMPETENCE QUESTIONNAIRE

Physical Activity Confidence Questionnaire

The following questionnaire requests information regarding your confidence and perceived competence with physical activity and teaching physical activity in your current early childhood setting.

Please answer all questions as honestly as possible.

You will not be identified in the results of the study.
Responses will be kept strictly confidential.

This questionnaire will be used to evaluate the physical activity program and professional development being run in your centre over the next 10 weeks.

Please complete the questionnaire and return to Annalisa Rilfmuller

Or post to: Annalisa Rilfmuller
Child Obesity Research Centre
University of Wollongong
NSW 2522

This questionnaire will take between 10-15 minutes to complete

Your name:

Your name will be used only for data collection purposes.
You will not be identified in the results of this study.
A: Participant snapshot
The following section requests information regarding your role in programming, and your training background.

1. What is your job title? ____________________________________________________________________

2. What involvement do you have in writing the program for your room? (please circle one)

<table>
<thead>
<tr>
<th>None</th>
<th>Not much</th>
<th>Some</th>
<th>A lot</th>
<th>Total</th>
</tr>
</thead>
</table>

Please indicate training you have received (please tick as many as are applicable)

<table>
<thead>
<tr>
<th>Training</th>
<th>Completed</th>
<th>Currently training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untrained</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Certificate III in Children’s Services</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Diploma of Children’s Services</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Child Care Industry Excursions</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Bachelor of Teaching (Early Childhood)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Bachelor of Education (Early Childhood)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Masters (please provide title)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Doctor of Philosophy (please provide title)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other:</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Comments? ____________________________________________________________________
B: Perceived competence and confidence

The following section asks questions regarding your perception of your confidence and competence in physical activity and fundamental movement skills.

★ Note: **Fundamental movement skills** are movements that form the foundations for participating in physical activity and sports (such as hopping, running or catching).

Please make a cross on the line to indicate your response. One response per question. Please consider each response carefully.

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. How confident are you in your ability to catch?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. How confident are you in your ability to run?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. How confident are you in your ability to throw overarm?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. How confident are you in your ability to roll underarm?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. How confident are you in your ability to skip?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. How confident are you in your ability to balance?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Response</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>9. How confident are you in your ability to hop?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>Extremely</td>
</tr>
<tr>
<td>10. How confident are you in your ability to strike (hit a ball)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>Extremely</td>
</tr>
<tr>
<td>11. How confident are you in your ability to kick?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>Extremely</td>
</tr>
<tr>
<td>12. How confident are you in your ability to side gallop?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>Extremely</td>
</tr>
<tr>
<td>13. How confident are you in your ability to gallop?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>Extremely</td>
</tr>
<tr>
<td>14. How confident are you in your ability to jump?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>Extremely</td>
</tr>
<tr>
<td>15. How confident are you in your ability to leap?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>Extremely</td>
</tr>
<tr>
<td>16. How confident are you in your ability to keep a beat?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>Extremely</td>
</tr>
</tbody>
</table>

Comments? _____________________________________________________________

*(There is more space after the next section)*
### C: Teaching fundamental movement skills

The following section asks questions regarding your perception of your confidence and competence in teaching physical activity and fundamental movement skills.

Please make a cross on the line to indicate your response. One response per question. Please consider each response carefully.

<table>
<thead>
<tr>
<th>Question</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. How confident are you in your ability to teach children to catch?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>18. How confident are you in your ability to teach children to run?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>19. How confident are you in your ability to teach children to throw overarm?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>20. How confident are you in your ability to teach children to roll underarm?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>21. How confident are you in your ability to teach children to skip?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>22. How confident are you in your ability to teach children to balance?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>23. How confident are you in your ability to teach children to hop?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>Question</td>
<td>Response</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>24. How confident are you in your ability to teach children to strike (hit a ball)?</td>
<td>Not at all</td>
</tr>
<tr>
<td>25. How confident are you in your ability to teach children to kick?</td>
<td>Not at all</td>
</tr>
<tr>
<td>26. How confident are you in your ability to teach children to sidle gallop?</td>
<td>Not at all</td>
</tr>
<tr>
<td>27. How confident are you in your ability to teach children to gallop?</td>
<td>Not at all</td>
</tr>
<tr>
<td>28. How confident are you in your ability to teach children to jump?</td>
<td>Not at all</td>
</tr>
<tr>
<td>29. How confident are you in your ability to teach children to leap?</td>
<td>Not at all</td>
</tr>
<tr>
<td>30. How confident are you in your ability to teach children to keep a beat?</td>
<td>Not at all</td>
</tr>
<tr>
<td>31. How confident are you in your ability to identify the correct performance of fundamental movement skills?</td>
<td>Not at all</td>
</tr>
<tr>
<td>Question</td>
<td>Rating</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>32. How confident are you in your ability to support the development</td>
<td></td>
</tr>
<tr>
<td>of fundamental movement skills in your center?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>33. How confident are you in your ability to correct or advise</td>
<td></td>
</tr>
<tr>
<td>children regarding their performance of fundamental movement skills?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>34. How confident are you in your ability to lead a physical activity</td>
<td></td>
</tr>
<tr>
<td>lesson?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
<tr>
<td>35. How confident are you in your ability to lead a music and movement</td>
<td></td>
</tr>
<tr>
<td>lesson?</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Extremely</td>
</tr>
</tbody>
</table>

Comments? _____________________________
_____________________________________
_____________________________________
_____________________________________
_____________________________________
_____________________________________

Appendix G
C: Current Practice
The following section requests information regarding your current physical activity and fundamental movement skill practices.

36. How often do you find yourself encouraging children to be active (per week)? (please circle one)

<table>
<thead>
<tr>
<th>Never</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Often</th>
<th>All the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-3</td>
<td>3-7</td>
<td>7-15</td>
<td>15+</td>
</tr>
</tbody>
</table>

37. How often do you suggest ways children could improve their fundamental movement skills (per week)? (please circle one)

<table>
<thead>
<tr>
<th>Never</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Often</th>
<th>All the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-3</td>
<td>3-7</td>
<td>7-15</td>
<td>15+</td>
</tr>
</tbody>
</table>

38. How often do you consider your children’s level of physical activity (per week)? (please circle one)

<table>
<thead>
<tr>
<th>Never</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Often</th>
<th>All the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-3</td>
<td>3-7</td>
<td>7-15</td>
<td>15+</td>
</tr>
</tbody>
</table>

39. Is physical activity a part of your current program (per week)? (please circle one)

<table>
<thead>
<tr>
<th>Never</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Often</th>
<th>All the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-3</td>
<td>3-7</td>
<td>7-15</td>
<td>15+</td>
</tr>
</tbody>
</table>

40. How often do you think that physical activity should be a part of your program (per week)? (please circle one)

<table>
<thead>
<tr>
<th>Never</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Often</th>
<th>All the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-3</td>
<td>3-7</td>
<td>7-15</td>
<td>15+</td>
</tr>
</tbody>
</table>

41. How often do you think physical activity should be taught as a structured lesson (per week)? (please circle one)

<table>
<thead>
<tr>
<th>Never</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Often</th>
<th>All the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-3</td>
<td>3-7</td>
<td>7-15</td>
<td>15+</td>
</tr>
</tbody>
</table>

42. How often do you think that physical activity should be provided as an unstructured activity (per week)? (please circle one)

<table>
<thead>
<tr>
<th>Never</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Often</th>
<th>All the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-3</td>
<td>3-7</td>
<td>7-15</td>
<td>15+</td>
</tr>
</tbody>
</table>
43. Please describe opportunities for physical activity in your setting (tick all that apply).

<table>
<thead>
<tr>
<th>Physical activity opportunity</th>
<th>All children</th>
<th>3-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitness activities 3 or more times per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fitness activities less than 0.2 times per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured physical activity once a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured physical activity twice a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured physical activity more than twice a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured physical activity whenever I can fit it in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Games every now and then</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free play outside for less than an hour a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free play outside for more than an hour a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (eg the use of outside organisations) (please describe)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments: ______________________________________________________

__________________________________________________________

Thank you for completing this questionnaire.

We appreciate your support.
Appendix H. PROOF-OF-CONCEPT TRIAL: PROFESSIONAL DEVELOPMENT FEEDBACK QUESTIONNAIRE

Post-Professional Development

The following questionnaire requests information on your perception of the value of the professional development. The questionnaire also requests information on where you have learnt about similar content in the past.

Please answer all questions as honestly as possible.

You will not be named in the results of this study.

Thank you for your participation.
Part A: Strengths and Weaknesses of the Professional Development

I believe that the following things were strengths, or the most valuable components of the professional development...

(please include reasons where possible)

.

.

.

.

.

.

I believe that the following things were weaknesses, or the least valuable components of the professional development...

(please include reasons where possible)

.

.

.

.
Part B: Changes
The following section requests information regarding changes to your current program as a result of the professional development.

*Please respond to each question by placing a mark on the line which most closely matches your response to the question.*

Following the professional development I believe...

1. The amount of time we allow for physical activity needs to

<table>
<thead>
<tr>
<th>Be reduced</th>
<th>Stay the same</th>
<th>Be increased</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Because</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. The amount of structured physical activity needs to

<table>
<thead>
<tr>
<th>Be reduced</th>
<th>Stay the same</th>
<th>Be increased</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Because</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. The amount of unstructured physical activity needs to

<table>
<thead>
<tr>
<th>Be reduced</th>
<th>Stay the same</th>
<th>Be increased</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Because</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Our focus on fundamental movement skills needs to

<table>
<thead>
<tr>
<th>Be reduced</th>
<th>Stay the same</th>
<th>Be increased</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Because</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part C: Implementing the program: Confidence/expectations

Please describe how you are feeling about implementing the program in your centre.
Part D: Prior Knowledge
Please indicate which areas of the professional development were familiar to you and where you learnt about these. Please indicate as many as applicable.

<table>
<thead>
<tr>
<th>Area</th>
<th>Where you have learnt about this in the past</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix I. **PROOF-OF-CONCEPT TRIAL: LESSON EVALUATION TEMPLATE**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Date:</th>
<th>Skill:</th>
</tr>
</thead>
</table>

**Participation of children**

**Suitability of activities**
(please try to comment on each of the activities)

**Organisation of lesson**
(set up, material, duration and type of equipment)

**Possible modifications**

**Strengths of the lesson**
Appendix J. PROOF-OF-CONCEPT TRIAL: POST-INTERVENTION SEMI-STRUCTURED INTERVIEW QUESTIONS

POST interview questions

Preschool part-time staff (not involved in implementation)
- How did you feel about having the program running in your center?
- How did having the program affect you?
- From what you've seen what do you think of the program?
  - Appropriateness
  - Value
- Have you looked through the resources? If yes, what do you think?
- Why weren't you involved in any of the lessons?
- Did parents comment to you about the program?
- Did other staff?
- Did children?
- Have you used the equipment with the children or got equipment out for children?
- Do you think that the program has impacted the children in anyway?
- Did you observe the US? Do you think that it is feasible?
- Do you think that PD over the internet could work?

Preschool room special needs support staff (active observers in lessons)
You got to see lots of the lessons so I'm interested to know
- How you think they affected the children?
  - Were they suitable?
  - Did the children look forward/resent them?
  - Did the children talk to you about them?
- Affected the staff?
  - Did you see any impact on the rest of the day/week?
  - Eg increase in PA or pressure?
- Would you recommend any changes?
- Did it affect you?
- Would you have liked to have been involved in the PD?
- Would you access internet based PD?
- How suitable was it for (your child with special needs)?
  - Enjoyed, excluded, participated?
- Before the program did you do any PA with them?
- Would you now?
- Do you feel able/like it is important?
Preschool room permanent staff (involved in implementation)

- What did you think of the lessons?
  - Suitability for children
  - Lesson components
  - Unstructured
- Did you see the demo lessons as helpful?
- How did the project affect the rest of the week/program?
  - In your room
  - In other rooms
- Did you use the posters, equipment, lessons, to facilitate any additional experiences?
- Did you feel equipped (supported) to run the program?
- How do you feel the program affected the children?
  - Do they play different games?
  - Ask for equipment?
  - Enjoy lessons? Ask about lessons?
  - Ask you to watch them doing skills?
- Did parents comment?
- Other stuff?
- Did the program run as you expected?
- Did you agree with the program?
- What could be changed for it to suit your setting better?
Appendix K. PROOF-OF-CONCEPT TRIAL: PRE-INTERVENTION STAFF ATTITUDES TOWARDS PHYSICAL ACTIVITY FOCUS GROUP QUESTIONS

Focus Group Questions

- Questionnaire

Motivations
- What do you value about physical activity?
- What are your aims when you include physical activity in your program?
- What are things in your centre that you think help the inclusion of physical activity in your centre?
- What are barriers?
- What do you not like about physical activity?
- What do you like?
- Are there any areas that you avoid?

Past experience
- How would you normally do professional development?
- What are strengths of professional development you’ve done in the past?
- Weaknesses?
- How do you select resources?
- What do you value in resources?
- What do you dislike in resources?

This project
- What are areas you would most like professional development in?
- Least?
- (Show lesson cards) How do you feel about using these to run lessons?
- How do you communicate with parents?
- Would things like inserts/newsletter be useful?
- Are there any children with special needs that might influence the delivery of the program?
- How are you feeling about the project?
- Is there anything that you would like to know?
### Appendix L.  PROOF-OF-CONCEPT TRIAL: RESULTS OF STAFF CONFIDENCE AND COMPETENCE QUESTIONNAIRE

#### Number of Staff Members Confident to Teach Individual Skills

<table>
<thead>
<tr>
<th>Skills taught in the Proof-of-Concept trial</th>
<th>Catch</th>
<th>Run</th>
<th>Throw</th>
<th>Hop</th>
<th>Strike</th>
<th>Kick</th>
<th>Jump</th>
<th>Leap</th>
<th>Roll</th>
<th>Skip</th>
<th>Balance</th>
<th>Side</th>
<th>Gallop</th>
<th>Keep a beat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confident to teach (pre-intervention) (4)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Confident to teach (post-intervention) (4)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Involved in intervention and indicated higher confidence at post-intervention (2)**</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Not involved in intervention and indicated higher confidence at post-intervention (2)**</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

*Assessed as indicating confidence in the right half of the continuous rating scale; **Number of individual participants who indicated higher scores on post-intervention confidence scales compared with pre-intervention confidence scales. Two staff members attended professional development and were involved in observing demonstration lessons and implementing lessons. Two staff members were not involved in the program, following baseline testing.

#### Number of Staff Confident with General Areas of Teaching Fundamental Movement Skills

<table>
<thead>
<tr>
<th>Identify correct FMS performance</th>
<th>Support FMS in your centre</th>
<th>Correct or advise children regarding FMS</th>
<th>Teach physical activity lessons</th>
<th>Teach music &amp; movement lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-intervention (4)</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Post-intervention (4)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Involved in intervention and indicated higher confidence at post-intervention (2)**</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Not involved in intervention and indicated higher confidence at post-intervention (2)**</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*Assessed as indicating confidence in the right half of the continuous rating scale; **Number of individual participants who indicated higher scores on post-intervention confidence scales compared with pre-intervention confidence scales.
Appendix M. PILOT RCT: DETAILS OF PROFESSIONAL DEVELOPMENT WORKSHOPS

Professional Development Workshop 1
(proposed content)
Running Time: 30 minutes

Aim: To motivate and enable staff to implement Jump Start, through introducing centre staff to the Jump Start resource and the rationale that drives it. Also to outline what will be happening in their centre as they implement the pilot RCT trial and the expectations involved.

Equipment:
- PD Workshop 1 power point presentation
- Organisation folder
- Evaluation template
- Program timeline
- Lesson checklist
- Run observation cards
- Get Skilled Get Active DVD (Sprint) (optional)
- Jump Start resource
- Run equipment – scarves, music (L1 Exploration)

Introduction: Explain benefits of the running the Jump Start program in their centre and the benefits of being involved in the pilot RCT:

1. Value of PA
2. Value of FMS
3. Lesson components (and value of)
4. Expectations
   a. Value of lesson evaluations and communicating with the researcher
   b. Lesson time line (and show the folder which will store the timeline and evaluation timelapse)
   c. Lesson preparation (show lesson checklist)
5. ‘RunSprint’:
   a. Observation
      (Demonstrate, or use DVD, correct skill performance. Use cards with directions for performing one element of the skill incorrectly. Have staff demonstrate cards and other staff identify which component was incorrect)
   b. Run through lessons 1 + 2 with staff participating
   c. Play the games not covered already
Professional Development Workshop 2
(proposed content)

Running Time: 30 minutes

Aim: To encourage, motivate and equip setting staff to implement high quality movement experiences (using the Jump Start resource)

Equipment:

Workshop 2 Handout (using a powerpoint presentation was deemed to be inappropriate for the particular setting following Workshop 1)

- Observation cards
- Get Skilled Get Active DVD (optional)
- chalk
- targets
- markers
- music
- balls
- balloons
- bean bags
- plastic bottle

Pre-introduction: Give staff an opportunity to share any thoughts they have related to Jump Start.

Introduction: Tonight we’re going to continue to build familiarity with the lessons and activities that you will be teaching in the next couple of weeks. First I want to start with a brief reminder of why it’s worth your time to be implementing high quality physical activity programs.

1. Review
   a. value of physical activity
   b. value of fundamental movement skills

2. Encourage staff to
   a. plan ahead for the lesson
   b. think during the lesson about who might benefit from attention in free play time
   c. fill out evaluations and put them back in the folder

3. Unstructured
   a. let staff know that they are taking over all unstructured
   b. remind that unstructured activities can be simple, such as putting out equipment, or asking a child who wasn’t interested in the lesson to do a jumping game or kick with you
   c. remind staff that unstructured activity ideas are available in the back of the same folder they put their evaluations into

4. Observation
   a. Jump
   b. Kick

5. Jump
   a. Run through lessons 1 + 2 (briefly) with staff participating
   b. Play (briefly) any jump games not covered in the lessons

6. Kick
   a. Run through lessons 1 + 2 (briefly) with staff participating
   b. Play (briefly) any kick games not covered in the lessons
Professional Development Workshop 3
(proposed content)
Running Time: 30 minutes

Aim: To encourage, motivate and equip setting staff to implement high quality movement experiences (using the Jump Start resource)

Equipment:
Workshop 3 Handout
Observation cards
Get Skilled Get Active DVD (optional)
music (for hop and catch lessons)
footprints
scarves
batte
bubbles
ballons
bean bags

Pre-introduction: Give staff an opportunity to share any thoughts they have related to Jump Start.

Introduction: Tonight I'll explain what is going to happen for the second half of Jump Start and we're also going to continue to build familiarity with the lessons and activities that you will be teaching in the next couple of weeks.

1. Encouragement - Highlight the things they've been doing well (organised for lessons, looked over card/familiar with lesson, got equipment, engaging with children, keeping explanations short/simple and clear, supporting each other - going out to help with lessons when they're not teaching the lesson)

2. Next half of the program
   a. Two more weeks of demo lessons
   b. Following this will start the skill lessons again (repeat)
   c. Staff will run independently (through still following the program set at the beginning - 3 lessons per wk etc) for the purposes of the study (and I'll still follow up people if they forget they're on the lesson and so on)
   d. Keep looking over the lesson beforehand, even though you might feel you remember it

3. Observation
   a. Hop
   b. Catch

4. Hop
   c. Run through lessons 1 & 2 (briefly) with staff participating
      a. play (briefly) any hop games not covered in the lessons

5. Catch
   d. Run through lesson 1 (briefly) (Explain: object control games are similar, so many are modified from the same games used/covered in kick. Also, staff in the preschool room had already been involved in teaching each lessons by this time)
      a. play (briefly) any catch games not covered in the lessons (or kick)
Professional Development Workshop 4

(prepared content)

Running Time: 30 minutes

Aim: to support the ongoing inclusion of the fundamental movement skill development program, Jump Start, through provision of knowledge regarding alternate equipment options and also strategies to sustain the regular implementation of lessons and activities.

Introduction:
Tonight I want to spend some time trying to support the inclusion of Jump Start, or similar physical activity and fundamental movement skill development activities in your centre, for the long term. We’re going to look at alternate equipment you could use, and also strategies that you have been using or could use in the future to make structured physical activity and fundamental movement skill development a permanent part of your program.

1. Alternate Resources

   So, first we’ll look at alternate resources. At the beginning we gave you all the equipment that we expected that you would need to run Jump Start in an ‘optimum environment’. The loss of equipment – or not having it in the first place – is a realistic situation for a child care centre to find themselves in. Jump Start has been designed with the intention of overcoming this universal barrier, and so lack of equipment shouldn’t actually mean that you can’t do fundamental movement skill development experiences.

   When you don’t have the ideal equipment for an activity, with in lessons or individual activities, you have two main options. You can either change the activity, for lessons you can go back to the resource and look at the activities listed after the lessons (show) and pick something you can do, or you can modify from your idea of ideal equipment to something else that would suit. We’ve listed many of the options we could think of in the front of the resource (show), but just to demonstrate that you are capable of also thinking on your feet we’re going to play a bit of a brainstorming game.

   What you need to do is for each item of equipment that I hold up you write down as many alternatives you can think of. (equipment: ball, scarf, hoop, target, marker, bat, bean bag, paper/pens, 1:2). Everyone share their ideas. Add ideas if there aren’t many – they’ve missed some good options.

   Now to put this into practice we’re going to have one last Jump Start practical professional development time together (play End Ball: 1. balls 2. scrunched up newspaper 3. balloons 4. bean bags 5. rolled socks)

2. Sustainability

   Now we’ll just spend fifteen minutes getting your creative juices going, thinking about how this type of experience – I don’t know how you feel about Jump Start – but how you could overcome barriers and make sure that it is a regular part of your program. How can it be sustained? You can suggest things that you have already overcome or strategies you are already using.

   Brainstorm

   Column 1. Barriers (eg. not having someone on the lesson, not having a set time)

   Column 2. Overcoming barriers (linking it with shifts)
You all seem to be highly motivated, but from where I was it still seemed that even with motivated staff that it is hard to get permanent change going. I think that the biggest thing that only you all can identify because you know your centre and the way it runs, is working out how something can move from being a good idea, or recommended, into habit. I think that you achieved it with Jump Start, by determination and sustained commitment, but also logistically by linking it in with shifts, which you were already doing for other aspects of your program.

Next year, if you decide that Jump Start is something that is worthwhile and you’ll continue to implement it, I encourage you to continue to use some kind of structure so that you’re implementing all the skills. You could just alternate balls skills and locomotor skills and work your way through the resource. Some of the skills, like side gallop, don’t appear immediately valuable, but they are, and in early childhood it is important that you have opportunity to try lots of skills and gradually work towards competence in them all, rather than just achieving early competence in a few. I also encourage you, it’s tempting to just try to facilitate it through ad hoc unstructured experiences, or to use the beginning part and just go straight into games in the structured lessons, however the beginning of the lesson is really important for children learning to be able to self-coach and also for actually helping them to perform the skill correctly, so I encourage you to use full lessons, with children that you feel they are developmentally appropriate for.

3. Thank you

Well that’s it. Thank you very much for having me, and for implementing Jump Start for us. I’ve really appreciated the time that I’ve spent here with you. It’s been really great having your support with my research project, and I’ve appreciated the time and patience you’ve given to implementing it all and giving me feedback and having me in your centre. I’ve also really enjoyed being able to spend some time in a centre and see how you work with the children and how you respond to different situations (the nice ones and the hard ones). I’m really thankful, as a teacher, to have been able to have this experience, and I think that I’ve learnt a lot from you all, as I’ve spent so much time here. So thank you very much for having me, and I have a present for you as a symbol of both my gratitude and also from the research centre. We also have three weeks of data collection – so I thank you in advance for your patience with that!
## Appendix N. PILOT RCT: ADDITIONAL UNSTRUCTURED ACTIVITIES

<table>
<thead>
<tr>
<th>Skill</th>
<th>Activity</th>
<th>Equipment</th>
<th>Activity description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jump</td>
<td>Jumping</td>
<td>Hoops</td>
<td>Hoops were laid out. Children were encouraged to jump through hoops. Children were encouraged to jump out of hoops when their hoop colour was called.</td>
</tr>
<tr>
<td></td>
<td>Hot Hoops</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A beam was laid across two trestles, with mats underneath. Children jumped off the beam onto the mats.</td>
</tr>
<tr>
<td>Throw</td>
<td>Paper aeroplanes</td>
<td>Paper, crayons</td>
<td>Children were encouraged to decorate paper and then assisted with folding it into a paper aeroplane (or vice versa). Children were then encouraged to throw their aeroplane.</td>
</tr>
<tr>
<td>Run</td>
<td>What’s the Time?</td>
<td>None</td>
<td>Children played What’s the Time? (One person, the timekeeper, stood with their back to everyone else. The group of children called out ‘What’s the Time?’ and the timekeeper called out an o’clock (eg, 2 o’clock). The group of children all took that number of steps (eg 2). The timekeeper, alternatively, could call out ‘Chasing time!’ at which point all the children ran back to a safe zone as quickly as possible and the timekeeper chased them. A new timekeeper was then chosen and the game began again.)</td>
</tr>
<tr>
<td></td>
<td>Duck, Duck, Goose</td>
<td>None</td>
<td>Children played Duck, Duck, Goose. (Children sat in a circle. One person walked around the circle and tapped seated players on the head and saying ‘duck’. When they tapped someone and say ‘goose’ that person chased them as they raced around the circle and tried to sit in the goose’s original seat. If they were not caught the goose began walking around the circle saying duck, duck… until they chose a new goose. If the goose caught them before they sat down, the goose resumed their seat and the original player walked around the circle again saying duck, duck… until they chose a goose.)</td>
</tr>
</tbody>
</table>
Appendix O. PILOT RCT: PARTICIPANT CONSENT FORM

Testing the feasibility, acceptability and potential efficacy of Jump Start

PARENT INFORMATION

PURPOSE AND RATIONALE OF THE STUDY
The purpose of this project is to produce an effective resource to support staff promotion of physical activity and fundamental movement skill development in long day care settings. Fundamental movement skills are the skills that underpin participation in physical activity. Research suggests that increasing an individual’s competence and confidence with physical activity positively impact on the individual’s social, psychological, and physical wellbeing, both short and long term.

METHODS

DURATION OF THE STUDY
- The study will be completed over 6 months.
- The researchers will provide (length of time, and total number of hours to be determined in partnership with the participating centre) of professional development for staff of the intervention centre.
- The researchers will also be in the intervention centre for three days per week to provide support and to collect data, depending on staff preferences.
- In 2008 the comparison centre will receive Jump Start and professional development in consultation with centre staff.

DATA COLLECTION
- Collection of the following measurements will occur before the program starts and then again at the end.
  - Height and weight of your child
  - Video footage of the child attempting each of the 10 fundamental movement skills, to allow the researcher to identify whether the program has influenced the child’s ability level
  - An accelerometer (a small device similar to a pedometer) will be fitted when your child arrives at the centre and removed before they go home, for two days (a total of four days).
This data will allow the researchers to see whether the program has had any affect on physical activity levels in the centre.

- Data collected will be kept in a locked filing cabinet, and will only be used for the purposes listed above.
- Data will be collected by trained assessors who have child protection clearance forms.

RISKS AND INCOVENIENCES

There are no foreseeable risks involved in this study. Data collection will occur during times that your child would normally be at the centre. Setting staff will not be detained from their normal responsibilities as a result of data collection. The resource aims to enhance the physical development experiences already provided in the centre.

POSSIBLE OUTCOMES OF THE STUDY

If you decide to be involved in the program, you will provide valuable information regarding the design and content of effective physical activity resources for long day care settings.

ETHICS REVIEW AND COMPLAINTS

This study has been reviewed by the University of Wollongong’s Human Ethics Committee (Social Science, Humanities and Behavioural Science). If you have any concerns or complaints about this study, please contact the Ethics Officer on (02) 4221 4457.

YOUR RIGHTS

Participants have the right to discontinue participation in this research project at any time. Participants have the right to withdraw from the program with no repercussions from the University or the researchers.

PEOPLE INVOLVED FROM THE UNIVERSITY OF WOLLONGONG

Annaliese Riehmuller
PhD candidate
University of Wollongong
(02) 4221 5351
ariha5@uow edu au

Dr Tony Okely
Senior Lecturer
Faculty of Education
(02) 4221 4641
tonyokely@uow edu au

Dr Jillian Treslice
Director of Early Childhood
Faculty of Education
(02) 4221 3374
jtreslice@uow edu au

Dr. Rachel Jones
Research Fellow
Faculty of Education
(02) 4221 3321
rjones@uow edu au
Testing the Feasibility, Acceptability and Efficacy of Jump Start

Consent Form for Parents

Researcher's Name: Annaleise Riedmuller
Supervisor's Names: Dr. Tony Cikely, Dr. Jillian Trezise, Dr. Rachel Jones

I have read the participation information sheet and have had the opportunity to ask the researcher any further questions I may have had. I understand that the risks to my child are minimal in this study and have read the information sheet and asked any questions I may have about the risks.

I understand that my child's participation in this research is voluntary and I may withdraw my child at any time from the study without affecting my treatment at Dapto Children's Centre, or by the University of Wollongong in any way.

I understand:

- that the program will run for 6 months
- my child will be weighed twice, have their height measured twice and be video recorded completing 13 fundamental movement skills twice
- my child will be asked to wear an accelerometer for four days (while in the centre)
- my child will not be identified in the results
- that data will only be accessed by the researchers involved in the study
- that the information collected in this study may be published in a thesis, journal articles and conference proceedings

I understand that education details of the parents/carers of my child's are requested (over the page) and that it is my choice whether I provide this information or not. I understand that this information will be used only in analysis of data to control for outside influences on the study, and will not affect the delivery of the project in any way.

I understand that if I have any concerns or complaints regarding the way the research is or has been conducted I can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, University of Wollongong on 4221 4457.

Please sign over the page
By signing below I am consenting to:

- My child participating in a physical activity program.
- My child’s height and weight being measured twice, at the beginning and end of the study.
- My child being video recorded attempting 13 skills on two occasions, at the beginning and end of the study.
- My child wearing an accelerometer for 4 days, for two days at the beginning, and two days at the end of the study.
- The data collected being published in a thesis and possibly other publications such as journals and conference proceedings.

I give permission for my child __________________________ (please insert your child’s name) to participate in this research.

Parent/Guardian Signature ____________________________________________

Date ___________ Name (please print) __________________________________

Optional: By providing the education details of the primary care providers (parent/guardian) of the child involved in the study you provide valuable information for determining the relevance of the project for other areas and other families.

As with all other information collected in the project this information is kept confidential.

If there is only one parent/guardian, please ignore the option for parent/guardian 2. If your child has more than two parents/guardians, please provide details of the two main guardians in the child’s home.

**Parent / Guardian 1**

Please tick one

- Male
- Female

Please tick the highest level of education completed by this parent / guardian

- Never attended school
- Currently still at school
- Year 8 or below
- Year 9 or equivalent
- Year 10 or equivalent
- Year 11 or equivalent
- Year 12 or equivalent
- TAFE
- University
- Don’t know

**Parent / Guardian 2**

Please tick one

- Male
- Female

Please tick the highest level of education completed by this parent / guardian

- Never attended school
- Currently still at school
- Year 8 or below
- Year 9 or equivalent
- Year 10 or equivalent
- Year 11 or equivalent
- Year 12 or equivalent
- TAFE
- University
- Don’t know
Appendix P. PILOT RCT: PRE-INTERVENTION INTERVIEW QUESTIONS FOR STAFF

Pre-test staff questions

Name, training, experience

Please describe your personal, childhood experience of physical activity

Please describe your current physical activity experience

What do you think is the role of physical activity in long day care settings?

How confident would you be taking a structured physical activity lesson with 20 children?

How do you feel about the possibility of having Jump Start in your centre?
Appendix Q. PILOT RCT: DIRECTOR QUESTIONNAIRE

Director Questionnaire

Filled out by: [Redacted] at Children's Centre
(please circle)

1. How many children are enrolled in your centre?

2. How many are enrolled in the 3-5 room?

3. How many staff work in your centre?

4. How many staff work in the 3-5 room?

5. How many children in the 3-5 room have special needs? ____
   ADHD? _____
   Developmental Delays? _____
   Autism? _____
   Other: ___________________________

6. How many families in your centre are from a non-English speaking background? _____

7. Could you please provide details regarding the number of families attending your centre in each wage bracket?

8. Could you please provide details of the indoor and outdoor space (m²)
   Indoor
   Outdoor
Physical Activity Self-Assessment for Long Day Care Settings

Name of Centre: __________________________ Date: __________

Please read each statement or question carefully. Mark the response that best fits your child-care centre. Your honest responses will help us in our research.

**PA1) Active Play and Inactive Time**

<table>
<thead>
<tr>
<th>1. Active (free) play time is provided to all children:</th>
<th>□ 15-30 min each day</th>
<th>□ 31-45 min each day</th>
<th>□ 45-60 min each day</th>
<th>□ More than 60 minutes each day</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Structured physical activity (teacher-led) is provided to all children:</td>
<td>□ Less than 1 time per month</td>
<td>□ 2-4 times per month</td>
<td>□ 2-4 times per week</td>
<td>□ Daily</td>
</tr>
<tr>
<td>3. Outdoor active play is provided for all children:</td>
<td>□ 1 time per week or less</td>
<td>□ 2-4 times per week</td>
<td>□ 1 time per day</td>
<td>□ 2 or more times per day</td>
</tr>
<tr>
<td>4. Staff restrict active play time for children who misbehave:</td>
<td>□ Often</td>
<td>□ Sometimes</td>
<td>□ Never</td>
<td>□ Never and provide more active play time as a reward</td>
</tr>
<tr>
<td>5. Children are seated (excluding nap time) more than 30 minutes at a time</td>
<td>□ 1 or more times per day</td>
<td>□ 3-4 times per week</td>
<td>□ 1-2 times per week</td>
<td>□ Less than one time per week or never</td>
</tr>
</tbody>
</table>
### PA2) TV Use and TV viewing

<table>
<thead>
<tr>
<th>1. Television use consists of the:</th>
<th>□ TV turned on most of the day including meal time, everyday</th>
<th>□ TV turned on for part of the time most days</th>
<th>□ TV turned on for part of the time some days</th>
<th>□ TV used rarely and only for viewing educational programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Children are allowed to watch TV, videos or play video games:</td>
<td>□ Throughout the day</td>
<td>□ Once a day</td>
<td>□ 2-4 times per week</td>
<td>□ 1 time per week or less, usually for educational use only</td>
</tr>
</tbody>
</table>

### PA3) Play environment

<table>
<thead>
<tr>
<th>1. Fixed play equipment (swings, slides, climbing equipment, overhead ladders) is:</th>
<th>□ Unavailable at our site</th>
<th>□ Swing sets (or one type of equipment) only available</th>
<th>□ Different equipment available that suits most children</th>
<th>□ Wide variety of equipment available that accommodates needs of all children</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Safety checks on equipment occur:</td>
<td>□ Only when equipment is installed</td>
<td>□ 1 time per year</td>
<td>□ 1 time per month</td>
<td>□ 1 time per week</td>
</tr>
<tr>
<td>3. Portable play equipment that stimulates a variety of gross motor skills (wheel toys, balls, tumbling mats) consists of:</td>
<td>□ Little variety and children must take turns</td>
<td>□ Some variety but children must take turns</td>
<td>□ Good variety but children must take turns</td>
<td>□ Lots of variety for all children to use at the same time</td>
</tr>
<tr>
<td>4. When weather is not suitable to go outdoors, indoor play space is available</td>
<td>□ for quiet play</td>
<td>□ for very limited movement (jumping and rolling)</td>
<td>□ for some active play (jumping, rolling and skipping)</td>
<td>□ For all activities including running</td>
</tr>
<tr>
<td>PA4) Supporting physical activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. During active (free) play time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>staff:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Rarely or never join</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>children for active play</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mostly sit or stand)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Sometimes join children in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>active play</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Often or always join</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>children in active play</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Often or always join</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>children in active play</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ No posters, pictures, books</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>about physical activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>displayed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ A few posters, pictures and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>books about physical activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>displayed in a few rooms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Posters, pictures, or books</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>about physical activity are</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>displayed in most rooms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Posters, pictures, or books</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>about physical activity are</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>displayed in every room</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PA5) Physical activity education for children parents and staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Training opportunities are provided for staff in physical</td>
</tr>
<tr>
<td>activity:</td>
</tr>
<tr>
<td>□ Rarely or never</td>
</tr>
<tr>
<td>□ Less than 1 time per year</td>
</tr>
<tr>
<td>□ 1 time per year</td>
</tr>
<tr>
<td>□ 2 times per year</td>
</tr>
<tr>
<td>2. Physical activity training is provided by qualified</td>
</tr>
<tr>
<td>professional:</td>
</tr>
<tr>
<td>□ Rarely or never</td>
</tr>
<tr>
<td>□ Less than 1 time per year</td>
</tr>
<tr>
<td>□ 1 time per year</td>
</tr>
<tr>
<td>□ 2 times per year</td>
</tr>
<tr>
<td>3. Staff provide physical education for children</td>
</tr>
<tr>
<td>□ Rarely or never</td>
</tr>
<tr>
<td>□ 1 time per month</td>
</tr>
<tr>
<td>□ 2-3 times per month</td>
</tr>
<tr>
<td>□ 1 time per week</td>
</tr>
<tr>
<td>4. Physical activity education is offered to parents (</td>
</tr>
<tr>
<td>workshops and activities):</td>
</tr>
<tr>
<td>□ Rarely or never</td>
</tr>
<tr>
<td>□ Less than 1 time per year</td>
</tr>
<tr>
<td>□ 1 time per year</td>
</tr>
<tr>
<td>□ 2 times per year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PA6) Physical activity policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A written policy on physical activity is:</td>
</tr>
<tr>
<td>□ Not available</td>
</tr>
<tr>
<td>□ Available but not followed by most staff</td>
</tr>
<tr>
<td>□ Available but followed only by some staff</td>
</tr>
<tr>
<td>□ Available and routinely followed by all staff</td>
</tr>
</tbody>
</table>
Appendix R. PILOT RCT: VISUAL AUDIT OF PHYSICAL ACTIVITY
SUPPORTING ENVIRONMENTS

Visual Audit of Long Day Care Environment (Physical Activity)

Outdoor environment
Mark □ if present/available at the given point in time.
Mark □ if not present/available at given point in time.

<table>
<thead>
<tr>
<th>Equipment/activity observed</th>
<th>8am</th>
<th>9am</th>
<th>10am</th>
<th>3pm</th>
<th>4pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climbing frames</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riding toys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance beams</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jumping equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parachute</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push/pull toys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocking toys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twirling toys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basketball hoop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunnels</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Running space</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff engaging in physical activity with children</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yard markings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shade areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bike tracks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Indoor Environment**
Complete an indoor audit for each room (eg. Foyer, staff room, babies, toddlers, preschoolers)

**Room/age ___________**
Please circle the most appropriate response

<table>
<thead>
<tr>
<th>Item</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books on display</td>
<td>0</td>
</tr>
<tr>
<td>Physical activity books on display</td>
<td>0</td>
</tr>
<tr>
<td>Posters displayed</td>
<td>0</td>
</tr>
<tr>
<td>Physical activity posters displayed</td>
<td>0</td>
</tr>
<tr>
<td>Physical activity brochures displayed</td>
<td>0</td>
</tr>
<tr>
<td>Computers visible</td>
<td>0</td>
</tr>
<tr>
<td>Television</td>
<td>None visible</td>
</tr>
</tbody>
</table>

**Additional comments:**

---
---
---
---
**Indoor Environment (cont.)**

*Complete an indoor audit for each room (e.g., Foyer, staff room, babies, toddlers, preschoolers)*

Room/age: __________

*Please circle the most appropriate response*

<table>
<thead>
<tr>
<th>Item</th>
<th>0</th>
<th>1.5</th>
<th>2.5</th>
<th>6+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books on display</td>
<td>0</td>
<td>1</td>
<td>2.5</td>
<td>6+</td>
</tr>
<tr>
<td>Physical activity books on display</td>
<td>0</td>
<td>1</td>
<td>2.5</td>
<td>6+</td>
</tr>
<tr>
<td>Posters displayed</td>
<td>0</td>
<td>1.2</td>
<td>3.5</td>
<td>6+</td>
</tr>
<tr>
<td>Physical activity posters displayed</td>
<td>0</td>
<td>1.2</td>
<td>3.5</td>
<td>6+</td>
</tr>
<tr>
<td>Physical activity brochures displayed</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3+</td>
</tr>
<tr>
<td>Computers visible</td>
<td>0</td>
<td>1.2</td>
<td>3.5</td>
<td>6+</td>
</tr>
<tr>
<td>Television</td>
<td>None visible</td>
<td>Visible but in state of storage (covered or in a cupboard)</td>
<td>Visible and set up in room</td>
<td>In use</td>
</tr>
</tbody>
</table>

Additional comments:

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________
**Indoor Environment (cont.)**

*Complete an indoor audit for each room (e.g., Foyer, Staff room, Babies, Toddlers, Preschoolers)*

**Room/age**

_Please circle the most appropriate response_

<table>
<thead>
<tr>
<th>Item</th>
<th>None visible</th>
<th>Visible but in state of storage (covered or in a cupboard)</th>
<th>Visible and set up in room</th>
<th>In use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books on display</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity books on display</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posters displayed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity posters displayed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity brochures displayed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers visible</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prevalence</th>
<th>0</th>
<th>1-5</th>
<th>6-15</th>
<th>16+</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2-5</td>
<td>6+</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2-5</td>
<td>6+</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2-5</td>
<td>6+</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2-5</td>
<td>6+</td>
<td></td>
</tr>
</tbody>
</table>

Additional comments:

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________
## Indoor Environment (cont.)

Complete an indoor audit for each room (e.g., foyer, staff room, babies, toddlers, pre-schoolers)

Room/age ____________________________

Please circle the most appropriate response

<table>
<thead>
<tr>
<th>Item</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books on display</td>
<td>0</td>
</tr>
<tr>
<td>Physical activity books on display</td>
<td>0</td>
</tr>
<tr>
<td>Posters displayed</td>
<td>0</td>
</tr>
<tr>
<td>Physical activity posters displayed</td>
<td>0</td>
</tr>
<tr>
<td>Physical activity brochures displayed</td>
<td>0</td>
</tr>
<tr>
<td>Computers visible</td>
<td>0</td>
</tr>
<tr>
<td>Television</td>
<td>None visible</td>
</tr>
<tr>
<td>Visible but in state of storage (covered or in a cupboard)</td>
<td></td>
</tr>
<tr>
<td>Visible and set up in room</td>
<td>In use</td>
</tr>
</tbody>
</table>

Additional comments:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

299
Indoor Environment (cont.)
Complete an indoor audit for each room (eg. Foyer, staff room, babies, toddlers, preschoolers)

Room/age
Please circle the most appropriate response

<table>
<thead>
<tr>
<th>Item</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books on display</td>
<td></td>
</tr>
<tr>
<td>Physical activity books on display</td>
<td></td>
</tr>
<tr>
<td>Posters displayed</td>
<td></td>
</tr>
<tr>
<td>Physical activity posters displayed</td>
<td></td>
</tr>
<tr>
<td>Physical activity brochures displayed</td>
<td></td>
</tr>
<tr>
<td>Computers visible</td>
<td></td>
</tr>
<tr>
<td>Television</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1-2</th>
<th>3-5</th>
<th>6+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books on display</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity books on display</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posters displayed</td>
<td>0</td>
<td>1-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity posters displayed</td>
<td>0</td>
<td>1-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity brochures displayed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers visible</td>
<td>0</td>
<td>1-2</td>
<td>3-5</td>
<td>6+</td>
</tr>
<tr>
<td>Television</td>
<td>None visible</td>
<td>Visible but in state of storage (covered or in a cupboard)</td>
<td>Visible and set up in room</td>
<td>In use</td>
</tr>
</tbody>
</table>

Additional comments:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
**Indoor Environment (cont.)**

*Complete an indoor audit for each room (e.g., Foyer, staff room, babies, toddlers, preschoolers)*

**Room/age_______**

**Please circle the most appropriate response**

<table>
<thead>
<tr>
<th>Item</th>
<th>0</th>
<th>1-5</th>
<th>6-15</th>
<th>16+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books on display</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity books on display</td>
<td></td>
<td>1</td>
<td>2-5</td>
<td>6+</td>
</tr>
<tr>
<td>Posters displayed</td>
<td></td>
<td>1-2</td>
<td>3-5</td>
<td>6+</td>
</tr>
<tr>
<td>Physical activity posters displayed</td>
<td></td>
<td>1-2</td>
<td>3-5</td>
<td>6+</td>
</tr>
<tr>
<td>Physical activity brochures displayed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers visible</td>
<td></td>
<td>1-2</td>
<td>3-5</td>
<td>6+</td>
</tr>
<tr>
<td>Television</td>
<td>None visible</td>
<td>Visible but in state of storage (covered or in a cupboard)</td>
<td>Visible and set up in room</td>
<td>In use</td>
</tr>
</tbody>
</table>

**Additional comments:**

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
**Appendix S. PILOT RCT: LESSON EVALUATION TEMPLATE (EXAMPLE)**

<table>
<thead>
<tr>
<th>Aspects of Lesson:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration: spend time catching (different heights/speeds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guided discovery: look at the ball</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Activities:**

(Consider children's enjoyment and ease of teaching the activity)

<table>
<thead>
<tr>
<th>Activity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Juggling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End Ball</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bubble Catching</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**General:**

<table>
<thead>
<tr>
<th>Aspect</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of lesson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of lesson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time required to set up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment needed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additional comments (e.g. Strengths/weaknesses of lesson, possible modifications)

- 
- 
-
Appendix T. PILOT RCT: POST-INTERVENTION INTERVIEW QUESTIONS

Post-test Interview Questions

"Thanks very much for answering these questions. Please be as honest as possible in your responses. All the information you can give us will be valuable for making changes and providing long day care centres with the best possible support."

Professional Development

- Could you please describe how you felt about the relevance of the content within professional workshops?
- Was there anything that you thought was not covered or would have liked covered in more detail?
- How did you find the workshop structure (having four workshops at your staff meetings)?
- Do you know how staff from the Piccolo (baby) room felt about being involved in the professional development workshops?
- What do you think were the strengths of the workshops?
- What do you think were the weaknesses of the workshops?
- As part of the professional development there were demonstration lessons taught at the beginning of the program. What did you think of having Annaleise run these demonstration lessons?
- On a scale of 1-10 (with 10 being the best professional development you've ever attended and 1 being the least useful) how would you rate the professional development?
- Is there anything you would like to add?

Structured Lessons

- Could you please describe your experience of teaching the lessons?
- How do you think the children responded to the structured lessons?
- Please rate the following from 1-5 and explain your rating (with 5 being optimum).
  - How suitable were the lessons for:
    - Equipment required
    - Setup/pack up
    - Location of lessons
    - Length of lessons
    - Frequency of lessons (3x p/wk)
    - Lesson content
    - Number of activities
- What would you say were strengths of the structured lessons?
- What would you say were weaknesses of the structured lessons?
- Could you please explain whether you felt that the structured lessons were suitable for your long day care setting?
- Could you please describe how effective you thought your system for organising who was teaching each lesson was (i.e. Early shift doing the first lesson)?
- Is there anything you would like to add?

Unstructured Activities

- Could you please describe your perspective of the children's response to the unstructured activities?
- Could you please give your opinion of the suitability of the unstructured experiences?
Did you implement unstructured activities? (if yes) How did you find this as the facilitator (in relation to coming up with ideas, available time)? Where did you get your ideas for unstructured ideas?

Is there anything you would like to add?

Other

How did you find using the resource (navigating the folders, running the lessons from the card)?

What changes would you recommend?

Do you think that Jump Start is something that the centre should or should not continue on with? Why/why not?

Do you think that Jump Start is something the centre will continue on with? Why/why not?

Do you have any feedback that you would give on being involved in the research process?

Why do you think that there was such high consent from parents?

Why do you think that there was such high completion of evaluations?

Why do you think there was such high implementation of the program as planned?

Is there anything you would like to add?
Appendix U. PILOT RCT: ACCEPTED MANUSCRIPT

Manuscript accepted for publication in Pediatric Exercise Science, May 2011.

Title: Promoting fundamental movement skill development and physical activity in early childhood settings: A cluster randomized controlled trial.

Running Head: Physical activity program for early childhood settings

Type of Manuscript: Original Article

Authors

Rachel A Jones¹, Annaleise Riedmiller¹, Kylie Hesketh², Jillian Trezise¹, Marijka Batterham¹, Anthony D Okely¹

Addresses of Institutions where the work was carried out

¹Faculty of Education, University of Wollongong, Australia, 2522

²Centre for Physical Activity and Nutrition Research, Deakin University, Australia, 3125

³Department of Mathematics and Applied Statistics, University of Wollongong, Australia, 2522

Corresponding Author

Dr Rachel Jones

Faculty of Education, University of Wollongong, Wollongong NSW 2522, Australia

Email: rachelj@uow.edu.au

Phone: +61 2 42213321 Facsimile: +61 2 42213892
Acknowledgements

The authors would like to thank the participating children and staff. A University of Wollongong Faculty Grant supported this study. KH is supported by a National Heart Foundation of Australia Career Development Grant.

Conflicts of Interest: There were no conflicts of interest.
Jones: Physical activity program for early childhood settings

Title: Promoting fundamental movement skill development and physical activity in early childhood settings: A cluster randomized controlled trial.

ABSTRACT

The aim of this study was to assess the feasibility, acceptability and potential efficacy of a physical activity program for preschool children. A 20-week, 2-arm parallel cluster randomized controlled pilot trial was conducted. The intervention comprised structured activities for children and professional development for staff. The control group participated in usual care activities, which included designated inside and outside playtime. Primary outcomes were movement skill development and objectively measured physical activity. At follow-up, compared with children in the control group, children in the intervention group showed greater improvements in movement skill proficiency, with this improvement statistically significant for overall movement skill development (adj. diff. = 2.08, 95% CI 0.76, 3.40; Cohen's $d = 0.47$) and significantly greater increases in objectively measured physical activity (counts per minute) during the preschool day (adj. diff. = 110.5, 95% CI 33.6, 187.3; Cohen's $d = 0.46$). This study demonstrates that a physical activity program implemented by staff within a preschool setting is feasible, acceptable and potentially efficacious.

Key words: preschool children, intervention, motor skills, physical activity

Australia and New Zealand Clinical Trials Registration Number: 082604
INTRODUCTION

The early years (broadly speaking 3-5 years old) have been identified as a critical time for the development of healthy behaviours, such as physical activity (39). A rationale for promoting physical activity is that it provides the milieu for movement skills to develop, with movement being the substrate for physical activity during these early years (22).

Unfortunately, many young children are not engaging in sufficient physical activity (39) nor showing sufficient development in their movement skills (14,24).

Early childhood settings have a central role in the promotion of physical activity and movement skill development as the majority of preschool-aged children attend preschool (38, 26) and settings generally have the resources to implement physical activity or movement skill programs (39). Furthermore, movement skill development is a core element of preschool curricula (6). As such, interventions to improve movement skills and promote physical activity in young children have been a priority (14). Riehmuller et al. (28) recently reviewed physical activity programs for preschool children, specifically those focusing on movement skills. Of the 10 published studies reviewed, 50% were successful in improving movement skill proficiency, however, several significant limitations were identified. First, the overall methodological quality of the studies was poor with few aligned to either the CONSORT or TREAD statements (1,7); Second, most studies were implemented by research staff, limiting the sustainability of the programs in these settings; and third, the majority were less than 11 weeks in duration. Longer interventions, certainly among older children, have been suggested to be more effective (41).

To address these limitations, a movement skill development program, aimed at promoting physical activity in early childhood settings, was designed, implemented, and evaluated.
Appendix U

Jones: Physical activity program for early childhood settings

This paper reports on the feasibility, acceptability and potentially efficacy of this program. We hypothesized that children participating in the intervention program, compared with children in the control group, would show greater improvements in movement skill development and greater increases in physical activity during preschool hours.

METHODOLOGY

Design and participants

This was a 20-week 2-arm parallel cluster pilot randomized controlled trial comparing a movement skill development physical activity program (Jump Start) with usual care (control group). Two childcare centres were purposively selected by a local governing early childhood corporation (Illawarra Children's Service, March 2008). The centres were chosen based on similarities in size, resources, equipment and the socio-economic regions from which they drew their children (parental yearly income, education level and language spoken at home). Centres (comprising one class each) were randomized using a computer generated random number producing algorithm and the bias coin method, following baseline measurements. Children aged between 3 and 5 years were eligible to participate if they were enrolled on a permanent basis either on Monday, Tuesday and/or Friday (i.e. the days the intervention was implemented). There were no exclusion criteria. Parents or guardians provided informed consent and the study was approved by the University of Wollongong Human Ethics Research Committee.
Jones: Physical activity program for early childhood settings

Treatment Intervention (Jump Start)

The treatment intervention was designed in response to formative research conducted within early childhood settings (29) and a proof-of-concept feasibility study implemented in a separate childcare setting during 2007.

Jump Start is a movement skill development physical activity program, implemented primarily by setting staff. (A description of the program is provided in Table 1). It comprises two components: professional development for setting staff and structured lessons and unstructured activities for children. The professional development involves 4x30min workshops and includes both theory and practical components. Each 20-minute structured lesson focuses on one fundamental movement skill: children are encouraged to explore the different movement concepts related to the skill (e.g., running fast or slow) and each component of the skill. Each skill comprises a number of components, for example, the skill of running has four components (9). Lastly, children practice the skill, through a series of fun activities and games. Structured lessons were implemented three times a week for 20 weeks (Table 1). Unstructured activities are facilitated in the afternoons of the structured lessons with the aim of offering an additional opportunity for the children to practice the skills learnt in the structured lessons. Specific equipment is provided during the unstructured activities to encourage participation (for example, if the skill of catch was taught in the morning, a greater number of balls would be available to play with in the afternoon and staff specifically facilitated catching games).

The Control Group

The control group continued with their usual program, which included designated time outside for free play.
Measures

Measures were taken at baseline (prior to randomization; April, 2008) and at follow-up (late October, 2008) on both the intervention and control participants. Additionally, physical activity was measured in the intervention group in the final two weeks of the intervention (mid October, 2008). This was to ascertain if physical activity levels were different during the implementation period, where structured lessons were compulsory, compared with follow-up (when the formal intervention period had ended). Trained independent assessors, blind to group allocation, conducted all measures. The primary outcomes were movement development and objectively measured physical activity, with body mass index (BMI) a secondary outcome.

Primary Outcomes

Movement skill development was assessed using the Test of Gross Motor Development (2nd edition), which has established validity for use with young children (34). Following a visual demonstration by a trained assessor, children performed each skill twice. Children's skill performances were video recorded and later analysed by a trained assessor to allow greater measurement scrutiny. Each skill was scored ('1' indicated the individual components of each skill were present and '0' indicated they were not). Scores for each child were calculated by totalling the correctly performed components for two trials for each skill. Each skill comprises 3-5 components, thus if a skill comprises three components the score range is 0-6, 4 components the score range is 0-8 and 5 components, the score range is 0-10. To give a total score, individual scores were standardised and summed as per the assessor manual. The maximum total score was 40.
Jones: Physical activity program for early childhood settings

Physical activity was measured objectively using MTI 7164 Actigraph accelerometers (MTI Health Services, Fort Walton Beach, Florida, USA). Each child wore an accelerometer on their right hip for two consecutive days while attending childcare (i.e., accelerometers were fitted on intervention days when children arrived at the centre and removed before they went home). Data were collected in 15-second epochs. Average counts per minute and percentage of time spent in sedentary and in light (LPA: <3 METs), moderate (MPA: 3.0-5.9 METs), vigorous (VPA: ≥6 METs) and moderate-to-vigorous (MVPA) physical activity were calculated using age-specific child-validated equations developed by Stroud and colleagues (31).

Secondary Outcome

Height and weight were measured using standardised procedures and used to calculate BMI (kg/m²).

Process measures

Process measures were included to assess intervention feasibility, including fidelity, dose, reach and acceptability of the intervention components. These included evaluations of the structured lessons, using a standardized checklist, and individual semi-structured interviews with setting staff (n=7, 100% female) at baseline and follow-up.

Statistical Analyses

Data were analyzed with SPSS version 16 using intention-to-treat principles. The intervention and control groups were compared using analysis of covariance, with the follow-up measure as the dependent variable, group as the independent variable, and the baseline measure as the covariate (37). A post-hoc analysis was performed to adjust
significance tests for the clustered nature of the data. The adjustment was conducted using the approach of Hedges (15), which involves a correction to the t-test using a multiplicative factor. The study data for the variables of interest were converted to a change score (follow-up – baseline), which were then compared using an independent samples t-test for the difference between treatment and control groups. The main analysis was presented as an ANCOVA; however, the computationally simpler approach using a t-test has been used in the adjustment and relies on the relationship between the t and F statistic when it is a two group comparison, \((r^2 = F)\). In the absence of a value of an intraclass correlation from the sample studied, a range of external estimates were employed from the literature (35), in this case the values (intraclass correlations of 0.01 and 0.05) were obtained from the work of Murray and colleagues (23).

As a pilot study, this RCT was not adequately powered to detect statistically significant differences between groups. As such, standardized effect sizes were calculated to demonstrate effects and trends, and are the focus of the results and discussion. Effect sizes of approximately 0.2, 0.5 and 0.8 are generally considered small, medium and large effects, respectively (3).

RESULTS

The mean age of participants was 4.13 years, with 71% (69/97) classified as non-overweight, 22% (21/97) as overweight, and 7% (7/97) as obese at baseline (4). The flow of participants through the study is shown in Figure 1.

Based on the results from our proof-of-concept feasibility trial, we suggested a priori that the study would be feasible if 60 participants were recruited; 80% of participants were
Jones: Physical activity program for early childhood settings

retained; and 100% of data would be collected at baseline and follow-up, except for objectively measured physical activity (90% of data could be collected, to account for equipment malfunctions). Ninety-seven participants were recruited and 97% were retained. Movement skill data were collected for 94% of participants at baseline and 88% at follow-up. Objectively measured physical activity data were collected for 96% of participants at baseline and 97% at follow-up. Height and weight data were collected on 95% of participants at baseline and 97% at follow-up.

We postulated, again based on our proof-of-concept feasibility trial, that the program would be acceptable if: 100% of the professional development content and structured lessons were delivered; staff reported that 90% of the program content was appropriate; and staff reported high satisfaction with the program. All professional development content and structured lessons were delivered. For all structured lessons, staff strongly agreed that the length of the lesson (mean of means 4.74 out of 5), the activities provided (4.75 out of 5), the number of activities (4.86 out of 5), the time needed to set up the equipment and the equipment needed for the lessons (4.89 and 4.91 out of 5, respectively) were highly appropriate.

Overall, staff reported high satisfaction with the program and suggested that children engaged with the activities and were motivated to participate in the program. Several staff commented that they could clearly see a difference in the movement skill development of the children. Additionally staff identified several strengths of the structured lessons, including the variety in the activities. Staff also suggested that the "hands-on nature" of the professional development workshops encouraged them to work collaboratively and facilitated acquisition of new knowledge.
Jones: Physical activity program for early childhood settings

[Delivering the Professional Development] at the workshops worked really well... it was good that everyone was all once doing it together... we all knew that when we were doing the lessons we could jog each other memories if we forgot [something]...

5 The potential efficacy results are summarised in Tables 2 and 3. For movement skill development, greater improvements were reported for each individual skill in the intervention group compared with the control group. A medium-to-large effect size was reported for the jump (d=0.75) and statistically significant differences between intervention and control groups were reported for jump and for the sum of the five skills assessed (referred to as overall movement skill development in Table 2) (p=0.00). The intervention group, compared with the control group, reported significantly greater increases in objectively measured physical activity (counts per minute) in the final two weeks of the intervention (p=0.01, adjusted diff = 110.48, 95% CI 33.62, 187.33; Cohen’s d = 0.40) (Table 3). Additionally, during the final two weeks of the program, the intervention group spent less time being sedentary and more time in light- and moderate-to-vigorous intensity physical activity. (These analyses involved post-test intervention (follow-up) measures for the control group, which would be assumed to be the same two weeks earlier when during intervention measures were being taken on intervention group). However, at follow-up, differences in physical activity between the intervention and control groups were not maintained (Table 3).
While a significant difference in BMI between groups was not observed, changes in BMI were greater for the intervention group compared with the control group. Medium effect sizes were reported for BMI (Table 2).

5

DISCUSSION

The results show that Jump Start was feasible, acceptable and potentially efficacious. Our retention goals were exceeded. To date, very few studies have reported retention rates (28). Connor-Krantz and Drummer (5) and Ignico (19) retained all participants at post-intervention and Ignico retained 83% at 3-month follow-up, with Reilly and colleagues (27) retaining approximately 90% of participants at both 6- and 12-month follow-up. Our retention rates were consistent with these intervention studies. The high level of support offered by the Director and staff of the childcare centre and the potential benefits of the program perceived by the parents may have contributed to these high retention rates. Additionally, the relatively short duration of the intervention may have positively influenced retention rates.

The collection of the majority of outcome measures at baseline and follow-up can be attributed to multiple measurement sessions being conducted during standard centre hours. The reasons for not collecting data at either baseline or follow-up included absenteeism or in a small number of instances, participants refusing to wear the activity monitor or participate in the movement skill testing. We suggest that working closely with the centre staff is critical to overcome such situations and maximise data collection.

Implementation rates for the professional development and structured lessons were high. It is not possible to compare our implementation rates with other studies because, to the best of
our knowledge, no other studies have reported such data. Despite this lack of evidence, there is strong evidence to suggest that positive, strong leadership is critical for implementation of new programs within organizations (18, 30). In our study, the Director of the intervention centre intentionally allocated time during the staff meetings for the professional development and modified the Centre’s program to incorporate the structured lessons. Further, the Director strongly encouraged all staff members to be proactively involved in the program. Collectively, this meant that, over time, the structured sessions became routine. Moreover, staff suggested that participants consistently enjoyed the structured sessions, which further encouraged staff in their implementation.

Several factors may have contributed to the reasons why staff uniformly suggested that the content was highly appropriate. First, Jump Start was designed in response to extensive formative research (28) and a proof-of-concept feasibility study. Stevens and colleagues (32) strongly encourage a series of smaller studies to thoroughly test intervention components, including recruitment, appropriateness of content and delivery to maximize retention and achievement of outcomes. Second, all resource components were developed by trained professionals who understood the developmental stages of young children and their cognitive abilities. Third, the content was flexible in delivery, particularly in terms of the number of children who could participate in the structured lessons and the location (i.e. indoor and outdoor) in which the structured lessons could be implemented.

Positive feedback from the staff and the Director of the centre demonstrated the acceptability of Jump Start among key stakeholders. Acceptability by stakeholders has been reported in studies targeting older participants (25). The engagement of stakeholders has been shown to be influential in the short- and long-term success of school-based interventions (17, 40).
Appendix U

Jones: Physical activity program for early childhood settings

Based on these findings with older children, we suggest that engaging key stakeholders overseeing preschool interventions may be as equally important for program success.

Our results for movement skill development are consistent with those reported by Goodway et al. (12), Goodway and Branta (11) and Hamilton et al. (13); that is, the improvements in individual skills (and by nature overall skill proficiency) was greater in the intervention group (Table 2). We compared our results with these studies as similar instruments were used. However, direct comparison of the individual skills is limited, as effect sizes for the above studies could not be calculated. The significant improvements in movement skills reported in our study could be a result of the Jump Start intervention only focusing on five movement skills. This meant that each skill was revisited twice, providing greater opportunities for the children to practice each skill. Additionally, the structured lesson allowed facilitators to focus on the individual components of the skills. For those components that children found more difficult to master, staff had the knowledge (from the professional development sessions) and time to facilitate mastery. This may have been particularly true for the jump, where medium to large effect sizes were reported (Table 2). Mastery of the jump requires coordinated movement between the arms and the legs which young children often find difficult (10). However with direct instruction and adequate practice time, mastery can potentially be accomplished.

To date, very few interventions that include an objective measure of physical activity and target young children have been published. Of the two studies identified, one measured physical activity during preschool hours (33) and the other measured habitual physical activity (27). Trost and colleagues' (32) 8-week randomized controlled trial aimed to increase physical activity during normal preschool hours by modifying the preschool
Appendix U

Jones: Physical activity program for early childhood settings

The intervention group participated in significantly higher levels of moderate-to-vigorous activity and vigorous activity (all p< 0.05) compared with the control group (33). Reilly et al. (27) reported small to medium effect size (0.39) for counts per minute following implementation of their 24-week group randomized controlled trial. Our physical activity data, collected in the last two weeks of the intervention are consistent with these results (counts per minute, p<0.01, d= 0.40, Table 3). These results suggest that Jump Start was potentially effective, while being implemented, in changing physical activity behaviours of young children. In addition, our results highlight that an intervention implemented primarily by setting staff has the potential to affect significant to the amount of physical activity that preschool children obtain during the school day.

These initial results are encouraging; however, the changes were not maintained at follow-up (even though follow-up was within a month of finishing the program) (Table 3). We suggest that cessation of the program is the most likely reason for the change in physical activity at follow-up. Despite all staff indicating strongly that they would continue to implement Jump Start following the trial period, it is likely that it did not continue to be taught due to conflicting end of year priorities (such as the completion of children's learning portfolios).

Further, staff may have been less motivated to continue implementing the program as the researcher was not present. These results highlight the very real barriers (e.g. conflicting priorities and motivation of staff) associated with medium to long-term sustainability of physical activity programs within the early childhood setting. We suggest that future studies incorporate relapse prevention components or longer follow-up periods in order to sustain changes (26).
Jones: Physical activity program for early childhood settings

In our study, trends towards decreases in BMI were greater in the intervention group compared with the control group, resulting in a medium effect size (Table 2). Few interventions targeting preschool children report changes in BMI (16, 28); only five studies were identified that reported changes in BMI, with only one reporting significant changes in BMI (8). The Hip-Hop to Health cluster randomized controlled trial aimed to prevent obesity in minority 3-5 year-olds (8). It reported smaller BMI increases in the intervention group at both 1- and 2-year follow-ups ($p=0.01$, $p=0.02$, respectively). Although we report a medium effect size for BMI, our results should be interpreted with caution, as there are a number of additional unmeasured variables that could account for these changes. Future studies, with larger sample sizes and longer follow-up periods are needed to confirm our results. We suggest that based on our findings, an adequately powered efficacy trial with a similar design (i.e. group randomized controlled trial) would involve approximately 500 preschool children.

This study was implemented with high rigor and was of high methodological quality. In light of these strengths, a number of recommendations for future physical activity and motor development interventions delivered within childcare facilities can be made:

1. Strong leadership and support from key stakeholders are critical for program fidelity. A leader/director must encourage staff involvement and be willing to modify usual programs and policies to accommodate the implementation of ongoing professional development and structured physical activity sessions.

2. Intervention success is somewhat dependent on the ability of childcare staff to incorporate the intervention into their normal routine. That is, designated times must be allocated for physical activity and staff must be aware of when and how these sessions will occur.
3. Interventions should incorporate a sustainability component, to ensure implementation following cessation of the formal intervention period. Long-term behaviours changes are more likely to result from ongoing implementation (21).

5 Study Strengths and Limitations

This study has two main strengths. First, it is a true pilot randomized controlled trial that employed trained blinded assessors and validated instruments and objective measures of physical activity. Second, it addressed many of the recommendations for practice highlighted in a recent systematic review (28). Specifically, our intervention was longer than past interventions, potentially enhancing the efficacy of the program. Further, setting staff implemented the majority of the program, potentially increasing the sustainability of the program, although we acknowledge that relapse prevention strategies will need to be considered in future studies. Only one other study was identified that involved setting staff implementing the majority of the intervention (27). Finally, our study was of high methodological quality and aligned closely with recommendations from the extended CONSORT statement for group-randomized controlled trials (1, 2).

The main limitation of this study was the sample size, although our sample size was comparable with other studies (11, 12, 36). This meant that the study was not powered to detect statistical significance and we were not able to report trends for boys and girls separately. This study was intentionally designed as a pilot randomized controlled trial with overall aims of reporting trends in outcomes and feasibility and acceptability outcomes to inform larger studies. Another limitation of this study is the follow-up period (6 months). Longitudinal studies are needed to confirm long-term mastery of fundamental movement skills and time spent in physical activity. Furthermore, we acknowledge that physical
activity data would need to be collected over a longer period to determine habitual change rather than setting change. Additionally physical activity data would also need to be collected in the final two weeks of the program to allow accurate comparison with the intervention group.

5 Conclusion

This study contributes to the dearth of feasibility and acceptability data available in the published literature and addresses many of the limitations in other preschool interventions. Additionally, it shows that a physical activity program delivered by staff within the preschool setting is potentially efficacious. These encouraging results will inform the design, development and implementation of a larger full-scale efficacy trial.
REFERENCES


Jones: Physical activity program for early childhood settings


21. Jones, R.A., Sinn, N., Campbell, K., Hesketh, K., Denney-Wilson, H., Morgan, P.J.,  


Figure 1: Flow of individual participants through study (Adapted from Campbell et al., [2])

* Reasons for no consent - child welfare cases (n=2) and not wanting to be involved in a research project (n=1).

** Reasons why not follow-up - 6 children left the intervention centre and 5 children left the control centre.
Table 1: Description of JumpStart movement skill development program and facilitators.

<table>
<thead>
<tr>
<th>Week</th>
<th>Focus Skill and Lesson</th>
<th>Focus Skill Components</th>
<th>Facilitator of structured lessons</th>
<th>Facilitator of unstructured lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Run (L1)</td>
<td>Eyes forward, arms swing in opposition to legs</td>
<td>Researcher**</td>
<td>Researcher</td>
</tr>
<tr>
<td>2</td>
<td>Run (L2)</td>
<td>Eyes forward, arms swing in opposition to legs, land on the ball of foot</td>
<td>Researcher</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>3</td>
<td>Catch (L1)</td>
<td>Eyes on object</td>
<td>Researcher</td>
<td>Researcher</td>
</tr>
<tr>
<td>4</td>
<td>Catch (L2)</td>
<td>Eyes on object, reach hands out and bring object in</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>5</td>
<td>Jump (L1)</td>
<td>Eyes forward, bend knees on landing, take off and land on two feet</td>
<td>Setting Staff</td>
<td>Researcher</td>
</tr>
<tr>
<td>6</td>
<td>Jump (L2)</td>
<td>Eyes forward, bend knees on landing, take off and land on two feet, swing arms</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>7</td>
<td>Kick (L1)</td>
<td>Eyes on object</td>
<td>Setting Staff</td>
<td>Researcher</td>
</tr>
<tr>
<td>8</td>
<td>Kick (L2)</td>
<td>Eyes on object, non-kicking foot next to ball</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>9</td>
<td>Hop (L1)</td>
<td>Eyes forward, one foot up (non-support foot behind body)</td>
<td>Researcher</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>10</td>
<td>Hop (L2)</td>
<td>Eyes forward, one foot up (non-support foot behind body)</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>11</td>
<td>Run (L1)</td>
<td>Eyes forward, arms swing in opposition to legs</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>12</td>
<td>Run (L2)</td>
<td>Eyes forward, arms swing in opposition to legs, land on the ball of foot</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>13</td>
<td>Catch (L1)</td>
<td>Eyes on object</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>14</td>
<td>Catch (L2)</td>
<td>Eyes on object, reach hands out and bring object in</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>15</td>
<td>Jump (L1)</td>
<td>Eyes forward, bend knees on landing, take off and land on two feet</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>16</td>
<td>Jump (L2)</td>
<td>Eyes forward, bend knees on landing, take off and land on two feet, swing arms</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>17</td>
<td>Kick (L1)</td>
<td>Eyes on object</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>18</td>
<td>Kick (L2)</td>
<td>Eyes on object, non-kicking foot next to ball</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>19</td>
<td>Hop (L1)</td>
<td>Eyes forward, one foot up (non-support foot behind body)</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
<tr>
<td>20</td>
<td>Hop (L2)</td>
<td>Eyes forward, one foot up (non-support foot behind body)</td>
<td>Setting Staff</td>
<td>Setting Staff</td>
</tr>
</tbody>
</table>

*Lessons: Two different lessons were implemented for each movement skill, which is not focused on different components of the skills and were delivered three times per week. **The researcher facilitated some lessons as part of the ongoing professional development for staff.


Table 2: Changes in movement skill development proficiency and body mass index for intervention and control groups

<table>
<thead>
<tr>
<th>Movement skill Development</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>6-month differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervention</td>
<td>Control</td>
<td>Intervention</td>
</tr>
<tr>
<td></td>
<td>Mean (SD) N=52</td>
<td>Mean (SD) N=45</td>
<td>Mean (SD) N=52</td>
</tr>
<tr>
<td>Rate (range 0 - 8)</td>
<td>5.52 (1.87)</td>
<td>5.91 (1.45)</td>
<td>6.22 (1.74)</td>
</tr>
<tr>
<td>Hop (range 0 - 10)</td>
<td>2.53 (2.13)</td>
<td>2.09 (2.17)</td>
<td>3.98 (3.66)</td>
</tr>
<tr>
<td>Jump (range 0 - 8)</td>
<td>2.61 (1.71)</td>
<td>2.74 (1.50)</td>
<td>4.08 (2.21)</td>
</tr>
<tr>
<td>Catch (range 0 - 6)</td>
<td>2.29 (1.19)</td>
<td>2.47 (1.42)</td>
<td>2.92 (1.20)</td>
</tr>
<tr>
<td>Kick (range 0 - 8)</td>
<td>3.65 (1.05)</td>
<td>3.67 (1.61)</td>
<td>4.34 (1.83)</td>
</tr>
<tr>
<td>Total Score</td>
<td>14.68 (4.43)</td>
<td>15.98 (4.17)</td>
<td>18.50 (4.57)</td>
</tr>
</tbody>
</table>

Body mass index (kg/m²) 16.50 (1.74) 16.57 (1.47) 16.75 (1.84) 16.85 (1.62) -0.86 (-0.33, 0.17) 0.53 0.60-0.74 0.46

* P values adjusted using methods of Hodges [17] as outlined in the methods

** Standardized effect size (Cohen's d) expressed in standard deviation multiples to allow comparisons of effect sizes across different measures and studies, calculated as the adjusted difference between treatment and control groups divided by the pooled within group standard deviation.
Jones: Physical activity program for early childhood settings

Table 3: Changes in physical activity for intervention and control groups

<table>
<thead>
<tr>
<th>Physical activity measures taken during intervention</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>6-month differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervention Mean (SD) N=52</td>
<td>Control Mean (SD) N=45</td>
<td>Intervention Mean (SD) N=52</td>
</tr>
<tr>
<td>Counts per minute</td>
<td>743 (241.43)</td>
<td>796 (221.38)</td>
<td>894 (308.95)</td>
</tr>
<tr>
<td>% time being sedentary</td>
<td>82.20 (9.33)</td>
<td>80.92 (8.83)</td>
<td>78.12 (11.00)</td>
</tr>
<tr>
<td>% time in light physical activity</td>
<td>16.83 (4.12)</td>
<td>12.64 (3.23)</td>
<td>14.15 (6.59)</td>
</tr>
<tr>
<td>% time in moderate physical activity</td>
<td>2.91 (1.51)</td>
<td>3.11 (1.87)</td>
<td>3.85 (2.32)</td>
</tr>
<tr>
<td>% time in vigorous physical activity</td>
<td>4.43 (2.98)</td>
<td>3.72 (1.18)</td>
<td>2.76 (2.27)</td>
</tr>
<tr>
<td>% time in moderate to vigorous physical activity</td>
<td>6.96 (5.14)</td>
<td>7.63 (4.42)</td>
<td>7.32 (5.94)</td>
</tr>
</tbody>
</table>

Physical activity measures taken during follow-up **

| Counts per minute                                  | 743 (241.45) | 796 (221.28) | 783 (229.87) | 829 (246.51) | -18.11 | -104.39, 77.78 | 0.25 | 0.25-0.64 | 0.16 |
| % time being sedentary                            | 82.20 (9.33) | 80.92 (8.83) | 82.64 (9.66) | 78.24 (14.30) | 4.16 (6.68, 8.50) | 0.09 | 0.36-0.58 | 0.34 |
| % time in light physical activity                  | 16.83 (4.12) | 12.64 (3.23) | 14.15 (6.59) | 14.83 (8.37) | -2.21 (-5.02, 1.00) | 0.19 | 0.37-0.87 | 0.26 |
| % time in moderate physical activity               | 2.91 (1.51)  | 3.11 (1.87)  | 3.85 (2.32)  | 4.21 (4.32)  | -1.06 (-2.47, 0.34) | 0.14 | 0.32-0.62 | 0.30 |
| % time in vigorous physical activity               | 4.43 (2.98)  | 3.72 (1.18)  | 2.76 (2.27)  | 2.76 (1.74)  | -0.74 (-1.70, 0.28) | 0.16 | 0.68-0.79 | 0.28 |
| % time in moderate to vigorous physical activity   | 6.96 (5.14)  | 7.63 (4.42)  | 5.10 (1.66)  | 6.97 (6.24)  | -1.86 (-3.80, 0.18) | 0.73 | 0.16-0.65 | 0.36 |

* P-values adjusted using methods of Hedges (2007) as outlined in the methods
** Standardised effect size (Cohen's d) expressed in standard deviation multiples to allow comparisons of effect sizes across different measures and studies, calculated as the adjusted difference between treatment and control groups divided by the pooled within-group standard deviation.
*** Physical activity measures during the intervention were only assessed on the intervention participants. For these analyses, the post-intervention (follow-up) measures were used for the control group.
### Physical activity measures were taken following the implementation of the program (i.e., one week after the program had finished)
Appendix V.  PILOT RCT: FLOOR PLAN SKETCHES OF PARTICIPATING CENTRES

Comparison Centre Provided Floor Plan
Appendix V

Intervention Centre Provided Floor Plan
Comparison Centre Indoor Sketch
Appendix V

Intervention Centre Indoor Sketch
Comparison Centre Outdoor Sketch
Intervention Centre Outdoor Sketch
Appendix W. PILOT RCT: PHOTOGRAPHS OF INDOOR AND OUTDOOR ENVIRONMENTS OF PARTICIPATING CENTRES

Comparison Centre: Indoor
Comparison Centre: Outdoor
Appendix W

Intervention Centre: Indoor

Intervention Centre: Sleep/Music Room
Intervention Centre: Outdoor
Appendix X. PILOT RCT: SUMMARY TABLES OF PARTICIPANTS ETHNIC AND SOCIO-ECONOMIC STATUS

### Centre Similarity: Parent Education

<table>
<thead>
<tr>
<th>Year</th>
<th>Intervention /74 (%)*</th>
<th>Comparison /56 (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 8</td>
<td>0 (0)</td>
<td>1 (2) **</td>
</tr>
<tr>
<td>Year 9</td>
<td>7 (9)</td>
<td>0 (0) **</td>
</tr>
<tr>
<td>Year 10</td>
<td>12 (16)</td>
<td>9 (16) **</td>
</tr>
<tr>
<td>Year 11</td>
<td>6 (8)</td>
<td>3 (5) **</td>
</tr>
<tr>
<td>Year 12</td>
<td>6 (8)</td>
<td>8 (14) **</td>
</tr>
<tr>
<td>TAFE</td>
<td>33 (45)</td>
<td>22 (39) **</td>
</tr>
<tr>
<td>Uni</td>
<td>10 (14)</td>
<td>13 (23) **</td>
</tr>
</tbody>
</table>

*The denominator represents the number of parent/guardians education details were provided for; **% Do not equal 100 as values were rounded.

### Centre Similarity: Wage Brackets

<table>
<thead>
<tr>
<th>Wage Bracket</th>
<th>Intervention* /113 (%)</th>
<th>Comparison /101 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$28,000</td>
<td>10 (9)</td>
<td>15 (15)</td>
</tr>
<tr>
<td>$28,000 – 65,000</td>
<td>56 (50)</td>
<td>30 (30)</td>
</tr>
<tr>
<td>&gt;$65,000</td>
<td>47 (42)</td>
<td>56 (55)</td>
</tr>
</tbody>
</table>

*110 children were enrolled in the centre. However the numbers provided by the Director for this question give a denominator of 113, which was used to calculate %. The Director was not asked about this discrepancy.

### Centre Similarity: Special needs among children in the three- to five-year-old room

<table>
<thead>
<tr>
<th>Special Need</th>
<th>Intervention /78 (%)</th>
<th>Comparison /54 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children with special needs</td>
<td>6 (8)</td>
<td>7 (13)</td>
</tr>
<tr>
<td>ADHD*</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Developmental Delays</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Autism</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Families with ESL**</td>
<td>7 (9)</td>
<td>9 (17)</td>
</tr>
</tbody>
</table>

*ADHD = Attention Deficit Hyperactivity Disorder, **ESL = English as a second language
### Appendix Y. PILOT RCT: IMPLEMENTATION FIDELITY

<table>
<thead>
<tr>
<th>Lesson (lx)</th>
<th>Weekly Component Implementation</th>
<th>Exploration</th>
<th>Guided Discovery</th>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run Lesson 1 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Run Lesson 2 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Catch Lesson 1 (4)**</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Catch Lesson 2 (6)</td>
<td></td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Jump Lesson 1 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Jump Lesson 2 (6)</td>
<td></td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Kick Lesson 1 (5)*</td>
<td></td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Kick Lesson 2 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Hop Lesson 1 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Hop Lesson 2 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Run Lesson 1 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Run Lesson 2 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Catch Lesson 1 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Catch Lesson 2 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Jump Lesson 1 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Jump Lesson 2 (6)</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Kick Lesson 1 (6)</td>
<td></td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Kick Lesson 2 (6)</td>
<td></td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Hop Lesson 1 (6)</td>
<td></td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Hop Lesson 2 (4)**</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>TOTAL (/115)</td>
<td></td>
<td>104</td>
<td>115</td>
<td>114</td>
<td>115</td>
<td>114</td>
</tr>
</tbody>
</table>

*lx indicates the number of lessons taught on a given week, usually two lessons taught Mondays, Tuesdays and Fridays; **Denotes a week which includes a public holiday, therefore a total of 4 lessons were run that week; *Only one lesson run on this day due to less children being in attendance than normal.
### Appendix Z. PILOT RCT: LESSON EVALUATION MEAN SCORES BY THIS CANDIDATE (APPROPRIATENESS OF LESSON COMPONENTS)

<table>
<thead>
<tr>
<th>Week</th>
<th>Lesson</th>
<th>Exploration (/5)</th>
<th>Guided Discovery (/5)</th>
<th>Activity 1 (/5)</th>
<th>Activity 2 (/5)</th>
<th>Activity 3 (/5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Run Lesson 1</td>
<td>2.8</td>
<td>4.8</td>
<td>4.5</td>
<td>3.8</td>
<td>4.3</td>
</tr>
<tr>
<td>2</td>
<td>Run Lesson 2</td>
<td>3.8</td>
<td>4.8</td>
<td>3.8</td>
<td>3.8</td>
<td>3.5</td>
</tr>
<tr>
<td>3</td>
<td>Catch Lesson 1</td>
<td>5.0</td>
<td>4.5</td>
<td>5.0</td>
<td>3.5</td>
<td>4.0</td>
</tr>
<tr>
<td>4</td>
<td>Catch Lesson 2</td>
<td>4.5</td>
<td>3.7</td>
<td>5.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>5</td>
<td>Jump Lesson 1</td>
<td>4.7</td>
<td>4.7</td>
<td>5.0</td>
<td>4.7</td>
<td>4.0</td>
</tr>
<tr>
<td>6</td>
<td>Jump Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>4.7</td>
<td>3.3</td>
<td>4.7</td>
</tr>
<tr>
<td>7</td>
<td>Kick Lesson 1</td>
<td>5.0</td>
<td>4.3</td>
<td>2.7</td>
<td>3.3</td>
<td>3.3</td>
</tr>
<tr>
<td>8</td>
<td>Kick Lesson 2</td>
<td>5.0</td>
<td>3.0</td>
<td>3.7</td>
<td>4.3</td>
<td>4.3</td>
</tr>
<tr>
<td>9</td>
<td>Hop Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>10</td>
<td>Hop Lesson 2</td>
<td>5.0</td>
<td>4.7</td>
<td>4.3</td>
<td>5.0</td>
<td>4.7</td>
</tr>
</tbody>
</table>

**Total Mean (weeks 1 - 10)** * 4.6 4.5 4.4 4.1 4.3

<table>
<thead>
<tr>
<th>Week</th>
<th>Lesson</th>
<th>Exploration (/5)</th>
<th>Guided Discovery (/5)</th>
<th>Activity 1 (/5)</th>
<th>Activity 2 (/5)</th>
<th>Activity 3 (/5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Run Lesson 1</td>
<td>4.7</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>12</td>
<td>Run Lesson 2</td>
<td>5.0</td>
<td>4.8</td>
<td>3.5</td>
<td>5.0</td>
<td>4.8</td>
</tr>
<tr>
<td>13</td>
<td>Catch Lesson 1</td>
<td>4.0</td>
<td>4.7</td>
<td>5.0</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td>14</td>
<td>Catch Lesson 2</td>
<td>3.7</td>
<td>4.0</td>
<td>4.7</td>
<td>4.3</td>
<td>4.0</td>
</tr>
<tr>
<td>15</td>
<td>Jump Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.3</td>
<td>5.0</td>
</tr>
<tr>
<td>16</td>
<td>Jump Lesson 2</td>
<td>4.7</td>
<td>5.0</td>
<td>5.0</td>
<td>3.7</td>
<td>5.0</td>
</tr>
<tr>
<td>17</td>
<td>Kick Lesson 1</td>
<td>5.0</td>
<td>3.7</td>
<td>3.7</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>18</td>
<td>Kick Lesson 2</td>
<td>4.5</td>
<td>3.6</td>
<td>4.4</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>19</td>
<td>Hop Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>20</td>
<td>Hop Lesson 2</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**Total Mean (weeks 11 - 20)** * 4.7 4.5 4.6 4.6 4.7

*Weeks 1-10 included the 15 demonstration lessons delivered by this candidate, in weeks 11 – 20 all lessons were delivered by setting staff
### Appendix AA. PILOT RCT: LESSON EVALUATION MEAN SCORES BY THIS CANDIDATE (ADDITIONAL FACTORS)

<table>
<thead>
<tr>
<th>Week</th>
<th>Length (/5)</th>
<th>Time (/5)</th>
<th>Number of Activities (/5)</th>
<th>Location (/5)</th>
<th>Set-up (/5)</th>
<th>Equipment (/5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Run Lesson 1</td>
<td>4.0</td>
<td>4.5</td>
<td>4.0</td>
<td>4.0</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>2 Run Lesson 2</td>
<td>4.0</td>
<td>3.2</td>
<td>3.8</td>
<td>4.0</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>3 Catch Lesson 1</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
<td>4.0</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>4 Catch Lesson 2</td>
<td>4.3</td>
<td>5.0</td>
<td>4.3</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>5 Jump Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>6 Jump Lesson 2</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.7</td>
<td>5.0</td>
</tr>
<tr>
<td>7 Kick Lesson 1</td>
<td>4.7</td>
<td>5.0</td>
<td>4.7</td>
<td>4.7</td>
<td>4.7</td>
<td>5.0</td>
</tr>
<tr>
<td>8 Kick Lesson 2</td>
<td>4.7</td>
<td>4.7</td>
<td>4.7</td>
<td>4.7</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td>9 Hop Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>10 Hop Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.3</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Total Mean (weeks 1 - 10)</strong></td>
<td>4.7</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>11 Run Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td>12 Run Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>13 Catch Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.7</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td>14 Catch Lesson 2</td>
<td>4.7</td>
<td>5.0</td>
<td>4.7</td>
<td>5.0</td>
<td>5.0</td>
<td>4.3</td>
</tr>
<tr>
<td>15 Jump Lesson 1</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>16 Jump Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>17 Kick Lesson 1</td>
<td>5.0</td>
<td>4.7</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>18 Kick Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.6</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>19 Hop Lesson 1</td>
<td>5.0</td>
<td>4.8</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>20 Hop Lesson 2</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Total Mean (weeks 11 - 20)</strong></td>
<td>5.0</td>
<td>4.9</td>
<td>5.0</td>
<td>4.8</td>
<td>5.0</td>
<td>4.9</td>
</tr>
</tbody>
</table>

*Weeks 1-10 included the 15 demonstration lessons delivered by this candidate, in weeks 11 - 20 all lessons were delivered by setting staff*