Evaluation of an eight week modified exercise program for overweight children

Brodie Cambourne

University of Wollongong

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:

This work is copyright. Apart from any use permitted under the Copyright Act 1968, no part of this work may be reproduced by any process, nor may any other exclusive right be exercised, without the permission of the author.

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.

Unless otherwise indicated, the views expressed in this thesis are those of the author and do not necessarily represent the views of the University of Wollongong.

Recommended Citation

EVALUATION OF AN EIGHT WEEK MODIFIED EXERCISE PROGRAM FOR OVERWEIGHT CHILDREN

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

Masters (Honours) of Science

Submitted by:

Brodie Cambourne
B. Sc. (Biomedical Science)

Biomedical Science Department
University of Wollongong.
Table of Contents

Declaration I
Dedication II
Abstract III
Acknowledgements V
List of Tables VI
List of Figures VIII
List of Appendices X

Chapter One 1
Introduction 1
1.1 Introduction 1
1.2 The Purpose of the Study 4
1.3 (a) Hypothesis 1 6
1.3 (b) Hypothesis 2 6
1.4 Significance of the Study 7
1.5 Limitations 9

Chapter Two 11
Literature Review 11
2.1 The Use of Literature in this Study 11
2.2 Childhood Overweight and Obesity 13
2.2 (a) What is Childhood Overweight and Obesity 13
2.2 (b) Prevalence and Trends in Childhood Overweight and Obesity 13
2.3 Effects of Childhood Overweight and Obesity 17
2.3 (a) Physiological Effects of Childhood Overweight and Obesity 17
2.3 (b) Psychological and Social Effects of Childhood Overweight and Obesity 18
2.3 (c) Increase likelihood of Obesity as an Adult 20
2.3 (d) Cost of Overweight and Obesity in Australia 20
of Overweight and Obesity in Children

2.7 (b) Exercise Behaviour Theories: Social Cognitive Theory ................................................. 46
2.7 (c) Exercise Behaviour Models: The Health Belief Model ................................................ 49
2.7 (d) Exercise Behaviour Models: The Modelling Principal .................................................. 49
2.7 (e) Exercise Behaviour Models: The Self-Determination Principal ...................................... 50
2.8 Popular Education Theories Applied to Child Exercise Habits .............................................. 52
2.8 (a) Learning Theory Models: Bruner’s Theory of Instruction .............................................. 54
2.8 (b) Learning Theory Models: Assimilation and Accommodation Theory .............................. 55
2.8 (c) Learning Theory Models: Cambourne’s Conditions of Learning ..................................... 55
2.9 (a) Modifying the Content of Children’s Physical Activity Programs: Aerobic Exercise Modifications .................................................. 67
2.9 (b) Modifying the Content of Children’s Physical Activity Programs: Including Resistive Exercise .................................................. 68
2.9 (c) Summary of Modifying Children’s Physical Activity Programs ........................................ 69
2.10 Past Childhood Obesity Prevention and Treatment Programs ............................................. 70
2.10 (a) What are the Difficulties Associated with Conducting Childhood Obesity Prevention and Treatment Programs .................................................. 70
2.10 (b) Applying Natural Learning Theories to Past Childhood Obesity Prevention and Treatment Programs .................................................. 71
2.10 (c) A Summary of Popular Childhood Obesity and Prevention and Treatment Programs .......... 76
2.11(a) What Might constitute an Effective Intervention Program for Overweight and Obese Children .................................................. 77

Chapter Three

Methods

3.1 Introduction .............................................................................................................................. 79
3.2 Methods Part 1: Summative Evaluation .................................................................................. 79
3.2 (a) Subject Recruitment .......................................................................................................... 79
3.2 (b) Apparatus .......................................................................................................................... 81
3.2 (c) Questionnaires .................................................................................................................. 82
3.2 (d) Anthropometry and Body Composition Measurements .................................................. 84
3.2 (e) Functional Fitness Measures ............................................................................................. 85
3.2 (f) Cardiovascular Fitness ....................................................................................................... 86
3.2 (g) Flexibility .......................... 88
3.2 (h) The Intervention Program ........ 88
3.2 (i) Data Analysis for Summative Evaluation .... 91
3.3 Method Part 2: Formative Evaluation ....... 92
3.3 (a) Data Collection for Formative Evaluation ... 95
3.3 (b) Conditions Under Which Observations Were Made .... 95
3.3 (c) Instruments of Data Collection .......... 96
3.3 (d) Procedures for Making Observations ...... 97
3.3 (e) Data Analysis for the Formative Evaluation .... 99

Chapter Four

Results

4.1 Summative Evaluation ................. 100
4.1(a) Hypothesis 1 ....................... 101
4.1 (b) Hypothesis 2 ....................... 109
4.2 Results: Formative Results .......... 121

Chapter Five

Discussion

5.1 Review of Purpose and Aims of the Study ...... 124
5.2 Discussion and Interpretation of Results ........ 125
5.3 Guidelines to Assist Teachers and Coaches with the Development of Lifetime Physical Activity Practices for Children .. 131

References .................................. 141
Dedication

This thesis is dedicated to all the overweight children I have worked with over the years who have been able to prove their capability and determination in sport and physical activity, when offered a little help. Thank You.
Abstract

The incidence of overweight and obesity amongst Australian children is high and steadily increasing.

Reasons offered for this trend in childhood obesity include increase in availability of foods high in fat and decreased opportunity to participate in regular exercise.

Recent research is bringing light to the difficulties overweight children have participating in daily living tasks. These difficulties are a result of the excess weight carried by these children and include a decreased range of motion, impaired balance and co-ordination and increased energy expenditure during daily tasks.

A solution for combating this increase in childhood obesity, may be to provide children with exercise programs and environments that are more suited to their anthropometric shape, physiological ability to exercise and confidence. These programs could stem from the traditional programs provided within school environments, but would include specific modifications that would enable all children to participate at manageable levels.

Using a combination of physiological research and education theory, an experimental program was designed that included modifications to traditional exercise programs and education theories. These modifications were then applied to the experimental program. Modifications included replacing long cardiovascular bouts of exercise with multiple short bouts of cardiovascular exercise, including resistance exercises and teaching or coaching children from a specific framework. Two groups completed an eight-week exercise intervention.
The control group (C)(n=7, age = 7.6, BMI=17.6) performed traditional exercises such as would be generally performed in outdoor group activities. The experimental (E)(n=10, age = 8.2, BMI = 23.3) group performed modified activities such as short bouts, within a studio and outdoor environment.

Both programs were designed to require approximately equal energy expenditure, but different delivery. Measures of attitude towards activity, participation levels in physical activity, knowledge of exercise concepts and functional fitness were taken before and after the eight-week program. When the two groups were compared results indicated that the experimental group had a greater improvement in attitude scores (p=0.04) and both groups showed a significant improvement in knowledge scores over 8 weeks (p=0.0001). Both groups displayed equal improvements in running scores (p= 0.002) despite the experimental group being delivered a program that contained less long running activities. Both groups had a significant improvement in rowing distances, completed in 6 minutes (p=0.03).

Both groups had a decrease in BMI (p=0.01).

Both groups also showed a significant increase in range of motion at the hips (p= 0.002 (left hip) p=0.003 (right hip)).

After evaluating the program it was found that modifying the content of a program and creating environments that assist with children engaging in physical activity programs, maybe as beneficial as traditional programs when increasing functional fitness. Modifying programs and learning environments may be more appropriate for children as an increase in fitness can still be achieved whilst maintaining a positive attitude towards exercise. Children who have a positive attitude towards exercise have been found to be more likely to adhere to exercise programs.
Acknowledgements

The author wishes to thank the following people without whose support and assistance this study and thesis would not have been possible: Sincere thanks are extended to:

Owen Curtis for inspiring me throughout my under-graduate years and helping me through my post-graduate years
Professor Arthur Jenkins for his guidance
Mum, Dan and Nan for all their support and belief that I can achieve anything I put my head to.
To all my children at Kidfit and their parents for teaching me about kids.
Susanne Hayes for her selflessness in times of need.
Paul Jones for always being positive and keeping me company at the computer
All my flatmates over the years for putting up with me working in front of the television and taking over the lounge room
Mark Kennedy for your interest and help right down to the last minute.
Robbie Parker for taking so much interest in my work.
Professor Andrew Hills for inspiring me to continue my work in this area.
List of Tables

2.1 Percentage Of Australian Children and Adolescents Overweight, Obese or Overweight/Obese Between 1995 and 1997 (Booth et al., 2001) 14

2.2 Parents’ Perceptions regarding the Etiology of Childhood Overweight and Obesity (%) (Adapted from Price et al., 1992) 23

2.3 Children's Lifetime Physical Activity Model (C-LPAM) (Adapted from Corbin, Pangrazi and Welk, 1999) 29

2.4 Children's Participation in Organised Sport (a) - April 2000 Children's Participation in Cultural and Leisure Activities, Australia, 2000 (4901.0) 36

2.5 Participation in The Most Popular Sports (a) - April 2000 Children's Participation in Cultural and Leisure Activities, Australia, 2000 (4901.0). 37

2.6 Calorie Equivalents Of Activities Performed By Children And Adolescents Of Various Body Mass 43

2.7 Common Factors Drawn From Successful Obesity Prevention and Treatment Programs 76

3.1 A Summary Of The Sources And Uses Of The Non-Reactive Data Used In The Formative Evaluation 99

4.1 Subject Questionnaire Data 101

4.2 Participation In Physical Activity (Control Group) 105

4.3 Participation In Physical Activity (Experimental Group) 106

4.4 Summary Of Self-Reported Estimated Energy Expenditure Per Week (Calories/ Week): Control And Experimental Groups. 107

4.5 Tabulated Results For Summative Analysis For Hypothesis 1 109

4.6 Anthropometric Measurements Of Subjects In Control (C) And Experimental (E) Groups 110

4.7 Subject Muscular Strength/Endurance Measurements For Control (C) And Experimental (E) Groups 112
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>Subject Flexibility Measurements For Control (C) And Experimental (E) Groups</td>
<td>115</td>
</tr>
<tr>
<td>4.9</td>
<td>Subject Cardiovascular Fitness Measurements</td>
<td>117</td>
</tr>
<tr>
<td>4.10</td>
<td>Subject Cardiovascular Fitness Measurements For Control (C) And Experimental Groups (E) (Run/Walk Distance)</td>
<td>119</td>
</tr>
<tr>
<td>4.11</td>
<td>Tabulated Results For Summative Analysis For Hypothesis 2:</td>
<td>120</td>
</tr>
<tr>
<td>4.12</td>
<td>Summary Of Field Notes Taken During Intervention</td>
<td>123</td>
</tr>
</tbody>
</table>
List of Figures

2.1 Increasing Prevalence of Overweight Among Australian Children – 1985-1995 (Havery et al., 1994) 15
2.2 Prevalence Of Overweight and Obesity Among Female Children in Australia* Compared With The United States and Five Other Countries (Booth, 2001, Popkin and Udry, 1998, Cole, 200) 16
2.3 Prevalence Of Overweight and Obesity Among Male Children In Australia* Compared With The United States and Five Other Countries (Booth, 2001, Popkin and Udry, 1998, Cole, 200) 16
2.4 How Children and Non-Specialist Teachers May Get Caught in a Cycle of Decreased Physical Activity. 34
2.5 Application of Cambourne’s Conditions of Learning Applied to Creating Optimal Environments for Children to Learn Physical Activity Concepts 56
4.1 Difference between Control (C) and Experimental (E) Groups’ Attitude Scores, Pre-program and Post-program 102
4.2 Average Pre-program and Post-program Knowledge Test Scores for Control (C) and Experimental (E) Groups 103
4.3 Self-reported Estimated Energy Expenditure of Control (C) and Experimental (E) Groups, and Ov/Ob and Lean Children 107
4.4 Number of Children wishing to Re-enrol in a Similar Program at the Cessation of the Intervention 108
4.5 Number of Overweight, Obese and Lean Children wishing to Re-enrol 108
4.6 Pre-program and Post-program Body Mass Index Scores for Control (C) and Experimental (E) Groups 111
4.7 Pre-program and Post-program Upper-body Strength/Endurance (push-up) Scores for Control (C) and Experimental (E) Groups 113
4.8 Pre-program and Post-program Lower-body Strength/Endurance (seated wall squat) Scores for Control (C) and Experimental (E) 114
Groups

4.9 Average Pre-program and Post-program Flexibility Scores (range of motion at hips) for Control (C) and Experimental (E) Groups

4.10 Average Pre-program and Post-program Rowing Distance Scores for Control (C) and Experimental (E) Group

4.11 Average Pre-program and Post-program Run/Walk Distance Scores for Control (C) and Experimental (E) Groups
Appendices

Appendix 1(a) Body Mass Index Percentiles for Boys Aged 2-20 Years 159
Appendix 1(b) Body Mass Index Percentiles for Girls Aged 2-20 Years 160
Appendix 3: The intervention Program 162
Appendix 4: Steps taken to Recruit Subjects 163
Appendix 5: The Information Session 164
Appendix 6: The CATPA Questionnaire 165
Appendix 7: The Physical Activity Participation Questionnaire 167
Appendix 8: The Knowledge of Physical Activity Concepts Quiz 170
Appendix 9: The Subject Information Package 173
Appendix 10: Intervention Program Outline 176
1. CHAPTER ONE
INTRODUCTION

1.1 Introduction
There is evidence that the prevalence of overweight and obesity (ov/ob) amongst Australian children is high and is increasing (Hills et al., 1994, Hardcastle et al., 1997, Lazarus et al., 2000, Riddiford-Harland, 2000). A common explanation for this trend is that there is an increasing imbalance between dietary intake and energy expenditure through the promotion of a sedentary lifestyle (Hills et al., 1994).

Some researchers argue that one way to combat this unhealthy trend is to develop intervention programs that will assist in the increase of daily energy expenditure of children (Bar-Or, 1998). In Western democracies like Australia, the school system offers a structure and an environment that could support such intervention programs.

An integral part of intervention programs would be daily guided physical activity designed to accommodate the individual self-esteem needs, body type, and physical capabilities of children who have a history of non-participation in physical activity. Such children may feel threatened and potentially humiliated if they were expected to participate in programs designed for more active children. It would appear that in order for intervention programs to be successful for children who have a history of non-participation in sustained physical activity, such programs would need to be modified to include a strong motivational component as well as a clinically sound exercise component.

Programs also need to be sufficiently flexible to be used in a range of settings. These settings may include the use of specialised gymnasium equipment (rowers, treadmills and cycling machines), as well as contexts such as home or school environments which frequently have little or no specialised equipment. Given the increased prevalence of ov/ob children, it is both urgent and timely that research and development be conducted to improve our knowledge and understanding of best practice in the conduct of physical activity and exercise programs for such children. Programs need to be carefully designed to help children and their parents/guardians to understand the importance of leading a healthy active lifestyle.
The current low levels of fitness and high levels of excess weight amongst a significant proportion of Australian children strongly suggests that more traditional 'exercise-for-fitness' programs will need to be modified or graded to ensure the participation of those children who are predominantly 'at-risk.' For example, there is evidence that indicates many children believe that exercise is too hard and too competitive for them. This perception in turn results in high dropout rates and low confidence levels when it comes to participation in sport (Hickey, 1992). If such perceptions are predominantly learned responses, this suggests that the content and structure of activity programs need to be carefully designed and also based on sound theories of learning and teaching.

The Australian Bureau of Statistics (2002) reported that the peak drop-out rates for children in sport are now occurring at 11 years of age for girls and 13 years for boys. The trend to early discontinuation of sport and physical activity for many children is of serious concern.

A report by the US Surgeon General on Physical Activity and Health reported the following in regards to youth in the USA:

“Nearly half of American youths aged 12-21 years are not vigorously active on a regular basis.”

“About 14 percent of young people report no recent physical activity. Inactivity is more common among females (14%) than males (7%) and among black females (21%) than white females (12%).”

“Participation in all types of physical activity declines strikingly as age or grade in school increases.”

“Only 19 percent of all high school students are physically active for 20 minutes or more, five days a week, in physical education classes.”

“Daily enrolment in physical education classes dropped from 42 percent to 25 percent among high school students between 1991 and 1995”
The following US research suggests many children are making other choices and generally not continuing with junior sport. One reason may be that the culture of junior sports programs is not providing supportive and comfortable environments for new exercisers. A related element may be that such a focus has been placed on the development of young sporting champions that the average ‘participant’ is no longer being catered for. Bigger children, and those who generally may be less physically competent, may not initially lack confidence and a desire to participate. However, if the programs in which they participate are delivered in a fashion that does not cater for their needs, this may quickly lead to a reduced confidence in the movement setting and limit the types of experiences one has in relation to the development of motor skills.

A lack of success in competitive activities, and the increased mass that the ov/ob individual must carry over long distances must be taken into account in the design of such activity programs. In short, it is imperative that such programs must not only focus on the development of a positive attitude towards exercise, but must also take into account individual differences between and difficulties among children. Simple adjustments can be made to aerobic programs to increase that chance that positive results in relation to both functional fitness and attitude towards exercise are gained. For example, Blair et al. (1993) prescribed multiple short bouts of activity rather than long, exhausting bouts of cardiovascular exercise in order to maximise the opportunity for participation and motivation.

The report by the US Surgeon General on Physical Activity and Health suggested the following approaches with respect to promoting physical activity initiatives and interventions such as the intervention outlined in this study:

- Provide quality, preferably daily, K-12 physical education classes and hire physical education specialists to teach them.

- Create opportunities for physical activities that are enjoyable, that promote adolescents' and young adults' confidence in their ability to be physically active, and that involve friends, peers, and parents.
Provide appropriate physically active role models for youths.

Provide access to school buildings and community facilities that enable safe participation in physical activity.

Provide a range of extracurricular programs in schools and community recreation centres to meet the needs and interests of specific adolescent and young adult populations, such as racial and ethnic minority groups, females, persons with disabilities, and low-income groups.

Encourage health care providers to talk routinely to adolescents and young adults about the importance of incorporating physical activity into their lives.

However, to encourage children to remain involved in an activity may not be as simple as replacing the content of the program. There also needs to be both cognitive and meta-cognitive dimensions to such programs. In this study it will be argued that such an approach would allow children with a history of aversion to physical activity to both learn, and learn about, the skills and knowledge associated with healthy diet and exercise. They would do this in ways that would help them become consciously aware (i.e. meta-cognitively aware: meta = above, cognitive = knowing) of the relationship between their body type and the role of exercise and lifestyle in helping to maintain an appropriate body weight.

The central thesis of the study is to create and evaluate an environment for the experimental group that allows children to learn about exercise and activity in the most effective learning way possible. In summary, this project sets out to address these key issues and concerns.

1.2 The Purpose of the Study

The study has a two-fold purpose:

To develop and evaluate an intervention program of physical activity which is congruent with the NSW State Department of Education and Training's (DET) physical education curriculum. The program is specifically designed to increase the functional capacity of all children, including obese and/or ov/ob primary
school children. Further, the program is designed with the view to developing a positive attitude in children towards physical activity in the hope that they will adhere to future activity program opportunities.

To conduct both a *summative* and a *formative* evaluation of this program in order to provide guidelines for the future direction of children’s physical activity programs.

These aims will be achieved through a design which will examine the differential impact of two (2) eight-week exercise and lifestyle programs for children aged 6-10 years. One program (‘the experimental program’) will be a modified exercise program, catering for the inexperienced child in physical activity and/or ov/ob children in this age range. The other (‘control program’) will be a more traditional ‘exercise-for-fitness’ program. Both groups will be assessed on the following outcome variables:

- knowledge of exercise concepts
- attitude towards physical activity
- participation in exercise
- functional fitness.

The development of the intervention program has been achieved through careful analysis and evaluation of current literature relating to patho-physiology of ov/ob children, theories related to drop-out in physical activity programs, and exercise physiology of lean and ov/ob children. In addition, current policies that underpin minimum guidelines for appropriate physical activity levels for children and the ability for schools and parent/carers to provide opportunities to children to achieve these minimum levels will be addressed.

The second aim of the study (formative and summative evaluations) will be achieved by drawing on two distinct paradigmatic perspectives. The formative evaluation will be drawn from field notes and observations made on the testing process and delivery of lessons. These field notes will be constructed through comments parents and children make about the program, its content and delivery. Data from interviews and children’s instructors will be used in an attempt to create an overall picture of reasons
why or why not one program was more successful than the other. The *summative* evaluation will be based on an empirical, *a-priori*, hypothesis-testing, quantitative design, which will test the following hypotheses:

### 1.3 (a) Hypothesis 1

After participating in the experimental program, the children will show a statistically significant positive growth in:

- Attitude towards exercise
- Knowledge of exercise concepts
- Participation rates in physical activity
- Levels of functional fitness including flexibility, muscular endurance and improvement in heart rate response to graded exercise.

### 1.3 (b) Hypothesis 2

The experimental group will achieve a higher level of improvement in each of these measures vis-a-vis the control group.

The *formative* evaluation will be located within the naturalistic paradigm of inquiry and will employ the methods of ‘responsive evaluation’ as described by Guba and Lincoln (1981, 1989). In responsive evaluation, the evaluator is expected to become involved in the situation and gather information from those who have a stake in what is being evaluated. The purpose of a formative evaluation is to respond to the issues and concerns identified and experienced by those who have a stake in the program. This is achieved by:

- talking to them and recording the outcomes of such conversations;
- observing them in action and taking observational field notes;
- collecting various ‘artefacts’ (worksheets, parent surveys, photographs etc) which emerge from the conduct of the program;
- obtaining written reflections as a participant observer in the program taking non-reactive measures.

Whilst the focus of the *summative* evaluation was based on quantitative measurements, the focus of what Guba and Lincoln call ‘responsive evaluation’ is
essentially qualitative in nature and is presented in prose form rather than numerical form.

1.4 Significance of the Study

This study is significant because of its potential to impact on improved community health, and the opportunity it provides for the development of new theoretical perspectives.

(A) Improved Community Health

Recent research indicates that we are experiencing an epidemic of childhood ov/ob (Hardcastle et al, 1997, Riddiford-Harland, 2000). The need for an intervention program to address the chronic effects and problems associated with ov/ob has become urgent, as research is indicating a decrease in the quality of life in adulthood due to problems associated with low levels of childhood activity (English et al., 1985, Seidell, 1985). These problems include both physical disabilities associated with injury and psychological and social problems (Rice et al., 1995).

(B) Development of New Theoretical Perspectives

The research cited above strongly suggests that traditional school-based exercise programs and cardiovascular programs are failing a significant number of children. Numerous explanations have been offered to account for the failure of these traditional programs and include the following:

i) Changes in Lifestyle

These explanations are typically couched in terms such as an increase in the use of public and private transport for school-related travel, a decrease in total time spent exercising at school, and less time spent engaged in vigorous exercise both during and outside of school.

i) Children are not being supplied with appropriate environments to learn physical activity principals
Physical activity guidelines for children suggest that children need to be engaging in a minimum of 30 minutes of moderate physical activity each day. A goal for all children should be to achieve 60 minutes each day of moderate to vigorous activity (Corbin, Pangrazi and Welk, 1999).

ii) Research showing that this minimum is not being achieved by many children. This may be due to the activity children are being provided not being of adequate intensity to have an effect on a child’s functional fitness levels or weight management.

Teachers and coaches may be allocating time for physical activity classes but may also be struggling to encourage the children to engage in the activity. This therefore may be contributing to the decreased levels of physical fitness of primary children and leave both the teachers/coaches and children, trapped in a cycle of inactivity.

The evaluation of a program that addresses these issues is, therefore, timely and urgent, both for immediate community health reasons and for theoretical reasons. There are a growing number of children whose social, personal, and physical well-being is threatened as a function of poor physical activity opportunities. There is a need for the physical and health education plus exercise professions to develop, extend, and/or modify theory that challenges traditional positions. Programs for children need to consider the relationship of exercise and the physical growth and development of individual children as well as the psychological consequences of being ov/ob. The impact of weight-bearing activities on the major joints of ov/ob children, the lack of confidence and self esteem in competitive sport, and unrealistic expectations of such children in the activity setting needs a much closer appraisal. In addition to the aforementioned challenges, possibly the biggest challenge is to attempt to create an environment and concomitant program that facilitates optimal learning for children, teachers and parents.

Given the complexity of factors involved, it can be argued that there is an urgent need for programs to be developed primarily for children who are considered at risk from ov/ob and/or unhealthy lifestyles. Such programs should aim to:

- Develop a “fun-and-accepting” environment and in so doing, help to create a positive attitude towards exercise in at-risk children;
• Modify the content of existing programs to emphasise multiple short bouts of activity and low repetitions of joint loading activities rather than longer term and exhausting cardiovascular exercise;
• Create an environment and program that will enable children to learn and establish skills and self-awareness before testing their skills against peers. This practice would increase their understanding of the benefits and needs related to participation in physical activity;
• Develop guidelines to assist instructors and teachers to encourage children to challenge themselves in a safe and supportive environment and set goals around their individual strengths;

1.5 Limitations

While the significance of the present study can be justified, it is only one of many that are required in the area. The study was undertaken subject to the constraints of time, university resources and policies, and access to subjects. The following elements represent the major limitations of the study.

1. The study was designed as an evaluation. Although the summative evaluation was conducted using an “a priori hypotheses testing” methodology, not all results are able to establish clear, cause-effect relationships.

2. The “real-world” constraints of time, university policies and regulations concerning the ethics of using human subjects, inevitably impact on the availability, range, and preparedness of subjects to participate in such studies. The subjects who participated in this study were 6-10 year-old volunteers rather than a statistically ideal “random sample”.

3. The amount of energy expended by each subject during all assessments could not be standardised. Therefore, measurements recorded during physiological assessments may not represent maximal energy output values in all performance parameters.

4. Strict adherence to either the experimental and/or control programs could be neither enforced nor guaranteed due to “real-world” constraints such as subjects relying on
parents for travel arrangements, unexpected illness of either child or parent, work commitments of parents, weather conditions, or prior engagements such as family celebrations and/or holidays.

Despite these limitations, careful research into the choice of statistical procedures that would be robust enough to minimise the effect of these limitations was carried out in consultation with supervisors and other experts at the University of Wollongong. Furthermore, procedures necessary for the maximisation of the trustworthiness and credibility of the qualitative data were carefully and rigorously established.
1. CHAPTER TWO
LITERATURE REVIEW

2.1 The Use of Literature in this Study

Much traditional research relies on a study of literature to guide and inform the
development of hypotheses and problems to be investigated. In such studies, the
theories generated by the research of others is used to direct and frame the research
that is about to be undertaken. In one sense this study is no different. All of the
research decisions made in the course of the project were made on the basis of a
careful review and analysis of several related domains of theoretical and research
literature, including:

The prevalence and aetiology of childhood ov/ob;
Reasons for drop-out in organised sport and physical activity for children;
Exercise physiology and exercise capabilities of ov/ob children;
Teaching, learning, and supporting educational theory which relates to
the design of intervention programs for ov/ob children.

Although the focus group of children in this evaluation were ov/ob children, the
literature covers psychosocial and behavioural issues of children in physical activity
that may be applied to any child who lacks confidence in their ability to participate in
physical activity or to learn about physical activity concepts.

The review of literature in this study differs in that it serves an important additional
function. The review also becomes a source of data for the design of the intervention
program, which in turn was evaluated. In this way, the role of literature is intertwined
with the processes of research throughout all stages of the project. In this study,
reviewing the literature served the vital purpose of informing and guiding not only the
formation of the study, but also its evolution and subsequent interpretations. Theory
and research relating to the four areas of prevalence and aetiology of ov/ob in
children, drop-out rates of children in physical activity, exercise physiology, and teaching and learning, had to be explored in order to guide the project in the traditional sense. At the same time, relevant concepts had to be identified, relationships between these concepts 'unpacked' and then reorganised in order to develop the experimental intervention program. This required a recursion uncommon in more traditional approaches. This recursivity is difficult to represent in a linear document such as a research thesis. It should be remembered in reading this thesis, therefore, that much of the literature employed was unearthed as a result of a number of overlapping factors such as:

- the need to develop a theoretically valid intervention program based on best available research and theory in three relevant domains of research and theory;
- using concerns expressed by participants in the intervention program, the researcher, academic peers, and supervisors as the project progressed;
- using these concerns expressed by participants, parents and instructors for the search and analysis of further literature to investigate behavioural and cognitive reasons behind these concerns;
- investigating concepts emerging from literature reviewed as a result of these concerns to assist in determining reasons for the lack of long-term success or follow-up in past physical activity programs for children;
- the construction and use of less traditional activities for children through a combination of initial research and research and ideas arising from concerns expressed.

These experiences were continually synthesised with ongoing day-to-day teaching experiences, together with the many questions (many of which remain unanswered) that emerged from the data, field notes and the literature. The conclusions that are drawn from this thesis are the result of this continual and on-going synthesis of literature, experience, data analysis and interpretation.
2.2 Childhood Overweight and Obesity

2.2 (a) What is Childhood Overweight and Obesity?

Many techniques have been used to create a scale of ov/ob, the most popular and cost efficient method being the measurement of Body Mass Index (BMI). BMI considers the relationship between height and weight by dividing weight in kilograms by height in metres squared. Booth et al. (2001) chose the BMI as a suitable, cost-effective measurement to determine the prevalence of ov/ob amongst Australian children and adolescents. Children with a BMI on or above the 95th percentile for their age and gender have generally been considered as obese, whilst children with a BMI in the range from the 85th to 95th percentile are considered overweight (Hammer et al., 1991; Steinbeck, 1996) (See Appendix 1).

2.2 (b) Prevalence of and Trends in Childhood Overweight and Obesity

It should be noted that prevalence rates vary because investigators have used a wide range of standards and techniques to measure and evaluate the extent of the problem. In spite of these differences, there is general agreement for the growing prevalence of the problem. For example, a recent study conducted on primary-aged children in the Illawarra region in NSW indicated that over 25% of children were obese (Riddiford-Harland, 2000).

Data from three separate studies conducted between 1995 and 1997 were analysed and are illustrated in Table 1. The prevalence of overweight, obese and overweight/obese children in Australia was 14-16%, 5% and 19-21% (boys) respectively and 16-18%, 5-6% and 21-24% (girls) respectively.
Table 2.1 Percentage Of Australian Children and Adolescents Overweight, Obese or Overweight/Obese Between 1995 and 1997 (Booth et al., 2001)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Overweight</th>
<th>Obese</th>
<th>Overweight/obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>14-16%</td>
<td>5%</td>
<td>21-24%</td>
</tr>
<tr>
<td>Female</td>
<td>16-18%</td>
<td>5-6%</td>
<td>21-24%</td>
</tr>
</tbody>
</table>

(a) $85^{th}$ percentile $<$ BMI $<$ $95^{th}$ percentile = overweight
(b) BMI $>$ $95^{th}$ percentile = obese

The data in Table 2.1 was drawn from three studies, the NSW Fitness and Physical Activity Survey 1997, the 1997 Health of Young Victorians Study and the 1995 National Nutrition Survey. All studies were conducted in the school environment or questionnaires were handed out within school. It must be taken into account that this data may have been influenced by the failure of many overweight or under-weight children to be available for physical measurements. Therefore, the percentage of overweight and obese children may be significantly higher than reported. Booth et al. (2001) found no significant correlation between BMI and socio-economic status (SES) and urban/rural place of residence amongst young males. Data collected on young girls however, did represent a significant association between SES and BMI.

Magarey and Daniels (2000) also found in the 1995 National Nutrition Survey that approximately 15% of boys aged 2-18 years were overweight and 16% of girls aged 2-18 years were overweight. A further 4.9 % and 4.5 % of girls and boys respectively were classified as obese. The age group with the highest prevalence of overweight/obesity amongst girls was the 8-11 year age group (25%) and for boys the 12-15 year age group (26.1%).
Figure 2.1 illustrates the increase in overweight among school age children from 1985-1995. The Australian Health and Fitness Survey conducted in 1985 indicated that approximately 9% of children aged 7-15 years were considered overweight. By 1995 this rate had increased by 12%.

Torres Strait Islander and Aboriginal children have been shown to be at particular risk. The first National Aboriginal and Torres Strait Islander Survey found that children 5-9 years of age were shorter and heavier than previous international references. Approximately 28% of children aged 7-15 years were at risk of overweight or were overweight (Cunningham et al., 1994).

Figures 2.2 and 2.3 compare rates of overweight and obesity for Australian children with rates from the United States and five other countries using the same criteria for assessing overweight.
Figure 2.2  Prevalence Of Overweight and Obesity Among Female Children in Australia*
Compared With The United States and Five Other Countries

Figure 2.3  Prevalence Of Overweight and Obesity Among Male Children In Australia*
Compared With The United States and Five Other Countries
2.3 Effects of Childhood Overweight and Obesity

2.3 (a) Physiological Effects of Childhood Overweight and Obesity

The major physiological differences between obese children and non-obese children are outlined below:

Musculo-skeletal problems

- Slower walking cadence, longer single stance period (Hills and Parker, 1991)
- Increased incidence of osteoarthritis of knee (Hartz et al., 1986; Cooper et al., 2000)
- Increased incidence of tibia valga and varus (Henderson et al., 1994; Catonne et al., 1999)
- Increase in heel pain and plantar fascitis (Gill, 1997)
- Increased incidence of lower back pain (Han et al., 1997; Leboeuf et al., 1999)
- Increase in rigid flatfoot and foot pain (Luhmann et al., 2000; Riddiford-Harland et al., 2000)
- Increased incidence of knee injury (Loder, 2001).

Range of Motion at Major Joints

- Decreased range of motion around joints due to excessive adipose tissue (Malina 1998).

Balance

- Decreased ability to balance due to less stable centre of gravity (Messier, 1995).

Respiratory System

- Decreased Forced Vital Capacity (FVC) (Lazarus et al., 1997)
- Increased incidence of asthma (Gennuso et al., 1998; Belamarich et al., 2000)
Heat stress

Increased injury from heat stress (Chung et al., 1986; Kenney, 1989)

2.3 (b) Psychological and Social Effects of Childhood Overweight and Obesity

Wadden and Stunkard (1987) supported the notion that discrimination against ov/ob children can begin as early as six years of age. For example, as early as 1967, Staffieri (1967) asked a group of 6-10 year old children to apply a list of adjectives to silhouettes of thin, muscular and ov/ob children. Results showed that the ov/ob silhouette was given such descriptors as “stupid” and “ugly”. Although this study dates back to the sixties, there are indirect indicators that attitudes towards ov/ob and the obese person have not changed. For example, television, nursery rhymes, gum wrappers and movies often portray fat characters as “clumsy and laughable” (Lebow, 1984). In Western cultures it is not unusual to condemn the obese person with such labels as “too weak”, “lazy” or even “too stupid” to maintain a healthy weight. In other studies identifying social status and ov/ob, people who smoke or have criminal tendencies are often given a higher status than ov/ob people (Lebow, 1984). Perhaps these stereotypes are even worse now. Society’s distaste for ov/ob is well documented and the cost of this discrimination can affect the social and economic situations for ov/ob children during adulthood (Gortmaker et al., 1993).

De Jong and Kleck (1986) concluded that the most common judgements made about ov/ob figures include lazy, lower intelligence and socially isolated or lonely. A common theme that emerges through the childhood recollections of ov/ob or obese children is one of suffering intense ridicule even more than they do as adults. This finding corresponds with the well-documented honesty/cruelty of children. Not only do such children feel confused about why they are treated differently, but they lack the maturity to deal with how they are treated. Hughes and Degher (1993) found that obese persons have five generic coping strategies: avoidance, compliance, reaction formation, compensation and accounting. Many of these strategies are developed from a young age and may be able to be prevented if guidelines and codes of behaviour for all children are developed and policed for the protection of children who merely wish to learn to participate in sport.
Avoidance includes avoidance of situations where being ov/ob is a problem, including exercise classes. Compliance includes acceptance of body weight and complying with treatments to please external influences rather than engaging in and enjoying the experience internally. Reaction formation includes rejection from social situations or defiance to complete certain tasks or social activity. Compensatory situations include over-achieving in certain areas or bad behaviour in an attempt to remove the focus off their dissatisfaction of their body image. Accounting includes recalling situations that resulted in negative feelings which in turn will result in all of the above.

Self-esteem in obese children is lower than in their lean peers. Similarly, the self-worth of obese children is lower than that of lean children (French et al., 1990). An adult study reported that 90% of people would rather have a leg amputated or be blind than be ov/ob (Rand et al., 1991). Some studies have shown that children as young as eight and nine years show dissatisfaction with their own body image (Wadden et al., 1989). Hills et al. (1994) illustrated that ov/ob children at the age of nine years displayed a significantly greater low self-esteem and dissatisfaction with their body image, with over 80% of ov/ob children desiring to be thinner. It was also shown that ov/ob girls displayed a greater dietary restraint than their peers as they attempted to change their body image. This study demonstrated that before these children have reached physical maturity, many nine-year old children are dissatisfied with their body shape. Girls within the group chose a body shape that was 11% below their ideal weight for age.

Bandini (1992) has suggested that society has stigmatised ov/ob people. This is part of a shift in society with responsibility totally vested in the individual which helps to release health professionals from having to find alternative solutions. Given the increasing evidence that current approaches are not effective in dealing with the obesity problem, a new approach is necessary, one that helps illustrate to ov/ob people that a change in one's lifestyle can be made easier with some simple modifications. Through the creation of more comfortable learning environments and activities, a greater proportion of children and adults may be better placed to enjoy the experience of increasing their functional fitness and in turn losing weight (and improving body composition).
2.3 (c) Increased Likelihood of Obesity as an Adult

A follow up study of 2548 women and 2814 men who were overweight at 14 years of age had higher BMI scores in four follow-ups over a 20-year period compared with adults who were not overweight as children (Whitaker et al., 1998; Guo et al., 1999).

2.3 (d) Cost of Overweight and Obesity on Australia

It is estimated that 4–5 % of total health care costs are related to obesity associated disease in Australia (Rissanen, 1996). A conservative estimate of health costs each year for weight management programs in Australia is $500 million with a further $810 million being spent on direct health costs associated with obesity (Riley, 1997). A Northern Territory study reported the effects of one nutrition study where a 70% decrease in the number of children hospitalised for gastrointestinal disease and nutritional problems (Warchivker, 2000). The estimated cost saving to health system was $59,322.

2.3 (e) Summary of Effects of Childhood Overweight and Obesity

Ob/ob is a disease with debilitating effects that can make rehabilitation difficult. Programs or advice offered to children should consider the following physiological and psychosocial/behavioural problems that obese children may experience:

Obese children may suffer from foot, knee and low back pain which will affect their potential exercise effort and exercise intensity (Cooper et al., 2000; Luhmann et al., 2000; Leboeuf et al., 1999; Gill, 1997; Han et al., 1997; Hartz et al., 1986);

Obese children are unable to adapt to environmental changes or heat stress at the same rates as lean children, thus making endurance activities in the heat difficult and increasing the danger of over-heating (Kenney, 1989; Chung et al., 1986);

Obese children are more susceptible to respiratory distress than their lean counterparts (Belamarich et al., 2000; Gennuso et al., 1998).
The development of strategies and behaviours that overweight children may display to avoid physical activity participation are also common behaviours that ov/ob adults tend to display. The promotion of physical activity programs and guidelines for instructors and teachers may assist in the creation of environments that all children feel accepted into.

2.4 Possible Causes of Childhood Overweight and Obesity

Ov/ob is a multifactorial problem with many risk factors for which a framework needs to be developed in order to understand each factor and their interrelatedness. In short, there are many complex potential interactions between modifiable, non-modifiable and less-easily modified life experience factors which may determine the onset of ov/ob and have an impact on any subsequent treatment.

2.4 (a) Dietary Energy Intake and Childhood Overweight and Obesity

Excessive caloric intake in relation to energy expenditure will result in the storage of energy as fat (Bray et al., 2003). A higher percentage of fat intake among children has been associated with a higher percentage body fat (Francis et al, 2003), increased fat mass (Ravelli et al., 1976) and skinfold thickness (Bray et al., 2003). Fisher and Birch (1995) found that children with a higher preference for energy dense foods and fat were associated with a greater triceps thickness.

2.4 (b) Television Viewing and Levels of Overweight and Obesity

In two studies, Klesges et al. (1993) found that the metabolic rate of children was significantly lower whilst watching television than when sitting and reading. Although both activities are sedentary, television viewing appears to result in a further decrease in resting metabolic rate. In turn, a low resting metabolic rate has been found to influence the likelihood of becoming obese. Watching television for extended periods of time on a regular basis may therefore be considered a major risk factor for weight gain (Dietz and Gortmaker, 1984, Bar-Or et al., 1998). Dietz and Gortmaker (1984) demonstrated a relationship between the number of hours of television viewing and the prevalence of ov/ob. The likelihood of becoming obese increased by 2% with...
every hour per week of television viewed. A similar relationship was found between fitness scores of children who were classed as light TV viewers and children classed as heavy TV viewers. Light TV viewers scored higher in their fitness scores (Tucker, 1986). Television viewing may not only take children away from time that may be spent outside being active, but is also often associated with increasing energy intake by promoting snacking, spurred on by the advertising of palatable foods during children’s television prime time (Story et al., 1990).

2.4 (c) Parental Behaviour and Education

Children’s dietary patterns are shaped within the family context and parental eating patterns serve as models for children to follow (Wake et al., 2002). Parent-child intake patterns are also likely to reflect environmental factors. There are a number of ways parental behaviour may affect a child’s energy intake including nutritional knowledge, the types of foods parents make available to children, parental modelling and child-feeding practices.

Moussa et al. (1994) found a significant correlation between a mother’s education level and ov/ob in the mother's children. Sallis et al. (1992) noted that heavier mothers tended to spend more time watching television with their children, thus serving as models for sedentary behaviour that may in turn be learned by the child. Price et al. (1992) reported that often, parental understanding of how and why children become overweight can be a hindrance to prevention and/or treatment of ov/ob in children. These parental perceptions are outlined in Table 2.2.
Table 2.2  Parents' Perceptions regarding the Etiology of Childhood Overweight and Obesity (%)(Adapted from Price et al., 1992)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Major Role*</th>
<th>No role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child has poor eating habits</td>
<td>76</td>
<td>4</td>
</tr>
<tr>
<td>Parents do not fix the right kinds of foods</td>
<td>61</td>
<td>4</td>
</tr>
<tr>
<td>Child eats too much</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>Child does not exercise enough</td>
<td>66</td>
<td>5</td>
</tr>
<tr>
<td>Child has psychological problems such as stress, boredom, etc.</td>
<td>52</td>
<td>7</td>
</tr>
<tr>
<td>Advertisements on TV cause children to want to eat unhealthy foods</td>
<td>54</td>
<td>10</td>
</tr>
<tr>
<td>Ov/ob runs in families (heredity)</td>
<td>52</td>
<td>7</td>
</tr>
<tr>
<td>Child does not have self-control around food</td>
<td>38</td>
<td>12</td>
</tr>
<tr>
<td>Child has hormone problems</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>Child has friends that cause him/her to eat</td>
<td>9</td>
<td>43</td>
</tr>
</tbody>
</table>

*Major role = 6 or 7 on a 7-point scale
No role = 1 or 2 on a 7-point scale
N = 375

This data illustrates that approximately 40% of parents do not believe that the food prepared by the family is a concern in the development of ov/ob (61% believe family plays a major role). Approximately 40% of parents do not believe that their child eats too much or that the amount of exercise their children are doing is sufficient. It is also
interesting to note that 52% of parents believe that their child has a psychological problem that may cause them to want to eat more. An equal number of parents believe that the cause of their childhood ov/ob is genetic. An additional statement of relevance that may have added further useful information to this questionnaire would have been - “Parents do not exercise with their children enough”.

Dietary habits maintained by parents are reflected in their children. Fisher et al. (1995) showed the fat consumption of 3-5 year olds was positively related to their parents’ adiposity. The results from this study suggest that preferences for fat intake by children are shaped by familial influences such as food choices made by parents and eating patterns of parents, as well as factors such as availability of high-fat foods. Parents can similarly support or hinder their children’s physical activity levels in direct and indirect ways (Sallis et al., 1992). Direct influences include behaviours such as parents controlling access to environments and facilities. Indirect influences include behaviours such as attitude and behaviour towards exercise. There is little literature examining the effects of parental attitudes towards physical activity and children’s attitudes towards physical activity, this area is reviewed in the next section.

2.4 (d) Genetic Predisposition

The research data clearly show that the risk of ov/ob among children increases in proportion to parental ov/ob (Sorenson et al., 1995). Levels are lowest when neither parent is obese (20% risk of becoming ov/ob), higher when just one parent is obese (40% risk) and highest when both parents are obese (80% risk) (Dietz and Gortmaker, 1986). It is believed that if one child in the family is obese, the chance of producing an obese sibling is 40-50%.

It needs to be kept in mind that the complex relationship between heredity and environment (“nature versus nurture”) is still being debated, and it is not yet possible to differentiate the exact contribution of each in the ov/ob of each individual. Estimates, for example by Bouchard et al. (1993) suggest that genetics accounts for up to 25% of the likelihood of becoming obese, thus leaving responsible adults including parents and health professionals to assist in the control of variables that contribute to 75% of the likelihood of becoming ov/ob.
2.4 (e) Racial Influences and Prevalence of Overweight and Obesity

Although racial differences in ov/ob prevalence are related to the genetic make-up and metabolic differences between each race, racial differences in ov/ob can also be a direct consequence of physical environment (Guinn, 1993). However, like genetic predisposition, it is difficult to isolate race *per se* as a specific determining factor of ov/ob. It is currently not possible to disentangle the cultural practices of race from its genetic determinants with respect to factors such as ov/ob.

Wang et al. (1996) found, when comparing a population of Northern Territory Aboriginal children to Caucasian Australians, that BMI levels are lower in Aboriginal children and young adults. Wang et al. (1996) also found young Aboriginal females have higher BMI's than non-Aboriginal female children.

Children of Middle Eastern and other ethnic backgrounds were significantly more ov/ob than Caucasian children in Australian society. Lynch et al. (2000) showed a significant association between BMI and ethnicity, with students from Mediterranean backgrounds having significantly higher BMI’s than those children with Anglo backgrounds.

2.4 (f) Gender Differences and Prevalence of Overweight and Obesity

The estimated total fat mass of boys and girls consistently increases during the first three years of life. This fat mass increases more rapidly in girls than in boys, and continues to increase during adolescence in girls, whilst in males it plateaus during adolescence (Beunen et al., 1994). The prevalence of overweight, obese and overweight/obese children in Australia is estimated as 14-16%, 5% and 19-21% (boys) respectively and 16-18%, 5-6% and 21-24% (girls) respectively (Mageray and Daniels, 2000).

Gilksman et al. (1990) found that 15-year old girls in an Australian study were the most ov/ob and least fit of Australian children.

2.4 (g) Social Economic Status and Prevalence of Overweight and Obesity

In order to develop effective obesity prevention strategies for children, it is important to understand how social factors and family situations are related to obesity.
Although the following studies are not directly related to children, the aforementioned studies have already established a relationship between parental education and behaviour and childhood obesity. There the social status of parents may directly effect the risk of a child becoming overweight or obese.

Studies with adults have indicated that lower socio-economic groups less active and have higher levels of body fat and there is a strong possibility that this difference may occur in children also (U.S Department of Health and Human Services, 1996).

Ball et al., (2003) evaluated the relationship between social factors and obesity within the Australian adult population. Evidence suggests women from lower socio economic backgrounds are more like to become overweight or obese. Men from industrialised countries are also at higher risk of becoming overweight or obese (Sobal et al, 1989).

A relationship between marital status and risk of ov/ob also exists with a higher risk associated with those who are married or getting married (Lahmann et al., 2000).

2.4 (h) Physical Environment Factors

The physical location that children live in can affect the opportunities they have to engage in spontaneous physical activity. Ov/ob is related to factors such as climate, season and population density (Dietz and Gortmaker, 1986). Climatic conditions can influence motivation and ability to participate in physical activity outdoors. Access to stores that provide ingredients for healthy meals as opposed to access to fast food chains can also contribute to the incidence of ov/ob. Population density can affect factors such as traffic congestion. This will in turn reduce the space available to children in which to play or expend energy.

2.4 (i) Low Levels of Physical Activity and Prevalence of Overweight and Obesity

Research shows that lower levels of physical activity and habitual activity among children is associated with higher BMI and greater skinfold thickness (Obarzanek, 1994).

Physical activity is a key component of maintaining energy expenditure and evidence suggests that decreasing levels of physical activity are contributing to the increase in the prevalence of childhood ov/ob (Steinbeck, 2000).
Vincent et al., (2003) found little correlation between the number of steps children aged between 6-12 are taking per day and BMI. This suggests that moderate activities such as walking may not be sufficient enough to combat the increase intake of high fat foods that children are consuming in present day society. The US Surgeon General’s Report suggested that children are not engaging in adequate amounts of vigorous activity.

Pangrazi and Corbin (1999) suggested that for children to maintain a healthy body weight and functional fitness level they need to be completing a minimum of 30 minutes per day of moderate activity of a heart rate range of 120-140 beats per minute. It was also suggested that children should be aiming to spend 60 minutes per day with a moderate to vigorous range of 141-160 beats per minute.

Seliger et al. (1974) reported that children aged 11 and 12 were spending less than 3% of their day doing activities classified as moderate to vigorous therefore these children were not achieving the "Goal for All Children" as set out by Pangrazi and Corbin (1999).

Klesges et al. (1995) reported that dietary intake and physical activity were more influential on weight gain than parental ov/ob status.

Roberts (2000) reported that obese children and adults tend to have lower energy expenditure than their non-obese counterparts.

2.4 (j) Summary of the Etiology of Childhood Overweight and Obesity

From the literature addressed, the following points can be presented as a summary of the prevalence and causes of childhood ov/ob.

Over 25% of Australian children are classified as obese (Riddiford-Harland, 2000; Booth et al., 2000).

Causes of childhood ov/ob are multifaceted and include factors such as dietary intake, energy expenditure, attitude and knowledge. Additional causes include genetics, physical environmental conditions, socio-economic status, gender and race.

A higher percentage of fat intake among children has been associated with a higher percentage body fat (Van der Koy, 1998).

Dietz and Gortmaker (1984) demonstrated a relationship between the number of hours of television viewing and the prevalence of ov/ob.
Moussa et al. (1994) found a significant correlation between a mother’s education level and ov/ob in the mother's children. The research data clearly show that the risk of ov/ob among children increases in proportion to parental ov/ob (Sorenson et al., 1995).

Wang et al. (1996) found young Aboriginal females have higher BMI’s than non-Aboriginal female children. Children of Middle Eastern and other ethnic backgrounds were significantly more ov/ob than Caucasian children in Australian society (Lynch et al., 2000).

Gilksman et al. (1990) found that 15-year old girls in an Australian study were the most ov/ob and least fit of Australian children. Studies with adults have indicated that lower socio-economic groups less active and have higher levels of body fat and there is a strong possibility that this difference may occur in children also (U.S Department of Health and Human Services, 1996).

Ov/ob is related to factors such as climate, season and population density (Dietz and Gortmaker, 1986). Climatic conditions can influence motivation and ability to participate in physical activity outdoors. Roberts (2000) reported that obese children and adults tend to have lower energy expenditure than their non-obese counterparts.

### 2.5 Levels of Physical Activity of Australian Children

#### 2.5 (a) What Constitutes Adequate Physical Activity and Exercise in Children?

Prior to addressing the specific purpose of this section, it is important that the differences between “participating in physical activity” and “actively participating in physical activity” be noted. Clarifying the distinction between the two is important. For example, a child may be present while physical activity is being conducted, but may not be participating actively.

Steinbeck (1999) suggested that physical activity as "anytime a child is not resting or asleep". However, this may cause parents and children to become confused as to why they continue to gain weight if they involved in physical activities such as cricket or ballet, which require standing around for long periods of time.

It is for this reason that it is important for teachers and coaches to be aware of the different levels of intensities that children exercise. Awareness of these exercise
intensities may be beneficial for increasing cardiovascular fitness and weight management by prescribing adequate amounts of exercise and activity at moderate to vigorous exercise intensities.

The Children's Lifetime Physical Activity Model (C-LPAM) developed by Corbin, Pangrazi and Welk (1999) creates guidelines for minimum standards for physical activity participation for children. This model also suggests physical activity goals that all children should be aiming for and is outlined in Table 2.3

<table>
<thead>
<tr>
<th>Table 2.3</th>
<th>Children's Lifetime Physical Activity Model (C-LPAM) (Adapted from Corbin, Pangrazi and Welk, 1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Health Standard: A Minimum Activity Standard</strong></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>Daily. Frequent activity sessions (3 or more) each day</td>
</tr>
<tr>
<td>Intensity</td>
<td>Moderate. Alternating bouts of activity with rest periods as needed or moderate activity such as walking or riding a bike to school</td>
</tr>
<tr>
<td>Time</td>
<td>Duration of activity necessary to expend at least 3 to 4 kcal/kg/day. Equal to calorie expenditure in 30 minutes or more of active play or moderate sustained activity which may be distributed over 3 or more activity sessions</td>
</tr>
</tbody>
</table>

| **The Optimal Functioning Standard: A Goal for All Children** |                                                                                                 |
| Frequency  | Daily. Frequent activity sessions (3 or more) each day                                         |
| Intensity  | Moderate to vigorous. Alternating bouts of activity with rest periods as needed or moderate activity such as walking or riding a bike to school |
| Time       | Duration of activity necessary to expend at least 6 to 8 kcal/kg/day. Equal to calorie expenditure in 60 minutes or more of active play or moderate sustained activity which may be distributed over 3 or more activity sessions |
Guidelines set out by Pangrazi and Corbin (2000) have suggested that children should be participating in 30-60 minutes of moderate activity on a daily basis.

2.5 (b) Measuring Physical Activity Participation Levels in Children

There are many methods for measuring physical activity levels of children including diaries, observation, accelerometers, pedometers, heart rate monitors and interview. All methods of data collection above have degrees of error and costs associated with them. For this study we have chosen to investigate the validity of self-reports or diaries as they are cost and time effective and most suitable to this study.

The validity of self-reports was assessed in a paper by Baranowski et al. (1984). The subjects used were children in grades 3-6. The self-report inventory required the children to list the frequency and duration of “aerobic” activity they performed each week.

“Aerobic activity” was defined in the instructions accompanying the form as “an activity intense enough to raise the heart rate and respiratory rate and produce...” Children were asked to fill in two questionnaires each week. Both questionnaires used, were structured to allow a column for community organisations visited to participate in sport, sporting activity attempted in the past 12 months and regular activities undertaken on a weekly basis.

One questionnaire was filled in on a weekly basis and the other was filled in on a daily basis. The completed questionnaires were then compared to test the validity of self-recall.

Results showed that the average minutes involved in aerobic activity on the daily self-reported forms varied from 40 to 50 minutes per day, whilst it was found that a mean from the weekly forms was 22 minutes per day in aerobic activity.

Self-reports tend to become less accurate as the time between doing the activity and the recall and recording of that activity is increased Baranowski et al. (1984). Diaries or report forms for young children are dependent upon parental report and parental knowledge of their child's activity levels when they are not in parental care. Similarly, having parents provide information may not be accurate as the problem of
accounting for children’s daily activity. Parents may not be able to provide accurate information about a child’s spontaneous activity, as they are unaware of activity levels during school hours and during unsupervised playtime. Self-report forms may be more accurate if the day is divided into specific time periods, such as before school, recess, lunch time and after school, so as to assist children in recalling specific sections of the day Baranowski et al. (1984).

Additionally, children’s questionnaires may need to be structured so as children are engaged in the questions they are being asked. Asking children if they perform activities that make them “sweat” may be of no benefit to the researcher if a child is not familiar with what “sweating” is.

2.5 (c) Participation in Physical Activity within Primary Schools

A recent review completed by Evans (2003) provides an insight into the state of physical activity participation in Australian primary schools. Evans refers to comments made by Dr Adrian Hurley in the Foreword to the resource manual “Planning for Action” published by ACPHER (1999) that:

“Participation in regular physical activity is no longer the normal way of life for many children at school, or even out of school hours. Sedentary activities and other priorities compete for children’s time.”

Over twenty years ago Sheehan et al. (1983) had had indicated that television viewing occupied most of a child’s out-of-school time. Although television and computer games have become a somewhat alternative form of parenting (Klieber, 1999), the accessibility of these passive recreation alternatives is not the only contributing factor. With the increased urbanisation of society, the home environment is often not conducive for physical activity and recreation with back yards becoming smaller and landscaped and front yards running along busy streets (Evans, 2000).

With the home environment not always being available for physical fitness opportunities, the school environment is now under more pressure to supply these experiences for children.
However, Hardman and Marshall (2000) reported that the ease of providing these opportunities for children has been decreased due to the following reasons:

- Decreased space within the school curriculum for physical activity opportunities;
- Lack of adequate equipment for teachers and children to use;
- Inadequate finance to renew equipment, material and personnel resources;
- A low priority placed on the need for more time and finance for this area within the curriculum.

A Review of Physical and Sport Education in Victorian Schools (Review of Physical and Sport Education Committee, 1993) found that the high emphasis placed on performance in numeracy and literacy is making it difficult to make physical education a priority. One principal in this particular survey remarked that in order to achieve numeracy and literacy benchmarks set out in the current curriculum, the entire morning is set aside for learning these two key areas. Therefore the remaining 6 Key Learning Areas are required to be squeezed into the 90 minutes available in the afternoon.

Although authors such as Pangrazi (2000) and Pangrazi, Corbin and Welk (1997) suggest that children should be engaging in 30-60 minutes of moderate to vigorous activity on a daily basis, it is clear that this amount of time would be difficult for most schools to aim for on a weekly basis.

A confounding problem with finding 30-60 minutes for moderate to vigorous activity per week, is that even if the time is found within the curriculum, whether the children are actually exercising vigorously enough for a health benefit also needs to be addressed (Warburton and Woods, 1996).

This is one reason why teachers and parents may need assistance with the delivery of physical activity programs. The clear message that is illuminated through most of the reasons for decreasing physical fitness of children is a lack of time at school and home. Therefore, the time that is made available needs to be utilised for the most
beneficial result. Children need to be provided with exercise and activity that is intense enough to maintain or increase physical fitness.

However, providing activity that moderate to vigorous and also enjoyable and confidence building, can be difficult for non-specialist teachers and parents.

Often children will shy away from vigorous activity as their present fitness level or body composition may not be conducive to traditional vigorous activities such as racing and games that require high levels of agility. Previous experience in these type of activities may have decreased the confidence of children so as they are reluctant to ‘have a go’ at activities that teachers and parents are providing.

This may be leaving non-specialist teachers and parents frustrated with their own attempts to assist these children with their physical activity experiences and hence the cycle begins as outlined in Figure 2.4.

Figure 2.4 How Children and Non-Specialist Teachers May Get Caught in a Cycle of Decreased Physical Activity.
By providing non-specialist teachers and parents with the skills to keep children engaged and confident in moderate to vigorous activity, then the little time that is made available for physical activity participation may become more beneficial.

Kraft (1989) investigated the connection between a well-planned physical education program and the amount of activity children are participating in whilst on their lunch and recess breaks. It was found that if during their physical activity lesson children were introduced to new activity and taught how to use these activities on their own, then they were more likely to engage in these activities during their break.

If physical activity programs and opportunities are going to be placed in the responsibility of non-specialist teachers and parents, then these teachers and parents need to be provided with the skills to construct well planned programs. This may assist with breaking the cycle outlined in Figure 2.4.

Recent school based interventions have attempted to conduct programs that do not cause an inconvenience for teachers and schools (Hamlin et al., 2002). However, for teachers to be up-skilled and taught how to conduct effective and well planned programs, some inconvenience may be needed during the initial stages of the teacher and parent education process.

Isn't stopping the cycle outlined in Figure 2.4 worth reshuffling the normal school day until both teachers and students feel confident in their ability to teach and learn physical activity concepts?

The concept of reteaching teachers and parents physical activity concepts is no unlike teaching teachers to teach their children another language.

Exercise for some children, is like learning another language, a physical a language that many children and families are not familiar with. Some teachers and parents are stumbling over the concepts in physical activity just as they would if the only method for learning a new language was from a book.

We would never expect teachers and parents to teach children to speak a second language with no formal training, so why do we place this pressure on them to produce active and fit children with no assistance.
A recent Australian study supports suggests that school sports programs should focus more on developing sports skills as a method to prevent drop-out (Booth et al., 1997). It is in these formative years that fundamental movement patterns are developing, along with lasting attitudes and values. It may be that during these years children are forming attitudes towards sports and physical activity.

2.5 (d) Participation in Physical Activity Outside School

Recent data collected from the Australian Bureau of Statistics outlines the number of children involved in organised sports outside of school hours. It can be seen from this table that the peak age for involvement in organised sport is occurring at 11 years of age for girls and boys indicating that as children progress to high-school age they are less likely to be involved in organised sport.

Table 2.4 also reports that at age 11, 30-40% of children are not involved in organised sport outside of school hours.

This 30-40%, correlates with the percentage of children classified as ov/ob and it can be assumed that the two variables may be related.

Table 2.4 Children's Participation in Organised Sport (a) - April 2000

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Males</th>
<th>Females</th>
<th>Persons</th>
<th>Males %</th>
<th>Females %</th>
<th>Persons %</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>46.0</td>
<td>37.9</td>
<td>83.8</td>
<td>55.1</td>
<td>29.5</td>
<td>32.3</td>
</tr>
<tr>
<td>7</td>
<td>79.5</td>
<td>42.8</td>
<td>122.2</td>
<td>58.9</td>
<td>36.2</td>
<td>48.3</td>
</tr>
<tr>
<td>8</td>
<td>90.1</td>
<td>62.2</td>
<td>152.3</td>
<td>65.8</td>
<td>48.6</td>
<td>57.5</td>
</tr>
<tr>
<td>9</td>
<td>101.5</td>
<td>78.9</td>
<td>180.4</td>
<td>72.2</td>
<td>57.2</td>
<td>64.8</td>
</tr>
<tr>
<td>10</td>
<td>99.4</td>
<td>80.1</td>
<td>179.5</td>
<td>72.0</td>
<td>59.6</td>
<td>65.9</td>
</tr>
<tr>
<td>11</td>
<td>106.8</td>
<td>77.2</td>
<td>184.0</td>
<td>74.1</td>
<td>59.2</td>
<td>67.0</td>
</tr>
<tr>
<td>12</td>
<td>108.7</td>
<td>77.3</td>
<td>186.0</td>
<td>76.3</td>
<td>60.7</td>
<td>69.0</td>
</tr>
<tr>
<td>13</td>
<td>88.9</td>
<td>82.1</td>
<td>171.0</td>
<td>71.8</td>
<td>60.6</td>
<td>66.0</td>
</tr>
<tr>
<td>14</td>
<td>90.9</td>
<td>72.1</td>
<td>163.1</td>
<td>69.1</td>
<td>56.6</td>
<td>63.0</td>
</tr>
<tr>
<td>Total</td>
<td>895.2</td>
<td>673.0</td>
<td>1,568.2</td>
<td>66.1</td>
<td>52.3</td>
<td>59.4</td>
</tr>
</tbody>
</table>

(a) Outside of school hours during the 12 months prior to interview in April 2000.

Source: Children's Participation in Cultural and Leisure Activities, Australia, 2000 (4901.0).
Table 2.5 also reports the most popular sports children are involved in outside of school hours.

Swimming and soccer were the highest ranked sports.

Data for children's involvement in non-competitive sports or physical activity was not available.

Table 2.5 Participation in The Most Popular Sports (a) - April 2000

<table>
<thead>
<tr>
<th>Sports</th>
<th>No. Males</th>
<th>No. Females</th>
<th>Total No.</th>
<th>Males %</th>
<th>Females %</th>
<th>Persons %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swimming</td>
<td>177.0</td>
<td>203.1</td>
<td>380.1</td>
<td>13.1</td>
<td>15.8</td>
<td>14.4</td>
</tr>
<tr>
<td>Soccer (outdoor)</td>
<td>265.0</td>
<td>37.3</td>
<td>302.3</td>
<td>19.6</td>
<td>2.9</td>
<td>11.4</td>
</tr>
<tr>
<td>Netball</td>
<td>*6.4</td>
<td>234.9</td>
<td>241.4</td>
<td>*0.5</td>
<td>18.2</td>
<td>9.1</td>
</tr>
<tr>
<td>Tennis</td>
<td>124.8</td>
<td>99.1</td>
<td>223.8</td>
<td>9.2</td>
<td>7.7</td>
<td>8.5</td>
</tr>
<tr>
<td>Basketball</td>
<td>119.6</td>
<td>80.7</td>
<td>200.3</td>
<td>8.8</td>
<td>6.3</td>
<td>7.6</td>
</tr>
<tr>
<td>Australian Rules football</td>
<td>170.3</td>
<td>*4.1</td>
<td>174.4</td>
<td>12.6</td>
<td>*0.3</td>
<td>6.6</td>
</tr>
<tr>
<td>Cricket (outdoor)</td>
<td>133.6</td>
<td>7.3</td>
<td>140.9</td>
<td>9.9</td>
<td>0.6</td>
<td>5.3</td>
</tr>
<tr>
<td>Martial arts</td>
<td>72.7</td>
<td>31.9</td>
<td>104.6</td>
<td>5.4</td>
<td>2.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Athletics and track and field</td>
<td>52.2</td>
<td>51.9</td>
<td>104.1</td>
<td>3.9</td>
<td>4.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Rugby League</td>
<td>92.5</td>
<td>*2.5</td>
<td>95.1</td>
<td>6.8</td>
<td>*0.2</td>
<td>3.6</td>
</tr>
</tbody>
</table>

(a) Children aged 5 to 14 years who participated in organised sport outside of school hours during the 12 months prior to interview in April 2000.

Source: Children's Participation in Cultural and Leisure Activities, Australia, 2000 (4901.0).

2.5 (e) Why are Children Dropping Out of Physical Activity?

The Rusbult's Investment Model of Sports Commitment (Rusbult 1983) supports the notion that children remain committed or involved in physical activity or sports the following reasons:

Satisfaction received as a result of being involved in the sport or activity, reflecting an individual's positivity or attraction to their involvement;
Attractiveness of alternatives that may be offered at times that may be similar or at more attractive times. Rewards, whether these be extrinsic or intrinsic, offered by other sports or activities may be more attractive; Investment dedicated to the sport or activity is balanced with the reward previously mentioned. If large amounts time into a sport or activity with children not engaging in why they are learning the activity then they are more likely to drop out (especially if the only incentive is a rank or a place)

Reasons for this drop out could be and are supported by research Bandura's Social Learning Theory (1977)

Self efficacy in physical activity and sport correlates with earlier experiences. If children have not experienced a degree of success in competition or organised sports they are less likely to enrol in these sports. Therefore, junior programs need to allow a degree of success for participants not juts competitors;

Research on the roles of significant others on the behaviour and attitude of children in sport and has found that moral development occurs through learning socially accepted values and behaviour in sport. Therefore the culture of the behaviour of children in sport and the actions they take with their competitors and team mates is shaped by the direct influences of their role models and significant others such as parents and coaches;

Perceived social approval in sport and physical activity has been found to have a relationship with the moral development in children and the decisions they make outside of the sporting context;

Influence on self approval in junior and individual sports and team mates have the highest influence on adolescence. Hence the need to create a positive culture in team mates in team sports and in parents in individual sports.

Some children may be ego orientated and focused more on demonstrating a superior ability to others, whilst others may be more focused on self improvement, therefore needing to be in an environment that allows them to measure their own success. Some competition sports such as surf life saving competitions and objectively judged
activities such as dancing and diving etc. are not set up for children to measure their own success and approaches need to be taken to provide children and even adults the ability to measure their own success. As surf is unpredictable and very luck orientated, then systems can only be set up in the coaching culture, not in the event itself.

The development of self-esteem should be a primary focus, not the winning of an event or the ranking of your competitor until the competitor is at age to make a decision. Sporting organisations that foster a culture of participation will find a larger number of children involved hence will much more easily achieve a higher ranking in competitions that foster and nurture their competitors.

Perceived Competence impacts highly on can be effected by the event itself, comments made in tents following an event, coaches comments, team mates comments and most importantly the emotions created from these comments. Coaches, officials and administrators need to understand the effect emotion plays on the adherence to sport and how these emotions effect a child's self esteem and ultimately their self confidence in sport.

2.5 (f) Children’s Attitudes Towards Physical Activity

Evidence suggests that an adult’s disinclination to exercise may be linked to his/her exposure to exercise during adolescence (Ferguson et al., 1989). Studies have also shown that the time and effort to maintain an exercise regime often outweigh the perceived benefits of exercise (Ferguson et al., 1989). But more importantly, self-expectations have a great influence on the amount of exercise one tends to engage in. If students believe they can complete (i.e. they expect to be able to complete) a particular task, they are more than often willing to participate in that activity (Ferguson et al., 1989). Ferguson et al. (1989) found that self-esteem correlated positively to intent and current exercise behaviour. It was also concluded from this study that early development of positive attitudes towards exercise may play a crucial role in the development of active lifestyle habits. As mentioned previously, Smoll et al. (1976) found that children participated more frequently in tasks they were more proficient in and in the activities they felt most positive about.
Smoll et al. (1976) investigated the relationship among children’s attitudes, involvement and proficiency in physical education. In this U.S. study, a large group of 4th, 5th and 6th grade boys and girls were selected to complete a CATPA questionnaire (Children’s Attitude towards Physical Activity). They also completed a series of motor tasks and provided information on the frequency of participation in physical activity. The skills the children performed constituted the foundation for most children’s sports, such as jumping, sprinting, catching and throwing. The results showed a relationship between the scores obtained on the CATPA inventory and the involvement and proficiency of the children in selected sports. Children with negative attitude scores for particular tasks showed less proficiency in that same task. The results also indicated that children are primarily involved in those activities towards which they hold the most positive attitudes. Therefore, a major factor that may be contributing to the decrease in the amount of physical activity being performed by children, may be that children are not being provided with the types of physical activity that they are comfortable with or feel positively about.

2.6 Physical Activity Guidelines for Coaching Overweight/Obese Children

2.6 (a) Understanding the Physiological Differences Between Adults and Children

“Children are structurally, psychosocially and physiologically different in each biological age group” (Watson, 1995). Programs for children need to be sensitive to the chronological age group and anatomical structure of children. The influential role played by parents, teachers, coaches, sports administrators and sports physicians in the development of children in sport cannot be overstated. The problems encountered in a variety of sports and physical activities are many. Consideration should be placed on the children’s limitations, fears, needs and wishes to ensure that sport is enjoyable and safe for all children. It may be that failure to consider these differences could result in children dropping out of physical activity pursuits.

Watson (1995) provides an insight into the some of the physiological factors that need to be considered when involving children in physical activity. These include:
Growth and maturation
Physiological differences
Environmental factors
Nutritional considerations.

Growth and maturation considerations include the differences in growth in height and weight in pre-pubescent and pubescent boys and girls. Other considerations include the fact that up to the age of 10 years, cardiovascular fitness is greater in boys than girls. Also up to the age of 14 to 16, muscular strength is greater in girls (ACSM, 1998) (See Appendix 2). Physiological differences to be noted between adults and children include children experiencing greater fatigue during high intensity tasks, greater heat stress, faster recovery from intermittent activities and early fatigability during tasks that require large respiratory volumes especially during long cardiovascular bouts, than do adults (ACSM, 1998) (See Appendix 2). The most important nutrition consideration to be taken into account with children is their decreased thirst response, which, if left unchecked, can result in heat stress and early fatigue (ACSM, 1998).

2.6 (b) Physiological Differences Between Lean Children and Overweight/Obese Children

Some research argues that obese children have a reputation for being physically inactive (Bullen et al., 1964). In sections the psychosocial pressures and physiological differences that obese children may encounter have been outlined. Each of these factors needs to be considered when prescribing exercise for ov/ob children.

The increased load carried by an obese child will lead to increased energy expenditure for a given weight bearing activity, and this in itself may explain why obese children appear less physically active during exercise. Ov/ob children may often actually be working harder than other children in a group and therefore they fatigue more quickly. For the obese child, strenuous or long bouts of cardiovascular exercise or activities involving agility can also be very difficult. This is due to a limited joint range of
motion and the fact that clothing is often uncomfortable. Equipment, environment and clothing are all genuine considerations when prescribing exercise.

The physiological differences between obese children and their leaner peers that need to be taken into account include: increased body weight and therefore increased load upon joints, and impaired thermoregulatory responses and thus a higher rating of perceived exertion while exercising at the same level (Messier et al., 1995). Furthermore, obese children have a significantly higher pulmonary ventilatory response to exercise than their leaner peers (Maffies et al., 1993).

2.6(c) Physical Performance of Overweight/Obese Children in Common Activities

During pre-school years it was found that only broad jumping distances were affected by body mass index (Parizkova et al., 1994). Cricket ball throws and 20m dash times were not significantly affected. However, levels of spontaneous activity were higher in children with a lower BMI, which may be an indicator that the impact of being ov/ob worsens as the pre-school child develops. During adolescence, ov/ob individuals are disadvantaged, particularly where transference of body weight is required (Parizkova et al., 1994). The energy costs of submaximal work on a cycle ergometer are also higher for obese children, resulting in lower mechanical efficiency. The results for various physical performance tests were lower for obese children, with the exception of muscular strength, where obese individuals showed similar or greater scores.

Table 2.6 below outlines the difference in energy expended by children of varying body mass. Note that a basketball game for 10-year old children differing in body weight by 20kg can require nearly twice as much energy from the heavier child (Bar-Or et al., 1995).
<table>
<thead>
<tr>
<th>Activity</th>
<th>20kg Calories</th>
<th>40kg Calories</th>
<th>60kg Calories</th>
<th>80kg Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basketball game</td>
<td>34</td>
<td>69</td>
<td>102</td>
<td>132</td>
</tr>
<tr>
<td>Cross-country skiing</td>
<td>24</td>
<td>48</td>
<td>72</td>
<td>96</td>
</tr>
<tr>
<td>Cycling 6 mph</td>
<td>15</td>
<td>26</td>
<td>39</td>
<td>52</td>
</tr>
<tr>
<td>Running 5mph</td>
<td>37</td>
<td>66</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>8 mph</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Swimming-breast</td>
<td>27</td>
<td>51</td>
<td>77</td>
<td>90</td>
</tr>
<tr>
<td>Swimming-Freestyle</td>
<td>19</td>
<td>36</td>
<td>54</td>
<td>78</td>
</tr>
<tr>
<td>Swimming-Back</td>
<td>17</td>
<td>26</td>
<td>34</td>
<td>41</td>
</tr>
<tr>
<td>Walking-2.5 mph</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Values are approximate and for 10 minutes of exercise. Actual calorie equivalents will vary with the intensity of the activity and with the child’s proficiency.

2.6 (d) Summary of Physical Activity Guidelines for Coaching Overweight/Obese Children

Adults placed in charge of children’s programs need to have some knowledge of the exercise physiology of children. Summarised below are the most important points to remember when training children:

Children are participating in low levels of physical activity and at low intensities (Durant et al., 1992; Sallis, 1993).

Children will be more likely to adhere to activities that they feel confident in or believe that they can complete (Ferguson et al., 1989).

Obese and ov/ob children are often at a disadvantage whilst exercising when compared to lean children due to a decreased ability to thermo-regulate and a
higher pulmonary ventilatory response to exercise (Maffies et al., 1993; Messier et al., 1995).

Obese children are disadvantaged during weight transfer activities (Parizkova et al., 1994).

A game such as basketball can require an ov/ob child to expend three times more energy than a lean child (Bar-Or et al., 1995).

2.7 Creating a Framework for the Provision of Optimal Learning Environments for Children Participating in Physical Activity

It appears that many steps have been taken in an attempt to provide programs to increase physical activity levels in children by providing competition sports, programs such as the Gold Medal Sports Program to inspire children, and the Fundamental Skills Program to increase co-ordination for children during motor skills. However, if one looks back over the years of sports programs applied to schools and the public, similar programs have been launched in the hope to combat the decreasing levels of physical activity amongst Australian children themselves in that although all the good intention is evident in these programs, the levels of physical activity have decreased and the levels of overweight and obesity have increased. The Life Be In It campaign is an example of a well organized and publicised program that could have been made more powerful if it had included in it’s program the process of “acculturating” of the people it was trying to reach.

Could it be that the major component missing from these programs is the process of creating an environment that people feel most comfortable learning within? In order to create guidelines for instructors and delivery of children’s activity programs, it is important to review how children behave in exercise situations and the theories behind why they behave this way. From a review of exercise behaviour theories it will then be possible to investigate methods for avoiding or curbing the behaviour children develop to avoid exercise situations. One such method for curbing avoidance behaviour may be to create environments that children feel comfortable learning and engaging in.
Example of frameworks that have been created for teaching children mathematical concepts and literacy will be used and re-organised in order to create a framework for the provision of optimal learning environments for children to learn how and why to become physically active. This process is known as “creating a culture” or “acculturation”.

2.7 (a) Acculturation Theory as a Framework for Understanding the Origins of Overweight and Obesity in Children

How and why do some young people become ov/ob, physically inactive and lead relatively unhealthy lifestyles? What role does their primary experiences in their family of origin play? Acculturation theory may provide a useful framework for addressing such questions. Acculturation may be defined as “the means by which beliefs, attitudes, values, patterns and practices are willingly and unwillingly, overtly and covertly, verbally and non-verbally, communicated, negotiated and mutated (i.e. altered) from one generation to another and within generations of a family, community and culture” (Huber, 1995:134). Huber (1995) cites a number of studies (Kingston et al., 1986; Guerin et al., 1987; Guerin and Pendagast, 1976) as the sources utilised in her derivation of this definition. Huber (1995:135) goes on to argue that acculturation is not a transmission process, but rather "one of proximity and probabilities in which significant others with whom we spend most of our early childhood years provide idiosyncratic models of how to think, feel and act in the world.”

Therefore, acculturation theory offers a conceptual framework for understanding how individuals learn to make sense of their experiences and thus develop a body of knowledge about how the world works. It is especially useful in explaining learning to use the language of the culture into which one is born, learning the cultural attitudes that are acceptable and expected in that culture, learning and acquiring the values, beliefs, and morals of the culture, and other complex cultural learning. It can also provide a framework for understanding how and why some children and their families develop the beliefs, values, and attitudes they have toward food, nutrition, diet and exercise, and the purpose, nature, and role of physical activity in their lives. Such a framework provides a holistic depiction of the issues associated with obese
and/or ov/ob, non-active children as a lifestyle problem, rather than as an arithmetical aggregate, the result of 25% nature and 75% nurture.

It should be noted that acculturation theory is not attempting to play down the effect of genetics on the likelihood of becoming ov/ob, but that placing a figure on genetic contribution can be ambiguous due to all the other confounding factors of lifestyle that affect genetics. On the other hand, programs should be individualised to accommodate for a child’s individual anthropometric make up, but this should apply to all children, not only ov/ob children.

In summary, being ov/ob and having an aversion to healthy physical activity could be seen as a type of cultural artefact, the end result of a lifestyle learned as a consequence of being a member of a certain family culture. It follows that any intervention program designed to deal with this should ultimately aim to bring about a change in that family culture.

Viewing the issues from this perspective raises an important question. What kind of teaching-learning theory is powerful enough to bring about changes in cultural learning? The approach would need to be more than a simplistic didactic transmission of information teaching model. In addition, it would need to go beyond the repetitive drill and practice of carefully designed physical exercises.

2.7 (b) Exercise Behaviour Theories: Social Cognitive Theory

Bandura’s (1977) social-cognitive theory regarding inclination to exercise combines cognitive, behavioural and environmental factors. This theory suggests that personal factors, such as exercise preference, competency and personal attributes, interact with behaviour and cognition, and are all determinants of each other. Taylor et al. (1985) outlined a mutual interaction that is combined with other factors associated with family influence, such as the home environment, parental cognition and behaviours, and child cognition and behaviours (Taylor et al., 1985). These researchers explain that this model outlines the following issues:

a) a child’s exercise behaviour can be influenced directly through parents (e.g. supplying a command): (modelling)
a) a child’s exercise behaviour can be influenced indirectly by parents (e.g. purchasing and making available equipment for exercise);

a) parents’ cognition can only affect children when mediated by some form of parental behaviour (e.g. parents intent to exercise);

a) a child’s behaviour can affect a parent’s behaviour.

These behaviours all influence the culture of the family.

The last observation in the social-cognitive theory is probably the most important when targeting children for exercise programs that parents are unable to become directly involved in. If children are able to learn why they are exercising and enjoy the experience, then a circular effect can evolve where children may be able to encourage parents to adopt physically active lifestyles.

Bandura’s social-cognitive theory also refers to expectations (expectation) and anticipatory aspects of behaviour (Bandura, 1977). This means that an individual anticipates many aspects of a situation and generates expectations before the act is carried out. These expectations can be developed from observing others acting out a particular behaviour, previous experiences, or hearing others talk about similar situations. Family environments and conversations can create normative expectations in children before a child has acted out a particular behaviour (Taylor et al., 1985). Family environments can also predetermine the identity options for the child. Expectations can be influenced by conditions placed on exercise behaviour such as saying “you can play as long as you don’t get dirty” or “don’t hurt yourself whilst playing.” Active children are more likely to report that their parents and friends expect them to be physically active (Godin and Shepherd, 1984).

Social cognitive theory suggests that rewards or incentives be used as motivators to exercise (response). Families can offer respect and approval as incentives for children to exercise. The family can also present perceived barriers to exercise, where time constraints and family obligations come between a child and a physically active lifestyle. Parents’ attitudes can affect children’s physical activity behaviours in the following ways:

Parental modelling
Social support processes and social influences provided to children by parents: (immersion)

Parental knowledge, beliefs and attitudes towards exercise

2.7 (b) (i) Parental Modelling

Observing the performance of others can teach children skills. This is known as observational learning. Inhibitory and disinhibitory effects act to strengthen or weaken inhibitions about previously learned behaviours. Response facilitation effects occur when others' actions serve as social prompts, response cuing for previously learned behaviours. The National Children and Youth Fitness Study II and I (NCYFS I and II) (U.S. Department of Health and Human Services, 1980) showed that 42.1% of mothers and 48% of fathers of children in grades 1 through to 4 did not participate in moderate intensity exercise in a week. Further, 58.1% of mothers and 61.7% of fathers did not exercise with their children during the week. It was also found that of those parents that were physically active, 58% spent more than half this time exercising with their family. Godin and Shephard (1984) found a strong correlation between the strength of seventh to ninth graders, and their fathers' current physical activity level. Gottlieb and Chen (1985) found that parental exercise levels were directly related to the frequency of children participating in exercise. Baronowski et al. (1984) found that most fathers were absent during the periods that their children were physically active, therefore minimising the chance for them to be physical activity models. Parents may exert direct influence on children's physical activity through encouragement, discouragement, pressure and direct prompts to promote or inhibit activity.

Direct social influence prompts by parents may be effective at some ages and not at others, due to children entering broader social networks at different ages (Lewko and Greendorfer, 1982). Parents may also not be aware of the damage that nagging and pressure can cause.

Some studies suggest that parents can influence the degree to which their children ultimately adopt healthy or unhealthy behaviours. For example, Epstein et al. (1994) noted the variables that may affect these treatments, and their success included factors such as the number of parents who were obese and the degree of parental involvement
in treatment. Wilson (1994) supports the concept of weight management for children and argues that success rates for weight control programs can be related to the age of the subjects or patients involved in treatment. This argument is based on the assumption that children’s habits are more malleable than those of adults because they have had less time to develop unfavourable eating habits.

2.7 (b) (ii) Social Support and Social Influences Provided to Children by Parents

Social support for children can be provided by parents, guardians or peers in a number of ways, such as:

- Providing information;
- Discussing physical activity with children;
- Viewing practice and play;
- Offering to exercise with the child;
- Assisting the child (e.g. By providing transport)

2.7 (b) (iii) Parental Knowledge, Beliefs and Attitudes towards Exercise

Knowledge about the health effects of physical activity may not be important to children and hence not be a motivator in encouraging children to exercise (O’Connell et al., 1985). However, of greater value perhaps is having the knowledge of how to be physically active, which has been shown to have a significant effect on intent to exercise (Gottlieb and Chen, 1985).

2.7 (d) Exercise Behaviour Models: The Health Belief Model

The Health Belief Model (Janz et al., 1984) proposes that a person needs to understand the following factors perceived benefits of exercise, perceived barriers to exercise and perceived threats of not exercising in order to adopt the belief that leading a healthy lifestyle will benefit them.

2.7 (e) Exercise Behaviour Theories: The Modelling Principle (Martens, 1986)

Children will model the behaviours of significant others. If children are saturated in an environment that makes exercise and healthy lifestyle a priority, then their
behaviour is more likely to mimic those who model this behaviour, such as parents, guardians and peers. This principle is known as immersion and assists greatly with the process of “acculturation”.

2.7 (i) Exercise Behaviour Theories: The Self-Determination Principle (Martens, 1986):

Children will tend to be involved in activities that offer optimal arousal and be engaged for longer periods of time. Many social problems suffered by children result from their failure to develop positive perceptions about themselves in their social environment or school (Martens, 1986). Children learn quickly during their early years that their worth in public situations is often associated with achievements. In regard to physical activity, talent and athleticism are often rewarded in front of their peers, instilling in children the belief that self-worth in exercise is gained if one possesses these qualities. Children who do not possess these qualities will turn to other activities to gain self-worth, such as being the class clown. Children will develop a range of complex behaviours in order to protect their self-worth, using avoidance or attention-seeking acts to distract attention from their athletic inadequacies. Physical activity programs for children need to develop methods to enhance the self-worth in children before they are asked to complete activities that are beyond their capabilities. Consider the following examples that many people involved in teaching or coaching children may have experienced:

Children are often asked to complete exercises and sports that are too difficult both physiologically and skill-wise for them. These children are then asked to complete similar sports or activities as adults, even though they have not learned the skills required for them as children;
Children are often thrown into competitive sports programs before they have acquired the game-related skill or the psychological development to make comparisons between themselves and others. Children may tend to over analyse why they lost or won a game if a majority of their time is involved in sport is also involved in competition;
Most competitive programs focus on performing skills rather than skill development. Therefore, normal learning mistakes can become public embarrassment;
Big steps in progress are often pointed out and rewarded, and are associated with the number of wins or the number of goals scored, rather than the small steps in progress that were learned along the way;
Children are often openly criticised for not performing as expected;
Children are often publicly evaluated and tested with rewards being given to those who perform the top scores, rather than to those who improve upon their own scores.

The Fun Principle outlines the need for optimal arousal to increase children's participation levels in physical activity (Martens, 1986). When arousal is too high in activities that can create anxiety or excitement, children will initiate tactics to decrease arousal in order to create The Flow Experience (Csikszentmihalyi, 1975). The Flow Experience offers an explanation for the feeling children experience when totally immersed in an activity that is so enjoyable, they often forget the duration of the activity. The experience is so intrinsically rewarding and fun that children are eager to perform it again.
The Fun Principle can be lost when adults delivering programs for children fail to do the following things:

Avoid constant instruction and over-evaluate the performance of children involved in each activity;
Avoid placing adult objectives for children's programs, such as creating a state representative side or making training sessions too military and rigorous;
Always vary the routine of program;
Never use exercise as a punishment and avoid punishing children with more exercise if they cannot perform an activity.

2.8 Popular Education Theories Applied to Child Exercise Habits
Theories of learning and teaching have been studied for centuries in an attempt to create environments that allow children and adults to learn tasks and skills in their own, individual and natural environment. A number of models will be presented to outline how learners are able to become skilled in certain tasks more ease than others. These theories will investigate the settings learners exist in and how by modifying settings, learners may be able to feel more comfortable with engaging in learning new tasks.

Bandura’s social cognitive theory suggests that individuals who see themselves as capable of achieving a particular outcome (perceived self-efficacy) will be more likely to try to strive for these achievements. Bandura (1977) believes that in order for people to believe they can achieve an outcome, health messages need to be modified so they instill in individuals the belief that they can change their health habits. This is especially important with children beginning exercise programs (Worsley et al., 1984). Programs for children need to enhance self-esteem. Ferguson et al. (1989) found a significant positive correlation between self-esteem and intent to exercise. They suggested that “programs which chart progress towards fitness goals and teach students exercise programs they can engage in, independent of their skill level, can enhance self esteem” (Ferguson et al., 1989:115). Students who perceived exercise as beneficial, who exhibited positive feelings about physical education, who had good self-esteem levels and who perceived themselves as being able to maintain commitments, were more likely to intend to exercise in the future than those who exhibited negative attitudes during childhood (Martens, 1996).

Is it possible that previous researchers in the field have been too reductionist in their approach to understanding the complexity of factors that determine the development of ov/ob children? At first glance the dichotomy surrounding modifiable, not easily-modifiable and less easily-modifiable risk factors seems to be logically persuasive. Bouchard et al. (1993) claim that genetics account for up to 25% of the likelihood of becoming obese, leaving other responsible adults such as health professionals to assist in the control of variables that contribute to 75% of the likelihood of becoming ov/ob. It is a compelling argument. On closer examination, however, some serious flaws in this kind of reasoning are evident.
First, this dichotomy implicitly carries with it an in-built presupposition of failure. It leaves open the possibility that the failure of any program can always be attributed to the 25% of genetic material which is not easily-modifiable. Genetics should not be used as a reason for not being able to maintain a healthy body weight, but rather as a reason to remain committed to a healthy lifestyle.

Second, such a dichotomy only partially explains the origins of lifestyles which result in low levels of fitness, ov/ob and all the accompanying symptoms of poor health and physical inactivity. The boundaries between what is modifiable and what is not become blurred when one tries to discriminate between, for example, genetics, race, family history and socio-economic status. Is the prevalence of ov/ob among Afro-Americans caused by their gene pool or by the fact that they are a minority group suffering economic and social discrimination? In turn does this scenario lead to poverty and all the social consequences accompanying it, including poor dietary habits and the lack of opportunity to lead healthy active lives? Or is it a complex mix of all these things?

Finally, while the dichotomy surrounding modifiable, not easily-modifiable and less easily-modifiable factors offers some insights into what the content of an intervention program should be, it does not provide much assistance with the practicalities of actually delivering (i.e. teaching) such a program.

The author first became aware of this need when confronted with a class of 10-12 primary school children who had signed up for a pilot intervention program in a formal studio setting. In this setting it quickly became obvious that in order to understand and evaluate the program, it was important to consider more than what the research had revealed about modifiable, not easily-modifiable and less easily-modifiable risk factors. The author had to focus on more than the weight and other measurable characteristics of each child in the group. It soon became apparent that the mechanisms of memory and attention, anxiety, risk-taking, the nature and uses of language, the comprehension of speech, interpersonal relations, socio-cultural differences, learning styles and other complex psychosocial factors were all crucial, and all of these had to be considered if an intervention program were to have any chance of succeeding.
In reality we must try to teach children the skills, knowledge and understanding they need in order to begin to deal with their weight problems. The planned content and activities of any intervention program first need to be embedded within a theory of learning in general, and the learning of young children in particular. Rather than looking at the causes of ov/ob and/or obese children in terms of modifiable, not easily-modifiable and less easily-modifiable factors, it might be more informative to look at the issue through a broader lens, such as acculturation theory.

2.8(a) Learning Theory Models: Bruner’s Theory of Instruction (Bruner, 1966)

Bruner’s theory states that when giving instruction, instructors should take into account:

- The nature of the learner as a knower
- The nature of the knowledge
- And the nature of the knowledge getting process

Bruner’s Theory of Instruction covers five main aspects of learning:
1. Instruction should minimise the risk when learners attempt to explore. It should maximise the information gained when error is made and should aim to weaken the previously established constraints placed on exploration and curiosity.
2. Knowledge should be constructed for ultimate comprehension. Knowledge should be coded in such a way that it is able to be used by students in present and future situations.
3. Material should be organised in a sequence that assists with learning. Instructors should organise material in order to suit the learner’s ability. Alternatively, instructors should allow learners to arrange the material in an order that may assist with their understanding of the use of the material.
4. Instructors should be familiar with the role of success and failure and reward and punishment. Mistakes may allow for a more rapid understanding of the use of the skill. A feeling of capability will allow a learner to feel comfortable with new challenges.
2. Information should be “translated into the learner’s way of solving a problem” (Bruner, 1966:53). Instruction should make the learner a problem-solver. Instruction should be designed to provide the learner with the tools for problem solving.

2.8 (b) Learning Theory Models: Assimilation and Accommodation Theory

(Piaget, 1929)

Assimilation is a process of changing the information relate to a child’s previous experiences Piaget (1929). In this process, new knowledge is assimilated with a previous experience such as, “remember when you learned to kick a soccer ball, we are going to use the same method to teach you to throw a cricket ball.”

Accommodation is the process that occurs at the child’s end of the process. A child learning a new task effectively will modify or their internal patterns to “accommodate” the new information; “o’ yeah, I remember learning to kick the ball, but now I am throwing, how can I use the same method to learn to throw.” The key to success of the assimilation and accommodation process is in the provision of cues and support provided by an instructor to the child.

2.8 (c) Learning Theory Models: Cambourne’s Conditions of Learning (2000)

The natural learning theories have been adapted from Cambourne’s (1988, 1995, 2000) theories applied to teaching children literacy skills within a classroom environment.

Figure 2.5 outlines the similarities between these learning theories used to teach children to read and write and the models covered in the previous section.
Learning principles associated with this theory have been used in teaching children to read, or to learn maths, or learn music. In particular they have been used to explain the learning of oral language. Every culture has an oral form of language which every member of that culture strives to learn. Sometimes this language is learnt against overwhelming handicaps, for example Helen Keller.

There is some evidence that the ability learn this behaviour is a function of the context in which it is learned. People learn complex things as a consequence of being immersed in a context that supports learning to talk, or other complex cultural knowledge and skills.

However, often the structure of the child’s classroom does not provide the same
natural learning. Most classrooms do not offer the same mix of the conditions shown in figure 2.5 above, especially with respect to approximation. Unfortunately an environment in which approximations are regarded as "mistakes to be avoided" is not one that learners find comfortable, so they choose to avoid the activity in order to avoid the risk of making a mistake.

For example, when children stumble over their words when learning to speak, they are not corrected or laughed at or placed in a threatening or demeaning situation. The fact that our children all tend to learn something as complex as their native language so successfully and easily suggests that a natural theory of learning might be worth serious consideration.

Over a long period of time, the human brain has evolved so that it learns most effectively under these conditions. When this natural model is deviated from, the complexity of learning is increased. This type of learning has been attempted and proved successful in the classroom by Cambourne (1988). It was found that when certain learning conditions were applied, not only did the children learn with more ease, but they became much more powerful readers and writers. This model of learning has also been supported in studies involving teaching children mathematics (Stossegger and Edmunds et al, 1984) learning the violin (Suzuki, 1969), children learning complex computer games (Gee, 2002).

The convergence of these studies with Cambourne's (1988) original theory suggests that there is a single, unified learning process with which the brain is most comfortable.

The conditions which make this learning possible will now be outlined. Each condition will be described in turn and an example of this condition will then be applied to physical activity. A review of a number of prominent studies in children's physical activity will then be conducted to determine if these learning conditions have been implicitly embedded in previous physical activity studies.
2.8(c)(i) Natural Learning Conditions: Immersion

To immerse children who are learning a new skill, whether it be reading or writing or physical activity, learners must be “flooded by, saturated with, and steeped in” that which they are expected to learn. (Cambourne, 1995)

An example of immersion in everyday life is that new born babies need to be surrounded by people who are talking and encouraging them in the acquisition of verbal skills.

An application of immersion to teaching children about the importance of remaining physically active physical active would be immersion in a culture of family, peers and role models exercising or enjoying being physically active, accompanied by aural saturation of members of this culture talking about the joy of being physically active.

2.8(c)(ii) Natural Learning Conditions: Demonstration

Learners acquire concepts through seeing, hearing, witnessing, experiencing, feeling, studying or exploring processes and products modelled by skilled persons.

An application of demonstration to life would be babies acquiring language by attending to spoken language modelled by care-givers and witnessing the resulting actions brought about by that language.

An application of demonstration to physical activity would be parents, peers, role models, coaches etc. modelling physical activity participation and demonstrating skills. It is important to remember that the demonstrator does not have to be experienced at the particular skill they are demonstrating. Often lacking of skill can assist with showing children that even adults have to go through a learning process that involves attempting, failing and attempting a skill again. Parents, carers, peers, role models should be encouraged to take children to sporting events that family are involved in, so children can witness adults attempting and valuing physical activity skills. Family members, teachers, coaches etc. can also collect, display physical activity promotion material.

This learning condition has been researched thoroughly in the exercise field and is the most common condition applied to children’s exercise programs. The effects or
demonstration or modelling can be both negative and positive on a child’s likelihood to be physically active. It has been noted that less active parents have less active children (Moore et al., 1994).

Observing the performance of others is another form of demonstration which can teach children skills. This is sometimes known as “observational learning”. Inhibitory and dis-inhibitory effects act to strengthen or weaken inhibitions about previously learned behaviours. Response facilitation effects occur when others’ actions serve as social prompts, response cuing for previously learned behaviours.

Godin and Shepherd (1984) found a strong correlation between the strength of seventh to ninth graders, and their fathers’ current physical activity level. Gottlieb and Chen (1985) found that parental exercise levels were directly related to the frequency of children participating in exercise. Baronowski et al. (1984) found that most fathers were absent during the periods that their children were physically active, therefore minimising the chance for them to be physical activity models. Parents may exert direct influence on children’s physical activity through encouragement, discouragement, pressure and direct prompts to promote or inhibit activity. Parents have control of this teachable window.

Direct social influence prompts by parents may be effective at some ages and not at others, due to children entering broader social networks at different ages (Lewko and Greendorfer, 1982). Parents may also not be aware of the damage that nagging and pressure can cause.

Klesges et al (1996) noted that parents of overweight children often respond differently to their children than parents of lean children. Parents of obese children provide less prompts and fewer reinforcements for exercising than parents of lean children. Parents may even actively suppress a child’s attempt to exercise (Waxmann et al. 1980). This may be out of fear or embarrassment of their child, but a parent’s reluctance for a child to participate in physical activity can often become a child’s excuse not to attempt to exercise. This overlaps with the next condition.

2.8(c)(iii) Natural Learning Conditions: Expectation
Messages from role models convey the belief that all learners can and will learn receptive and expressive language or skills. Adults communicate their confidence to the learner that he/she is capable of learning and that this learning will occur. Parents and significant others always expect and anticipate that their babies will learn to talk.

An application of expectation to physical activity is teachers and coaches communicating that every student is capable of learning to be physically active whilst also communicating that every student will learn to be physically active. A classic example of removing this learning condition from a physical activity lesson plan would be to allow a student to sit out for the lesson because they are not confident to participate or “too tired”. Although the teacher or coach believes they are doing the correct thing by allowing the child to sit down, they are actually removing the expectation or belief that this child is capable of completing the lesson, which in turn will transfer to the child’s self esteem in the activity.

Bandura’s (1977) social-cognitive theory regarding inclination to exercise combines cognitive, behavioural and environmental factors. This theory suggests that personal factors, such as exercise preference, competency and personal attributes, interact with behaviour and cognition, and are all determinants of each other. Taylor et al. (1985) outlined a mutual interaction that is combined with other factors associated with family influence, such as the home environment, parental cognition and behaviours, and child cognition and behaviours (Taylor et al., 1985). These researchers explain that this model outlines the following issues:

A child’s exercise behaviour can be influenced directly through parents (e.g. Supplying a command);

A child’s exercise behaviour can be influenced indirectly by parents (e.g. Purchasing and making available equipment for exercise);

Parents’ cognition can only affect children when mediated by some form of parental behaviour (e.g. Parents intent to exercise);

A child’s behaviour can affect a parent’s behaviour.
These behaviours all influence the culture of the family and the family’s likelihood to create a culture which promotes physical activity. This aspect of social-cognitive theory is probably the most important when targeting children for exercise programs that parents are unable to become directly involved in. If children are able to learn why they are exercising and enjoy the experience, then a cyclic process by which children encourage parents to adopt physically active lifestyles, may evolve.

Bandura’s social-cognitive theory also refers to expectations and anticipatory aspects of behaviour (Bandura, 1977). This means that an individual anticipates many aspects of a situation and generates expectations before the act is carried out. These expectations can be developed from observing others acting out a particular behaviour, previous experiences, or hearing others talk about similar situations. Family environments and conversations can create normative expectations in children before a child has acted out a particular behaviour (Taylor et al., 1985).

Family environments can also predetermine the identity options for the child. Expectations can be influenced by conditions placed on exercise behaviour such as saying “you can play as long as you don’t get dirty” or “don’t hurt yourself whilst playing”. Active children are more likely to report that their parents and friends expect them to be physically active (Godin and Shepherd, 1984).

Simons-Moreton et al. (1987) suggest that adult disinclination to exercise is linked to a lack of enjoyment in physical activity during adolescence. It was also suggested that physical exercise programs that are modified to be enjoyable at a young age could enhance intent to participate in physical activity. Social cognitive theory suggests that rewards or incentives be used as motivators to exercise. Families can offer respect and approval as incentives for children to exercise. The family can also present perceived barriers to exercise, where time constraints and family obligations come between a child and a physically active lifestyle. Parents’ attitudes can affect children’s physical activity behaviours through modelling and the social environment they create for a child to be active within.

Bandura’s social cognitive theory suggests that individuals who see themselves as capable of achieving a particular outcome (perceived self-efficacy) will be more likely
to try to strive for these achievements. Bandura (1977) believes that in order for people to believe they can achieve an outcome, health messages need to be modified so they instil individuals with the belief that they can change their health habits. This is especially important with children beginning exercise programs (Worsley et al., 1984). Programs for children need to enhance self-esteem. Ferguson et al. (1989) found a significant positive correlation between self-esteem and intent to exercise. They suggested that “programs which chart progress towards fitness goals and teach students exercise programs they can engage in, independent of their skill level, can enhance self esteem” (Ferguson et al., 1989, pp. 115). Students who perceived exercise as beneficial, who exhibited positive feelings about physical education, who had good self-esteem levels and who perceived themselves as being able to maintain commitments, were more likely to intend to exercise in the future than those who exhibited negative attitudes during childhood (Martens, 1996).

Many social problems suffered by children result from their failure to develop positive perceptions about themselves in their social environment or school (Martens, 1986). Children learn quickly during their early years that their worth in public situations is often associated with achievements. In regard to physical activity, talent and athleticism are often rewarded in front of their peers, instilling in children the belief that self-worth in exercise is gained if one possesses these qualities. Children who do not possess these qualities will turn to other activities to gain self-worth, such as being the class clown. Children will develop a range of complex behaviours in order to protect their self-worth, using avoidance or attention-seeking acts to distract attention from their athletic inadequacies. Physical activity programs for children need to develop methods to enhance the self-worth in children before they are asked to complete activities that are beyond their capabilities. Consider the following examples that many people involved in teaching or coaching children may have experienced:

Children are often asked to complete exercises and sports that are too difficult both physiologically and skill-wise for them. These children are then asked to complete similar sports or activities as adults, even though they have not learned the skills required for them as children.

Children are often thrown into competitive sports programs before they have acquired the game related skill or the psychological development to make
comparisons between themselves and others. Children may tend to over analyse
why they lost or won a game if a majority of their time is involved in sport is also
involved in competition.

Most competitive programs focus on performing skills rather than skill
development. Therefore normal learning mistakes can become public
embarrassment.

Big steps in progress are often pointed out and rewarded, and are associated with
the number of wins or the number of goals scored, rather than the small steps in
progress that were learned along the way.

Children are often openly criticised for not performing as expected.

Children are often publicly evaluated and tested with rewards being given to those
who perform the top scores, rather than to those who improve upon their own
scores.

2.8(c)(iv) Natural Learning Conditions: Responsibility

Learners must be encouraged to make some decisions and exercise choices regarding
what aspects of learning they will engage with and what they will ignore.

An application of responsibility to life would be that language is acquired by babies
when they are developmentally ready for that learning to occur and when they choose
to engage in attempts at imitating language. Their early attempts at speech are
strengthened by encouragement from care-givers.

An application of responsibility to physical activity would be to encourage children
who are involved in physical activity to make choices and to explain why they have
made that choice. Teachers and coaches should provide opportunities to make
decisions about their own physical activity programs. An example of including
“responsibility” into a physical activity program is allowing children to be in control
of when to cross roads as part of a walking program.

Teachers and coaches should also model and demonstrate examples of “taking
responsibility” and “ownership” of their physical activity program.

Children will often chose activities that reduced their risk of failure, thereby providing
the opportunity to practise skills at their own discretion.
This leads to the next learning condition which is “approximation” or “making mistakes”

2.8(c)(v) Natural Learning Conditions: Approximation

An application of approximation to life would be babies must be free to experiment whilst learning to talk. “Babbling”, “baby-talk” and early attempts at speech are essential to learning language to allow children to become comfortable with attempting to create meaning (“Dat doyng (cup)”? or “No it’s a cup” in a non-threatening way and being encouraged to try again.

An application of approximation to physical activity would be encouraging children to understand that “Having a Go” (making an attempt and not getting it perfect at first) is fundamental to learning sporting skills.

Teachers and coaches should share stories of how they learnt sporting skills and the steps they took to learn them. Examples of their own failures and embarrassing moments are essential for children to become aware that this is a process that most people take to become skilled at an activity. Children should be made aware that mistakes help us adjust and refine our skills and the role that approximations play in improving physical activity performance should be highlighted.

2.8 (c) (vi) Learning Conditions: Employment/Practice

The next learning condition in “employment” or “practice” which ties in well with approximation.

An application of employment/practise to life would be babies needing opportunities to practice emerging language skills. Two types of opportunities are necessary: Those requiring social interaction with other language users, and those that are done alone (Cambourne, 1995).

An application of employment/practise to physical activity would be to provide opportunities for practice of physical activity skills at home and with and without supervision.

This would provide opportunities for learner-exercisers to understand the process of increasing fitness. It would also provide opportunities for learner-exercisers to
understand that exercise can be used in authentic and meaningful ways such as walking to school.

Employment also gives children the chance to approximate in a comfortable, non-threatening environment.

When children are "employing" or "practising" a skill in company, then the learning condition of "response" should be applied.

2.8 (c)(vii) Natural Learning Conditions: Response

"Response" allows learners to be provided feedback or information as a consequence of using their developing language or sports skills. Typically this feedback is given by significant role models (Cambourne, 1995).

An application of response to life would be a child receiving response from others to confirm the validity of the child's approximations of language. This response must be timely and appropriate to be effective.

An application of response to physical activity would be to pay close attention to learners' approximations during a sporting skill whether it be kicking a ball or running around the oval. Parents, coaches, teachers must be careful that the response is appropriate and timely so as to increase the child's confidence in skill. Response can be harmful if delivered in a negative, destructive way.

The aim of delivering an appropriate response or acknowledgment of child's efforts is to teach and re-teach concepts learner-exercisers do not yet have under control.

Reinforcement Principle (ref) suggests that children are more inclined to repeat behaviours for which they are positively rewarded, and to avoid behaviours for which they are not rewarded.
2.7 (c)(viii) Natural Learning Conditions: Engagement

Finally, if these natural learning conditions are applied, children should be engaged in the program.

Engagement can be defined as learners participating actively in their learning upon perceiving a meaningful need or purpose for the learning. Some risk-taking is necessary. Engagement is the central condition of learning which facilitates and interacts with all other learning conditions. Without it, all other conditions are weakened.

An application of engagement to life would be that engagement in speech occurs when the baby perceives potential value or authentic purpose for communication to take place. The child feels it is safe to “have a go” or take a risk. He/she is capable of learning what has been demonstrated. The child understands the reason for completing a task and is mentally and physically involved in the activity.

An application of engagement to physical activity would be children understanding the relevance to their lives of why it is important to be physically active and making a choice to be active. To achieve engagement in a lesson plan the teacher or coach should tell personal stories about becoming fit and make programs mentally and physically stimulating by including activities that children need to think about and contribute too.

2.9 (a) Modifying the Content of Children’s Physical Activity Programs: Aerobic Exercise Modifications

Hills and Wahlqvist (1994) indicated that ov/ob people are less likely to participate in regular exercise than lean people are, and if they do take up a program, the chances of them adhering to a specific program are fairly low. Prolonged vigorous physical activity is one of the most difficult exercise modes for untrained, non-obese people to complete. It appears unreasonable, therefore, to expect untrained, obese people to adhere to similar programs, especially considering the increased physical problems that accompany ov/ob. It is for this reason that exercise protocols need to be developed to cater for the needs of individual capabilities and body types.
A strategy to address this issue could be to design activity programs in the same way programs are delivered to both untrained healthy subjects and untrained injury rehabilitation subjects. Activities that are contraindicated in rehabilitation are considered and eliminated before program delivery. Contraindicated exercises and activities should be considered before structuring programs for obese people. Prescribing a program of long vigorous exercise for an obese individual can result in non-participation due to reduced enjoyment or injury, which in turn will result in fear of attempting to exercise, or inability to exercise, and therefore further weight gain. What then is the answer when it comes to prescribing exercise programs for the obese population?

Blair et al. (1993) attempted to find a solution to this problem by comparing the effects of several short bouts of exercise with one long bout per day. It was hoped that such a program would enhance exercise adherence, cardio-respiratory fitness and weight loss in ov/ob adult females. Two groups received the same behavioural treatment and dietary instructions. Both groups were instructed to begin a 20-week exercise program consisting of five days per week of aerobic exercise, primarily walking. Duration of exercise was set to a minimum of 20 minutes per day for four weeks. Thirty minutes per day were prescribed for the next four weeks, and 40 minutes per day for the remaining 10-12 weeks. The Long Bout (LB) group performed the specific duration of exercise in one continuous bout, whilst the Short Bout (SB) group performed the specific duration of exercise in multiple 10-minute bouts of exercise per day. Results for this study indicated that the SB group had spent greater total time exercising as well as spending more days per week exercising. There was an increase in maximal oxygen consumption in both groups and a decrease in body weight and BMI in both groups, with the SB losing 8.9kg and LB losing 6.4 kg. Such findings suggest that short bout training can (and should) be an integral part of most daily routines, with one session being completed in the morning, one at lunchtime and one in the evening. Data such as these support the concept of multiple short-bouts of exercise in an effort to assist obese subjects in weight loss and adherence to exercise programs.
2.9 (b) Modifying the Content of Children’s Physical Activity Programs:

Including Resistance Training

In sedentary individuals, the Resting Metabolic Rate (RMR) is considered to be the best predictor of 24-hour energy expenditure, as it accounts for 60-70% of total metabolic activity of tissues (Maffies et al., 1993). Children classified as obese (>120% of ideal weight for height) have a higher RMR than lean children (Maffies et al., 1993). These results suggest that obese children possess a greater amount of highly metabolic active tissue. Many weight reduction programs consist mainly of energy restriction, resulting in a decrease in metabolic active tissue (Trembley et al., 1995). As previously mentioned, a substantial proportion of weight loss is attributed to a loss in Lean Body Mass (LBM), leading to an overall decrease in metabolic rate (Ballor et al., 1988). The percentage of LBM lost during weight loss can range from as little as 15% of total mass loss during mild caloric restriction, to 50-70% of total mass loss during periods of semi-starvation (Ballor et al., 1988).

Aerobic exercise has also been associated with significant losses in LBM in studies on adults (Ballor et al., 1988). Resistance exercise has shown positive gains in LBM and, until recently, has not been used as a means of treating ov/ob. With emphasis being placed on preservation or possible gains of LBM, resistance training has been introduced as a form of weight reducing exercise. Resistive exercise will not result in as much total energy expenditure as aerobic exercise, but it does increase LBM (Tremblay et al., 1995). Recent studies have attempted to combine resistance training with other methods of weight reduction, such as dietary changes and aerobic exercise, or a combination of all three. Donnelly and Jacobsen (1988) reported that combining resistance training four times per week with endurance training four times per week, in conjunction with a low-calorie diet, preserved more LBM in obese women than performing the endurance component of the program only. Fat mass represented 76% of the body weight lost in the endurance group, while in the resistance training group it represented 86% of body weight lost. Ballor et al. (1988) pointed out, however, that energy restriction and weight training act independently, energy restriction decreasing body fat and weight training maintaining and/or increasing fat free mass. Therefore, in the Donnelly and Jacobsen (1996) study, the weight-training
component of the program maintained or increased fat free mass, which in turn assisted in increasing the rate of fat metabolism, or mass lost as fat.

Ozmun, Mikesky and Surburg (1994) found improvements in neural activation, which would transfer to better skill and control for involvement in many components of physical activity. It was also found that children involved in resistive training also displayed an increase in flexibility, which would also transfer to ease of involvement in other areas of physical activity involvement. This increase in flexibility was contributed to the stretching regime that is encouraged following resistive training. Holloway (1998) noted that a positive increase in self-esteem can also be a result of children being involved in an alternative activity such as resistive training.

2.9 (c) Summary of Modifying the Content of Children’s Physical Activity Programs

Exercise programs for obese children should include the following modifications:

Long bouts of cardiovascular exercise should be replaced with multiple short bouts (Blair et al., 1996).

A combination of cardiovascular exercise and resistive training should be applied to weight management programs to promote an increase in LBM, which will in turn increase total daily energy expenditure (Ballor et al., 1988; Donnelly and Jacobsen, 1996).

2.10 Past Childhood Obesity Prevention and Treatment Programs

2.10 (a) What are the Difficulties Associated with Conducting Childhood Obesity Prevention and Treatment Programs?

In theory, the treatment of ov/ob appears to be quite simple. The achievement of a negative energy balance should result in fat loss by ensuring that more energy is expended rather than ingested. In practice, this type of treatment is difficult to implement because of the complexity of the many variables that contribute towards ov/ob and the multitude of factors that are obstacles to its control. According to Bjorntorp (1992), such obstacles include:
• poor adherence to recommended procedures
• poorly defined procedures
• lack of follow-up after initial weight loss.

Bjorntorp (1992) further argued that current therapies for ov/ob have predominantly focused on immediate weight loss as the main phase of therapy and tended to ignore any significant concentration on the habits that led to gains in weight (Bjorntorp, 1992). Studies like that of Bjorntorp highlight what seems to be a serious illogicality in such therapies, namely the emphasis on treating only the results of complex habits that have developed over a number of years, rather than the deeper, long-established causes of ov/ob. With treatment being focused only on losing the weight, but not the habit, Stunkard’s (1967) edict, that obese patients will regain their lost weight within a short time after treatment has ceased, is continually borne out (Wilson, 1994). Wilson’s (1994) data showed that 90-95% of adult obese patients will return to their baseline weight after five years following dietary and behavioural treatment. Although this relapse may be held off for one to three years, the slip back to baseline weight is almost inevitable without follow up treatment (Wilson, 1994).

Most of the literature pertaining to children’s obesity interventions, seems to have ignored the role that the culture that a child has matured in, might play in the origins of ob/ov. Typically most exercise programs and interventions for children have failed to take an holistic view of the origins of ob/ov, often ignoring the role that learning plays in the development of attitudes towards diet, exercise and life style, and the subsequent behaviours which result from such attitudes. Rather than view ov/ob merely as a mix of genetic and/or physical pre-dispositions, a holistic view would frame it more as a problem of cultural learning, and seek to exploit such learning in ways that would help children take control and change those aspects of their cultures so that they can ultimately take control of their exercise behaviour.

It is hoped that by reviewing both the culture and the content of these interventions, researchers can be made more aware of the “gaps” that are evident in exercise programs for children.
2.10 (b) Applying Natural Learning Theories to Past Childhood Obesity Prevention and Treatment Programs

This section will provide a brief outline of the studies reviewed for the paper and will highlight those studies that applied 1 or more of the natural learning conditions. Each intervention is awarded a 1 point for each learning condition applied and 1 point for modifying a component of the intervention to suit overweight children. In turn, each intervention was deducted a point if a learning condition is not applied, which in turn removes the power of acculturating the family or school or sporting environment.

2.10 (b)(i) Study by Gutin et al. (1999)

Components of the Intervention/Study

76 obese children aged between 7-11 years were involved in the 4 month after-school intervention. Children were transported to their place of exercise after school 3 days per week. The program involved a combination of gym equipment and games. Children were exercised wearing heart rate monitors and were exercised on each piece of equipment for 5 minutes max.

Heart rates were to be maintained above 150 beats per minute.

1 point was awarded for every minute kept above 150 beats. Children were given $1 for attending each session and $100 for attendance pre- and post- intervention assessments. Games were of low skill level and encouraged team building skills and active rest was encouraged.

Results of Intervention

Although children were increasing physical activity during school hours, their spontaneous daily activity did not decrease. Comments indicated that the children enjoyed equipment but preferred the games and the social interaction fostered by the games. Children showed a significant decrease in BMI and increase in levels vigorous physical activity.

Evaluation of the Design and Delivery of the Intervention

The intervention involved short bouts of activity on equipment and games were of low skill level, which is a good example of modifying the physical components of the program. Therefore modification was applied to this intervention. Staff were
instructed to demonstrate all activities.

Games involved team work and participation rather than competition fostering social interaction and removing the children from win/lose situations. This assists with the “Have a Go” attitude. Therefore expectation was applied as the children were expected to assist in team work.

Teams were constantly changed so as to prevent boredom and constant failure.

Constant heart rate monitoring provided constant feedback therefore response was applied to the program and responsibility was applied as the children were expected to maintain a heart rate of 150 beats or more. Children were therefore engaged in the exercise bout as they needed to be consciously aware of their heart rates and why it is important to remain at this heart rate. Children were also given a homework program to practise/employ.

The intervention provided transport, which removed responsibility from the parents.

Children were awarded prizes and monetary incentives for active participation therefore applying response to the intervention.

The program however did not involve immersion as there was little family involvement required.

In summary, the following learning conditions were applied to the Gutin intervention:
Response, Expectation, Responsibility, Engagement, Demonstration, Employment

Points allocated for modifying content: 1

Total Score: 7

2.10 (b)(ii) Study by Gortmaker (1999) The Planet Health Program

Components of the Intervention/Study

641 intervention children and 654 control children were used in this school-based intervention utilising school time and resources. The ratio of boys to girls was 52:48 respectively.

The intervention focussed on 4 subjects during Physical Education classes. It was an inter-disciplinary program combining exercise with maths and science classes, suggesting the children were mentally engaged.
These sessions included information about decreasing television viewing, decreasing the consumption of high fat foods, increasing consumption of fruit and vegetables and increasing vigorous activity. The intervention utilised existing staff without staff training in the area of children and physical activity.

The intervention also focused on decreasing sedentary activity and increasing vigorous activity rather than attempting to find extra time for physical activity therefore the program applied modification.

Results of the Intervention.

No follow up was conducted on this study.

Evaluation of the Design and Delivery of the Intervention

In summary, the following learning conditions were applied to the intervention:

Engagement

Points allocated for modifying content: 1

Total Score: 2

2. (b)(iii) Study by Robinson (1999)

This six month intervention involved 92 children with a mean age of 8.9 years. It was a school-based intervention utilizing existing staff. The program aimed to decrease the amount of time children spent watching television. The program was delivered in 18 thirty minute lessons. Children were expected to watch no more than 7 hours of television per week. They were given the responsibility to turn the television off if they reached their budget and were expected to record the total number of hours they watched per week.

Assessments included a 2 day TV self report, parental and child self-reported estimates of time spent being sedentary and food eaten whilst watching TV therefore included family involvement (thus immersion.)

Results of the Intervention

Resulted indicated a decrease in the total hours children were involved in sedentary activity.
Evaluation of the Design and Delivery of the Intervention

In summary, the following learning conditions were applied to the intervention:

   Expectation, Responsibility, Immersion

Total Score: 3

2.10 (b)(iv) Study by Ernst and Pangrazi (1999) : The PLAY program

This intervention attempted to change the behaviours of children and teachers. The main aim of the program was to decrease sedentary activity.

Activity was regarded as any activity rather than sitting therefore modifying the types of activity the children could participate in and placing the expectation that all children can be active.

Weeks 2-4 teachers were involved in modelling and participating in program. Therefore the classroom was immersed in the change as both teachers and children were expected to be involved in the change. Teachers were also provided with teaching ideas and cards to structure lesson plans from.

Weeks 8-12 children were given responsibility for recording their physical activity they completed in a handbook rather than be instructed.

Evaluation of the Design and Delivery of the Intervention

In summary, the following learning conditions were applied to the intervention:

   Immersion, Demonstration, Responsibility, Expectation

Total Score: 4

2.10 (b)(v) Study by Epstein et al. (1996)

This intervention was open to all ages and was an evaluation of an existing clinic based program offered to public.

Families could be involved in the existing program for 8-26 weeks. The program involved families being consulted as a family every 6 months as a follow-up therefore involving and immersing the family in the intervention.

Treatment meetings included weigh-ins and information quiz, thus ensuring all family
members were engaged in the process. Families were expected complete “habit books” for self monitoring of eating and activity levels therefore placing responsibility on the whole family to record their habits. Homework assignments were also given, allowing the families to employ and approximate any family changes.

Families are also seen separately and presented information to each other in child and parent groups.

The TRAFFIC LIGHT DIET was also used which is a modification of the existing food pyramid.

Children and parents were given responsibility to make a choice of activities at different MET levels to complete at home. Each activity had a different “point” for families to earn activity points, an example of response.

Evaluation of the Design and Delivery of the Intervention

In summary, the following learning conditions were applied to the intervention:

Response, Expectation, Responsibility, Engagement, Demonstration, Employment, Responsibility

Points allocated for modifying content: 1

Total Score: 8

2.10 (c) A Summary of Popular Obesity Prevention and Treatment Programs

Many obesity prevention and treatment programs and interventions have been conducted. Table 2.7 outlines some of the past interventions and the most beneficial conclusion drawn from each study.
Table 2.7  Common Factors Drawn From Successful Obesity Prevention and Treatment Programs

<table>
<thead>
<tr>
<th>Author</th>
<th>Common Factor Drawn From Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwyer et al., (1983)</td>
<td>A daily exercise session as short as 15 minutes</td>
</tr>
<tr>
<td>Epstein et al., (2000)</td>
<td>Decreased time spent doing sedentary activity</td>
</tr>
<tr>
<td>Epstein et al., (2000)</td>
<td>Reinforcing time spent not engaging in sedentary activity, rather than punishment for not being involved in physical activity</td>
</tr>
<tr>
<td>(Epstein et al., (1994)</td>
<td>Regular meetings with children and parents to provide feedback to children and parents - monthly or bimonthly</td>
</tr>
<tr>
<td>Epstein et al., (1994)</td>
<td>Parental involvement in both diet management and exercise participation to increase the likelihood of success of an intervention or weight management program</td>
</tr>
<tr>
<td>(Epstein et al., (1994).</td>
<td>Programmed follow-up dates by the exercise scientist, dietitian and counsellors to promote compliance and to further educate each family about its progress</td>
</tr>
</tbody>
</table>

2.11 (a) What Might Constitute an Effective Intervention Program for Overweight and Obese Children?

One clear message from the literature so far reviewed is that exercise prescription for the obese or ov/ob child needs to be approached carefully and individually. While most studies have been conducted on adults, guidelines in exercise prescription for children must also be followed (Watson, 1995). The physiological differences between ov/ob children and lean children, such as increased load on joints and thermoregulatory issues, should be primary considerations when designing programs for ov/ob children.

Evidence has shown that exercise prescribed in multiple short bouts is just as effective as prescribing one long bout, and is perceived as easier to complete (Jakcic et al., 1995). This has also been reported as assisting in the maintenance of lean body mass during periods of calorie restriction (Ballor et al., 1988; Dudley, 1987; Wharlberg et al., 1989). An increase in lean body mass results in an increase in resting metabolic rate (Maffies et al., 1993). Much more research needs to be conducted into this growing area and more practical application of all theories is also needed. Special consideration should be given to applying techniques and ideas in home, school,
“natural” and cost-effective environments such as gymnasium and studios. With the prevalence of childhood ov/ob on the increase and the level of fitness of Australian children on the decline, application of methods is desperately needed, with school environments being the primary target or opportunity for this application to occur.

This all begs some critical questions which previous research into the field seems to have ignored. Why has there been a decline in levels of fitness in Australian children? Why have previous programs designed to treat the burgeoning increases in obese and ov/ob children tended to be ineffectual in reversing the trend? Why do the best brains in physical education feel continually frustrated at the failure of carefully designed curricula to impact on the problem? Why is all the effort they are putting into the design of their lesson plans not working? Could it relate to a lack of awareness of the teaching-learning processes and structures that need to be an integral part of any such intervention program? The next sections of this chapter address these issues.

From the literature above, the construction of an empathetic program that will be used for the experimental group of children in this intervention should contain the following activities:

- Activities that are less competitive;
- Long exhaustive activities could be modified and replaced with multiple short bouts of cardiovascular exercise;
- Limitations could be placed on heavy load bearing or loading activities;
- Repetitions for load bearing activities could kept between 10-20.;
- Children should instructed on how to complete activities and also WHY they need to complete the provided activities;
- Parental involvement should be encouraged and the process of “re-acculturation” should be developed and monitored throughout the program;
- Resistive exercise should be included with short bouts of cardiovascular exercise;
Children and parents should be offered responsibility to choose activities that are more suited to their culture and/or environment;

Timely reward and incentives should be offered;

A variety of activities such as gymnasium equipment should be incorporated into the program;

A reduction in sedentary behaviour should be rewarded.
2. CHAPTER THREE
METHODS

3.1 Introduction

As this study used two paradigms for the evaluation of the intervention, the methods section is divided into two sections.

Summative Evaluation

Formative Evaluation

Prior to the study, ethical clearance was obtained from the University of Wollongong Human Research Ethics Committee. All assessments conducted according to the Statement on Human Experimentation (National Health and Medical Research, 1994).

3.2 Methods Part 1: Summative Evaluation

The study involved the assessment of attitude, knowledge and participation in physical activity, as well as performance in a number of modified functional fitness assessments. The assessments were conducted prior to and following the delivery of two eight-week programs. The control program involved the delivery of traditional types of exercise, such as long bouts of cardiovascular exercise, high repetitions of weight bearing activity and competitive activities. The experimental group was exposed to a modified exercise program that involved multiple short bouts of cardiovascular exercise, limited weight bearing activity and non-competitive activities.

3.2(a) Subject Recruitment

Subject recruitment procedures were constrained for two reasons:

1. It was deemed unethical and stigmatising to advertise for a specific anthropometric build of subject. Subject recruitment was therefore left open to all children wishing to be involved in a physical activity program.

2. The advertising opportunities and venues through which promotion was conducted meant that some children who responded were either too competitive or too
fit, and would therefore gain little benefit from the program. In these cases the children were discouraged from entering the program.

**The Recruitment Process**

Over 25 organisations were contacted, offering exposure to more than 1000 children. The majority of subjects were referred through a local exercise clinic specialising in ov/ob children. The research involved three recruiting drives in order to recruit pilot study children, experimental and control group children. The recruitment process is described in detail at Appendix 4.

**Orientation/Information Session**

After initial contact, the children and their parents were invited to attend an information night to gain additional details about the research before committing to the assessment and intervention. The instructions supplied to the families who attended are included at Appendix 5. These instructions were designed to assist in the standardisation of the assessment protocols.

**Standardising the Assessment Procedures**

In order to produce reliable and replicable results, children and assessors/instructors were provided with guidelines to follow during the assessment and intervention protocols.

**Subjects**

The study involved two groups of children. Seven control group subjects (mean age = 7.57 years, SD= 1.62) and ten experimental group subjects (mean age = 8.2 years, SD= 1.38) were drawn from the Illawarra region.

The control group contained four subjects classified as ov/ob, whilst the experimental group contained six subjects classified as ov/ob.

Subjects were selected if they:

- were not involved in competitive sport more than twice a week;
- had not suffered from any major injury over the past year that might have affected their ability to complete the assessments and the physical activity program;

- did not suffer from a disorder such as cystic fibrosis, cerebral palsy or intellectual disability that may affect their ability to complete the assessments and the program.

Children involved in competitive sport more than three times per week were excluded from the study, as it was believed they would not receive any significant benefit from being involved in the program.

3.2(b) Apparatus

**Wind-resistant rowing ergometer**

During the initial testing session, children underwent a sub-maximal oxygen consumption test on a wind-resistant rowing ergometer (Concept II C). The rowing ergometer was chosen as the desired testing equipment as it offered a non-biased testing alternative. No children involved in the program had previous experience on the equipment or with the technique involved in using a rowing ergometer and as such all the children were equally unfamiliar with the rowing ergometer.

Experience gained from activities such as running and cycling may have given some children an advantage over others if tests were conducted on the treadmill or cycle ergometer, rather than the rowing ergometer. Another advantage of the rowing ergometer was that it needed no modification in order for the children to complete the test.
3.2(c) Questionnaires

Information about Children’s Attitude Towards Physical Activity (CATPA) and their involvement in Participation in Physical Activity (PPA) was obtained from participants through the use of two questionnaires. All questionnaires were read to the children by the relevant assessor. Children were provided with an answer board to point to and the results were recorded on an answer sheet by the assessor.

Children’s Attitude Towards Physical Activity (CATPA) Questionnaire

The CATPA questionnaire was adapted from Schutz and Smoll et al., (1985) and involved the children colouring stylised faces in response to questions regarding their feelings about certain aspects of physical activity. The questions covered areas such as socialisation and physical activity, meeting new friends and physical activity, vertigo and physical activity, grace and physical activity, and healthy image and physical activity. Each question was scored on a five-point Likert scale, with the unhappy face representing a one point value and the most joyful face representing five points. Neutral faces were allocated three points and a response of “I don’t know”, or a question not being understood, were allocated three points. The numbers representing the faces coloured in were then totalled for each individual to give an overall attitude score.

Participation in Physical Activity (PPA) Questionnaire

The PPA questionnaire was administered to the children and parents on their first day of testing and provided information about the habitual physical activity of the children. This questionnaire was adapted from Baronowski et al. (1984), and involved
the children providing data from lists within the questionnaire. The first question provided a list of sporting or physical activity clubs that the children might have visited at least three times in the past 12 months. The second question provided a list of sports or activities that the children might have attempted at least three times in the last 12 months. The final question asked the children to provide details of a regular physical activity in which they were involved on a weekly basis.

Children were asked the name of the activity, how long they completed the activity for (15 minutes, 30 minutes, 45 minutes, 1 hour), and how often during the week they completed the activity (1-2 times per week, 3-4 times per week, more than 5 times per week). The activities the children listed were given metabolic equivalent values or MET values. This was done by using MET equivalents provided by Ainsworth et al. (1993). These values were used, together with the total self-reported estimated time spent exercising per week, to provide an estimated total number of calories expended per week exercising. As a follow-up, at the completion of the intervention, the children were provided with a form listing opportunities for them to participate in a follow-up physical activity program containing the same activities they had completed during the intervention.

**Knowledge of Health and Fitness Concepts**

The children also completed a simple health and fitness concepts quiz. The quiz was structured so that the children answered true or false to questions that were read to them, by pointing to an answer board containing a cross, a tick or a question mark. Children were advised to point to a "question mark" if they were confused by the question or did not know the answer.
Each child was read the question a maximum of three times before moving onto the next question.

3.2(d) Anthropometry and Body Composition Measurements

Height, weight and girth measurements (waist and hips) were recorded. These measurements were then used to derive Body Mass Index and Waist-to-hip ratio.

**Height**

Height measurements were taken with subjects barefoot and standing on a hard surfaced floor area using a stadiometer and were taken to the nearest millimetre. Children were encouraged to inhale whilst standing upright at the time of measurement.

**Weight**

Weight was measured to the nearest 0.5 kg using electronic scales. The scales were placed on a solid surface and were calibrated before use. Children were instructed to stand upright, evenly distributing their weight and to look straight ahead whilst their weight was being recorded.

**Waist and hip girths**

Girth measurements were taken over clothes to the nearest 0.5 cm. Measurements were taken three times and the mean score was recorded. Measurements for the Waist was recorded in line with the umbilicus, and hip girth measurements were recorded in line with the anterior superior iliac spine.
3.2(e) Functional Fitness Measures

Muscular Strength and Endurance

Measurements of abdominal and back endurance were taken using a timed balance test, involving the children lying prone and balancing on their elbows and toes. Assessors demonstrated the position for the children, who were allowed one practice before being assessed. Maximum time held in this position was recorded to the nearest 0.5 second.

Leg Endurance

Leg endurance was measured using a timed assessment involving the children sitting with their backs placed against a solid wall, and holding themselves in a seated squat position against the wall. Assessors demonstrated the position for the children, who were allowed one practice before being assessed. The test required the children to be sitting against the wall with their knees and hips both flexed at 90 degrees. The upper leg was positioned parallel to the ground. To ensure repeatability and reliability of the test, the distance between the child’s heels and the wall was recorded, as well as the distance from the occipital protuberance to the floor. This ensured that the child maintained the same position during post-program testing. The children were allowed to place their hands on top of their knees for balance, and the maximum time the children could hold the position was recorded to the nearest 0.5 second. The test was terminated when the child’s position shifted.
Upper-body Strength and Endurance

Arm endurance measurements were obtained by counting the number of modified push-ups the children could perform in 30 seconds. A modified push-up involved children only lowering their upper body to the ground. The starting position involved the hip being flexed at 90 degrees and the shoulder flexed and abducted at 90 degrees. During the down phase of the push-up, the shoulders were abducted to 90 degrees and the elbow flexed to 90 degrees. Children were instructed to complete their push-ups to a given rhythm up so as to maintain reliability for retesting.

3.2(f) Cardiovascular Fitness

Cardiovascular fitness measurements were taken using a 6-minute rowing distance test and a 7-minute run/walk distance.

Sub-maximal 6-minute Rowing Distance Test

A three-stage, six-minute sub-maximal exercise protocol was performed on a wind-resistant rowing ergometer, and a Polar heart rate monitor was used to assess the heart rate response each minute. Maximum distance was recorded after six minutes. Modifications to this protocol, originally developed by Hagerman (1993) included the children performing three two-minute stages, rather than six-minutes without rest as it was believed that the children would not stay engaged in the process for six minutes without resting. The work output prescribed for rowing was designed to place the children in low (120-140 beats per minute), moderate (140-161 beats per minute) and vigorous (161-180 beats per minute) heart rate ranges as referred to by Seliger et al., (1974).
The children were asked to keep the stroke rate between 25-30 strokes per minute and to maintain a given work ratio for two minutes before having a 30-second rest. Heart rate was recorded every minute and these recordings were used to create a graph of the child's heart rate response to exercise. These graphs were later used as part of the educational component of the program.

During the 30-second rest the rowing ergometer was not reset and subjects were instructed regarding the next target heart rate and the wattage they were to maintain for the next two minutes. After the third and final two-minute interval, the heart rate and the time the children’s heart rate took to recover below 120 beats per minute was recorded. Average wattage for the total six minutes rowing, the total distance rowed and the average heart rate were calculated.

**Seven-minute Run/walk Test**

The seven-minute run/walk test was used as a distance trial, with the total distance the children ran/walked over the set time period being recorded to the nearest five metres.

This test was conducted as a group field test during the first intervention session. Markers were placed every five metres around a 100m (35m x 15m) course. The children were informed that the test was not a race against each other, and to cover as much distance as possible within the seven-minute period. A whistle was blown every minute, and following this signal the total minutes remaining were called out to the children as they completed the test. A final whistle was blown and a stop sign was held up instructing the children to stand still on completion of the test. The children’s distance travelled was recorded to the nearest five metres.
3.2(g) Flexibility

**Straight Leg Raise**

The range of motion (ROM) at the hip was tested using the straight leg raise test. A plurimeter was chosen as the measuring device, as it is regarded as a less biased test for children with short arms and long legs etc. During the straight leg raise the children were instructed to relax whilst the assessor performed a passive stretch of the hamstrings. Hips were to be kept flat on the solid surface, and the leg at the knee was to be kept as close to 180 degrees as possible. Assessors avoided leaning over the child during this test due to the invasive nature of the test. Final range of motion of the hip was achieved when the buttock could no longer remain on the ground, the leg could not remain fully extended, and/or the child indicated that they could feel the muscle stretching behind the knee. At no time was the child to be taken to the point of feeling pain. Both right and left legs were measured three times each and the average for each leg was recorded.

3.2(h) The Intervention Program (See Appendix 10)

**Control Group Program**

The control group intervention was designed to meet the Children's Lifetime Physical Activity Model (C-LPAM) suggest by Pangrazi and Corbin (1999) (refer to Table 2.22). This model suggests that children should by participating in a minimum of 30 minutes per day of moderate activity (heart rate of 140-160 beats per minute).
The main theme of the control program was that the children were delivered with programs that contained more long bouts of cardiovascular activities rather than breaking it up into 3 or more short bouts as suggested in the C-LPAM model.

Activities that were provided for control groups were adapted from resource manuals made available for primary school teachers such as, the 1996, 1997 and 1998 Personal Development, Health and Physical Education Syllabus.

Criterion for selection of activities for the control group were as follows:

- Activities that involved competing and racing;
- Activities that contained high repetitions of weight bearing exercises;
- Activities that involved long bouts of running without scheduled rest (long = over 5 minutes);
- Children were instructed on how to complete activities but not WHY they need to complete the provided activities;

Activities were still designed to be fun, but placed different physiological stresses on the body than in the experimental group.

Both groups were allocated two homework tasks per week to complete with the control group being provided with activities that only allowed minimum choice of activity and all activities to be performed in one session.

All activities in all components of the program were given a MET value, and total time spent exercising and MET value were allocated for each lesson plan. MET values were calculated using the MET equivalents provided in Ainsworth et al. (1993). These MET values were then used to compare the approximate energy consumed between control lessons and experimental lesson plans. By doing this,
lesson plans were designed to consume equal amounts of energy, but to place varying amounts of physiological stress on the body.

**Experimental Group Program**

The experimental group was provided with intervention sessions that also followed the guidelines suggested in the C-LPAM including allowing children to accumulate their total energy expenditure. Children in the experimental group were allowed to complete their class and homework activities in multiple short bouts.

Criterion for selection of activities in the experimental group were as follows:

Activities were less competitive;

Long exhaustive activities were modified and replaced with multiple short bouts of cardiovascular exercise;

Limitations were placed on heavy load bearing or loading activities;

Repetitions for load bearing activities were kept between 10-20.;

Children were instructed on how to complete activities and **also** WHY they need to complete the provided activities;

These were criteria were adapted from the Basic Concepts: Physical Activity and Children outlined by Pangrazi and Corbin (1999) refer to Table 2.3

Activities that were provided for the experimental groups were also adapted from resource manuals made available for primary school teachers such as, the 1996, 1997 and 1998 Personal Development, Health and Physical Education Syllabus but were modified to suit the protocols stipulated above.
Instructors were given strict instructions to maintain consistency with motivation and sticker rewards for both groups with the main difference between each group's instruction being the explanation of **WHY** the children were performing each activity. It was believed that providing explanations children were more likely to **engage** in their class and homework activities.

Once again, each session was given a MET value and was designed to utilise the same energy expenditure as the control group.

**Home Sessions including Homework**

Children were provided with two 15-20 minute home sessions to complete during the week, each of which was signed by a parent and returned the following week. The content of home sessions was related to the theme of the group (control or experimental). Each session was allocated a MET value. Children were also supplied with three simple homework questions structured to correspond with the knowledge of the exercise concepts questionnaire. Children from both groups were supplied with the same knowledge based homework questions.

3.2(i) **Data Analysis for Summative Evaluation**

All statistical analyses were conducted using the JMP statistical package.

The dependant variables, which analysed changes over time in the present study, included:

1) BMI score;
2) The sum of skin folds at four sites, height and weight;
3) The maximum distance covered in seven minutes;
4) The maximum distance rowed in six minutes;
5) Range of motion at both hips;

6) Abdominal, leg and upper-body strength/endurance.

Means and standard deviations for these dependant variables were calculated. Statistical analysis was performed using Analysis of Variance (p<0.05).

3.3 Methods Part 2: Formative Evaluation

The purpose of a formative evaluation is to “fit or adapt the program or curriculum to a local context or situation” (Guba and Lincoln, 1981, p51). The purpose of this particular formative evaluation is twofold. Firstly, it is to discover what qualitative (as opposed to quantitative) perceptions, such as ‘feelings-toward-involvement-in-the-program’ or, ‘attitudes-towards-involvement-in-the-program’ or ‘degrees-of-commitment-to-and/or-engagement-in-the-program’, were experienced by those who participated in the study. The second purpose is to use these data, in concert with any relevant quantitative measurements which were taken, to adjust, modify, refine, and change the program so that it can be more successful in achieving its aims.

According to Hill & Kerber’s (1967) book on analytical models for educational research, ‘a-general-questions-to-be-answered’ approach is most appropriate when the aim is to understand and describe how certain variables are distributed in a setting, rather than to prove any cause and effect relationships between them. The focal questions generated to guide this part of the evaluation were:

* How did the participants respond to the program in terms of such qualitative factors as attitudes, levels of engagement and perceptions of the value of the program?

  What concerns and issues about the program emerged?

  How can the program be improved?
In keeping with the need to employ a naturalistic, qualitative methodology for this part of the study, it was decided to avoid the use of formal, structured interviews and/or questionnaires to obtain the data to address these questions. This is because of the strong evidence that formal, structured interviews and/or questionnaires are prone to a number of serious threats to their validity. As Webb et al. Argue (Webb et al., 1961, p13), “Even when he (sic) is well intentioned and cooperative, the research subject’s knowledge that he (sic) is participating in a scholarly research may confound the investigator’s data” They identify four major classes of this kind of error, namely:

1. Awareness of being tested (the “Hawthorne Effect”);
2. Role selection (‘what kind of a person should I be as I answer these questions or perform these tasks?’);
3. The act of measurement, per se, as a change agent (the messages and biases communicated by the researcher as he/she explains the process and purposes of the interview and/or questionnaire);
4. Response sets (respondents are more likely to endorse a statement than disagree, endorse a strong statement than a weak or ambiguous one, and so on).

In other words, formal, structured interviews and questionnaires were rejected as a methodology because the evidence clearly shows they intrude as foreign elements into the setting in which they are used. They create, as well as describe, attitudes and perceptions and they elicit atypical roles and responses, depending on the way respondents interpret the situation in which they are given. In short, they are flawed instruments when they are the only instruments used to obtain data about, for
example, attitudes, perceptions, motivations, engagement and other qualitative variables.

Children will often answer what they think the assessor wants to hear, or what their parents or role models have suggested may be the correct answer.

For example, providing a child with a questionnaire that asks them or even their parents how much activity the children are involved in outside of schools hours may result in answered that are muddied by the subject or subjects' parent not knowing what the definition of physical activity is. Is it organised sport? Is it playing in the yard? Is it hanging out the washing?

Another example of the value of qualitative analysis within this project is the that children may return to re-enrol in a program that is similar to a program that has previously been provided for them, but this may not necessarily mean that they enjoyed the specific components of the program. It may be that the particular child enjoys physical activity despite the program content. The collection of field notes and comments allows the researcher to develop themes and patterns across components of the programs and to use the definition and discovery of these themes to evaluate the effectiveness of the program.

In this study, the data collection has been based on a theory developed by Webb et al. (1966 p36) in their monograph Unobtrusive Measures: Non- Reactive Research in the Social Sciences. In this monograph they define unobtrusive or non-reactive measures as “those pieces of data which are NOT specifically produced for the purpose of comparison or inference, but which are available to be exploited by the alert investigator”. It was hoped that through the use of these comments and field notes that
more appropriate wording of questionnaires or instructions for children may be developed.

3.3(a) Data Collection for Formative Evaluation

This stage will be discussed in terms of three categories defined by Hill & Kerber (1967). They suggest the stage of data collection may be discussed in terms of:

1. The conditions under which observations are to be made;
2. The instruments of data collection (Hill and Kerber, 1967, p.46);
3. The methods, or procedures, of making observations.

While they admit that these categories are both “arbitrarily chosen” and are “not mutually exclusive”, they also argue that they provide a “relatively direct and simple means of discussing the data collection element of the research model”.

3.3(b) Conditions Under Which Observations were Made

The conditions under which the observations were made can be summarised as “standardised administration” of several objective measurements. To ensure that observation measures were taken with as little bias as possible, the following steps were taken:

- the children were offered a maximum of only two verbal encouragements per session;
- the children were given an explanation of what they were going to do at the beginning of the session, and were offered time to ask questions concerning the content of their lesson plans before the session began. However, only experimental
group children were offered explanations of WHY they were performing each activity and how this activity can benefit their functional fitness development.

- comments and observations were recorded in table form at the end of each activity in each session, whilst the children were rehydrating;
- the children were offered time at the end of each activity to ask questions about the next activity;
- homework sheets were explained before being handed out, and the children were asked if they understood the homework questions.

3.3(c) Instruments of Data Collection

The non-reactive (or unobtrusive) data collection methods employed in this study were based on processes that were integral parts of both the experimental and the control programs. In this sense they were truly “pieces of data which [were] NOT specifically produced for the purpose of comparison or inference, but which [were] available to be exploited by the [alert] investigator” (Webb et al., 1966, p. 36). In this study, seven sources of such data were available and collected throughout the duration of the entire study. These were:

1. comments made in field notes during the assessment sessions;
2. comments made in field notes during the six teaching sessions in both the experimental and control programs;
3. personal goal setting by the children;
4. the number of sessions attended;
5. health history;
6. intention to re-enrol/actual re-enrolment;
7. weekly homework worksheets.
Table 3.1 provides an example of the Instructor's Report Sheet that was filled in after each class session and allows the instructors to record weekly feedback on the comments made by parents and the instructors' observations through the session.

Table 3.1 Session Report Card Completed By Instructors Following Each Class Lesson

<table>
<thead>
<tr>
<th>Please comment on the following areas at the completion of each class session</th>
<th>Comments or observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children in attendance</td>
<td></td>
</tr>
<tr>
<td>Number of children who completed homework tasks</td>
<td></td>
</tr>
<tr>
<td>Reasons offered as to why homework tasks were not completed</td>
<td></td>
</tr>
<tr>
<td>Voluntary feedback offered by children and/or parents on homework tasks</td>
<td></td>
</tr>
<tr>
<td>Voluntary feedback offered by children and/or parents on class sessions</td>
<td></td>
</tr>
</tbody>
</table>

3.3(d) Procedures for Making Observations

Each of these data sources was an integral part of the program, and was originally put in place to meet purposes to address the specific questions to be answered. For example, the field notes made during the assessment and teaching sessions were
originally designed to provide the researcher with a record of observations made during the different sessions forming part of the project. The primary purpose of these notes was to provide information which the researcher, in her role as teacher of the program, could use to make decisions about issues such as each child’s learning growth, or any individual modifications needed to each child’s level of activity. As they were observations made during sessions, they often included comments about the nature of the child’s degree of motivation, enjoyment and other behaviours, from which affective factors such as attitude, commitment and engagement could be observed.

On the other hand, one of the other data sources listed above – personal goal setting by the children – involved the homework worksheet components of the program. While the original intent of these homework activities was to enhance the learning and knowledge acquisition of the children in each program, the number and quality of the children’s responses also provided valuable insights. For example, their motivation for participating in the study, and the child’s understanding of the role and function of exercise in their lives. Table 3.2 summarises the ways in which these non-reactive data were collected and used.
Table 3.2 A Summary of the Sources and Uses of the Non-reactive Data Used in the Formative Evaluation

<table>
<thead>
<tr>
<th>Unobtrusive data source</th>
<th>Original purpose of data source</th>
<th>Extra data gained</th>
<th>What can be inferred from this data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Comments made in field notes during the assessment sessions.</td>
<td>To document how each child behaved during each session for the purpose of guiding how he/she should be treated in future sessions.</td>
<td>Comments, observations of salient behaviours which indicate reactions such as enjoyment, motivation, attitude etc.</td>
<td>Relative degrees of enjoyment, commitment, engagement, attitude, interest etc.</td>
</tr>
<tr>
<td>2. Comments made in field notes during the six teaching sessions in both the experimental and control programs.</td>
<td>To document how each child behaved during each session for the purpose of guiding how he/she should be treated in future sessions.</td>
<td>Comments, observations of salient behaviours which indicate such things as enjoyment, motivation, attitude etc.</td>
<td>Relative degrees of enjoyment, commitment, engagement, attitude, interest etc.</td>
</tr>
<tr>
<td>3. Personal goal setting by the children.</td>
<td>Part of homework &amp; worksheet component of program.</td>
<td>The nature and range of the goals the children identify.</td>
<td>Insights into motivations for participating in the program.</td>
</tr>
<tr>
<td>4. The number of sessions attended</td>
<td>Record of attendance for the purpose of motivation to attend, parental responsibility to make sure children attend and general participation rates in program.</td>
<td>Relative number of attendances and/or absences.</td>
<td>Insights into levels of interest in and commitment to the program, by both the children and the parents who had to bring them.</td>
</tr>
<tr>
<td>5. Health history.</td>
<td>Background information on each child is part of the documentation required by law. Also necessary for the design of individual programs.</td>
<td>References to past exercise and eating history, and involvement in team and/or individual activities, clubs, sporting teams etc.</td>
<td>Insights into parents' perceptions of and beliefs about their children's physical activity abilities, the importance of participation etc.</td>
</tr>
</tbody>
</table>

3.3(e) Data Analysis for the Formative Evaluation

The non-reactive data were analysed using the methods of constant comparison as described by Hodson (1991). This basically involved reading the data repeatedly, and searching for patterns, categories and themes that were pertinent to the questions being addressed. Examples from the analysis of these patterns will be presented in the results section.
3. CHAPTER FOUR
RESULTS

4.1 Summative Evaluation

The results chapter will be structured so as to provide the following information for each variable measured

- tabulated data of measures;
- graphical representations of significant data - between groups;
  - over time;
  - between groups over time;
- summary of results for Hypothesis #1 and #2 outlining significant findings.

A descriptive explanation of the results will be given in the discussion section of the thesis.

The summative evaluation section analysed the following variables using two-way ANOVA:

- attitude towards physical activity;
- knowledge of exercise concepts;
- participation rates in physical activity;
- anthropometric measures;
- muscular strength/endurance;
- flexibility measures;
- cardiovascular fitness measures.
4.1 (a) Hypothesis 1

After participating in the intervention, the children in the experimental group will show a significant improvement in:

- attitude towards physical activity;
- knowledge of exercise concepts;
- participation rates in physical activity. Table 4.1 below contains pooled data from the knowledge questionnaire and CATPA attitude questionnaire. The subject’s age and BMI are presented together with knowledge and CATPA attitude scores.

Table 4.1 Subjects’ Questionnaire Data (n=17)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>Subject’s BMI</th>
<th>Pre-Test Attitude Score</th>
<th>Post-test Attitude Score</th>
<th>Change</th>
<th>Pre-Test Knowledge Score</th>
<th>Post-test Knowledge Score</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>10</td>
<td>18.9</td>
<td>16</td>
<td>19</td>
<td>3</td>
<td>10</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>C2</td>
<td>8</td>
<td>25.9</td>
<td>16</td>
<td>19</td>
<td>3</td>
<td>11</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>C3</td>
<td>8</td>
<td>17.9</td>
<td>17</td>
<td>16</td>
<td>-1</td>
<td>8</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>C4</td>
<td>9</td>
<td>16.8</td>
<td>22</td>
<td>19</td>
<td>-3</td>
<td>7</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>C5</td>
<td>6</td>
<td>16.6</td>
<td>19</td>
<td>18</td>
<td>-1</td>
<td>8</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>C6</td>
<td>6</td>
<td>15.3</td>
<td>13</td>
<td>11</td>
<td>-2</td>
<td>7</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>C7</td>
<td>6</td>
<td>14.4</td>
<td>24</td>
<td>18</td>
<td>-6</td>
<td>9</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td><strong>7.6</strong></td>
<td><strong>17.9</strong></td>
<td><strong>18.1</strong></td>
<td><strong>17.1</strong></td>
<td><strong>8.5</strong></td>
<td><strong>10.8</strong></td>
<td><strong>2.2</strong></td>
</tr>
<tr>
<td>SD</td>
<td></td>
<td><strong>1.6</strong></td>
<td><strong>3.8</strong></td>
<td><strong>3.8</strong></td>
<td><strong>2.9</strong></td>
<td><strong>3.2</strong></td>
<td><strong>1.5</strong></td>
<td><strong>2.1</strong></td>
</tr>
<tr>
<td>E1</td>
<td>7</td>
<td>16.8</td>
<td>16</td>
<td>17</td>
<td>1</td>
<td>6</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>E2</td>
<td>6</td>
<td>15.7</td>
<td>16</td>
<td>18</td>
<td>2</td>
<td>8</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>E3</td>
<td>8</td>
<td>16.4</td>
<td>19</td>
<td>19</td>
<td>0</td>
<td>11</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>E4</td>
<td>8</td>
<td>21.2</td>
<td>21</td>
<td>22</td>
<td>1</td>
<td>10</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>E5</td>
<td>7</td>
<td>29.7</td>
<td>18</td>
<td>19</td>
<td>1</td>
<td>8</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>E6</td>
<td>10</td>
<td>23.5</td>
<td>19</td>
<td>19</td>
<td>0</td>
<td>8</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>E7</td>
<td>7</td>
<td>26.1</td>
<td>17</td>
<td>20</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>E8</td>
<td>9</td>
<td>29.7</td>
<td>19</td>
<td>21</td>
<td>2</td>
<td>10</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>E9</td>
<td>10</td>
<td>27.5</td>
<td>16</td>
<td>23</td>
<td>7</td>
<td>9</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>E10</td>
<td>10</td>
<td>26.1</td>
<td>21</td>
<td>23</td>
<td>2</td>
<td>10</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td><strong>8.2</strong></td>
<td><strong>23.3</strong></td>
<td><strong>18.2</strong></td>
<td><strong>20.1</strong></td>
<td><strong>1.9</strong></td>
<td><strong>8.4</strong></td>
<td><strong>11</strong></td>
</tr>
<tr>
<td>SD</td>
<td></td>
<td><strong>1.5</strong></td>
<td><strong>5.5</strong></td>
<td><strong>1.9</strong></td>
<td><strong>2.1</strong></td>
<td><strong>2.02</strong></td>
<td><strong>2.1</strong></td>
<td><strong>2.4</strong></td>
</tr>
</tbody>
</table>

100
4.1(a)(i) Attitude towards Physical Activity

Figure 4.1 illustrates that results for change in attitude towards physical activity indicated that after eight weeks of supervised exercise, the children provided with a modified program showed a more positive increase in attitude towards physical activity than children provided with traditional types of exercise (p=0.0368). Refer to Section 3.2(c).
4.1(a)(ii) Knowledge of Physical Activity

Figure 4.2 Average Pre-program and Post-program Knowledge Test Scores for Control (C) and Experimental (E) Groups

Pre-intervention Knowledge Scores

Post-intervention Knowledge Scores

Figure 4.2 above shows a significant improvement in knowledge of physical activity concepts in both the control and experimental groups after completing the intervention (p=0.0001).

4.1(a)(iii) Participation in Physical Activity

The following tables, Tables 4.2 and 4.3, present information regarding the physical activity expenditure of both groups. The average time involved in physical activity...
(not including school sport) for the control (C) and experimental (E) groups was 3.39 and 4.75 hours per week respectively. The most commonly visited club over the preceding 12-month period was a swimming club, whilst the most common activity attempted in the same 12-month period was also swimming. The most common regular activity performed on a weekly basis was athletics for the control group and swimming for the experimental group. The average energy expended per week expressed as calories/week for the control (C) group and experimental group (E) was 545 and 1286 respectively.
<table>
<thead>
<tr>
<th>Subject</th>
<th>BMI</th>
<th>Age</th>
<th>Total CAL/week</th>
<th>CAL/week/Kg</th>
<th>Activities clubs visited at least 3 times in the past 12 months</th>
<th>Activities attempted at least 3 times in the past 12 months</th>
<th>Activities involved in on a weekly basis</th>
<th>Time per week spent doing regular activity</th>
<th>Re-enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>18.9</td>
<td>10</td>
<td>729</td>
<td>18</td>
<td>Athletics club, Art group</td>
<td>Aerobics, athletics, roller-blading, bike riding, softball</td>
<td>Art, Athletics</td>
<td>1 hour 2 hours</td>
<td>y</td>
</tr>
<tr>
<td>C2</td>
<td>25.9</td>
<td>8</td>
<td>339.5</td>
<td>7</td>
<td>Surf club, Tennis Club, Swimming Club</td>
<td>Softball, soccer, swimming, tennis, walking</td>
<td>Tennis</td>
<td>1 hour</td>
<td>y</td>
</tr>
<tr>
<td>C3</td>
<td>17.9</td>
<td>8</td>
<td>306</td>
<td>9</td>
<td>Kinda-gym Church, Soccer club, Hockey club</td>
<td>Basketball, Kinda-gym roller-blading, bike riding, softball, tennis, walking, cricket</td>
<td>Bike Riding, Walking</td>
<td>3 x 0.5 hour, 5 x 0.25 hour</td>
<td>n</td>
</tr>
<tr>
<td>C4</td>
<td>16.8</td>
<td>9</td>
<td>470.4</td>
<td>17.8</td>
<td>Swimming club, Brownies, Dancing group</td>
<td>Bike Riding, swimming, roller-blading, softball, dancing, athletics</td>
<td>Brownies, Bike Riding</td>
<td>1 x 1.5 hours, 3 x 0.3 hour</td>
<td>n</td>
</tr>
<tr>
<td>C5</td>
<td>16.6</td>
<td>6</td>
<td>504</td>
<td>18</td>
<td>Cubs, Swimming club, Dancing group</td>
<td>Aerobics, swimming, walking, ball games, bike riding, soccer, beach games</td>
<td>Athletics, Joeys, Swimming</td>
<td>1 x 2 hours, 1 x 1 hour, 1 x 0.5 hour</td>
<td>n</td>
</tr>
<tr>
<td>C6</td>
<td>15.3</td>
<td>6</td>
<td>690</td>
<td>30</td>
<td>Soccer club, Swimming club, Athletics club</td>
<td>Soccer, ball games, swimming, athletics</td>
<td>Soccer Swimming</td>
<td>2 x 1 hour, 1 x 2 hours</td>
<td>n</td>
</tr>
<tr>
<td>C7</td>
<td>14.4</td>
<td>6</td>
<td>779</td>
<td>38</td>
<td>Soccer club, Martial arts club, Swimming club, Athletics club, Surf club, Basketball</td>
<td>Soccer, surf games, basketball, martial arts, walking, gymnastics</td>
<td>Soccer, Athletics, Martial arts</td>
<td>2 x 1 hour, 1 x 2 hours, 2 x 30 minutes</td>
<td>n</td>
</tr>
<tr>
<td>Mean</td>
<td>17.9</td>
<td>7.57</td>
<td>545.4</td>
<td>19.6</td>
<td>Swimming club</td>
<td>Swimming</td>
<td>Athletics</td>
<td>3.39 hour</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>3.80</td>
<td>1.62</td>
<td>189.8</td>
<td>11.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>BMI</td>
<td>Age</td>
<td>Total CAL/week</td>
<td>CAL/week/Kg</td>
<td>Activities clubs visited at least 3 times in the past 12 months</td>
<td>Activities attempted at least 3 times in the past 12 months</td>
<td>Activities involved in on a weekly basis</td>
<td>Time per week spent doing regular activity</td>
<td>Re-enrolled</td>
</tr>
<tr>
<td>---------</td>
<td>-----</td>
<td>-----</td>
<td>----------------</td>
<td>-------------</td>
<td>---------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>----------------------------------------</td>
<td>--------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>E1</td>
<td>16.8</td>
<td>7</td>
<td>960</td>
<td>32</td>
<td>Athletics club, Swimming club</td>
<td>Swimming softball, tennis, football, athletics</td>
<td>Swimming Athletics</td>
<td>2 x 1 hour 1 x 2 hours</td>
<td>n</td>
</tr>
<tr>
<td>E2</td>
<td>15.7</td>
<td>6</td>
<td>800</td>
<td>32</td>
<td>Athletics club, Swimming club</td>
<td>Swimming softball, tennis, football, athletics</td>
<td>Swimming Athletics</td>
<td>2 x 1 hour 1 x 2 hours</td>
<td>n</td>
</tr>
<tr>
<td>E3</td>
<td>16.4</td>
<td>8</td>
<td>702</td>
<td>26</td>
<td>Swimming club</td>
<td>Aerobics, bike riding, roller-blading, walking</td>
<td>Bike riding Swimming</td>
<td>5 x 0.5 hour 2 x 0.3 hour</td>
<td>y</td>
</tr>
<tr>
<td>E4</td>
<td>21.2</td>
<td>8</td>
<td>506</td>
<td>11</td>
<td>Brownies, Dancing, Music</td>
<td>Bike riding, cricket, roller-blading, dancing, walking</td>
<td>Dancing Brownies</td>
<td>2 x 1 hour 1 x 2 hours</td>
<td>y</td>
</tr>
<tr>
<td>E5</td>
<td>29.7</td>
<td>7</td>
<td>962.5</td>
<td>17.5</td>
<td>Swimmers, Brownsians</td>
<td>Walking, cricket, swimming, Kinda-gym, volleyball, dancing, waterpolo</td>
<td>Swimming Walking</td>
<td>2 x 1 hour 1 x 0.5 hour</td>
<td>y</td>
</tr>
<tr>
<td>E6</td>
<td>23.5</td>
<td>10</td>
<td>1527.5</td>
<td>44.9</td>
<td>Swimming club, Dancing club</td>
<td>Bike riding, swimming, walking, dancing, roller-blading, tennis, athletics</td>
<td>Dancing Jogging Bike riding</td>
<td>2 x 1 hour 5 x 0.25 hour 5 x 0.5 hour</td>
<td>y</td>
</tr>
<tr>
<td>E7</td>
<td>26.1</td>
<td>7</td>
<td>996.2</td>
<td>29</td>
<td>Soccer club</td>
<td>Soccer, bike riding, swimming, cricket, jogging</td>
<td>Soccer Jogging Bike riding</td>
<td>2 x 2 hours 5 x 0.15 hour 3 x 0.3 hour</td>
<td>n</td>
</tr>
<tr>
<td>E8</td>
<td>29.7</td>
<td>9</td>
<td>2464</td>
<td>44</td>
<td>Church club, Swimming club, Soccer group, Athletics club</td>
<td>Aerobics, soccer, football, swimming, athletics</td>
<td>Soccer Swimming</td>
<td>3 x 1 hour 2 x 1 hour</td>
<td>y</td>
</tr>
<tr>
<td>E9</td>
<td>27.5</td>
<td>10</td>
<td>1767</td>
<td>31</td>
<td>Brownies, Surf club, Martial arts club</td>
<td>Swimming, bike riding, martial arts, soccer, surf club, walking, skating</td>
<td>Martial arts Swimming Skating</td>
<td>2 x 1 hour 1 x 1 hour</td>
<td>y</td>
</tr>
<tr>
<td>E10</td>
<td>26.1</td>
<td>10</td>
<td>2175</td>
<td>37.5</td>
<td>Brownies, Swimming club, Dancing club, Music club</td>
<td>Drums, softball, swimming, dancing, roller-blading, tennis, walking</td>
<td>Drums, Roller-blading, Swimming</td>
<td>2 x 0.5 hour 3 x 1 hour 1 x 1 hour</td>
<td>n</td>
</tr>
<tr>
<td>Mean</td>
<td>23.3</td>
<td>8.2</td>
<td>1286</td>
<td>30.7</td>
<td>Swimmers</td>
<td>Swimming</td>
<td>Swimming</td>
<td>4.75 hours</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>5.5</td>
<td>1.5</td>
<td>662.4</td>
<td>12.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.4 Summary of Self-reported Estimated Energy Expenditure per Week (Calories/week): Control and Experimental Groups

<table>
<thead>
<tr>
<th>Subject</th>
<th>BMI</th>
<th>Age</th>
<th>Total CAL/week</th>
<th>CAL/week/Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>17.97</td>
<td>7.57</td>
<td>545.4</td>
<td>19.6</td>
</tr>
<tr>
<td>SD</td>
<td>3.80</td>
<td>1.62</td>
<td>189.8</td>
<td>11.0</td>
</tr>
<tr>
<td><strong>Experimental Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>23.3</td>
<td>8.2</td>
<td>1286</td>
<td>30.7</td>
</tr>
<tr>
<td>SD</td>
<td>5.5</td>
<td>1.5</td>
<td>662.4</td>
<td>12.8</td>
</tr>
</tbody>
</table>

Figure 4.3 Self-reported Estimated Energy Expenditure of Control (C) and Experimental (E) Groups, and Ov/Ob and Lean Children
Figure 4.4 Number of Children Wishing to Re-enrol in a Similar Program at the Cessation of the Intervention (n=17)

Figure 4.4 above demonstrates that a greater percentage of children from the experimental group were interested in re-enrolling in a similar physical activity program after the cessation of the intervention.

Figure 4.5 Number of Overweight, Obese and Lean Children Wishing to Re-enrol
Figure 4.5 above presents another interesting observation, namely that children classified as ov/ob or obese from both groups were more interested in re-enrolling at the cessation of the intervention.

4.1(a)(iii) Summary of Results for Hypothesis 1

After participating in the intervention, the children in the experimental group showed a significant positive improvement in attitude, knowledge of exercise concepts and participation in physical activity.

Table 4.5 Tabulated Results for Summative Analysis for Hypothesis 1

<table>
<thead>
<tr>
<th>Variable/ analysis</th>
<th>Between groups</th>
<th>Over time</th>
<th>Between groups over time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P=</td>
<td>P=</td>
<td>p=</td>
</tr>
<tr>
<td>Attitude</td>
<td>0.21</td>
<td>0.49</td>
<td>0.04</td>
</tr>
<tr>
<td>Knowledge</td>
<td>0.99</td>
<td>0.0001</td>
<td>0.75</td>
</tr>
<tr>
<td>Physical Activity</td>
<td>P=0.01</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Participation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.1(b) Hypothesis 2

The experimental group will achieve an equal or higher level of improvement on each of the following functional fitness measures:

- anthropometric measures;
- muscular strength and endurance;
- flexibility measures;
- cardiovascular measures.
4.1(b)(i) Anthropometric Measures

The age, height, weight and Body Mass Index (BMI) of participants pre-program and post-program are presented in Table 4.6 below.

Table 4.6 Anthropometric Measurements of Subjects in Control (C) and Experimental (E) Groups (n=17)

<table>
<thead>
<tr>
<th>Subject and Group</th>
<th>Pre-weight (kg)</th>
<th>Post-weight (kg)</th>
<th>Change in Weight (kg)</th>
<th>Pre-height (cm)</th>
<th>Post-height (cm)</th>
<th>Change in Height (cm)</th>
<th>Pre BMI</th>
<th>Post BMI</th>
<th>Change in BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>40.5</td>
<td>40</td>
<td>-0.5</td>
<td>146.6</td>
<td>147.5</td>
<td>0.9</td>
<td>18.9</td>
<td>18.4</td>
<td>-0.5</td>
</tr>
<tr>
<td>C2</td>
<td>48.5</td>
<td>48</td>
<td>-0.5</td>
<td>136.6</td>
<td>137.2</td>
<td>0.6</td>
<td>25.9</td>
<td>25.5</td>
<td>-0.4</td>
</tr>
<tr>
<td>C3</td>
<td>34</td>
<td>34</td>
<td>0</td>
<td>137.5</td>
<td>140.2</td>
<td>2.7</td>
<td>17.9</td>
<td>17.3</td>
<td>-0.6</td>
</tr>
<tr>
<td>C4</td>
<td>26.5</td>
<td>27</td>
<td>0.5</td>
<td>125.6</td>
<td>128</td>
<td>2.4</td>
<td>16.8</td>
<td>17.1</td>
<td>0.3</td>
</tr>
<tr>
<td>C5</td>
<td>28</td>
<td>27.5</td>
<td>-0.5</td>
<td>128.9</td>
<td>129.5</td>
<td>0.6</td>
<td>16.6</td>
<td>16.3</td>
<td>-0.3</td>
</tr>
<tr>
<td>C6</td>
<td>23</td>
<td>23</td>
<td>0</td>
<td>122.5</td>
<td>124.8</td>
<td>2.3</td>
<td>15.3</td>
<td>13.8</td>
<td>-1.5</td>
</tr>
<tr>
<td>C7</td>
<td>20.5</td>
<td>20.5</td>
<td>0</td>
<td>119.5</td>
<td>121.8</td>
<td>2.3</td>
<td>14.4</td>
<td>13.8</td>
<td>-0.6</td>
</tr>
<tr>
<td>Mean</td>
<td>31.6</td>
<td>31.4</td>
<td>-0.1</td>
<td>131.0</td>
<td>132.7</td>
<td>1.7</td>
<td>18.0</td>
<td>17.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>SD</td>
<td>10.1</td>
<td>9.8</td>
<td>0.4</td>
<td>9.6</td>
<td>9.2</td>
<td>0.9</td>
<td>3.8</td>
<td>4.0</td>
<td>0.5</td>
</tr>
<tr>
<td>E1</td>
<td>30</td>
<td>32</td>
<td>2</td>
<td>133.5</td>
<td>133.8</td>
<td>0.3</td>
<td>16.8</td>
<td>17.8</td>
<td>1</td>
</tr>
<tr>
<td>E2</td>
<td>25</td>
<td>26</td>
<td>1</td>
<td>126.2</td>
<td>127</td>
<td>0.8</td>
<td>15.7</td>
<td>16.1</td>
<td>0.4</td>
</tr>
<tr>
<td>E3</td>
<td>27</td>
<td>27.5</td>
<td>0.5</td>
<td>128.2</td>
<td>129.5</td>
<td>1.3</td>
<td>16.4</td>
<td>16.4</td>
<td>0</td>
</tr>
<tr>
<td>E4</td>
<td>46</td>
<td>43</td>
<td>-3</td>
<td>140.5</td>
<td>141.8</td>
<td>1.3</td>
<td>23.3</td>
<td>21.3</td>
<td>-2.2</td>
</tr>
<tr>
<td>E5</td>
<td>55</td>
<td>56</td>
<td>1</td>
<td>141</td>
<td>144</td>
<td>3</td>
<td>27.6</td>
<td>27</td>
<td>-0.6</td>
</tr>
<tr>
<td>E6</td>
<td>50.5</td>
<td>47</td>
<td>2</td>
<td>146.5</td>
<td>148</td>
<td>1.5</td>
<td>23.5</td>
<td>21.4</td>
<td>0.6</td>
</tr>
<tr>
<td>E7</td>
<td>34</td>
<td>36</td>
<td>2</td>
<td>129</td>
<td>131.5</td>
<td>2.5</td>
<td>21.2</td>
<td>20.8</td>
<td>-0.4</td>
</tr>
<tr>
<td>E8</td>
<td>56</td>
<td>54</td>
<td>-2</td>
<td>137</td>
<td>137.2</td>
<td>0.2</td>
<td>29.7</td>
<td>28.8</td>
<td>-0.9</td>
</tr>
<tr>
<td>E9</td>
<td>57</td>
<td>55</td>
<td>-2</td>
<td>144</td>
<td>144.2</td>
<td>0.2</td>
<td>27.5</td>
<td>26.5</td>
<td>-1</td>
</tr>
<tr>
<td>E10</td>
<td>58</td>
<td>56.5</td>
<td>-1.5</td>
<td>149</td>
<td>149.8</td>
<td>0.8</td>
<td>26.1</td>
<td>25.2</td>
<td>-0.9</td>
</tr>
<tr>
<td>Mean</td>
<td>42.2</td>
<td>42.2</td>
<td>0</td>
<td>137.5</td>
<td>138.7</td>
<td>1.2</td>
<td>22.0</td>
<td>21.6</td>
<td>-0.4</td>
</tr>
<tr>
<td>SD</td>
<td>13.5</td>
<td>12.3</td>
<td>1.9</td>
<td>8.0</td>
<td>8.0</td>
<td>1.0</td>
<td>5.5</td>
<td>4.9</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Figure 4.6 over page shows a significant decrease in BMI over time (p=0.0123) for both groups. On average the experimental group had children with significantly larger BMI scores or degrees of ov/ob than the control group (p=0.04).
Figure 4.6 Pre-program and Post-program Body Mass Index Scores for Control (C) and Experimental (E) Groups.
4.1(b)(ii) Muscular Strength/Endurance Measurements

Table 4.7 below contains data from the subjects’ pre- and post-test scores for muscular strength and endurance.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Subject's BMI</th>
<th>Pre-test push-up score</th>
<th>Post-test push-up score</th>
<th>Change</th>
<th>Pre-test leg endurance score</th>
<th>Post-test leg endurance score</th>
<th>Change</th>
<th>Pre-test abdominal strength score</th>
<th>Post-test abdominal strength score</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>18.9</td>
<td>26</td>
<td>33</td>
<td>7</td>
<td>90</td>
<td>64</td>
<td>-26</td>
<td>43.9</td>
<td>51.9</td>
<td>8</td>
</tr>
<tr>
<td>C2</td>
<td>25.9</td>
<td>29</td>
<td>40</td>
<td>11</td>
<td>75</td>
<td>47.2</td>
<td>-27.8</td>
<td>26</td>
<td>28.2</td>
<td>2.2</td>
</tr>
<tr>
<td>C3</td>
<td>17.9</td>
<td>21</td>
<td>26</td>
<td>5</td>
<td>46</td>
<td>40</td>
<td>-6</td>
<td>11.7</td>
<td>8</td>
<td>-3.7</td>
</tr>
<tr>
<td>C4</td>
<td>16.8</td>
<td>12</td>
<td>14</td>
<td>2</td>
<td>27.5</td>
<td>85</td>
<td>57.5</td>
<td>30.5</td>
<td>36.1</td>
<td>5.6</td>
</tr>
<tr>
<td>C5</td>
<td>16.6</td>
<td>12</td>
<td>23</td>
<td>11</td>
<td>9.3</td>
<td>16.4</td>
<td>7.1</td>
<td>20.8</td>
<td>25.1</td>
<td>4.3</td>
</tr>
<tr>
<td>C6</td>
<td>15.3</td>
<td>19</td>
<td>21</td>
<td>2</td>
<td>66</td>
<td>39</td>
<td>-27</td>
<td>52.9</td>
<td>49.6</td>
<td>-3.3</td>
</tr>
<tr>
<td>C7</td>
<td>14.4</td>
<td>15</td>
<td>18</td>
<td>3</td>
<td>13.5</td>
<td>18.3</td>
<td>4.8</td>
<td>72</td>
<td>33.8</td>
<td>-38.2</td>
</tr>
<tr>
<td>Mean</td>
<td>18.0</td>
<td>19.1</td>
<td>25</td>
<td>5.9</td>
<td>46.8</td>
<td>44.3</td>
<td>-2.5</td>
<td>36.8</td>
<td>33.2</td>
<td>3.6</td>
</tr>
<tr>
<td>SD</td>
<td>3.8</td>
<td>6.7</td>
<td>8.9</td>
<td>3.9</td>
<td>31.4</td>
<td>24.3</td>
<td>30.4</td>
<td>20.8</td>
<td>15.0</td>
<td>15.9</td>
</tr>
<tr>
<td>E1</td>
<td>16.8</td>
<td>17</td>
<td>17</td>
<td>0</td>
<td>31</td>
<td>68</td>
<td>37</td>
<td>62</td>
<td>83</td>
<td>21</td>
</tr>
<tr>
<td>E2</td>
<td>15.7</td>
<td>13</td>
<td>17</td>
<td>4</td>
<td>36</td>
<td>122</td>
<td>86</td>
<td>96</td>
<td>64</td>
<td>-32</td>
</tr>
<tr>
<td>E3</td>
<td>16.4</td>
<td>4</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>16</td>
<td>4</td>
<td>15</td>
<td>23</td>
<td>8</td>
</tr>
<tr>
<td>E4</td>
<td>21.2</td>
<td>20</td>
<td>31</td>
<td>11</td>
<td>37</td>
<td>47</td>
<td>10</td>
<td>70</td>
<td>47</td>
<td>-23</td>
</tr>
<tr>
<td>E5</td>
<td>29.7</td>
<td>14</td>
<td>33</td>
<td>19</td>
<td>17</td>
<td>14</td>
<td>-3</td>
<td>28</td>
<td>31</td>
<td>3</td>
</tr>
<tr>
<td>E6</td>
<td>23.5</td>
<td>22</td>
<td>21</td>
<td>-1</td>
<td>65</td>
<td>78</td>
<td>13</td>
<td>44</td>
<td>53</td>
<td>9</td>
</tr>
<tr>
<td>E7</td>
<td>26.1</td>
<td>14</td>
<td>25</td>
<td>11</td>
<td>17</td>
<td>30</td>
<td>13</td>
<td>33</td>
<td>27</td>
<td>-6</td>
</tr>
<tr>
<td>E8</td>
<td>29.7</td>
<td>18</td>
<td>27</td>
<td>9</td>
<td>20</td>
<td>44</td>
<td>24</td>
<td>6</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>E9</td>
<td>27.5</td>
<td>20</td>
<td>34</td>
<td>14</td>
<td>21</td>
<td>35</td>
<td>14</td>
<td>27</td>
<td>67</td>
<td>40</td>
</tr>
<tr>
<td>E10</td>
<td>26.1</td>
<td>19</td>
<td>32</td>
<td>13</td>
<td>24</td>
<td>57</td>
<td>33</td>
<td>21</td>
<td>45</td>
<td>24</td>
</tr>
<tr>
<td>Mean</td>
<td>23.3</td>
<td>16.1</td>
<td>25.7</td>
<td>9.6</td>
<td>28</td>
<td>51.1</td>
<td>23.1</td>
<td>40.2</td>
<td>47</td>
<td>6.8</td>
</tr>
<tr>
<td>SD</td>
<td>5.5</td>
<td>5.2</td>
<td>6.7</td>
<td>6.7</td>
<td>15.5</td>
<td>32.4</td>
<td>25.3</td>
<td>28.0</td>
<td>19.9</td>
<td>22.3</td>
</tr>
</tbody>
</table>
Muscular Strength/Endurance Scores

Figure 4.7 Pre-program and Post-program Upper-body Strength/Endurance (push-ups) Scores for Control (C) and Experimental (E) Groups (p=0.0004)

Figure 4.7 above illustrates that both the control and experimental groups showed a significant improvement in upper-body strength (push-ups) over time (p = 0.0004). No significant difference was evident between the groups.

Figure 4.8 Pre-program and Post-program Lower-body Strength/Endurance (seated wall squat) Scores for Control (C) and Experimental (E) Groups (p=0.08)
Pre-intervention Leg Endurance Scores

Post-intervention Leg Endurance Scores

Figure 4.8 above illustrates that over the time of the intervention an increase in leg endurance (seated wall squat) scores was evident in the experimental group. However, this was not a significant increase (p = 0.08). There was no significant difference between the groups.

4.1(b)(iii) Hip and Lower Back Flexibility Scores

Table 4.8 below presents the results of the subjects' pre- and post-intervention flexibility scores.
Table 4.8 Subjects' Flexibility Measurements for Control (C) and Experimental (E) Groups (n=17)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Subject's BMI</th>
<th>Pre-test left hip ROM</th>
<th>Post-test left hip ROM</th>
<th>Change</th>
<th>Pre-test right hip ROM</th>
<th>Post-test right hip ROM</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>18.9</td>
<td>100</td>
<td>120</td>
<td>20</td>
<td>80</td>
<td>110</td>
<td>30</td>
</tr>
<tr>
<td>C2</td>
<td>25.9</td>
<td>70</td>
<td>100</td>
<td>30</td>
<td>70</td>
<td>80</td>
<td>10</td>
</tr>
<tr>
<td>C3</td>
<td>17.9</td>
<td>80</td>
<td>90</td>
<td>10</td>
<td>100</td>
<td>110</td>
<td>10</td>
</tr>
<tr>
<td>C4</td>
<td>16.8</td>
<td>90</td>
<td>90</td>
<td>0</td>
<td>80</td>
<td>88</td>
<td>8</td>
</tr>
<tr>
<td>C5</td>
<td>16.6</td>
<td>75</td>
<td>85</td>
<td>10</td>
<td>80</td>
<td>85</td>
<td>5</td>
</tr>
<tr>
<td>C6</td>
<td>15.3</td>
<td>70</td>
<td>70</td>
<td>0</td>
<td>65</td>
<td>70</td>
<td>5</td>
</tr>
<tr>
<td>C7</td>
<td>14.4</td>
<td>88</td>
<td>100</td>
<td>12</td>
<td>92</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>Mean</td>
<td>17.9</td>
<td>81.8</td>
<td>93.6</td>
<td>11.7</td>
<td>81</td>
<td>91.9</td>
<td>10.9</td>
</tr>
<tr>
<td>SD</td>
<td>3.8</td>
<td>11.3</td>
<td>15.5</td>
<td>10.7</td>
<td>12.0</td>
<td>15.3</td>
<td>8.9</td>
</tr>
<tr>
<td>E1</td>
<td>16.8</td>
<td>88</td>
<td>85</td>
<td>-3</td>
<td>88</td>
<td>88</td>
<td>0</td>
</tr>
<tr>
<td>E2</td>
<td>15.7</td>
<td>80</td>
<td>75</td>
<td>-5</td>
<td>74</td>
<td>75</td>
<td>1</td>
</tr>
<tr>
<td>E3</td>
<td>16.4</td>
<td>100</td>
<td>96</td>
<td>-4</td>
<td>90</td>
<td>92</td>
<td>2</td>
</tr>
<tr>
<td>E4</td>
<td>21.2</td>
<td>82</td>
<td>100</td>
<td>18</td>
<td>82</td>
<td>90</td>
<td>8</td>
</tr>
<tr>
<td>E5</td>
<td>29.7</td>
<td>72</td>
<td>80</td>
<td>8</td>
<td>74</td>
<td>70</td>
<td>-4</td>
</tr>
<tr>
<td>E6</td>
<td>23.5</td>
<td>90</td>
<td>90</td>
<td>0</td>
<td>90</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>E7</td>
<td>26.1</td>
<td>53</td>
<td>55</td>
<td>2</td>
<td>60</td>
<td>57</td>
<td>-3</td>
</tr>
<tr>
<td>E8</td>
<td>29.7</td>
<td>70</td>
<td>94</td>
<td>24</td>
<td>60</td>
<td>85</td>
<td>25</td>
</tr>
<tr>
<td>E9</td>
<td>27.5</td>
<td>84</td>
<td>98</td>
<td>14</td>
<td>84</td>
<td>95</td>
<td>11</td>
</tr>
<tr>
<td>E10</td>
<td>26.1</td>
<td>90</td>
<td>108</td>
<td>18</td>
<td>110</td>
<td>112</td>
<td>2</td>
</tr>
<tr>
<td>Mean</td>
<td>23.3</td>
<td>80.9</td>
<td>88.1</td>
<td>7.2</td>
<td>81.2</td>
<td>85.4</td>
<td>4.2</td>
</tr>
<tr>
<td>SD</td>
<td>5.5</td>
<td>13.2</td>
<td>15.2</td>
<td>10.6</td>
<td>15.1</td>
<td>15.1</td>
<td>8.6</td>
</tr>
</tbody>
</table>
Flexibility at Hips

Figure 4.9 Average Pre-Program and Post-Program Flexibility Scores (Range of Motion at Hips) for Control (C) and Experimental (E) Groups
Right Hip: P=0.009, Left Hip: P=0.01

Range of motion (degrees)

Pre-intervention Flexibility Scores

Post-intervention Flexibility Scores
Figure 4.10 above illustrates a significant improvement in range of motion of the left hip in both groups over time (left hip: p=0.01). No significant difference was noted between the groups.

4.1(b)(iv) Cardiovascular Fitness Measurements

Cardiovascular fitness measures of cardiovascular endurance included the total distance covered by foot in seven minutes, and the distance rowed in six minutes. Pre- and post-intervention scores are listed in Table 4.9.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Subject's BMI</th>
<th>Pre-test rowing distance scores</th>
<th>Post-test rowing distance scores</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>18.9</td>
<td>986</td>
<td>1048</td>
<td>62</td>
</tr>
<tr>
<td>C2</td>
<td>25.9</td>
<td>1134</td>
<td>1267</td>
<td>133</td>
</tr>
<tr>
<td>C3</td>
<td>17.9</td>
<td>900</td>
<td>879</td>
<td>-21</td>
</tr>
<tr>
<td>C4</td>
<td>16.8</td>
<td>782</td>
<td>755</td>
<td>-27</td>
</tr>
<tr>
<td>C5</td>
<td>16.6</td>
<td>876</td>
<td>923</td>
<td>47</td>
</tr>
<tr>
<td>C6</td>
<td>15.3</td>
<td>718</td>
<td>795</td>
<td>77</td>
</tr>
<tr>
<td>C7</td>
<td>14.4</td>
<td>650</td>
<td>695</td>
<td>45</td>
</tr>
<tr>
<td>Mean</td>
<td>18</td>
<td>863.7</td>
<td>908.7</td>
<td>45.1</td>
</tr>
<tr>
<td>SD</td>
<td>3.8</td>
<td>164.9</td>
<td>196.3</td>
<td>55.7</td>
</tr>
<tr>
<td>E1</td>
<td>16.8</td>
<td>1146</td>
<td>1120</td>
<td>-26</td>
</tr>
<tr>
<td>E2</td>
<td>15.7</td>
<td>921</td>
<td>1078</td>
<td>157</td>
</tr>
<tr>
<td>E3</td>
<td>16.4</td>
<td>234</td>
<td>681</td>
<td>447</td>
</tr>
<tr>
<td>E4</td>
<td>21.2</td>
<td>1421</td>
<td>1573</td>
<td>152</td>
</tr>
<tr>
<td>E5</td>
<td>29.7</td>
<td>677</td>
<td>1300</td>
<td>623</td>
</tr>
<tr>
<td>E6</td>
<td>23.5</td>
<td>1390</td>
<td>1363</td>
<td>-27</td>
</tr>
<tr>
<td>E7</td>
<td>26.1</td>
<td>1080</td>
<td>1151</td>
<td>71</td>
</tr>
<tr>
<td>E8</td>
<td>29.7</td>
<td>1344</td>
<td>1568</td>
<td>224</td>
</tr>
<tr>
<td>E9</td>
<td>27.5</td>
<td>1260</td>
<td>1432</td>
<td>172</td>
</tr>
<tr>
<td>E10</td>
<td>26.1</td>
<td>1290</td>
<td>1495</td>
<td>205</td>
</tr>
<tr>
<td>Mean</td>
<td>23.3</td>
<td>1076.3</td>
<td>1276.1</td>
<td>199.8</td>
</tr>
<tr>
<td>SD</td>
<td>5.5</td>
<td>375.1</td>
<td>276.3</td>
<td>201.3</td>
</tr>
</tbody>
</table>
Six-minute Rowing Ergometer Distances

Figure 4.10 below illustrates that significant differences were noted between the groups (p=0.04) and over time (p=0.03) for the six-minute rowing distances.

Figure 4.10  Average Pre-Program and Post-Program Rowing Distance Scores for Control (C) and Experimental (E) Groups (P=0.0250) over Time (P= 0.037) Between Groups Over Time
Run/walk distance

Table 4.10  Subjects’ Cardiovascular Fitness Measurements for Control (C) and Experimental (E) Groups (Run/walk distance)  (n=17)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Subject’s BMI</th>
<th>Pre-test distance</th>
<th>Post-test distance</th>
<th>Change</th>
<th>Subject</th>
<th>Subject’s BMI</th>
<th>Pre-test distance</th>
<th>Post-test distance</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>18.9</td>
<td>900</td>
<td>1000</td>
<td>100</td>
<td>E1</td>
<td>16.8</td>
<td>900</td>
<td>1100</td>
<td>200</td>
</tr>
<tr>
<td>C2</td>
<td>25.9</td>
<td>650</td>
<td>750</td>
<td>100</td>
<td>E2</td>
<td>15.7</td>
<td>735</td>
<td>800</td>
<td>65</td>
</tr>
<tr>
<td>C3</td>
<td>17.9</td>
<td>532</td>
<td>700</td>
<td>168</td>
<td>E3</td>
<td>16.4</td>
<td>832</td>
<td>900</td>
<td>68</td>
</tr>
<tr>
<td>C4</td>
<td>16.8</td>
<td>732</td>
<td>900</td>
<td>168</td>
<td>E4</td>
<td>21.2</td>
<td>665</td>
<td>1032</td>
<td>367</td>
</tr>
<tr>
<td>C5</td>
<td>16.6</td>
<td>100</td>
<td>950</td>
<td>850</td>
<td>E5</td>
<td>29.7</td>
<td>765</td>
<td>1050</td>
<td>285</td>
</tr>
<tr>
<td>C6</td>
<td>15.3</td>
<td>900</td>
<td>950</td>
<td>100</td>
<td>E6</td>
<td>23.5</td>
<td>732</td>
<td>1000</td>
<td>268</td>
</tr>
<tr>
<td>C7</td>
<td>14.4</td>
<td>900</td>
<td>800</td>
<td>-100</td>
<td>E7</td>
<td>26.1</td>
<td>700</td>
<td>835</td>
<td>135</td>
</tr>
<tr>
<td>Mean</td>
<td>18.0</td>
<td>673.4</td>
<td>864.2</td>
<td>191</td>
<td>E8</td>
<td>29.7</td>
<td>700</td>
<td>900</td>
<td>200</td>
</tr>
<tr>
<td>SD</td>
<td>3.8</td>
<td>290.6</td>
<td>114.3</td>
<td>305</td>
<td>E9</td>
<td>27.5</td>
<td>817</td>
<td>950</td>
<td>133</td>
</tr>
<tr>
<td>E10</td>
<td>26.1</td>
<td>700</td>
<td>850</td>
<td>150</td>
<td>Mean</td>
<td>23.3</td>
<td>754.6</td>
<td>941.7</td>
<td>187</td>
</tr>
<tr>
<td>SD</td>
<td>5.5</td>
<td>73.8</td>
<td>100.9</td>
<td>97</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.10 above contains the measurements for run/walk distances that the children covered when walking around a 100m course in seven minutes. Both the experimental and control groups showed a significant improvement in run/walk distances during the duration of the eight-week intervention. (p=0.0021). No significant difference was noted between the groups.

Figure 4.11  Average Pre-Program and Post-Program Run/Walk Distance Scores for Control (C) and Experimental (E) Groups (P=0.0021)
4.1(b)(v) Summary of Results for Hypothesis 2

Table 4.11: Tabulated Results for Summative Analysis for Hypothesis 2

<table>
<thead>
<tr>
<th>Variable/ analysis</th>
<th>Between groups p=</th>
<th>Over time p=</th>
<th>Between groups over time p=</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>0.05</td>
<td>0.01</td>
<td>0.72</td>
</tr>
<tr>
<td>Skin folds</td>
<td>0.13</td>
<td>0.07</td>
<td>0.21</td>
</tr>
<tr>
<td>Waist/hip ratio</td>
<td>0.84</td>
<td>0.81</td>
<td>0.85</td>
</tr>
<tr>
<td>Push-ups score</td>
<td>0.71</td>
<td>0.0001</td>
<td>0.21</td>
</tr>
<tr>
<td>Leg endurance</td>
<td>0.06</td>
<td>0.15</td>
<td>0.08</td>
</tr>
<tr>
<td>Abdominal endurance</td>
<td>0.40</td>
<td>0.75</td>
<td>0.31</td>
</tr>
<tr>
<td>Sit and reach</td>
<td>0.70</td>
<td>0.20</td>
<td>0.97</td>
</tr>
<tr>
<td>Range of motion (right hip)</td>
<td>0.65</td>
<td>0.003</td>
<td>0.14</td>
</tr>
<tr>
<td>Range of motion (left hip)</td>
<td>0.62</td>
<td>0.002</td>
<td>0.40</td>
</tr>
<tr>
<td>Six-minute rowing distance</td>
<td>0.21</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Heart rate during six-minute row</td>
<td>0.78</td>
<td>0.90</td>
<td>0.04</td>
</tr>
<tr>
<td>Seven-minute run distance</td>
<td>0.11</td>
<td>0.002</td>
<td>0.97</td>
</tr>
</tbody>
</table>
Referring to Table 4.11 above and using two-way ANOVA, the following variables and groups presented significant results between the groups at the beginning of the intervention:

- Body Mass Index

Using two-way ANOVA, the following variables and groups presented significant improvements over the duration (time) of the intervention:

- Body Mass Index - both groups;
- push-ups score - both groups;
- range of motion at hips - control group;
- six-minute rowing distance - experimental group;
- seven-minute run distance - both groups.

Using two-way ANOVA, the following variables and groups presented significant differences between the groups at the cessation of the intervention:

- six-minute rowing distance - experimental group rowed significantly further in six minutes;
- heart rate response - experimental group completed rowing test at a significantly higher heart rate.

4.2 Results: Formative Results

Using the methods described in Chapter Three (Hodson, 1991, p83) the following themes emerged from the analysis of the field notes, the written material produced by
the children, and general observations made during conversations with children and their parents, and the researcher's reflective summaries of all these observations:

- confidence in participation in physical activity;
- role and type of motivation needed;
- perception of goals and goal setting behaviour;
- inter-generational influences;
- commitment enthusiasm for participation.

These results are organised in terms of two foci, namely Control versus Experimental Groups, and Obese versus Lean Groups.
<table>
<thead>
<tr>
<th>Obese vs. Lean Children</th>
<th>Control vs. Experimental Children</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comments made during assessment sessions</strong></td>
<td><strong>As assessment sessions were completed in the same manner, only comparisons between obese children and lean children were relevant for this section.</strong></td>
</tr>
<tr>
<td><strong>Obese children</strong> were quite timid about trying new things but enthusiastic once an activity was demonstrated. It was also observed that these children were quite competitive once comfortable with an activity. Observations on <strong>lean children</strong> illustrated that although they were quite confident, they would often begin an activity without waiting for full instructions.</td>
<td><strong>Experimental group children</strong> - Children in the experimental group liked to compare their scores from the sessions (eg. Rowing scores, push up scores) and responded well to developing intrinsic motivation and the ability to compete with their own scores. As the experimental group activities contained a balance of strength and short bouts of cardiovascular activities, the obese children were as capable as performing the strength activities and cardiovascular activities as the lean children were, therefore they were less likely as the weeks progressed to approach the activities with caution. <strong>Control group children</strong> - Both obese children and lean children in the control group were as unenthusiastic to complete long bouts of cardiovascular work, with both becoming upset or naughty during periods of exhaustion. Children tended to become easily distracted or unmotivated when the athletic children &quot;won&quot; the cross-country runs by so much and told the other children</td>
</tr>
<tr>
<td>Obese children tended to need extrinsic motivation in the initial stages of cardiovascular work. However, after the activity was explained the obese children appeared less threatened and tended to try harder if offered verbal encouragement and congratulations at the end of activity. Obese children tended to respond better to verbal encouragement than the lean children. Lean children also need verbal encouragement to complete long cardiovascular bouts, and although they were more capable at completing the long bouts, they tended to get as disinterested in repetitive cardiovascular work as the obese children.</td>
<td><strong>Goal setting sheets</strong> The most common goal listed by ov/ob children was to &quot;become better at running&quot;. The lean children listed sports orientated goals &quot;score more goals in soccer&quot; or &quot;Get better at athletics&quot;.</td>
</tr>
<tr>
<td><strong>Health History</strong></td>
<td><strong>NA</strong></td>
</tr>
<tr>
<td>Parents of the obese children, who themselves were also obese, admitted that they were obese and that their children like to opt for passive recreation if given the chance. The parents who were ov/ob reported that they had at least one obesity risk factor such as high cholesterol, high blood pressure. Parents of ov/ob children tended to record greater amounts of health history information. Parents of <strong>lean children</strong> listed no past health problems for their children. 2 sets of parents that their children were involved in ball games at school.</td>
<td><strong>Control group children</strong> were more likely to attend the intervention sessions than the experimental group children.</td>
</tr>
<tr>
<td><strong>Sessions attended</strong></td>
<td><strong>Weekly homework answers</strong></td>
</tr>
<tr>
<td><strong>Control group children</strong> were more likely to attend the intervention sessions than the <strong>experimental group children</strong>. Children within the experimental group on were more likely to return homework questions and to complete their practical sessions. These children were more likely to have parental involvement in both theory and practical homework questions. The lean child who returned all the homework questions was in the experimental group. Children within the control group had little parental involvement in homework sessions.</td>
<td>Children within the experimental group on were more likely to return homework questions and to complete their practical sessions. These children were more likely to have parental involvement in both theory and practical homework questions. The lean child who returned all the homework questions was in the experimental group. Children within the control group had little parental involvement in homework sessions.</td>
</tr>
</tbody>
</table>
4. CHAPTER FIVE

DISCUSSION

5.1 Review of Purpose and Aims of the Study

This study had two purposes:

i) to evaluate an intervention exercise program for ov/ob children that was congruent with minimum physical activity guidelines for children and complimented the primary school curriculum;

ii) to evaluate this program through both summative and formative evaluation.

The first of these purposes (the development of the program) was achieved through a wide-ranging literature review, and included physiological modifications to exercises and activities and behavioural theories. This experimental program contained modified exercises, such as reduced weight-bearing exercises and multiple short bouts of cardiovascular exercise. The ultimate outcome was the production of an intervention program that was designed to be physiologically appropriate and to be delivered in a manner that considers the behavioural theories behind exercise adherence. It was hoped, taking these factors into consideration, that a program could be designed that would be more suitable for ov/ob children.

The second of these purposes (the summative and formative evaluations) was achieved by comparing the intervention program to a control program based on exercises often found in traditional school programs and activities such as star jumps and long bouts of cardiovascular exercise. The majority of exercises given to the control group were drawn from the Department of Education and Training’s Health and Fitness syllabus (1996, 1997, 1998).

Two hypotheses were generated and tested to complete the summative evaluation. The first hypothesis proposed that, compared to the control group, the children involved in the experimental group would show an equal or greater improvement in their attitude towards physical activity, knowledge of exercise concepts and participation rates in physical activity at the cessation of the intervention. The second hypothesis stated that, when compared to the control group, the experimental group
would achieve an equal or higher level of improvement on each of the following functional fitness measures:

- anthropometric measures;
- muscular strength/endurance;
- flexibility measures;
- cardiovascular measures.

The formative evaluation was designed to address these broad evaluative questions:

- How did the participants respond to the program in terms of such qualitative factors as attitudes to, commitment to, engagement in, and perceptions of the value of the program?
- What concerns and issues about the program emerged?
- How can the program be improved?

In this chapter, the results of the summative and formative evaluations will be interpreted and discussed in terms of the original purposes of the study. Finally, some conclusions about this study and some suggestions for further research will be presented.

5.2 Discussion and Interpretation of Results

With the increasing prevalence of ov/ob amongst Australian children, the need to research this multifaceted condition is becoming greater. Of the many factors that contribute to the increasing Body Mass Index (BMI) of Australian children (Riddiford-Harland, 2000, Booth et al., 2001), the most flexible and self-achievable factor tends to be attempting to increase the levels of physical activity that children perform. The relationship between physical activity and levels of ov/ob is clear (Davies et al., 1995). Research has shown that a positive relationship has been found between low levels of physical activity and increasing levels of adiposity in children. More importantly, however, studies have also indicated that those children who are participating in regular exercise and physical activity may not in fact be engaging at an intensity that reaps benefits in weight management or increasing physical fitness. This is not a new concept as Seliger et al. (1974) reported that children are not participating in adequate levels of moderate and vigorous activity (Seliger et al., 1974). Studies conducted on children who volunteered to wear heart rate monitors for
seven days, showed that little time was spent in the vigorous (161 and over beats per minute) heart rate zone. Children spent a majority of their playtime in low-moderate heart rate zones (80-140 beats per minute).

A major reason for children not engaging in intense activity may be the inability to engage in the programs they are involved in, resulting in children dropping out of sport or activity sessions before reaching and maintaining vigorous heart rate zones. There are many other reasons offered for children not participating in adequate amounts of physical activity, including lack of self esteem, decreased physical ability, lack of parental support and negative attitudes towards exercise and physical activity. After reviewing the literature, it is clear that one possible way to combat this increase in ov/ob amongst our children would be to encourage physical activity to be performed more often and more vigorously. Programs for children, therefore, need to be designed along a consistent set of guidelines and need to be designed so as take into account the reasons why children drop out of sport.

For the purposes of this study two programs were delivered. Both were delivered in with as little bias as possible between the delivery of each program with the main differences between the delivery methods was the provision of explanations to children as to WHY they were performing each activity. At the cessation of the intervention, the children from the experimental group showed a greater improvement in the attitude score. An explanation for this may be due to the following reasons:

- Children within the experimental group were offered a variety of new activities during the program.
- Children within the experimental group were offered activities that were less threatening by offering multiple short bouts of cardiovascular activity.
- Children within the experimental group were offered a decrease in the amount of loading activities.
- Children within the experimental group were offered explanations as to WHY they were being asked to complete certain activities.
- Children were provided with a choice of a variety of activities to perform in multiple short bouts for homework tasks.
Formative results indicated that children in the control group were less likely to return their homework sheets, which may be explained by the content of their homework exercises. Practical homework sessions with little variety for the control group contained long cardiovascular bouts of exercise may have deterred the children from attempting any of their homework. This type of disinterest was supported by Bandura’s (1986) social cognitive theory, which stated that children who display a positive attitude towards physical activity and exercise are more likely to continue or adhere to exercise programs than those children who do not develop positive attitudes. Children who do not feel as they perform well at long bouts of running will be less likely to display a positive attitude towards participating in these long bouts of cardiovascular activity. It may have been that the provision of multiple short bouts with a variety of activities, that more children from the experimental group re-enrolled at the cessation of the program. Five out of nine experimental group children wished to re-enrol, whilst only two out of eight control group children wished to re-enrol in a similar program. Another interesting finding is that six out of ten ov/ob children wished to re-enrol whilst only two out of seven lean children wished to re-enrol.

Of the six ov/ob wished to re-enrol, four were from the experimental group, indicating that this type of program may have been more suited towards the ov/ob children than the control group. It should be pointed out though, that the lean children that were involved in the intervention, only one child was considered and commented on as athletic, indicating that the lean children were not of a high fitness level. Bandura’s (1986) social cognitive theory suggests that a child’s past experiences with an event will reflect their willingness to participate in the experience again. Therefore, a majority of ov/ob children obviously enjoyed the program enough to participate in it again.

It is worthwhile investigating a child’s exercise history before he/she commences an exercise program. This gives teachers some information about a child’s past experience and can allow them to make a judgment about the child’s current attitude towards exercise. Children in both groups provided an exercise history before participating in the intervention. Exercise history was recorded by the children on a ‘participation in exercise’ questionnaire, which included questions concerning clubs
and activities in which the children have been involved during the past 12 months. Children were also asked to provide information about their regular sports and activities, and how often they completed these during the week and for how long.

No significant difference was evident between the self-reported weekly energy expenditure by both lean children and ov/ob children, or between the groups. Therefore ov/ob children self-reported that they expended as much energy as their leaner peers outside of school hours. These data disagree with the literature, which suggests that obese children expend less energy per week than their leaner peers (Bandini et al., 1990). In some cases, when body weight was taken into account, the ov/ob children within the study expended more energy per kilogram of body weight than their peers did. The data collected in this study was gathered using a self-report questionnaire and a child's ability to recall his/her weekly activities may, however, not be accurate. Therefore, reported energy expenditure may contain some errors for reasons such as a child and their parent/carer not understanding the question and the possibility of providing misleading answers through confusion regarding definitions of "physical activity", "exercise" and "involvement in organised sport".

It is for these reasons that the development of interview tools that are suited to particular age groups is needed so as to decrease the error in determining the physical activity levels of primary aged children. It became evident during the instructed class sessions that both the children and their parent/carers were not aware of important physical activity concepts. Therefore the answers they had provided in the questionnaires provided to them prior to the program would not have been answered consistently across the group due each person's differing interpretation of the questions.

The literature reviewed outlined the physiological difficulties from that many ov/ob children suffer whilst trying to participate in physical activity. It was revealed that ov/ob children have an increased incidence of foot, knee and back pain, and their ability to deal with heat stress is less efficient than a lean child's. This factor, as well as the intervention being performed in a coastal town may explain why this sport was the most commonly participated activity. It may also be that with the availability of swimming shirts and shorts, ov/ob children may feel more comfortable dressing in swimming costumes.
Taking into account the difficulties that ov/ob children encounter in sport, it should be noted that the obese and ov/ob children listed non-weight-bearing activities or sports requiring intermittent energy bursts, such as dancing and softball, as their 2nd and 3rd regular sports. These sports enable children to have allocated rest breaks. It can therefore be said that children will often tend to try sports that are easier for them to participate in. This is often mistaken by observers to mean the children are being lazy, however, these children are opting for sports and activities that are easier on their bodies and carry decreased risk of embarrassment through physiological failure. These types of sports should be encouraged as a starting point to gradually graduate from until a child has developed enough self esteem to take on more difficult activities.

What must be remembered is that at least these children are participating in some regular activity, whereas 40% of children are not participating in physical activity (ABS 2000). Although initial participation heart rates may be in the low-moderate heart rate range, whilst being involved in sports that allow rest breaks, at least these children are involved socially and physically in the sport.

It is through participation in any sport, at any intensity for any duration that the process of acculturation begins. Once children and their parents have initiated the acculturation process the next step would be to educate both parents and children about increasing upon the minimum standards for lifetime physical activity and progressing to Optimal Functioning Standard: A Goal for all Children, as set out by Pangrazi and Corbin (1999). These standards state that children should be aiming for 60 minutes of moderate to vigorous activity (120-161 beats per minute) each day distributed over 3 or more sessions.

The sports that ov/ob children are opting for are friendlier to their bodies and more enjoyable, but are not within the correct heart rate zones or intensities to maintain a healthy body weight. The types of sports and activities being provided for children in school classes are within the correct heart rate zones, but are too difficult for some children, both lean and ov/ob, to complete, often because they are undertaken in long bouts. The experimental program worked around this problem by supplying the children with short bouts of exercise at heart rate ranges that were within the moderate
to vigorous ranges. From the summative data and goal setting sheets given to the children, it can be seen that children are being asked to perform long running bouts as part of their daily physical education or sports classes. Therefore a majority of the children set their goals around trying to improve their running skills as to prevent them constantly coming last or being unable to finish their sports tasks at school. On the goal setting sheets completed by the children before the commencement of the intervention, the obese and unfit lean children listed their number one goal as being to ‘improve running’. The athletic lean children listed sports specific goals related to their chosen sports, such as ‘score more goals in soccer’. It can therefore be assumed that children, although participating in regular exercise outside school, still feel that the most important aspect of them becoming fitter is that they need to be able to run well, despite not enjoying it the majority of the time. The paradox in this situation is that children need to exercise at these intensities such as running to manage their weight and fitness, but are often unable to sustain these levels and are likely to drop out due to fear of failure. Adults placed in charge of children’s programs are actually providing the desired energy expenditures; however, the steps taken to produce this result often have not been thought out so as to produce the result and maintain a positive attitude in the children simultaneously.

It is this paradoxical situation that encouraged the author to seek methods for teachers and coaches to be able to provide children with exercise programs that were effective for weight management and functional fitness establishment and enhancement. With a slight modification to the content of the program through multiple short bouts, less competition and weight bearing and increased resistive exercise, the last remaining factor to be manipulated was the coaching or teaching environment. After a brief summary of exercise behaviour theories and natural learning theories, it was concluded that teaching environments adopted for teaching children to read, write and learn music or mathematics, should be adopted for teaching children and their parent/carers, physical activity concepts.

Various constructivist and social cognitive theories combined with a learning framework previously applied to learning to read, was applied to the experimental group in this intervention. The aim of this application was to increase a child and parent/carers engagement in the learning of lifetime physical activity concepts.
Guidelines produced from this thesis have been developed to assist those in charge of children’s activity programs to prevent children from dropping out.

5.2 Guidelines to Assist Teachers and Coaches with the Development of Lifetime Physical Activity Practices for Children and Their Families

5.2(a) Pre-screening Children Through Pre-Exercise Questionnaires and Pre-Exercise Assessment

The first guideline that should be included would be for teachers or trainers to obtain some information about a child’s exercise competency or confidence in sport before commencing training. In this study, both groups were provided with an exercise, and a health history question was recorded by the parents on the Pre-Exercise Questionnaire. Parents were required to comment on their child’s ability to exercise or his/her exercise competency.

It should be noted that the parents of ov/ob children were most likely to provide detailed information voluntarily regarding their own health problems and their child’s exercise history. One particular question asked parents to provide information that could be helpful regarding their children and exercise. Parents responded suggested they provide their children with monetary rewards to participate in the intervention. Other responses included ‘she is very self-conscious when exercising’, or ‘he is very weak in his upper body and has trouble with ball skills’, or ‘she drops out of most sports within the first few weeks’, or ‘will work well as long as she is encouraged’. This type of information indicated that these children had at some point expressed their feelings about themselves in their sports. The parents were aware of changes that could be made to programs that might assist in their child’s development in sporting activities.

This type of feedback allowed those involved in assessing the children to make the assessment session as comfortable and non-threatening as possible. If this approach were adopted by those in control of children’s sports and activities, maybe a child’s initial introduction to sport could be made more effective. By providing parents with pre-exercise questionnaires before a child commences a physical activity program,
sports coaches and teachers could become aware of problems that children have with sports, and hence attempt to work with these children and their issues more individually. This does not imply that children should be placed in one-on-one situations whilst exercising in a class group. It simply means that adults in charge of programs can avoid placing children in situations that make them feel uncomfortable.

5.2 (b) Avoid Comparing Children to Norms and Standards and Positively Reinforce any Progress.

Whilst testing children, avoid comparing children to norms or standards and encourage children to only compete against their previous scores. However, charting children's progress consistently and regularly will allow the children to monitor their own progress. Children will display a positive feeling about their involvement in an activity if they are able to visualise their achievements.

Experimental group children enjoyed comparing the improvements they had made from week to week, and tended to exert themselves more when encouraged to beat their own scores.

5.2 (c) Avoid Assuming a Child's Ability by Their Physical Characteristics

Following on from the need to pre-screen and assess children, assumptions that obese children do not participate in equal amounts of activity should not be made. Through the pre-screening process, coaches and teachers will be made more aware of a child's belief in themselves and their exercise participation history.

Also, lean children are not always fit children and they may also experience a lack of self esteem and confidence in activities if they have not been exposed to a lifestyle of physical activity.

Both lean and obese children attended on average the same total amount of sessions. Control group children in this study attended on average one more session than experimental group children.

Interestingly, experimental group children still achieved similar gains in functional fitness and strength, despite attending one session less. Hence, the effectiveness of the short bout and resistive program is further supported.
5.2 (d) Encourage Parental Involvement in Children's Physical Activity Development

Another guideline would be to involve parents in some aspect of a child's fitness program. Epstein (1992) suggested that the most effective treatment programs for children had some type of parental involvement. This study encouraged parental involvement through the homework given to the children. To apply the process of "acculturating" a child's learning environment, then parental involvement is required at many levels. This does not directly apply to parents' involvement at a level requiring the parent to become a coach or a physical participant in their child's program, but can simply mean assisting with the immersion principal. This can be achieved through displaying healthy lifestyle practices or posters etc or saturating the child's environment in messages that communicate the benefits being physically active. Other examples of parental involvement include supplying appropriate response regarding a child's efforts in a physical activity experience Parental involvement was not required for the children to complete their practical and theory homework sessions, but parents were encouraged to become involved through signing the completed homework sheets. Children from both groups showed a significant improvement in knowledge of exercise concepts (p=0.0001). Children who returned their homework regularly, achieved the highest points for homework participation, and these were the children whose parents signed their homework most often. Children with the most parental signatures received the most stickers on their sticker cards. Those children whose parents provided feedback on homework sheets also had the most positive attitude scores on their CATPA questionnaire during post-intervention testing. This suggests that parental involvement at an interest or observation level can be beneficial. Parents who are restricted due to work commitments, and may not have the time to allocate to participating in physical activity with their child, should still provide encouragement and interest in their child's activity levels.

In this intervention, parents of the ov/ob children and parents within the experimental group were more likely to be involved in their child's homework and practical sessions. This involvement may be one reason why this group of children displayed a greater significant improvement in attitude score. Parents of the lean children were least likely to return signed homework sheets. It could be suggested that the parents of the lean children did not perceive home exercise sessions and homework as important,
since their children were not ov/ob, and there was therefore not as much interest or motivation.

Children within the experimental group appeared more interested in their homework questions than the children in the control group, who rarely returned their homework sheets. However, the children most likely to return their homework sheets in the control group were the obese children, indicating again that the parents of ov/ob appeared more interested in encouraging their children to complete the homework sessions.

5.2 (e) Encourage Demonstration and Child Input in Every Lesson.
An example of an activity that children can demonstrate safely is stretching. Flexibility training should be encouraged at the end of each session and should be used as a confidence building activity for all children. All children can be competent at flexibility exercises if stretching exercises are chosen with thought, and stretches that may cause injury are avoided.

5.2 (f) Replacing Long Bouts of Cardiovascular Exercise with Multiple Short Bouts at Vigorous Intensities.
Cardiovascular exercise can be provided for children in multiple short bouts rather than long exhausting bouts without a loss in training benefit. Exercise programs that are more easily completed, such as multiple short bouts, will often result in children feeling more positive about exercise and their ability to exercise. Children provided with programs that involve large amounts of running may show a decrease in attitude towards exercise; therefore long-distance running and cross-country running should be used carefully in programs.

5.2 (g) Initial Cardiovascular Exercise Sessions Should Be Provided In Multiple Short Bouts with Active Rest Periods.
Despite the short length of the intervention, the children in both groups managed to significantly decrease their BMI scores (p=0.01). A change in the BMI of the children in both groups was achieved over the eight-week period. The experimental group, despite reducing the amount of long, exhausting cardiovascular work, was as successful as the control group in decreasing the BMI of its members.
A point that should be noted is that both groups demonstrated a significant improvement in the seven-minute running distance scores, despite only the control group performing the long cardiovascular bouts during training sessions. Short bouts of cardiovascular exercise and running can therefore be effective in improving running scores and ability. This result is probably one of the most significant results gained from the study. It indicates that children can increase their running ability and fitness with multiple short bouts of cardiovascular exercise, and that this type of training may be just as beneficial as prescribing long bouts of cardiovascular exercise. This simple modification to children's exercise programs could therefore be implemented with no detrimental effect on the fitness of the children involved in the program.

Alternative programs have been tried with more success. Jackie et al. (1995) demonstrated that by replacing long bouts of cardiovascular exercise with multiple short bouts of exercise, people were more likely to adhere to a program, as the shorter time periods appeared less daunting to complete and were easier to fit into busy time schedules. Shorter time periods were also able to be completed at higher intensities or higher MET levels, therefore expending more energy per day. Energy balance can be achieved by summing the total energy expended per day. Therefore, performing more sessions per day, for shorter periods of time, and at higher intensities can result in creating and/or maintaining an energy balance. Also, an increase in metabolic rate during recovery periods results in calories being consumed after exercise sessions have been completed.

Children within the experimental group tended to exert themselves for a longer period of time, as short cardiovascular bouts were broken up with strength exercises. These strength exercises contained short rest periods that allowed the children to be aware of each approaching rest period.

Children within the control group became disinterested with the cardiovascular sessions by the second week of the program and requested that they not complete the running warm-up by the third week.
Both the lean and athletic children became easily distracted and needed disciplining at times. Overall, the children within the control group became disinterested and 'naughty' quite early every lesson, whilst the children in the experimental group rarely needed disciplining.

This type of approach is more child-friendly and allows children to be aware of when rest breaks are approaching. This method may also be easier for encouraging children to maintain their intensity, as they can be rewarded with a rest at the end of each effort. Gradually the length of each bout can be increased as children become more confident in completing the length of the original bout (Foreyt and Goodrick, 1990).

Rest periods can be made 'active' rest periods by asking the children to perform exercises, such as modified push-ups, crunches, or resistive work with dumbbells or rubber cords etc.

5.2 (h) Include Resistive Exercise in Children's Programs.

The inclusion of resistive exercise can be beneficial in increasing core body strength and therefore increasing a child's strength to complete alternative sporting activities. Resistive exercise has also been shown to maintain lean body mass that in turn is beneficial for weight management.

The inclusion of resistive exercise has been shown to have a positive effect on subjects who are attempting to decrease fat mass (Ballor et al., 1998). Resistive work assists in increasing lean body mass and resting metabolic rate, and hence total daily energy expenditure (Schwinghandl et al., 1995). Including resistive exercise may also be offered as an explanation for the decrease in the sum of skinfolds of children involved in the experimental group.

Resistive work was also proved to assist children in the experimental group, with a significant improvement in upper-body strength scores \( p=0.0004 \). No significant difference was evident between the groups, with the control group displaying similar post-intervention upper-body strength scores.

Children within the control group performed push-ups as part of the control group exercises, which may explain their increase in upper-body strength. Push-ups
performed by the control group were not modified as they were in the experimental group. The children in the control group performed level 2 or level 3 push-ups, which were often too difficult to perform in high repetitions. This resulted in children often stopping and not completing the push-up sets they were asked to do. Although level 2 and level 3 push-ups require greater strength, the children performing these push-ups did not improve any further on their upper-body strength scores than the children in the experimental group, who performed modified push-ups. Modifying strength exercises for children, so that **all** children can perform them, does not therefore result in any less gains in strength.

Lower-body muscular strength/endurance improved within the experimental group, and showed a greater improvement than in the children in the control group. This was likely to be a result of the children in the experimental group completing resistive leg exercises within their program.

5.2 (i) Educate Children about the Importance of Completing Stretching Exercises.

Another guideline for children's activity programs includes flexibility training to be encouraged at the end of each session for an increase in flexibility to occur. This study indicated that children of this age are able to complete partner stretches together and by being allowed input to stretching demonstrations, an increase in range of motion can occur.

Range of motion scores did not improve in the experimental group, but did increase in the control group. Children within the control group showed a significant improvement in range of motion scores at the hip (p=0.009 right hip, p=0.01 left hip). Children in both groups completed the same set of stretches before and after the lesson, therefore no bias was present in the content of stretching provided in the program. However, less variety was offered in exercise choice within the control group, whereas variety was introduced in the Experimental group warm-downs and included such things as partner stretches and allowing the children to teach each other various stretches.
5.2 (j) Discover and Encourage Each Child's Individual Strengths

Coaches should be taking notes on the strengths of the children and when appropriate use children to demonstrate their strengths to other children. Children who are successful at physical activity are often the children who are "winners" or "the best" at certain sports. Using children to demonstrate specific tasks or components of skilled activities, rather than "the whole package" can assist in developing self-efficacy and confidence in activities rather than just sport in general. The use of the rowing ergometer allowed the larger children to perform cardiovascular exercise without the discomfort of loading on their ankles and knees etc. The use of the rowing ergometer also allowed the children to discover that they could use their heavier frame as an advantage in certain physical activities.

A training effect was evident in the experimental group's rowing scores. The children within the experimental group showed an increase in rowing distances after the intervention (p=0.02), and a greater improvement in rowing scores than the control group (p=0.037). Children within the experimental group, however, were able to use the rowing ergometer during training sessions, thus increasing their skills on the rower between pre-test and post-test.

Another interesting point to note is that the children in the experimental group completed their rowing test at a significantly higher heart rate. This indicates that the children in the experimental group were willing to exert themselves at higher intensities, and were becoming more confident with their ability to exert themselves than they were at the start of the intervention. Children became more accustomed to the sensation of exertion and the execution of the exercise and therefore less anxious about the activities.

5.2 (k) Encourage Child Input and Allow Children to Become Responsible for Their Physical Activity Choices

Keep activities fun by allowing the children to have input into their programs and avoiding placing adult expectations and goals on what ultimately should be "owned" by the children. Coaches should also avoid over-correcting and over-analysing children in sport and their progress.
5.2 (l) Explain Purposes and Procedures of Each Lesson to Children and Engage Children in Learning Why Fitness is Important to Remaining Healthy

Children should be educated about all aspects of fitness and sport and why developing a positive attitude towards exercise is so important.

The fact that most children in this study, and all the obese children, listed running as their highest priority in their goal setting sheets, indicates that they believe this is the most important aspect of fitness to achieve. This could be due to the amount of running included in school programs and after-school sport.

Athletic children listed goals that were more sports orientated, indicating that they are not as concerned with one aspect of fitness as children who are less athletic.

The purpose and procedures of activities should be explained to children before they commence the activity.

During initial assessment sessions, obese children tended to be less confident and approached activities with caution. However, once the procedure of the activity was explained, and the reason for completing the activity, the children relaxed and became quite confident in their own ability. They appeared comfortable with themselves and were quite talkative by the end of the assessment session.

5.2 (m) Support and Encourage Children and Practise Using Timely Response

During exercise sessions, obese children tended to need encouragement during the initial stages of cardiovascular work. Once children were informed of the distance or time they were completing, they needed less encouragement.

Practise using response and feedback that is appropriate for each particular child. Avoid over-responding to a child's efforts and encourage parent/carers to use consistent response so as to create environments at home, school and outside activity that are comfortable and consistent for children to develop their skills.

5.2 (n) Minimise Competitive Situations and Avoid Placing Children in Embarrassing Situations

During cardiovascular sessions, lean children needed as much encouragement to complete tasks as ov/ob children. The athletic lean children tended to complete their first cardiovascular activity at full effort, maximum speed etc. This highly competitive attitude had two negative effects on the program. By not curbing the competitiveness of some of the children, the obese children were left further behind in cardiovascular
activities. Also, children who raced every activity tended to become tired within the first half of the lesson. Once they were tired they became negative towards activities, which often transferred to the obese children.

Taking into account the physiological challenges that ov/ob children deal with every day in sport, adults in charge of children's programs should be careful not to place children in situations that they have a greater chance at failing. For example: balance activities for ov/ob children are more difficult to complete as are long-exhausting cardiovascular activities.

Children will develop complex behaviours to avoid being placed in these situations such as attention seeking, avoidance or disrespect to instructions.

5.3 Areas of Further Research
Much research has been conducted on the benefits of exercise for weight management and physical fitness in children. Studies have also been conducted on the benefits of using the school system to deliver such programs. However, little research has been conducted on the problems experienced by specific populations of children with traditional exercise programs and activities. Future research needs to focus on further removing bias from activities provided for children in situations that may cause them discomfort or embarrassment.

Research should be directed towards creating environments that children and their parent/carers best learn physical activity practices. By discovering methods for creating these environments, the application of previous research into appropriate exercise dose and program content, can be much more effective.

Researchers attempting to discover how active children are and how to increase a child's activity levels, should be encouraged to firstly investigate how a child learns best, if they understand the baseline questionnaires and how the environment they are currently part of can be manipulated to facilitate increased learning potential.

This research could then be used in delivery guidelines for adults in charge of children’s programs, in an attempt to create empathy for ov/ob children attempting exercise programs and new sports.
REFERENCES


Australian Bureau of Statistics (2000) Children's participation in sports and leisure activities, Commonwealth of Australia


Hagerman, F. Concept II ergometer nomogram for prediction of maximal oxygen consumption. Morrisville VT: Concept II, Inc.


Lahmann, P.H.,Lissner,L., Gullberg, B., Berglund,G. (2000) Differences in body fat and central adiposity between Swedes


Senate standing committee on environment, physical activity in the school curriculum, recreation and the arts. *Physical and Sport Education*, May, 1996.


APPENDICES
Appendix la: Body Mass Index Percentiles for Boys Aged 2-20 Years

2 to 20 years: Boys
Body mass index-for-age percentiles

<table>
<thead>
<tr>
<th>Date</th>
<th>Age</th>
<th>Weight</th>
<th>Stature</th>
<th>BMI*</th>
<th>Comments</th>
</tr>
</thead>
</table>

*To Calculate BMI: Weight (kg) + Stature (cm) + Stature (cm) x 10,000
or Weight (lb) + Stature (in) + Stature (in) x 703

Published May 30, 2000 (modified 10/16/00)
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000)
http://www.cdc.gov/growthcharts

CDC
SAFER • HEALTHIER • PEOPLE™
Appendix 1b: Body Mass Index Percentiles for Girls Aged 2-20 Years

2 to 20 years: Girls
Body mass index-for-age percentiles

<table>
<thead>
<tr>
<th>Date</th>
<th>Age</th>
<th>Weight</th>
<th>Stature</th>
<th>BMI*</th>
<th>Comments</th>
</tr>
</thead>
</table>

*BMI = Weight (kg) / Stature (cm)²

Published May 30, 2000 (modified 10/18/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts
## Appendix 2: Physiological Characteristics of the Exercising Child – Summary (ACSM, 1998)

<table>
<thead>
<tr>
<th>Function</th>
<th>Comparison to adults during exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>METABOLIC</strong></td>
<td></td>
</tr>
<tr>
<td>Aerobic</td>
<td></td>
</tr>
<tr>
<td><strong>VO₂ max (ml/kg/min)</strong></td>
<td>Greater fatigability in prolonged high intensity tasks (running &amp; walking): greater heat production in children at a given speed of walking or running.</td>
</tr>
<tr>
<td>Anaerobic</td>
<td>Lower concentration and rate of utilisation of muscle glycogen</td>
</tr>
<tr>
<td></td>
<td>Ability of children to perform intense anaerobic tasks that last 10 to 90 secs is distinctly lower than adults.</td>
</tr>
<tr>
<td></td>
<td>Children reach metabolic steady state faster. Children contract a lower oxygen deficit. Faster recovery. Children, therefore, are well suited to intermittent activities.</td>
</tr>
<tr>
<td><strong>CARDIOVASCULAR</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Immature cardiovascular system means child is limited in bringing internal; heat to surface for dissipation when exercising intensely in the heat.</td>
</tr>
<tr>
<td></td>
<td>Up to maturity HRₓ is between 195 &amp; 215 beats/min)</td>
</tr>
<tr>
<td></td>
<td>Higher HR compensating for lower MV</td>
</tr>
<tr>
<td></td>
<td>Potential deficiency of peripheral blood supply during maximal exertion in hot climates</td>
</tr>
<tr>
<td></td>
<td>No known beneficial or detrimental effects on working capacity of child</td>
</tr>
<tr>
<td></td>
<td>Early fatigability in tasks that require large respiratory minute volumes</td>
</tr>
<tr>
<td>Respiratory frequency and tidal volume</td>
<td>Less efficient ventilation would mean a greater oxygen cost of ventilation. May explain the relatively higher metabolic cost of submaximal exercise.</td>
</tr>
<tr>
<td></td>
<td>Children’s physiological dead space is smaller than adults: therefore, alveolar ventilation is still adequate for gas exchange.</td>
</tr>
<tr>
<td>Perception (RPE rating of perceived exertion)</td>
<td>Exercising at a given physiological strain is perceived to be easier by children</td>
</tr>
</tbody>
</table>
Appendix 3: The intervention Program

The Intervention Program

Control Group
(n=8 age= 7.57 ± 1.62)
Delivered an exercise program 3 x per week
1 session per week supervised
2 sessions per week completed at home or on weekends
Exercises within the program were drawn from traditional school exercise and physical activity programs.
These programs were competitive, contained high amounts of weight bearing activity and long bouts of cardiovascular exercise.

Experimental Group
(n=10 age = 8.2 ±1.38)
Delivered an exercise program 3 x per week
1 session per week supervised
2 sessions per week completed at home or on weekends
Exercises within the program were modified so as to reduce the amount of weight bearing activity and long bouts of cardiovascular exercise.
A restriction was also placed on the levels of competition encouraged in the program.
The program also included resistive exercise and multiple short bouts of high intensity exercise.
Appendix 4: Steps taken to Recruit Subjects

Search of subject availability within local area
Design of suitable advertisements for local clinics
Design of suitable advertisement for local newspaper
Parent information session dates finalised

Mail-out to local school newsletters and health clinics
Details of information session provided over phone to interested parents.

Bookings taken for information night.

Information on testing protocols and intervention details presented at formal meeting. The information provided centered around the particular intervention being recruited for at the time (pilot, control or experimental phase of the study). Parents and children were then given the chance to make appointments to have children assessed for that particular intervention.

Children and parents were provided with the following instruction sheet before they attended the assessment session.
Appendix 5: The Information Session

After initial contact children and parents were invited to attend an information night to gain additional details about the research before committing to the assessment and intervention. Outlined below are the instructions supplied to the families who attended. These instructions were designed to assist in the standardising of the assessment protocols. The instructions also assisted in the delivery of instructions to the children involved in the assessment process and intervention sessions.

Instructions for assessment session.

Parental involvement-

- Parents are welcome to stay during the testing process but are asked to limit their involvement in encouraging their child. Children will need to listen to the instructions given by the testers carefully and will only need parental assistance as a last resort.

Consent and assent-

- Before commencing the assessment children must have a consent form filled in by their parent/guardian giving them permission to take part in the assessment. Children will also explained about “assent”, allowing them, to chose whether they would like to be involved or would like to cease involvement at any time during the assessment or intervention program.
Appendix 6: The CATPA Questionnaire

CHILDREN'S ATTITUDES TOWARDS PHYSICAL ACTIVITY.

COLOUR IN THE FACE THAT DESCRIBES HOW YOU FEEL ABOUT EACH QUESTION.

IF YOU DON'T UNDERSTAND THE QUESTION, COLOUR IN THE CIRCLE WITH THE QUESTION MARK (?)

1. How do you feel about taking part in exercise and at the same time meeting new friends?

2. How do you feel about exercising together with your friends?
3. How do you feel about exercising to make you look and feel better?

4. How do you feel about exercises where you could hurt yourself by moving very fast or changing direction quickly?

5. How do you feel about doing exercises which have beautiful and graceful movements?
Appendix 7: The Physical Activity Participation Questionnaire

Please wait for instructions from the teacher before answering the questions on this form.

1. Here is a list of places and groups where you can do different exercises and activities. Tick the boxes next to the places and groups where you’ve been and done these activities in the last year.

<table>
<thead>
<tr>
<th>Place/Group</th>
<th></th>
<th>Place/Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Church groups</td>
<td>[ ]</td>
<td>Police citizens club</td>
<td>[ ]</td>
</tr>
<tr>
<td>Cubs</td>
<td>[ ]</td>
<td>Brownies</td>
<td>[ ]</td>
</tr>
<tr>
<td>Little athletics</td>
<td>[ ]</td>
<td>Pony Club</td>
<td>[ ]</td>
</tr>
<tr>
<td>Tennis club</td>
<td>[ ]</td>
<td>Netball team</td>
<td>[ ]</td>
</tr>
<tr>
<td>Soccer team</td>
<td>[ ]</td>
<td>Surf club</td>
<td>[ ]</td>
</tr>
<tr>
<td>Swimming group</td>
<td>[ ]</td>
<td>Physical culture group</td>
<td>[ ]</td>
</tr>
<tr>
<td>Dancing group</td>
<td>[ ]</td>
<td>Martial arts group</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

If you have been to any groups or activities in the last year which aren’t in the list, write them in the space below.
2. Here is a list of different sports and activities.

Tick which of these you have done 3 times or more in the last year:

<table>
<thead>
<tr>
<th>Sport</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobics</td>
<td></td>
</tr>
<tr>
<td>Basketball</td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td></td>
</tr>
<tr>
<td>Flipperball</td>
<td></td>
</tr>
<tr>
<td>Gym</td>
<td></td>
</tr>
<tr>
<td>Martial arts</td>
<td></td>
</tr>
<tr>
<td>Rollerskating</td>
<td></td>
</tr>
<tr>
<td>Softball</td>
<td></td>
</tr>
<tr>
<td>Swimming</td>
<td></td>
</tr>
<tr>
<td>Tennis</td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td></td>
</tr>
<tr>
<td>Wrestling</td>
<td></td>
</tr>
<tr>
<td>Athletics</td>
<td></td>
</tr>
<tr>
<td>Cricket</td>
<td></td>
</tr>
<tr>
<td>Dancing</td>
<td></td>
</tr>
<tr>
<td>Football</td>
<td></td>
</tr>
<tr>
<td>Horse Riding</td>
<td></td>
</tr>
<tr>
<td>Rollerblading</td>
<td></td>
</tr>
<tr>
<td>Soccer</td>
<td></td>
</tr>
<tr>
<td>Surfing</td>
<td></td>
</tr>
<tr>
<td>Tai Chi</td>
<td></td>
</tr>
<tr>
<td>Volleyball</td>
<td></td>
</tr>
<tr>
<td>Waterpolo</td>
<td></td>
</tr>
<tr>
<td>Yoga</td>
<td></td>
</tr>
</tbody>
</table>

Write down any other sport or activity which you have done 3 times or more in the last year.
3. Make a list of up to three sports that you do most often and draw a circle around how long you play for each day, and another circle around how many days you play each sport.

<table>
<thead>
<tr>
<th>Sport 1</th>
<th>How long</th>
<th>10 minutes</th>
<th>20 minutes</th>
<th>30 minutes</th>
<th>1 hour</th>
<th>2 hours</th>
<th>longer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>How often</td>
<td>1 or 2 days per week</td>
<td>3 or 4 days per week</td>
<td>5 or more days per week</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sport 2</th>
<th>How long</th>
<th>10 minutes</th>
<th>20 minutes</th>
<th>30 minutes</th>
<th>1 hour</th>
<th>2 hours</th>
<th>longer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>How often</td>
<td>1 or 2 days per week</td>
<td>3 or 4 days per week</td>
<td>5 or more days per week</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sport 3</th>
<th>How long</th>
<th>10 minutes</th>
<th>20 minutes</th>
<th>30 minutes</th>
<th>1 hour</th>
<th>2 hours</th>
<th>longer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>How often</td>
<td>1 or 2 days per week</td>
<td>3 or 4 days per week</td>
<td>5 or more days per week</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 8: The Physical Activity Knowledge Quiz

CHILDREN'S FITNESS STUDY
HEALTH AND FITNESS QUIZ
(To be read through with the participant.
Participants will answer by pointing to the TRUE or NOT true symbols)

1. Activities that involve sitting down and being relaxed will improve your physical fitness.
   - TRUE
   - NOT TRUE

2. Activities that involve moving around and puffing will help to improve your physical fitness.
   - TRUE
   - NOT TRUE

3. Muscles help move your body.
   - TRUE
   - NOT TRUE

4. Bones help you stand up straight.
   - TRUE
   - NOT TRUE

5. Your heart pumps blood through your body.
   - TRUE
   - NOT TRUE
TRUE NOT TRUE

6. Two muscles in your legs are called your Latissimus and Pectoral muscles.

✓ ❌

TRUE NOT TRUE

7. Two muscles in your arms are called your Triceps and Biceps muscles.

✓ ❌

TRUE NOT TRUE

8. Is NOT important to warm up your body before you exercise.

✓ ❌

TRUE NOT TRUE

9. It is VERY important to stretch after you exercise.

✓ ❌

TRUE NOT TRUE

10. The stretch in the picture is stretching out the Hamstrings muscle.

✓ ❌

TRUE NOT TRUE
11. Throwing a heavy ball once is an example of an ENDURANCE activity.

TRUE  NOT TRUE

12. Sprinting is an example of a SPEED activity.

TRUE  NOT TRUE

13. If you DO NOT drink water whilst you are exercising for long periods of time you will dehydrate.

TRUE  NOT TRUE
SUBJECT INFORMATION PACKAGE
(Parents: Guardians and Children)

A. PROJECT TITLE.

Physical Activity Levels in Childhood: Early Intervention with an Eight Week Outdoor and Home Exercise Program.

B. BACKGROUND INFORMATION.

The level of participation of Australian children in physical activities is low and decreasing. This is resulting in a gain in average weight and also a decline in the general fitness levels of Australian children. Not all children have the same body builds and capacities and many have difficulty with "traditional" activities such as high energy sports and high repetitions of weight bearing exercise as occurs with jumping, push-ups, lunges etc. It is for this reason that some children may need more individualised, less competitive exercise programs. These programs should be designed so as to fit in with the child's home environment and local neighborhood. Programs should also be cost effective and fun with the emphasis on the child developing an exercise habit.

C. PROJECT OBJECTIVES.

The purpose of this study is to develop and test an eight week lifestyle intervention program suitable for general use in an outside environment and the home environment. The first program has already been conducted and involved a combination of resistive and cardiovascular exercise.

The programs designed for this particular intervention will consist of mainly cardiovascular exercise and ball skills. The programs will be designed so as to be similar to traditional exercise programs offered in primary schools. Individual children will receive a program tailored to their particular needs.
D. **TEST PROCEDURES.**

All testing will be performed in the university laboratory and by the primary researcher, Brodie Cambourne.

The program contains both lifestyle education and physical education and will involve the children exercising at the University of Wollongong grounds one day per week and at home two days per week. The children will be recruited one treatment group. The group will be delivered a program involving traditional activities such as walking, jogging, ball games and predominantly cardiovascular exercises.

All children participating in the program will be awarded weekly stickers and points for their participation in their program for each particular week.

The children will be assigned homework questions to help maintain maximum points.

A series of tests will be conducted before and after the eight week program in order to assess the effects of the program.

The study requires that two questionnaires be completed. The questionnaires assessing the children's attitudes towards physical activity and participation in physical activity. Also each child will be required to complete a knowledge of health and exercise concepts quiz. Each child will also be given a three day food record to be filled out by the parents/guardians on three consecutive school days.

Measures of blood pressure will also be obtained.

Measures of flexibility will also be conducted which will simply involve children reaching for their toes. Measures of body composition will include height and weight, and selected girth measurements measurement and skintold thickness.

Measures of muscular endurance of the legs and abdominals will also be obtained.

Simple measures of fitness will be taken which will involve rowing on a rowing machine for 9 minutes and walking / running for 7 minutes.

All testing will require a Physical Activity Readiness Questionnaire (PARQ) to be completed which provides a brief medical background of the child, including any injuries or conditions that may influence their exercise participation.

E. **RISKS AND DISCOMFORTS**

All tests will be conducted in a relaxed non-competitive environment and will be made as enjoyable for the children as possible.

All tests will be conducted with the knowledge and consent of both the children and parents and will be terminated at request of either the child or parent/guardian.
## Appendix 10: Outline of the Intervention Program

### Exercise Intervention Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Program Focus and session</th>
<th>Control Group Home Sessions</th>
<th>Experimental Group Home Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week one</td>
<td>Differences between passive recreation and active recreation</td>
<td>2-3 x 20 minutes moderate walking</td>
<td>3 x 5 minute vigorous sessions, 3 x per week</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week two</td>
<td>Difference between endurance, speed and strength</td>
<td>2-3 x 20 minute walking sessions with 30 second sprints</td>
<td>2-3 sessions of 10 x 100m sprints on local oval</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week two</td>
<td>Measuring your pulse rate and recovery rate</td>
<td>2-3 x 20 minute sessions of moderate cycling</td>
<td>2-3 sessions per week of 5 laps of a bicycle course</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week three</td>
<td>How strong are you? Activities that involve strength</td>
<td>2-3 sessions of floor exercises strength circuit</td>
<td>2-3 sessions of strength circuit including hand weights</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week four</td>
<td>Learning about muscle groups</td>
<td>2-3 15 minute walk with nominated muscle group exercise at end.</td>
<td>2-3 x of 10 x 100m sprints on local oval with hand weight exercises between each lap</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week five, six, and seven and eight similar format</td>
<td>Learning about new muscle groups each week muscle groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week Nine</td>
<td>Re-assessments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>