2001

Descriptive epidemiology and correlates of physical activity in young adults

Eva Rose Leslie
University of Wollongong

DESCRIPTIVE EPIDEMIOLOGY AND CORRELATES OF PHYSICAL ACTIVITY IN YOUNG ADULTS

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

DOCTOR OF PHILOSOPHY

from

UNIVERSITY OF WOLLONGONG

by

EVA ROSE LESLIE
B.App.Sci (Phys.Ed.), M.H.N.

BIOMEDICAL SCIENCE
2001

Declaration

I hereby certify that the material presented in this thesis titled **'Descriptive Epidemiology and Correlates of Physical Activity in Young Adults'** has not been submitted for the award of any other degree or diploma in any other University or Institution. To the best of my knowledge, this thesis contains no material previously published or written by another person, except where due reference is made in the text.

Eva R. Leslie

November 2001

Context of the Thesis and Acknowledgements

The studies contained in this thesis were carried out both at Deakin University and the University of Wollongong. At Deakin University, I was Research Coordinator in the Physical Activity and Health Research Program in the School of Health Sciences. During this time I was responsible for coordinating a number of research projects, including the Active Recreation on Tertiary Education Campuses [ARTEC] project funded by the Commonwealth Department of Health & Family Services. This project was part of the implementation strategy to reduce the prevalence of cardiovascular disease in specific target groups as recommended in Better Health Outcomes for Australians (1994). The aims of ARTEC were to investigate the physical activity patterns, exercise habits and sedentary behaviours of tertiary-education students in order to inform physical activity promotion programs for this target group.

As part of the ARTEC project, I worked with a research team to conduct a series of studies that involved large cross-sectional surveys of young adults from campus settings. The original studies reported in this thesis utilise data from the ARTEC project and from the broader program of research on physical activity participation, determinants and interventions in which I was involved. I acknowledge this program of research as a context for, and major contributor to, the development of my own studies.

The set of studies presented in this thesis includes both my own already-published first-author papers from peer-reviewed journals, and additional studies that I carried out within the broader research program. I also cite other papers of which I am first author or a co-author, which are part of the context for the specific studies reported in this thesis. A summary of my first author publications relating to the content of this thesis are listed in the Section 'Publications arising from thesis studies', and are included in Appendix A. Other publications of which I am a co-author are cited in relevant sections of the thesis. The advice, support and contributions of my co-authors are gratefully acknowledged. They are identified in my list of peer-reviewed papers and as authors on the papers bound into this thesis as Appendix A.

I wish to specifically thank several senior investigators, colleagues and collaborators who have guided and advised me, worked with me on the peer-reviewed papers

completed as part of my work towards this thesis, and without whose support I would never have completed my thesis studies. In particular, sincere gratitude to my two supervisors, Professor Neville Owen and Professor Adrian Bauman, who encouraged, supported and guided me over the course of my thesis studies. Neville, as my principal supervisior, gave me the belief that I could undertake this thesis, and was instrumental in motivating and providing me with the confidence to do so. He gave very generously of his time throughout to help me 'put it all together' and encouraged me with 'pep' talks when it all seemed too hard. Adrian was highly insightful in framing analyses and providing statistical advice and ideas, as well as generously providing me with access to large population data sets. Special mention must also be made for my San Diego colleague, Professor James F. Sallis, who was involved in devising the original project from which my studies came. Jim's energy, enthusiasm and ideas helped to clarify my writing and shape much of the work completed.

Particular appreciation is also due to Dr Sing Kai Lo for invaluable statistical advice for much of my earlier work, to Dr Michael Booth, whose perspective on children helped shape my thinking around young adults, and to Professor Phillip Sparling, who has many shared interests and has been a congenial and thoughtful collaborator.

Many of my work colleagues have been instrumental in providing a positive, friendly and happy work environment for which I am grateful. For this I would like to thank Jo Salmon, Kylie Ball, Jenny Veitch, and Ornella Clavisi. Thanks also to the research assistants and students who worked tirelessly on ARTEC and other projects with me: Jane Smith, Sue Mounsey, Sherryn Bassett, Rebecca Wonnacott, Nancy Humpel, and Alison Marshall. Thanks also to all those 'techies' who attended to my computer problems in times of turmoil.

Special thanks of course to my mother and father, who came to this country to give me every opportunity and have always provided love and support. They taught me that with hard work and commitment anything is possible. Finally, I would like to dedicate this thesis to my best buddy, husband and soulmate Bruce, who in his cheeky manner originally encouraged me to take up this challenge, and has supported me fabulously with humour and love throughout. He is my biggest fan and will be the happiest person of all to see this thesis completed.

Publications arising from thesis studies

Some of the original material presented in this thesis has previously been published in peer-reviewed papers for which I am first author:

Peer-reviewed papers:

1. **Leslie E,** Mounsey S, Owen N. (1998). University campuses as settings for health promotion: physical activity. *Health Promotion Journal of Australia*, 8(2): 136-139.

2. **Leslie E,** Owen N, Salmon J, Bauman A, Sallis JF, Lo SK. (1999). Insufficiently-active Australian college students: perceived personal, social and environmental influences. *Preventive Medicine*, 28(1): 20-27.

3. **Leslie E,** Owen N, Sallis JF. (1999). Inactive Australian college students' preferred activities, sources of assistance and motivators. *American Journal of Health Promotion*, 13(4): 197-199.

4. **Leslie E,** Fotheringham M, Veitch J, Owen N. (2000). A university campus physical activity promotion program. *Health Promotion Journal of Australia*, 10(1): 51-54.

5. **Leslie E,** Fotheringham MJ, Owen N, Bauman A. (2001). Age-related differences in physical activity levels of young adults. *Medicine and Science in Sports and Exercise,* 33(2): 255-258.

6. **Leslie E,** Sparling P, Owen N. (2001). University campus settings and the promotion of physical activity in young adults: Lessons from research in Australia and the USA. *Health Education,* 101(3): 116-125.

7. **Leslie E,** Bassett S, Owen N. (2001). Qualitative findings identifying environmental influences on young adult's physical activity in campus settings. *Health Promotion Journal of Australia,* 11(1): 73-74.

Abstracts and Conference Presentations on work arising from the thesis:

1. **Leslie E.** (1997). *Activity Levels for Tertiary Students and Implications for Health.* Paper presented at National Physical Activity, Sport and Health Conference, Melbourne 20-21 March, 1997.

2. Owen N, Salmon J, **Leslie E,** Veitch J, Sallis JF. (1997). *Physical Inactivity, Sedentary Behavior and Increasing the Levels of Physical Activity among College Students.* Paper presented at Society of Behavioral Medicine, April 16-19, San Francisco, California. Annals of Behavioral Medicine: Eighteenth Annual Meeting. Vol. 19, 1997 Supplement S040 [Abstract].

3. **Leslie E**, Owen N, Salmon J, Bauman A, Sallis JF, Lo S. (1998). *Insufficiently Physically-Active College Students.* Paper presented at Society of Behavioral Medicine, March 25-28, New Orleans, Louisiana. Annals of Behavioral Medicine: Nineteenth Annual Meeting. Vol. 20, 1998 Supplement S026 [Abstract].

4. **Leslie E.** (1998). *University Campuses as Settings for Physical Activity or Inactivity?* Invited presentation, Australian Universities Sports Federation Conference, Sydney 25 March, 1998.

5. **Leslie E,** Fotheringham MJ, Veitch J, Owen N. (1998). *Understanding and influencing physical inactivity in young adults.* Paper presented at Australian Society for Behavioural Health and Medicine, Australian Cancer Society and National Heart Foundation Conference, Behavioural Science in Health: Opportunities and priorities, Melbourne, December 13-15, 1998.

6. Fotheringham MJ, Owen N, Clavisi O, **Leslie E.** (1998). *Smoking, drinking, and physical activity in TAFE and University students.* Australian Society for Behavioural Health and Medicine, Australian Cancer Society and National Heart Foundation Conference, Behavioural Science in Health: Opportunities and priorities, Melbourne, December 13-15, 1998.

7. **Leslie E**, Fotheringham MJ, Bauman A, Owen N. (1999). Declines in physical activity from late adolescence through young adulthood – four Australian data sets. *Medicine Science Sports and Exercise* 31(5), S165. [Abstract].

8. **Leslie E,** Owen N, Salmon J, Fotheringham M. (2000). Physical activity and sedentary behaviour among young adults in university campus settings. Sixth International Congress of Behavioral Medicine, Brisbane, November 15-18, 2000. *International Journal of Behavioral Medicine* 7, S220. [Abstract].

9. **Leslie E,** Owen N, Bauman A, Marshall A. (2001). Stages of Change for moderate intensity and vigorous physical activity in young adults. The Cooper Institute Conference Series: Innovative Approaches to Understanding and Influencing Physical Activity, Dallas, Texas, October 4-6, 2001.

Abstract

Physical inactivity, as a modifiable risk factor for a number of chronic diseases, is now a key public health concern. Age-related declines in leisure-time physical activity have been reported across the entire lifespan. Recent findings based on analyses of large cross-sectional and longitudinal data sets suggest that there is a steady decline in physical activity during the young adult years. Given the evidence linking sedentary lifestyle with increased risk for coronary heart disease and other chronic diseases, health experts have concluded that an important health objective is to increase physical activity levels among all persons including adolescents and young adults. Long-term health behaviour patterns are being established during the early years of young adulthood.

In Chapter 2, age-related differences in the physical activity levels of young adults are examined in three cross-sectional samples of young Australian adults. Prevalence of moderate-intensity and vigorous activity, and walking are described for three age ranges (18 to 19, 20 to 24 and 25 to 29 years). Estimated energy expenditures derived from self-reported activity were used to classify respondents as 'sufficiently physically active for long-term health benefits', using a threshold of 800 kcal/week as the cut-point. There were significant differences between successive age groups, with lower proportions of young adults in moderate-intensity and vigorous activity, and being sufficiently active for long-term health benefits. There was a 15% age-related decrease in vigorous leisure-time physical activity participation from the 18 to 19 year old group to the 25 to 29 year old group, and a 10% age-related decrease in moderate leisure-time physical activity. Rates of walking showed slight downward trends with age (less than 8%), but these were not significant. Males were found to have higher rates of overall moderate-intensity and vigorous leisure-time physical activity than females in each of the age groups examined, and consequently had higher rates of sufficient physical activity than did females. Females however, reported higher rates of participation within each of the age groups for walking than did males. While both males and females showed decreases in participation across these age groups, the decrease was greater for males over the entire (18 to 29 years) age range.

Chapters 3 and 4 of this thesis examine factors related to being insufficiently active among young adults.

Chapter 3 examines the personal, social and environmental factors associated with young adults being insufficiently physically active for health benefits. Based on energy-expenditure estimates, derived from self-reported activity, thirty-seven percent of the sample did not participate in levels of physical activity sufficient to achieve long-term health benefits. Females were more likely to be insufficiently active, with a higher proportion in the sedentary and low-activity categories than males. Sixty percent of the sample perceived they were doing less activity currently than they did as high school students. A social learning perspective based on Sallis & Hovell's model (1990) was applied to identify potentially modifiable factors associated with physical activity. For females, predictors of being insufficiently active were lower social support from family and friends, lower enjoyment of activity and being unemployed, and for males, lower social support from friends.

Chapter 4 reported physical activity preferences, preferred sources of assistance to be active and motivators for activity for insufficiently active young adults. Males and females expressed different preferences for physical activity, and different motivators to being active. While the overall most-preferred physical activity choice was racquet sports, there were strong gender differences for activities. Females preferred aerobics, walking, dance and yoga, and males preferred weight training and team sports. Both males and females were found to express similar choices for assistance to be more active. The strongest preferences overall for assistance to be more active were for a group to exercise with, a trainer's advice, and having more facilities. Significantly more females than males wanted a group to exercise with. Significantly more males chose no form of assistance, and more females chose a video or a group to exercise with. Males were motivated to be active by weight gain, while females were motivated by weight loss, muscle tone, opportunities for exercising closer to home, feeling good and looking better.

Chapter 5 examines correlates of Stages of Change for moderate-intensity and vigorous physical activity in young adults. Separate staging measures that reflect guidelines for moderate-intensity and vigorous activity were used. The test-retest reliability of the staging measures was 'fair' for moderate-intensity activity and 'moderate' for vigorous activity. Ratings of barriers to physical activity and motivators for activity were factor analysed separately to produce three barriers factors: personal barriers, environmental

barriers and competing demands, and two motivator factors: personal motivators, and environmental motivators. These factors were examined in relation to Stages of Change, separately for moderate-intensity and vigorous physical activity. When staged by the vigorous physical activity measure, significant differences emerged for personal barriers between Stages of Change, for both males and females. Those in Action and Maintenance perceived fewer barriers than did those in the earlier stages. When staged by the moderate-intensity activity measure, significant differences emerged for personal barriers between Stages of Change for females only. Females showed significant differences in personal and environmental motivators between Stages of Change for both moderate-intensity and vigorous activity. Those in Precontemplation identified fewer motivators than did those in the Preparation, Action and Maintenance stages. There was considerable variation by Stages of Change for both moderate-intensity and vigorous physical activity in the barrier and motivator factors for females. For males, there were differences between Stages of Change for vigorous activity for personal barriers only.

The findings from these studies and the implications for promoting physical activity in young adults are discussed in Chapter 6. These findings can be used to target intervention approaches to specific subgroups, such as chronically sedentary women or previously active men. Suitable physical activity promotion strategies and programs could feasibly be designed within campus settings.

DESCRIPTIVE EPIDEMIOLOGY AND CORRELATES OF PHYSICAL ACTIVITY IN YOUNG ADULTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction and overview

The first US Surgeon General's Report on Physical Activity and Health (U.S. Department of Health & Human Services [USDHHS], 1996) has made a strong case for health benefits of physical activity. As part of this new public health agenda, several expert committees have recommended the promotion of regular physical activity (American College of Sports Medicine, 1998; Pate et al., 1995; National Institutes of Health Consensus Development Panel, 1996; USDHHS, 1996). With the most current recommendations comes an emphasis on participation in regular moderate-intensity activity. For example the National Physical Activity Guidelines for Australians recommend doing at least 30 minutes per day of moderate-intensity activity, such as brisk walking, and additional vigorous activity for added health benefits (Commonwealth Department of Health & Aged Care [CDHAC], 1999).

In order to increase activity levels in whole populations, there is a need to better understand the factors involved in participation in physical activity in specific sub-groups. Young adults (18 to 30 years) are a group of particular interest, and little is known about the patterns for physical activity behaviour around this period. During young adulthood, roles and responsibilities are undergoing change while many patterns of behaviour are being consolidated. Habits of sedentariness, developed during the young adult years may persist over the adult lifespan and increase the long-term risk of several inactivity-related diseases. Thus, the young adult years are a life-stage that provides a potentially important window of opportunity to influence lifelong physical activity habits.

Participation in physical activity has been observed to decline sharply during the teenage and young adult years, with females showing this decline earlier than males, particularly for vigorous activities. There are also gender differences in the prevalence of moderate-intensity and vigorous activity in younger adults, with males having considerably higher rates of vigorous activity than females at the same ages. It is during the young adult years, that there are apparent changes to environments for physical activity, after completion of high school and on entering the workforce or going on to tertiary-education study. Active

recreation and sporting opportunities that were previously available in school environments cease to be available and settings for other forms of activity become more salient. A more detailed understanding of the characteristics of physical activity behaviour for this age group is important. It can inform the design of more effective interventions to help increase overall levels of physical activity in the population.

This thesis deals with some of the potentially modifiable factors that are important for understanding and influencing physical activity in young adults. It examines the distribution and determinants of physical activity behaviour in this age group, describing the different patterns and correlates for moderate-intensity and vigorous physical activity behaviour. The focus is on using well-developed measurement methods to assess the prevalence of moderate-intensity and vigorous physical activity and the factors that may be associated with both types of activity. Males and females are examined separately in the studies presented as they have been shown to have different patterns of physical activity behaviour and different factors are associated with their participation. Australian population-based data, together with data from original studies of samples of young adults are used to examine the prevalence and correlates of leisure-time physical activity in young adults.

The studies described in this thesis use a descriptive epidemiology research strategy to characterise patterns of physical activity and associated factors. In presenting these studies, the conceptual frameworks from which I draw are from more than one discipline – theoretical models from health psychology (Social Learning Theory and the Transtheoretical Model), the behavioural epidemiology framework and aspects of exercise science (particularly for physical activity measurement) are the main conceptual and methodological underpinnings for the studies that I report.

The thesis is divided into six chapters.

Chapter 1 describes the background and rationale for the thesis and the public health significance of studying the physical activity behaviours of young adults. Public health

guidelines for physical activity, and their significance in relation to the problem of age-related patterns of physical activity participation are described. The importance of accurately measuring moderate-intensity and vigorous activity and categorising physical activity levels in populations are introduced. The specific measures used for describing leisure-time physical activity levels in population-based surveys, and how these levels can be categorised to indicate whether sufficient activity to achieve health benefits is achieved, are described. The rationale for studying young adults is then presented followed by a brief account of the relevant theoretical models that will be used. A summary of the literature on the known correlates of physical activity for adults is presented, with a focus on the differences between males and females. This chapter concludes by outlining the aims and specific research questions for the studies to be reported.

Chapter 2 presents data on physical activity patterns for young adults, reporting findings from three Australian data sets. Age-related differences in the prevalence of participation in physical activity over the young adult age years are described for moderate-intensity and vigorous activity, as well as the patterns for walking, and for 'sufficient' physical activity for achieving health benefits. Patterns for young adult males and females are examined separately.

Chapter 3 describes correlates of physical activity and inactivity in young adults. Findings of a descriptive study are reported that examine the personal, social and environmental factors associated with being insufficiently active in young adult males and females. This study uses a sample from a campus setting to examine physical activity related attributes within the context of a specific environment. Findings in Chapter 2 support the generalizability of these findings, given that they showed a large tertiary-education sample to be similar to a general population sample in the prevalence of physical activity behaviours for males and females.

Chapter 4 examines the preferences for physical activities, sources of assistance wanted to be more active and motivators for being active for insufficiently active young adults. Differences between males and females are reported.

Chapter 5 examines barriers and motivators to being more active as correlates of Stages of Change for physical activity. Two different staging measures are used to distinguish between Stages of Change for moderate-intensity and vigorous activity. Differences between males and females are reported.

Chapter 6 synthesises the key findings from Chapters 2, 3, 4, and 5 and discusses their relevance together with the limitations of the studies.

Directions for future research to address the problem of reductions in the prevalence of participation in physical activity in young adults are discussed in relation to these findings. Public health implications for promoting physical activity in young adults are also considered. Particular attention is given to the factors that may potentially be modified through public health programs and campaigns aimed at young adults and the settings in which this may be successful. Campus settings in particular are discussed as a context for providing opportunities for such programs.

LIST OF ABBREVIATIONS

AA	Active Australia
ABS	Australian Bureau of Statistics
ACSM	American College of Sports Medicine
AIHW	Australian Institute of Health and Welfare
ARTEC	Active Recreation on Tertiary Education Campuses
BRFSS	Behavioral Risk Factor Surveillance System
CDCP	Centers for Disease Control and Prevention
CDHAC	Commonwealth Department of Health and Aged Care
CDHSH	Commonwealth Department of Human Services and Health
DASET	Department of the Arts, Sport, the Environment and Territories
DEST	Department of Environment, Sport and Territories
IPACG	International Physical Activity Consensus Group
IPAQ	International Physical Activity Questionnaire
kcal	kilocalorie
kg	kilogram
kJ	kilojoule
LTPA	leisure-time physical activity
METs	metabolic equivalents
MPA	moderate-intensity physical activity
NHF	National Heart Foundation
NHMRC	National Health and Medical Research Council
NCHRBS	National College Health Risk Behavior Survey
PHAA	Public Health Association of Australia
PSFA	Pilot Survey of the Fitness of Australians
RFPS	Risk Factor Prevalence Study
RPE	rating of perceived exertion
USA	United States of America
UK	United Kingdom
USDHHS	Unites States Department of Health and Human Services
VO_{2max}	maximal oxygen uptake
VPA	vigorous physical activity

CHAPTER 1

LITERATURE REVIEW: ASSESSING AND UNDERSTANDING PHYSICAL ACTIVITY PATTERNS IN YOUNG ADULTS

Section 1.1 starts by setting the context for the thesis, introducing the known links between physical activity and health outcomes, and then discussing physical inactivity as a public health problem. A description of what is known about the decline in physical activity participation across the lifespan follows. The emphasis is on findings for the young adult age group. Current recommendations and guidelines for physical activity are then reviewed.

In Section 1.2, the measurement of physical activity in population studies is examined. The distinction between moderate-intensity and vigorous physical activity is discussed with reference to earlier and the more recent physical activity and health guidelines. The use of different measures in Australian population surveys is then discussed as background for the measures that are used in this thesis.

Section 1.3 provides the rationale for studying patterns of physical activity in young adults and relevance to public health. The patterns of decline for moderate-intensity and vigorous physical activity are examined for males and females in this age group.

In Section 1.4, studies on the factors associated with physical activity are reviewed in more detail, with an emphasis on the differences between patterns for males and females. Theoretical models that have been most widely applied in public health-orientated studies of physical activity behaviour are described. These models are used to focus on modifiable factors that potentially may be influenced through physical activity promotional strategies.

Section 1.5 presents the research objectives and specific research questions for this thesis.

1.1 Physical Inactivity as a Public Health Problem

1.1.1 Physical activity and health outcomes

Physical inactivity, as a modifiable risk factor for a number of diseases, has become a key public health concern. National and international bodies have produced consensus statements on the central role of promoting physical activity in the adult population as part of efforts to reduce rates of premature mortality and morbidity associated with several chronic diseases. Notable among them is the 1996 US Surgeon General's Report on Physical Activity and Health (U.S. Department of Health and Human Services [USDHHS], 1996), and the 1994 UK publication "Moving On. International perspectives on promoting physical activity" (Killoran, Fentem, & Caspersen, 1994).

In Australia, several key policy documents have been produced which emphasise the importance of physical activity to public health. Among these are the National Health and Medical Research Council's 'Acting on Australia's Weight' (National Health and Medical Research Council's [NHMRC], 1997), the 'Active Australia' framework (Commonwealth Department of Health and Family Services [CDHFS], 1998) and the Physical Activity Policy Statement of the Australian Public Health Association (Public Health Association of Australia [PHAA], 2000).

The Centers for Disease Control and Prevention in the USA and the American College of Sports Medicine have emphasised the importance of regular, sustained physical activity in reducing the risk of coronary heart disease, some forms of cancer, type 2 diabetes, and osteoporosis (Pate et al., 1995; Powell & Blair, 1994).

These statements and their counterparts for several other nations contend that higher rates of participation in physical activity among populations will result in a reduced burden from coronary heart disease, type 2 diabetes, osteoporosis and some forms of cancer - if widespread behavioural changes can be achieved (Pate et al., 1995). The evidence for the relationship between physical activity and a number of major health benefits has been recently summarised (Kesaniemi et al., 2001; Kohl, 2001; Kelley & Goodpaster, 2001; Vuori, 2001; Thune & Furberg, 2001).

The new policy context of physical activity and health outcomes, building on the scientific justification spelled out in the U.S. Surgeon General's Report (USDHHS, 1996), by Pate et al (1995) and by Bauman and Owen (1999), is exemplified by practical initiatives in the USA, South Africa and Australia. All aim to influence population levels of physical activity in several different settings, where large-scale physical activity promotion campaigns targeting particular groups are being conducted (Sparling, Owen, Lambert & Haskell, 2000). Addressing physical activity as a central public health objective must build on an understanding of those determinants of activity and inactivity that may be changed and those that may not.

This thesis is not concerned primarily with the evidence for the beneficial health impact of physical activity. This evidence has been extensively reviewed elsewhere (Bauman & Owen, 1999; Bauman, Owen & Leslie, 2000; Kesaniemi et al., 2001; Lee & Skerrett, 2001; Pate et al, 1995; USDHHS, 1996). Rather, the emphasis is on understanding levels of participation and correlates of physical activity, as a pattern of behaviour. The particular focus is on physical activity during the young adult years.

1.1.2 Physical activity and public health: recommendations and guidelines

The evidence linking physical activity and health outcomes has led to the development of national physical activity goals and targets in several nations, including the USA, UK and Australia. In Australia, the 1994 *Better Health Outcomes for Australians* report (Commonwealth Department of Human Services and Health [CDHSH], 1994) put forward a refined National Health Goals and Targets program, in which it identified the goal of increasing the prevalence of physical activity. It identified the target of reducing the proportion of the population that is physically inactive, from 35.6% in men and 36.0% in women (Australian Bureau of Statistics [ABS], 1991) to 25% for both men and women by the year 2000.

Previous physical activity recommendations emphasised the cardiorespiratory fitness benefits of regular participation in vigorous physical activity (American College of Sports Medicine [ACSM], 1978). The recommendations in this position statement prescribed vigorous activity, at least three times per week, for 15 – 60 minutes per session in order to obtain significant cardiac benefits. This message was later expanded

to include the development of muscular strength and endurance, and the recommended duration modified to a minimum of 20 minutes three times per week (ACSM, 1990). The 1990 ACSM Position Stand (which replaced the 1978 Position Stand) acknowledged the distinction between physical activity as it relates to health versus fitness. It pointed out that the quantity and quality of exercise needed to obtain health-related benefits could be distinguished from what was recommended for fitness benefits.

This shifted the "fitness gain" emphasis of the previous recommendations to one of public health gain, recognising that regular, moderate-intensity activity could confer significant health benefits by reducing the risk of certain chronic degenerative diseases and improving metabolic fitness. In 1993, a group of experts brought together by the U.S. Centers for Disease Control (CDC) and the American College of Sports Medicine (ACSM) reviewed the pertinent scientific evidence and formulated the following recommendation:

> "Every American adult should accumulate 30 minutes or more of moderate-intensity activity over the course of most days of the week" (ACSM/CDC Summary Statement on Physical Activity & Public Health, 1993).

A further statement was released in 1995, which produced a concise public health message regarding physical activity. This formally endorsed the above recommendation on the health benefits of regular, moderate-intensity physical activity for all adults (Pate et al., 1995). This statement also indicated that relatively short bouts (at least 8 – 10 minutes) of physical activity could be accumulated to obtain health benefits. The U.S. Surgeon Generals' Report, published a year later, made the same recommendations with the addition that it applied to people of all ages (USDHHS, 1996). This report provides a comprehensive summary of the historical changes to physical activity recommendations (USDHHS, 1996, Table 2.2, page 24).

There is now a widely accepted view that the most important health benefits of regular physical activity can be obtained at a low to moderate volume of physical activity and at less than vigorous intensity (Bouchard, 2001; Haskell, 1994). The current physical activity recommendations which emphasise the public health message – that there are significant health benefits associated with taking part in at least five sessions of

moderate-intensity activity (for example, brisk walking) for 30 minutes – have been incorporated into national guidelines for physical activity in Australia and the USA (Commonwealth Department of Health and Aged Care [CDHAC] 1999; USDHHS, 1996). The National Physical Activity Guidelines for Australian were developed as a result of recommendations arising from the National Health and Medical Research Council [NHMRC] Report *Acting on Australia's Weight: a Strategic Plan for the Prevention of Overweight and Obesity* (NHMRC, 1997). These guidelines were recently published by the Commonwealth Department of Health and Aged Care (CDHAC, 1999) in collaboration with the Australian Sports Commission, under the new "Active Australia" banner.

The Australian guidelines refer to the minimum levels of physical activity required for good health and are not intended for high level fitness or sports training. The guidelines stress the importance of thinking of physical activity as an opportunity to improve health rather than as a time-wasting inconvenience. The recommendations are that people should put together at least 30 minutes of moderate-intensity activity on most, preferably all, days of the week, and if they can to do some regular vigorous exercise for extra health and fitness. These guidelines explain the minimum recommended levels of physical activity, and how they can be incorporated into people's lifestyles.

The National Physical Activity Guidelines for Australians (CDHAC, 1999) are:

1. Think of movement as an opportunity, not an inconvenience.
   (Where any form of movement of the body is seen as an opportunity for improving health, not as a time-wasting inconvenience).

2. Be active every day in as many ways as you can.
   (Make a habit of walking or cycling instead of using the car, or do things yourself instead of using labour-saving machines).

3. Put together at least 30 minutes of moderate-intensity physical activity on most, preferably all, days.

(Moderate-intensity activity includes things such as a brisk walk or cycling. Combine short sessions of different activities of around 10 to 15 minutes each to a total of 30 minutes or more. The 30 minutes total need not be continuous).

4. If you can, also enjoy some regular, vigorous exercise for extra health and fitness. (Vigorous exercise makes you 'huff and puff'. For best results, this should be added to the above guidelines on 3-4 days a week for 30 minutes or more each time).

While the main focus is on being generally more active and on moderate-intensity activities, inclusion of a vigorous-intensity activity recommendation for those who are able to participate (Guideline 4 above) is an important one for young adults. Greater energy expenditure has been associated with increased longevity (Lee & Paffenbarger, 2000), and is thus included in the above recommendations for obtaining additional benefits.

A focus solely on moderate-intensity activity may not be totally appropriate for young adults, who because of their relative aerobic capacity require a higher level of intensity to achieve the full health benefits of physical activity (Shephard, 2001). The significance of both moderate-intensity and vigorous-intensity activity is discussed more fully in Section 1.2 - Measurement of physical activity in population studies.

1.1.3 Age-related patterns of physical activity participation

Age-related reductions in the prevalance of participation in leisure-time physical activity have been reported across the entire lifespan. Earlier reviews that contended that physical activity decreases and sedentariness increases with age (Stephens, 1987; Stephens, Jacobs & White, 1985) have been supported by more recent cross-sectional (Caspersen, Merritt & Stephens, 1994; Stephens & Caspersen, 1994; USDHHS, 1996) and longitudinal data (van Mechelen, Twisk, Post, Snel & Kemper, 2000; Telama & Yang, 2000). While physical activity levels generally decrease with increasing age, levels tend to be higher in males than in females. The period during childhood appears to be the most physically active time of life, after which levels of physical activity decrease during adolescence and early adulthood (Anderssen et al., 1996; van Mechelen & Kemper, 1995).

Several studies have shown that age is inversely associated with participation in physical activity in children (Sallis, Prochaska, & Taylor, 2000), children and adolescents (King & Coles, 1992), and adults (USDHHS, 1996). Data from cross-sectional and prospective studies have been recently examined to determine whether there are critical periods of the age-related decline and to quantify sex differences in the decline (Sallis, 2000; Caspersen, Periera, & Curran, 2000; van Mechelen et al., 2000; Telama & Yang, 2000).

Caspersen, Periera, and Curran (2000) examined cross-sectional data for five activity patterns from two large national surveys of adolescents and adults in the USA: 1) leisure-time physical inactivity; 2) regular, sustained, light to moderate activity; 3) regular, vigorous physical activity; 4) strengthening; and 5) stretching. They reported a decrease in each of the physical activity patterns with increasing age. Peak declines were observed in the 15 – 18 year age group in virtually every case, while for adults, there were different patterns of decline for different activities. For regular, sustained activities, there were declines in early and late adulthood but stability during the middle years. Regular, vigorous physical activity also declines, but is seen to increase in the later years. This may be due in part to the differences in relative intensity for older adults (Sallis, 2000; Capersen, Merritt & Stephens, 1994). Across all the age groups, females had a higher prevalence of physical inactivity than did males, with the largest divergence at the youngest (18 – 29 years) and oldest age groups (> 75 years).

Van Mechelen et al. (2000) and Telama & Yang (2000) report longitudinal data for adolescents and young adults from the Amsterdam Growth & Health Study and from the Cardiovascular Risk in Young Finns Study. In the Amsterdam study, habitual physical activity was measured by structured interviews at ages 13, 14, 15, 16, 21, and 27 and included all activities (at work, school, during leisure, organised and nonorganised sports, and active transport) equal to or greater than an intensity of 4 METs[1]. Over the 15-year follow-up period, habitual physical activity declined for both males and females, but the decline was only statistically significant in males. There was a decrease in total average weekly energy expenditure ($METs.wk^{-1}$) of 42% in males

[1] One MET is defined as the energy expended while sitting quietly, which is 3.5 ml of oxygen per kilogram of body weight per minute (3.5 $mL\ kg^{-1}\ min^{-1}$).

and 17% in female subjects. For both of these measures (total weekly time and total amount of physical activity) the decline was observed to be greater for males than for females. This finding is partly explained by the authors as being a result of the males having higher levels of activity to start with, thus having more opportunity to reduce the amount of physical activity over time. Over the entire longitudinal study period, the decrease was mainly found for the weekly time spent in nonorganised sport activities and "other" activities, which included physical activity at school or work, active transportation (walking and cycling), leisure-time activities other than sport activities, stair climbing, household activities, shopping, etc. When analysing data by intensity level, females were consistently shown to be more active than were males, with respect to moderate-intensity-activities.

The findings of van Mechelen et al. (2000) are similar to those described in longitudinal studies of Finnish young people from a national-level research program (Telama & Yang, 2000). The Young Finns study used a self-report questionnaire to measure physical activity in both genders at ages 9, 12, 15 and 18 years, with a nine-year follow-up. These data combine six different cohorts to cover the age period of nine to 27 years. A pattern of decline for all types of reported activities was reported (i.e. leisure-time physical activity, participation in sports club training, and participation in competitive sports) but physical activity frequency and sport participation had particularly steep declines. These findings show that the changes in physical activity with age vary according to the types of physical activity investigated. The simplest measure, frequency of physical activity, showed a marked decline after the age of 12 years (Telama & Yang, 2000). Among males the decline was steeper, and continued up to the age of 27 years, after the age of 18 years females actually engaged in physical activity more often than did males.

In summary, recent findings based on analyses of large cross-sectional and longitudinal data sets have described a steady decline in physical activity during young adulthood (Stone, McKenzie, Welk & Booth, 1998; Caspersen et al., 2000). It is during this life-stage that young adults are gradually assimilating into adult roles. This transitional period is quite likely to have an impact on levels of physical activity participation (King et al., 1992). However, the knowledge base around such transitional periods remains meager. Recent longitudinal data on the transition from college student to young

alumnus support the trends observed in cross-sectional studies of declining physical activity participation through young adulthood (Calfas et al., 2000).

A more-detailed understanding of the declines in physical activity observed within this specific age group can inform the planning and implementation of public health physical activity strategies. Preventing the decline in physical activity during the young adult years is a potentially important public health objective. From the data that are available in population surveys, mostly broad age group categories (often ten or more years) are reported. These do not provide a detailed perspective on age-specific prevalences and trends occurring within the early years of adulthood. Descriptive studies can be used to identify factors associated with physical activity participation in young adults.

1.1.4 Assessing, understanding and influencing physical activity

Epidemiology has been defined as "the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control of health problems" (Last, 1988). Traditionally, epidemiology examines the links between behaviours and disease. The sub-field of behavioural epidemiology focuses on the causes of health-related behaviours, which are often linked to lifestyle (Sallis & Owen, 1999). In the case of physical activity, finding out who is active, why they are active and what barriers there may be to being more active are essential elements in affecting change in the population through public health policies and strategies.

The Behavioural Epidemiology framework describes how basic and applied research on physical activity and health may be used to inform the development of programs for promoting physical activity interventions and public health policy (Sallis & Owen, 1999; Sallis, Owen & Fotheringham, 2000). This framework outlines the following main research phases:

1. establishing the links between physical activity and health
2. developing methods for accurately measuring physical activity
3. identifying factors that influence physical activity habits

4. evaluating interventions to promote physical activity
5. translating research into practice

The studies reported in this thesis are shaped by the Behavioural Epidemiology framework.

There is now considerable evidence on the associations between physical activity and inactivity and health outcomes (phase 1, above). The particular focus of this thesis is, however, on applying good quality physical activity measures to accurately assess patterns of young adult's leisure-time physical activity participation (phase 2, above), and to examine factors that are associated with participation (phase 3, above).

The studies in this thesis use self-report measures of known reliability and validity to characterise physical activity levels in young adults (Booth, Owen, Bauman & Gore, 1996a; 1996b). These measures have been used in Australian population surveys (see Section 1.2.2). Physical activity characterised by employing such measures is used to describe levels of participation and their correlates for active and inactive young adults.

The implications of the findings are then discussed with reference to the last two phases of the Behavioural Epidemiology framework (phases 4 & 5, above).

1.2 Measurement of Physical Activity in Population Studies

In order to describe the measurement of physical activity accurately, some key definitions are helpful.

Physical activity has been defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powel & Christenson, 1985). Some examples of physical activity are walking, stair climbing, gardening, playing sport and work-related activity.

Leisure-time physical activity (LTPA) is a broad descriptor of activities carried out in a person's free or leisure-time, based on interests or needs (Howley, 2001). This can include activities like walking, gardening, dance and formal exercise programs, but does

not include activities related to performance of a job (usually described as 'occupational activity').

Exercise (or exercise training) is a subcategory of leisure-time physical activity in which "planned, structured, and repetitive bodily movements are performed to improve or maintain one or more components of physical fitness" (Howley, 2001).

Physical fitness is "a set of attributes that people have or achieve that relates to the ability to perform physical activity" (Caspersen et al., 1985). These attributes include cardiorespiratory endurance, skeletal muscle endurance, skeletal muscle strength, power, flexibility, agility, balance, reaction time and body composition.

The focus of this thesis is on *physical activity*.

Characteristics of intensity (effort), frequency (number of sessions), duration (time frame) and type of activity are commonly used to describe the dose of physical activity necessary to bring about a particular response.

Intensity describes the effort associated with physical activity, in relative or absolute terms. The *absolute* intensity of an activity is the actual rate of energy expenditure. Measures used to describe this include maximum oxygen uptake (VO_{2max}), kcal, kJ per minute or multiples of resting metabolic rate (METs).

Relative intensity is the self-perceived level at which a person participates in physical activity, and is commonly characterised by terms such as light or low, moderate or mild, hard or vigorous, and very hard or strenuous (USDHHS, 1996). A rating of perceived exertion (RPE) scale, ranging from 6 to 20, has been developed to describe these different levels of intensity relative to a person's perception of the effort involved (Borg, 1982). This scale has been used to help prescribe levels of exercise for adults (ACSM, 1991; see Table 2.4, USDHHS, 1996, p33). Thus, intensity can be expressed in relative terms in relation to a person's capacity for a specific type of activity (for example, % of VO_{2max} or maximal heart rate), or in absolute terms such as a specific activity with an assigned intensity, such as walking at 4 miles per hour (Ainsworth et al., 1993).

Recent public health guidelines have used absolute intensity to define appropriate levels of physical activity, so that brisk walking for healthy adults is regarded as moderate-intensity activity (see Section 1.2.2).

In order to relate levels of physical activity to health outcomes, it is necessary to have accurate and reproducible measurement techniques. Methods for measuring physical activity can be classified as direct or indirect. Direct methods provide measures of the energy costs, types, and patterns of physical activity, as well as physiological responses to physical activity. These include the use of doubly labelled water, motion sensors, heart rate monitors, diaries and logs and behavioural observation techniques (Montoye, Kemper, Saris & Washburn, 1996; USDHHS, 1996). Indirect methods include indirect calorimetry, physiological measures (such as heart rate and ventilation), and physical activity surveys or questionnaires (Lamonte & Ainsworth, 2001).

The measurement of physical activity in population-based and epidemiological studies generally uses self-report measures, either as interview- or self-administered questionnaires where participants are asked to recall their past physical activity. Self-report measures are commonly used to describe prevalence rates within the population, to identify relationships between physical activity and various health outcomes, and to assess the effect of intervention programs (Sallis & Owen, 1999).

Self-report measures of physical activity participation represent the best compromise between acceptability and accuracy for the purpose of population surveys and other physical activity research. They are the most practical tool for these purposes as they are inexpensive, relatively easy to administer to large groups, and acceptable to study participants as they are not intrusive (Caspersen, 1989; Montoye & Taylor, 1984; USDHHS, 1996).

1.2.1 Assessing physical activity by self-report

Several reviews have described the benefits and limitations of self-report instruments for physical activity (Ainsworth, Montoye & Leon, 1994; Kriska & Caspersen, 1997; Montoyne et al., 1996; Sallis, 1991; Sallis & Saelens, 2000). Overall they are regarded as the most widely used type of physical activity measure with benefits of low cost and

ease of administration to large groups of people, as well as being less likely to alter behaviour than are direct measures such as diaries and logs. Sallis & Saelens (2000) state:

> "There are multiple self-report physical activity measures with adequate reliability, content validity, and relative criterion validity that can be used with youth, adults and older adults" (Sallis & Saelens, 2000, p3).

There are a number of limitations in the precision of self reports, as they rely on an individual's perceived level of intensity of physical activity (Kesaniemi et al., 2001). This can be a problem, particularly for estimating low levels of physical activity. Self-report measures may also not assess the primary modes of activity for some population groups, nor the different domains of physical activity (for example, leisure-time, occupational, incidental or unplanned activity, and transport-related activity).

While self-report measures can assess the type of physical activity, they do not provide accurate estimates of the absolute amount of physical activity. This is needed in epidemiological research to define the dose-response association between physical activity and health (Haskell, 1994; Kesaniemi et al., 2001; Kohl, 2001; Lee & Skerret, 2001), and for population monitoring of the proportion of the population who are meeting the guidelines for physical activity. Objective measures, such as motion detectors and accelerometers, are increasingly being used for this purpose by physical activity researchers. While these tools can be costly and time-consuming to administer, they can help in assessing the various intensity levels which are related to different health outcomes (Andersen, Crespo, Bartlett, Cheskin & Pratt, 1998; Eaton et al., 1995; Pate et al., 1995; USDHHS, 1996). In addition, these instruments can be used to capture the contributions to physical activity and energy expenditure (other than those described in self-reported leisure-time activities) through different contexts, for example, in occupational settings.

Self-report measures of physical activity have tended in the past to focus primarily on leisure-time physical activity (LTPA), but are now including additional questions on other dimensions of activity, such as incidental physical activity, domestic and occupational activity, making assessment more complex. Self-report physical activity

measures may also contain ambiguous terms, for example, "moderate-intensity", that may be differently interpreted (Ainsworth, Montoye & Leon, 1994). Recall may also be more difficult for young children and for older adults.

One of the uses of standardized measures is the need to define a prevalence rate which can reflect the proportion of the population who are participating in a level of physical activity sufficient for achieving a health benefit (see Section 1.1.2). In the past, different cut-points and methods have been used to describe a 'threshold' in various surveys (Macera & Pratt, 2000). This can result in different prevalence rates from the same survey instrument depending on the cut-point that is used (Brownson, Jones, Pratt, Blanton & Heath, 2000; Pratt, Macera & Blanton, 1999; Sarkin, Nichols, Sallis & Calfas, 2000). For example, eight different definitions of 'adequate' physical activity produced prevalence estimates ranging from 13% to 38% of the U.S. adult population described as being 'sufficiently active for health' (Brownson et al., 2000).

The different measures currently in use for population monitoring and surveillance that can make it difficult to make comparisons across studies. This problem is of global interest. Currently an International Physical Activity Consensus Group [IPACG] is working to develop standardised measures in an International Physical Activity Questionnaire [IPAQ], so that such comparisons can be made (Booth, 2000; Pratt, Ainsworth, Booth, & Craig, 1999).

Self-report measures typically require participants to recall the frequency and duration of participation in a particular type of physical activity (for example, walking, moderate-intensity or vigorous activity) over a particular time period (anywhere between 24 hours to 7 or 14 days, but can be as long as one year). Respondents may be required to recall leisure-time physical activity, occupational physical activity (including household tasks and garden chores) or both, with varying levels of detail required. While such measures rely on recall and may be influenced by self-report bias they are less likely to influence behaviour than are direct self-report measures such as diaries and logs.

Australian population-based studies have most commonly used the past two weeks as the recall period (Department of Art, Sport, the Environment and Territories [DASET],

1992; Department of the Environment, Sport and Territories [DEST] 1995; Bauman et al., 1996; Booth, Owen, Bauman & Gore, 1996a; 1996b), to assess participation in three broad classes of physical activity (vigorous, less vigorous (considered moderate-intensity) and walking). These measures form the background for those used in the studies reported in this thesis (see Appendix B: Questions 34-40).

Self-reported measures have been found to be reasonably robust in terms of describing population levels of physical activity (Booth et al., 1996a, 1996b; Bauman et al., 1996; Smith, Owen, Leslie & Bauman, 1999). The results of self-report surveys have also been correlated with longevity and morbidity in populations. Data reported from the Harvard Alumni Health Study found self-reported walking and stair climbing to predict longevity in men, and vigorous activity was associated with lower mortality rates (Lee & Paffenbarger, 2000).

A number of different surveys have been carried out in Australia to describe the population prevalence of physical activity. These include the National Heart Foundation's *Risk Factor Prevalence Study* (RFPS) surveys conducted in 1983, 1985, and 1987 (Risk Factor Prevalence Management Committee, 1990), and the Department of Sport, Recreation and Tourism national data collections during the 1980's (Bauman, Owen & Rushworth, 1990). In 1991 the *Pilot Survey of the Fitness of Australians* included direct objective assessment of a number of components of physical fitness, as well as self-report information from a representative population sample (DASET, 1992; DEST, 1995; Booth et al., 1996a; 1996b; Booth, Bauman, Owen & Gore, 1997). The Australian Bureau of Statistics also conducts quarterly household surveys which include information on participation in sport and physical activities (ABS, 1999).

In 1996 the *Active Australia* initiative was developed as an Australia-wide campaign which sought to bring together major stakeholders from government and non-government sectors to provide the structures for effective promotion of, and opportunities to participate in, physical activity in Australia. An Active Australia National Physical Activity survey was conducted in November 1997. Results have been used to produce state-based reports on physical activity levels such as the *New South Wales Health Promotion Survey* (Bauman et al., 1996) and the *Active for Life Victorian Survey* (Smith, Owen, Leslie & Bauman, 1998).

The 1997 Active Australia National Physical Activity Survey was used as a benchmark for comparing trends in physical activity over the main two year time-period of the *Active Australia* initiatives. The survey indicated that 50% of men and 49% of women aged 18 – 75 years undertook physical activity at a level which was beneficial to health (Australian Institute of Health and Welfare [AIHW], 2000). This level was defined as participation in at least 150 minutes activity of at least moderate intensity, spread over five sessions per week. This total equates to meeting the current recommendation of 30 minutes of moderate-intensity activity on at least 5 days per week. In agreement with the trends described in Section 1.1.3 (Patterns of Physical Activity Participation in Populations), the levels of physical activity reported cross-sectionally, were generally shown to decline with increasing age (some increases for those over 60 years).

In 1999 the Commonwealth Department of Health and Aged Care and the Australian Institute of Health and Welfare jointly funded a National Physical Activity Survey. (Armstrong, Bauman & Davies, 2000). This survey was comparable to the earlier 1997 Active Australia survey. Between 1997 and 1999, there was a decline in the proportion of Australians participating in 'sufficient' physical activity to provide a health benefit (62% to 57%). This decline was observed for both men (63% to 60%) and women (61% to 54%). The results of this survey are reported in the *Physical Activity Patterns* of *Australian Adults* (Armstrong et al., 2000).

The Australian population surveys described above set the context for the measures that are used in this thesis. While self-report measures provide reasonable estimates of population prevalence of physical activity, they have some limitations. They do not provide accurate estimates of the absolute amount of physical activity, and the relative validity of self-report measures of vigorous activity tend to be higher than for moderate-intensity activities (Sallis & Saelens, 2000). However, categories of activity (vigorous, moderate, low level, sedentary) derived from self-report measures have been shown to be correlated with a number of biological indices of cardiovascular disease risk (e.g., Bauman & Owen, 1991). Those classified as being in the sedentary category have had similar socio-demographic characteristics as have those who are inactive in other studies (Owen & Bauman, 1992). Thus, these measures are useful in categorising the population into those who are likely to achieve health benefits from physical activity.

For the purposes of establishing the specific health outcomes from particular types of physical activity (see Section 1.2.2 below), there is a need for the use of objective measures to more accurately assess time spent in moderate-intensity and vigorous activity, including 'incidental' unplanned activity.

It is likely that the combination of self-report measures, which can provide information on the context and type of activity, and objective measures, which can provide more accurate estimates of energy expenditure, will be the most useful for future studies of physical activity.

1.2.2 Moderate-intensity and vigorous-intensity physical activity: a key distinction

The accurate assessment of energy expenditures associated with physical activity requires a distinction to be made between different intensities and types of activity. The distinction between moderate-intensity and vigorous-intensity physical activity is important, as there is evidence that different behaviours are related to some different health outcomes. For example, sedentary behaviour, using television viewing as a proxy measure, has been associated with body weight and fatness in children (Andersen et al., 1998), components of fitness in children (Armstrong et al., 1998) and with overweight in adults (Salmon, Bauman, Crawford, Tempiero & Owen, 2000). For some health benefits, for example blood pressure lowering, clinical trials of exercise intensity suggest similar, if not greater, benefit from moderate-intensity activity than from vigorous activity (USDHHS, 1996).

In a review of 23 national and international consensus panel judgements on the intensity of physical activity to enhance health, Shephard (2001) concluded that almost all expert groups regarded light to moderate-intensity of aerobic activity (40 –60% of VO_{2max}) to be an appropriate minimal recommendation for population health. It also appears that light to moderate-intensity activity is more effective in motivating those with low levels of physical activity or who are sedentary (Dishman & Buckworth, 1996). As was described in Section 1.1.2, national physical activity guidelines from Australia and from the USA now recommend engaging in at least 30 minutes per day of moderate-intensity activity, and additional vigorous activity for added health benefits (Commonwealth

Department of Human Services and Health [CDHSH], 1994; USDHHS, 1996). The 30 minutes can be done in a single bout or "accumulated" in multiple bouts with each lasting at least 8 to10 minutes (Pate et al., 1995).

Moderate-intensity activity can be described as "activity that does not make you breathe harder or puff and pant, such as recreational or incidental activity". Examples include walking briskly, climbing stairs, and bicycling leisurely. Moderate-intensity activity is quantified as an intensity of 3 to 6 METs (1 MET = resting metabolic rate) or 4 to 7 kcal/min; this level is equivalent to brisk walking for most healthy young adults (Ainsworth et al., 1993; Ainsworth et al., 2000).

Vigorous-intensity activity can be described as "activity that makes you breathe harder or puff and pant, such as sport and fitness activities". Examples include running, aerobic classes, and sports like football, basketball, and squash. Vigorous-intensity activity is defined as an intensity greater than 6 METs or more than 7 kcal/min ; this level is equivalent to walking briskly uphill or carrying a load (Pate et al., 1995).

The items used in the studies for this thesis make use of separate measures to distinguish between moderate-intensity and vigorous activities (see Chapter 2 for details).

The issue of intensity is important. This is because when adults age, their aerobic capacity steadily declines so that activity at any given MET level (an absolute intensity) requires a greater percentage of their aerobic capacity (a relative intensity). Thus, the definitions of intensity levels described above are most applicable to younger adults (18 to 39 years of age). A moderate-intensity activity performed by a 20 year old may be of vigorous-intensity when performed by a 60 year old (USDHHS, 1996, Table 2.4, p33). Thus, for young adults, a focus solely on moderate-intensity activities may not be totally appropriate, but nor would be a sole focus on vigorous activities. The establishment of a habitual pattern of moderate-intensity activity during the young adult years may be an important behaviour pattern that forms a basis for the longer-term health benefits that are argued to accrue from lifelong physical activity (USDHHS, 1996).

1.2.3 Categorising physical activity

Self-report data can be interpreted in a number of ways depending on the purposes of the particular study. Physical activity measures can be analysed as continuous variables of either the time spent in particular activities; as estimated energy expenditure (kcal/week); or, as categorical variables. The use of energy expenditure calculations from reported physical activities allows the development of a range of values (on a continuous scale) which can then be used to estimate dose-response relationships for epidemiological studies. Categorical data are also useful for estimating population prevalence and trends in physical activity and for assessing the effect of intervention trials (Sallis & Saelens, 2000). Categorical variables are created by establishing energy expenditure cutoff points for various levels of activity, and are most frequently used to describe whether individuals are reaching the threshold required for achieving health benefits. Energy expenditure (kcal) estimates have been used to describe population physical activity levels in several Australian studies (Booth et al., 1996a; 1996b, Gore, Owen, Bauman & Booth, 1993).

It has been estimated that a person needs to expend more than 800 kcal/week in recreation or exercise in order to enjoy the health benefits associated with physical activity (Blair, Kohl, Gordon & Paffenbarger, 1992). Previously it was considered necessary to do vigorous physical activity three times per week, reaching 60% of maximum heart rate, in order to achieve cardiovascular benefits (ACSM Position Stand, 1990) – requiring a 'high' energy expenditure level of 1600 kcal/week (see Section 1.1.2). Recent consensus from the Centres for Disease Control and Prevention and the American College of Sports Medicine (Pate et al., 1995), has lowered this threshold, so that those engaging in 'moderate' physical activity (above 800kcal/week) are also considered to be doing 'sufficient' activity to accrue long term health benefits. This recognises that many of the health benefits of physical activity may be apparent at lower intensity levels without a large effect on fitness or maximal aerobic power.

Energy expenditure may be calculated from the frequency and duration of reported leisure-time physical activity. For example, in Australian population surveys, a two-week recall period has been used to obtain the total time spent in walking, moderate-intensity activity and vigorous-intensity activity. The time in hours for each type of

activity is then multiplied by weight (kg) and by the relevant rate of energy expenditure (MET value) for that activity. A MET, or metabolic equivalent, is a unit used to estimate the metabolic cost (oxygen consumption) of physical activity (Wilmore & Costill, 1994). [One MET equals the resting metabolic rate of approximately 3.5ml O_2 per kg per minute]. MET values can be assigned to various activities to define physical activity intensity. (Ainsworth et al., 1993, Ainsworth et al., 2000; Montoye et al., 1996). Moderate-intensity activity is equivalent to 3 – 6 METs or "3 to 6 times as much energy as rest" (Sallis & Owen, 1999, p.10), while vigorous-intensity activity is equivalent to 7 or more METs.

Values for walking, moderate-intensity activity and vigorous-intensity activity can be summed to obtain total estimated energy expenditure for the previous two weeks, which is then divided by two to obtain energy expenditure per week (kcal/week). The resultant value is then used to place people in categories of energy expenditure (Bauman et al., 1996; Booth et al., 1997 – see also Appendix F). Using this method, a 'high' level indicates energy expenditure of more than 1600 kcal/week and participation in more than 1 hour of vigorous activity; a 'moderate' level indicates energy expenditure of more than 800 kcal/week but not engaging in at least one hour of vigorous activity; a 'low' level indicates energy expenditure between 50 – 800 kcal/week; and a 'sedentary' level indicates energy expenditure of less than 50 kcal/week.

1.2.4 Categorising physical activity as 'insufficient' for health benefits

The four categories described in the previous section (high, moderate, low and sedentary) can be collapsed into two categories to indicate those people who are or are not, obtaining the health benefit threshold (using 800 kcal/week as a cutoff). The cutoff point of 800 kcal/week for achieving 'sufficient' physical activity represents a safe and accessible exercise prescription for health benefit, and is approximately equal to the energy expended in performing 30 minutes of a moderate-intensity type of activity (such as brisk walking) per day. This is the amount suggested by Blair and associates (Blair, Kohl, Gordon, et al., 1992) as the level required to achieve significant health benefits and is based on current national physical activity and health guidelines (Pate et

al., 1995; USDHHS, 1996; Bauman et al., 1996). This amount of moderate-intensity physical activity equates to 3.5 hours per week, or 800-1000 kcal/week.

A recent analysis of the dose-response relationship between the volume of physical activity and all-cause mortality rates concluded that the minimal effective dose was not well defined. However, physical activity expending 1000 kcal/week was associated with as much as a 30% reduction in all-cause mortality rates, with some evidence that volumes as low as 500 kcal/week may also have a favourable effect (Kesaniemi et al., 2001). Thus the cutoff point of 800kcal/week is a conservative estimate for classifying those who are "insufficiently" active for achieving a health benefit. The threshold of 800kcal/week represents 'how much' physical activity is required to obtain health benefits, and broadly equates to meeting current recommendations of regular participation in 30 minutes of moderate-intensity physical activity on most days of the week (see Section 1.1.2). This is a liberal interpretation of 'regular' physical activity, recognising that this may not occur on every day. For the purposes of assessing and targetting population groups for interventions in health-related research this is a reasonable cutpoint to use.

It should be noted that the categories derived from using such a cutpoint to describe obtaining a health benefit from physical activity have been described in different studies with varying terminology, such as 'adequate' or 'inadequate', 'sufficient' or 'insufficient', 'active' or 'inactive'. However the threshold for achieving health benefits has remained the same in several Australian studies that have used the cut-off point of 800kcal/week (or 1.8kcal/day/kg) to describe *adequate*, or *sufficient* activity (Bauman, Owen & Rushworth, 1990; Booth et al., 1996a; 1996b; Booth et al., 1997).

1.3 Why Study Physical Activity in Young Adults?

As described in Section 1.1.3, population data from several countries suggest that activity levels decrease considerably over the lifespan. Given that lifelong patterns of physical activity behaviour can contribute to health outcomes, it is pertinent to address the decline in physical activity during the young adult years. This is an important public health objective given the evidence linking sedentary lifestyle with increased risk for coronary heart disease and other chronic and prevalent diseases.

Several epidemiological studies have demonstrated strong links between physical inactivity, morbidity, and mortality rates (Pate et al., 1995: Powell & Blair, 1994; Raitakari et al., 1994). In essence, these studies document the inverse relationship between physical activity levels and the incidence of coronary heart disease. Many studies have focused on the positive effects of vigorous physical activity, but more recent, long-term studies have found that moderate-intensity physical activity is effective in reducing the incidence of cardiovascular disease risk (Blair & Connelly, 1994). Adopting moderate-intensity physical activity at any age through adulthood, including younger ages reduces the risk of coronary heart disease. Consequently, health experts have concluded that an important health objective is to increase physical activity levels among all persons including adolescents and young adults (USDHHS, 1996; 2000).

1.3.1 Evidence on the physical activity habits of young adults

A variety of surveys have been used in several countries to assess the population-wide prevalence of physical activity participation. The findings across survey type are consistent: rates of physical activity participation appear to decline during the teenage and young adult years (Stephens, Jacobs & White, 1985; Stone et al., 1998; Stephens & Caspersen, 1994; Caspersen, Pereira & Curran, 2000).

It should be noted that the evidence for this apparent 'decline' is largely from cross-sectional studies, which consistently show lower levels of participation in the later compared to the earlier years of adulthood (USDHHS, 1996). The older groups in these studies have lower proportions in vigorous-intensity and moderate-intensity activity than do the younger groups. Thus the word 'decline' is used to describe a lower proportion within successively older age groups. Although this phenomenon may be the result of a cohort effect, it has been consistently reported in several population surveys and is likely to reflect actual age-related declines in participation.

While the steepest age-related differences appear to occur in late adolescence (Sallis, 2000) they continue into early adulthood (18 to 30 years). For example, Australian population-sample data collected from the surveys described in Section 1.2.1 show age-related differences in physical activity levels during the young adult years. The rate of

leisure-time physical inactivity among Australians aged less than 20 years is only 9%, while in the 20-29 year age group it is 20% (Bauman, Owen & Rushworth, 1990). In pooled Australian population data, the reported prevalence of 'sedentariness' was 14% for those aged less than 25 years and 24% for those aged 25-39 years (Owen & Bauman, 1992). Data from the Pilot Survey of the Fitness of Australians indicate that over 35% of men and 50% of women in the 18 to 29 year age category are not participating in physical activity at levels that are likely to diminish cardiovascular disease risk factors (Booth et al., 1997; DASET, 1992).

It has been argued that long term health behaviour patterns are established during the early years of young adulthood (Dishman & Dunn, 1988; USDHHS, 1996), however there is limited research examining the decline in physical activity in this age group. In the USA, the National Health Institutes Surveys – Youth Risk Behaviour Surveillance Surveys, which are carried out systematically every three years, have monitored physical activity in young adults (USDHHS, 1996). The 1995 National College Health Risk Behavior Survey [NCHRBS] - a nationally representative sample of undergraduate college students in the USA - shows physical activity findings that are consistent with those of the general population studies (Centers for Disease Control & Prevention [CDCP], 1997; Pratt et al., 1999). Age-related differences in physical activity participation were observed during the period of early adulthood with vigorous activity reported by 42% of those aged 18-24 years, and 31% of those aged 25 and older (Douglas et al., 1997). A full report on the NCHRBS is available on-line at URL:http://www.cdc.gov/mmwr/preview/ind97_ss.html (Centers for Disease Control and Prevention [CDCP], 1997).

The reasons for the substantial age-related differences in physical activity levels that occur between adolescence and early adulthood are not well understood. This is a period when young people are in transition from an active youth to a more sedentary adult behaviour pattern. There is evidence that the decreases in physical activity participation during this life stage are associated with increases in body weight (Williamson, Kahn, Remington & Anda, 1990) and an increased prevalence of overweight and obesity (Kuczmarski, Flegal, Campbell & Johnson, 1994; NHMRC, 1997).

As young adults move through the major life transition of leaving school and either attending a university or college, or entering the workforce, patterns of physical activity are likely to be influenced by several factors (King et al., 1992). During this phase of life, many young adults may face increased demands on time, or additional environmental barriers to physical activity related to convenience, accessibility and cost.

The age-related differences observed in cross-sectional studies may also be related, at least in part, to changes in priorities or new time constraints as a consequence of entering the workforce or starting a family, or by leaving school environments and youth sport programs that facilitate physical activity (Calfas, Sallis, Lovato & Campbell, 1994). However, little is known about the physical activity 'determinants' specific to young adults during this life transition (King et al., 1992). While young adults may gain increased control over their lifestyles during this time, they may not necessarily develop behaviours like regular physical activity and may have limited access to physical activity facilities compared to their time at school. The activity patterns established during the transition from school may be maintained in adulthood (Dishman, 1988; Dishman & Dunn, 1988). If this is so, then the time of the early adult years between the final school years, tertiary studies or eventual employment or unemployment may be an important factor in determining patterns of activity in subsequent adult life.

Despite the lower prevalence of participation in older compared to younger age groups, national-level physical activity campaigns have not focused on young adults. Rather, their target groups have been older adults (Booth, Bauman, Oldenburg, Owen & Magnus, 1992; Marcus, Owen, Forsyth, Cavill & Fridinger, 1998; Owen, Bauman, Booth, Oldenburg, & Magnus, 1995). The emphasis in these campaigns has been walking, an activity that has less appeal to both younger adults (Booth et al., 1997) and to men (Leslie, Owen & Sallis, 1999). Moreover, activities such as walking – which are the focus of current recommendations for physical activity (see Section 1.1.2) – may be a biological stimulus of relatively weak intensity for many young adults (Shephard, 1997). This is due to the higher aerobic capacity of younger adults compared to older adults, which results in a lower relative intensity for activities such as walking (see Section 1.2.2).

1.3.2 Gender differences in moderate-intensity and vigorous physical activity

Sections 1.1.3 and 1.3.1 have documented that the steepest decreases in physical activity prevalence occur during adolescence (approximately 15 to 18 years of age), and in the 20 to 25 years age group (Caspersen et al., 2000; Sallis, 2000; Stephens, 1987; Stephens et al., 1985; Telama & Yang, 2000; van Mechelen et al., 2000). During this time both moderate-intensity and vigorous activities have been shown to decrease for both males and females. At the same time, rates of physical inactivity have increased during early adulthood (Bauman, Owen & Rushworth, 1990; Owen & Bauman, 1992).

Gender differences in the prevalence of moderate-intensity and vigorous activity in young adults have been documented in multiple surveys (USDHHS, 1996; Douglas et al., 1997; Pratt et al., 1999). On average, males have considerably higher rates of vigorous activity than do females at the same ages (USDHHS, 1996). In addition, physical activity declines appear to start earlier in females, particularly for vigorous activities (Sallis, 2000). Most studies have found lower levels of vigorous activity among women than among men at all ages (Sallis & Hovell, 1990).

Australian studies have shown differences in physical activity levels between men and women, with more women than men being insufficiently active to achieve most of the long-term health benefits (Bauman, Owen & Rushworth, 1990; Owen & Bauman, 1992; Booth et al., 1996a; 1996b; Bauman et al., 1996; Booth et al., 1997). However, few studies have examined gender differences in the factors associated with physical activity in young adults. The following section of this thesis describes these factors more fully with reference to theoretical models that can help explain and understand these patterns in young adults. In particular, social-cognitive models which have been influential in helping to explain physical activity are utilised (Godin, 1994).

1.4 Understanding Factors that Influence Physical Activity

Understanding the factors associated with physical activity in young adults can help provide information for designing effective interventions to increase participation in physical activity. As was argued in Section 1.1.4, Phase 3 of the Behavioural Epidemiology framework involves identifying factors that may influence physical

activity behaviours. This is an important step in developing the evidence base for interventions designed to increase physical activity participation.

1.4.1 Studies of physical activity 'determinants'

There is a large body of literature on physical activity 'determinants'. The word 'determinants' has been used to describe factors found to be *associated with* physical activity (Sallis & Owen, 1999). Thus, 'determinants' often refers to findings of cross-sectional studies of the correlates of physical activity, and not to 'causes' of physical activity. Although the term, 'determinants', has been widely used, it is probably a misnomer in this context. Examining these correlates for young adults can inform efforts to foster participation in increased activity for this age group. It is important, for example, to identify preferences for physical activities, the sources of assistance to be more active and the potential motivators and barriers to increased participation, specifically for young adults.

Several studies have been reported that use the descriptive epidemiology of physical activity to identify characteristics of active and inactive groups (e.g., Caspersen & Merritt, 1995; Owen & Bauman, 1992). Several reviews have been published on the factors associated with physical activity in adults (DEST, 1995; Dishman, 1990; Dishman & Sallis, 1994; Dishman, Sallis & Orenstein, 1985; King et al., 1992; Sallis & Owen, 1999).

The most recent review summarizes the findings of approximately 300 studies (Sallis & Owen, 1999, Chapter 7). In that review, studies that used the dependent variable of physical activity, exercise, or Stages of Change were included. Wherever multiple measures of physical activity were included, the measure of vigorous exercise was used, as this measure appears to show evidence of better reliability and validity than do measures of other types of physical activity. From the summary of results presented (Sallis & Owen, 1999; Table 7.2, page 115-6) there were consistently documented associations with all categories of determinants (demographic and biological factors, psychological, cognitive, and emotional factors; behavioural attributes and skills; social and cultural factors; and physical environment factors). Different factors may influence different people to a greater or lesser extent, and that the strength of these influences

may vary at different periods across the lifespan (for example, early adulthood). However, as argued in Section 1.1.3, little is known about physical activity determinants specific to particular life transitions or milestones.

Researchers describing physical activity find it useful to highlight those factors that are amenable to modification through interventions or through public health initiatives (Marcus & Sallis, 1997; Sallis & Owen, 1999). Variables that have been strongly supported in their associations with physical activity include social support, self-efficacy, perceived barriers, perceived benefits, enjoyment of activity, processes of change, intention to exercise and lower intensity of exercise. Variables that are consistently unrelated were health/exercise knowledge, history of exercise during youth, normative beliefs and perceived susceptibility to illness (Sallis & Owen, 1999). The majority of variables that have been studied to date reside in psychosocial and behavioural domains (Baker, Brennan, Brownson & Houseman, 2001; Dishman & Sallis, 1994; Dishman, Sallis & Orenstein, 1985; King, et al., 1992; Sallis & Owen, 1999).

Of the intrapersonal variables, self-efficacy, social support, intention, enjoyment, and barriers have been the most widely studied. Self-efficacy is a construct from social-cognitive theory (Bandura, 1986) which refers to a person's confidence in his or her ability to perform physical activity behaviour under specific circumstances. Self-efficacy has been argued to be the most powerful proximal determinant of behaviour (Bandura, 1986) and has been consistently associated with physical activity behaviour in different population subgroups (e.g., Booth, Owen, Bauman, Clavisi & Leslie, 2000; Hall, 1998; Oman & King, 1998; Rogers & Gauvin, 1998; Clark & Nortwehr, 1999, Sternfeld, Ainsworth & Quesenberry, 1999). This construct has been positively associated with adult physical activity (e.g., Courneya & McAuley, 1994; Hofstetter et al., 1991) and with physical activity Stages of Change (e.g., Marcus, Eaton, Rossi & Harlow, 1994, Marcus & Owen, 1992; Marcus, Pinto, Simkin, Andrain & Taylor, 1994, Marcus, Selby, Niauru & Rossi, 1992).

Social support from family and friends has been consistently related to physical activity in adults (Sallis, Hovell & Hofstetter, 1992; Treiber et al, 1991), to physical activity Stages of Change (Lee, 1993) and to adherence to structured exercise programs

(Duncan & McAuley, 1993). There is some evidence that there are differences in the influence of social support between males and females (Calfas, et al., 1994; Duncan, Duncan & McAuley, 1993; Sallis et al., 1989; Sallis, Hovell & Hofstetter, 1992). One relevant finding is that social support can be more important for women than it is for men (Calfas et al., 1994; Sallis & Hovell, 1990). Social support from family appears to be a stronger influence for young women than for young men (Myers & Roth, 1997). Social support from friends has been found to be a stronger influence for young men than for young women (Wallace-Silver, Buckworth, Kirby & Sherman, 2000).

Behavioural intention, a key construct from the Theory of Planned Behaviour and several other social-cognitive models (Godin, 1994), has also been related to adult physical activity (Courneya & McAuley, 1994; Godin, Valois, Jobin & Ross, 1991; Godin, Valois & Lepage, 1993), Stages of Change (Courneya, 1995) and adherence to structured programs (Courneya & McAuley, 1995).

Exercise enjoyment has been consistently positively associated with adult physical activity (Courneya & McAuley, 1994; McAuley, 1991) and Stages of Change (Calfas et al., 1994). In a sample of young adults attending college, exercise maintainers had higher scores for a measure of enjoyment of team sports and individual sports than did those at other stages (Calfas et al., 1994), with men reporting more enjoyment than did women.

A focus on "barriers" has been central to studies of the factors that can influence physical activity. Regardless of how firmly people may believe that physical activity is beneficial to their health, there are many barriers that may limit or prevent regular activity. Whether these barriers are real or perceived, they represent significant potential obstructions to the adoption, maintenance, or resumption of participation in physical activity (Booth et al., 1997). By identifying the major barriers to physical activity, practitioners can design interventions that accommodate or remove the obstacles and increase the probability for adoption of habitual physical activity.

Barriers to physical activity may be true reasons for not being able to participate in physical activity or they may be considered to be convenient "excuses" for not wanting to participate in this behaviour (Brawley, Martin & Gyurcsik, 1998). Barriers have been

consistently negatively associated with adult physical activity (Dishman & Steinhardt, 1990; Godin et al., 1991; Hofstetter et al., 1991). One study which rated the relative importance of several barriers in a community sample, found the most important barrier was finding time, followed by finding a partner to exercise with, physical health problems, the financial cost and lack of access to facilities (Godin et al., 1994).

A number of studies have identified a consistent set of reported barriers to increased participation in physical activity. In the 1980s, several researchers identified "lack of time" as a common barrier for not participating in physical activity or for dropping out of exercise programs (Dishman, Sallis & Orenstein, 1985; Myers, Weigel & Holiday, 1989). Steinhardt & Dishman (1989) also found that available time and motivational factors differed between those who were identified as inactive and those who were active. In a community based study, "barriers to activity" was found to be a strongly associated variable with self-reported vigorous activity among both young males and females (Sallis et al., 1989). This association was negative; that is, the more barriers reported, the less vigorous activity was reported. However, this same data examined correlates of walking for exercise and found that barriers were not a significant factor (Hovell et al., 1989). In a follow-up study of the same survey sample two years later, reporting stronger barriers to activity was found to be strongly inversely related to the adoption of vigorous activity over a 24-month period (Sallis, Hovell, Hofstetter & Barrington, 1992). From these findings, it seems likely that barriers to activity may be more relevant to participation in vigorous activity than they are to walking for recreation or for exercise.

In an Australian population sample, the most frequently cited barrier to participation by those who were described as inactive was lack of time, followed by lacking motivation to exercise, injury or disability that prevented them from being active and not being the sporty type (Booth et al., 1997). Differences were seen, however, across age groups, with lack of time being the most common barrier for those under 60 years of age whilst injury and poor health were more important among those aged 60 years or more. Similarly, a lack of motivation to exercise was more common among those under aged 60. Gender differences were also evident with more men than women wanting to rest in their free time, whilst more women than men nominated each of the other barriers.

Owen & Bauman (1992) described pooled data from a sample of 17,053 participants in population surveys in Australia in which 30% were identified as sedentary in their leisure-time physical activity habits. The most commonly reported reasons for inactivity among those who were sedentary were no time (35%), physically unable (24%), don't want to exercise (13%), need encouragement (9%), no chance to exercise (7%) exercising is too difficult (5%), no facilities (2.5%), no transport (2.3%). The first three barriers were more likely to be reported by those who were older, and who had lower incomes, with the exception that being 55 years or older was not associated with less time. Females were more likely to report being physically unable to exercise.

There have been few studies that have specifically investigated whether population subgroups are influenced by different factors. One consistently observed difference indicates that social support may be more influential for women than it is for men (Sallis et al., 1992), and that women are more likely to engage in moderate-intensity physical activity, while men are more likely to engage in vigorous activity. Women also experience a greater reduction in physical activity with age and report more demands on time that may serve as barriers to participation (Marcus, Dubbert, King, & Pinto, 1995).

1.4.2 Factors influencing physical activity in young adults

Factors such as "time" and "competing demands" have been identified as particularly relevant for young adults (Calfas et al., 1994; Booth et al., 1997; Myers & Roth, 1997). Differences in the perceptions of barriers have been reported for younger adults compared to older adults. For example, younger adults are twice as likely as are older adults to report "not having time" as a barrier to physical activity participation (Booth et al, 1997). Younger adults were also twice as likely to report "lack of motivation" as a barrier. In a sample of college students, Myers and Roth (1997) found that perceived benefits (for example, social factors) and barriers (for example, specific obstacles) were associated with differences in stages of exercise adoption. In another college sample Calfas et al. (1994) found that those in earlier stages of exercise adoption (eg. contemplation) perceived more barriers and fewer benefits than did those in later stages (eg. maintenance). However, studies of barriers have tended to focus on personal and social factors, with relatively few studies examining the possible influence of physical environment factors (Brawley et al., 1998; Sallis & Owen, 1999).

The studies of physical activity 'determinants' outlined in Section 1.4.1 highlight that the factors associated with physical activity may not be the same in different segments of the population, and can be different for males and females, and can vary for different types of physical activity.

One of the important aspects of the transition period between adolescence and adulthood are the competing demands on time and increased responsibilities that come with adulthood (King, 1994). Employment, study and social commitments are all factors that may increase the barriers to being physically active, as well as reducing the opportunities to be active. It has also been suggested that this age group undergoes changes to cognitive factors (such as personal attitudes toward physical activity) and social factors (peer encouragement to exercise), which may also contribute to the observed decline in levels of activity (Sallis & Hovell, 1990). These factors may all contribute to the observed declines that occur in physical activity during the young adult years, particularly during the transition between late adolescence and early adulthood (see Section 1.1.3 Age-related patterns of physical activity participation, and Section 1.3 Why study physical activity in young adults?).

While there are some similarities between males and females, there are differences in preferences for specific types of activity (King et al., 1992). A recent study examining the characteristics of the insufficiently active found significant differences in the activities preferred by males and females (Booth et al., 1997). More women than men nominated walking and aerobics, while more men than women nominated other activities like team sports. That study also found differences in sources of support to exercise, with the younger insufficiently active group (18-29 years), wanting to exercise with others, and older groups wanting advice from a health professional.

There are also differences between males and females in perceived benefits or motivators for physical activity. In a study of young adults, Calfas and colleagues found that women reported body image factors (weight loss, dissatisfaction with body) to be more motivating, while young men rated strength (muscle gain, muscle tone) and social aspects (organised competition, meeting people) of physical activity more highly than did young women (Calfas et al., 1994).

Pinto & Marcus (1995) examined physical activity stages of change in a young adult sample of college students (see Section 1.4.3). They used reported frequency of participation in up to three activities to stage individuals into the Precontemplation, Contemplation, Preparation and the Action stages (Maintenance was not assessed). There were no differences in the proportions of men and women across stages. There were however, differences in preferences for activity between men and women. Women were more likely to report participation in aerobics and walking than were men. Men were more likely to report participation in weight lifting than were women.

Studies of factors associated with physical activity in adults have generally used vigorous exercise as the dependent variable (Marcus & Sallis, 1997; Sallis & Owen, 1999). Given the recent CDC/ACSM recommendations on moderate physical activity (see Section 1.1.2), more attention is needed on the factors related to participation in moderate-intensity activity.

In order to help understand the various factors that may influence physical activity participation, several theories have been applied. The following section describes those theories that have been most often used in understanding the factors that are associated with physical activity and to developing interventions.

1.4.3 Relevant theoretical approaches

Several theories and models have been used to help understand and explain physical activity and to help to focus on the variables that are most strongly related to physical activity (Marcus & Sallis, 1997). As was argued in Section 1.4.2, knowledge of these variables and an understanding of physical activity behaviour in young adults can guide the development and refinement of interventions to increase physical activity participation. The use of conceptual models central to current research for physical activity can help to focus on the modifiable variables that can be influenced.

The US Surgeon Generals' Report on Physical Activity and Health describes a number of theories and models that are used in behavioural research on physical activity (USDHHS, 1996; Table 6.1, p 212). The theoretical frameworks that have been most widely applied in public health-orientated studies of physical activity behaviour

research are social cognitive models, including the Transtheoretical Model (Godin, 1994; Prochaska & Marcus, 1994; USDHHS, 1996). Other types of models have been applied (e.g., Kendzierski, 1994), but social-cognitive models have been most often used in understanding determinants of physical activity and in the development of interventions (Calfas, Sallis, Oldenburg & Ffrench, 1997). The theoretical focus of this thesis is on social cognitive models. The inclusion of personal and environmental factors, as well as their implications for targeting modifiable factors for interventions, makes these particular models appear to be the most useful at this time.

The model proposed by Sallis and Hovell (1990), based on social cognitive theory, aims to explain variations in physical activity levels. This model utilises information about environmental, social, personal, cognitive, and physiological factors to explain patterns of activity. These include enjoyment of activity, age, self-efficacy (that is, confidence in one's ability to exercise regularly), family and peer influences and access to facilities. Self-efficacy and other factors such as social support and exercise enjoyment, have been found to be positively related to participation in leisure-time physical activity for both adolescents and adults (Sallis, Hovell, Hofstetter, et al., 1989; USDHHS, 1996). Findings from both cross-sectional and prospective studies have found higher levels of physical activity self efficacy to be related to higher levels of participation (Dzewaltowski, Noble & Shaw, 1990; Sallis, Haskell, Wood, Fortmann & Vranizan, 1986). Environmental variables such as proximity of exercise facilities (Sallis et al., 1990) and satisfaction with community recreational facilities (MacDougall, Cooke, Owen, Willson & Bauman, 1997) have also been found to be associated with being more likely to be physically active.

One of the key elements of the Sallis & Hovell (1990) model of physical activity behaviour is the importance of the role of environmental settings and supports and the social and contextual consequences of activity. These are important determinants of whether people engage in physical activity. Environments that lack resources or pose barriers may act to reduce the probability that people can choose to be physically active. "Ecological" models applied to physical activity aim to take into account the role of environmental influences and the concept of "behaviour settings" (Sallis & Owen, 1999). Ecological models provide a theoretically anchored perspective and point strongly to the role of the physical and organisational environments as proximal

determinants of healthy or unhealthy choices (Sallis & Owen, 1997; Stokols, 1992). Applied to physical activity, ecological models point to the importance for health promotion strategy of understanding the specific links between particular settings attributes, particular behavioural choices and the attributes of those who spend time in the setting (Sallis & Owen, 1997; Sallis, Bauman & Pratt, 1998). Sallis and Owen (1999) have argued for an ecological approach to physical activity behaviour. This includes a distinction between social and physical environmental influences and the importance of multiple levels of influence. This is consistent with settings-based perspectives on health promotion, which take into account environmental barriers in workplaces, schools and communities (Green & Kreuter, 1990).

The Transtheoretical Model integrates concepts and theories from multiple models (Marcus & Simkin, 1993; 1994; Prochaska & Marcus, 1994). This model is primarily psychological and specific processes of change, measures of perceived benefits ("pros") and measures of perceived barriers ("cons") include both social and physical environment factors (Prochaska & Marcus, 1994). The Transtheoretical Model specifies five stages related to a person's readiness to change: Precontemplation, Contemplation, Preparation, Action and Maintenance (Prochaska & DiClemente, 1983; 1984). As people are believed to progress at varying rates through the stages, this progress is best described as spiraling or cyclical rather than linear (Prochaska, DiClemente & Norcross, 1992). Individuals use different processes of change as they move from one stage to another. Several studies of factors associated with physical activity have examined associations with Stages of Change, rather than with actual physical activity behaviour (Calfas et al, 1994; Courneya, 1995).

The 'Stages of Change' within the Transtheoretical Model describe motivational readiness to engage in physical activity. Stages integrate current behavioural status with intention to maintain or change behaviour (Marcus & Owen, 1992). Applied to physical activity (Marcus & Owen, 1992), the five stages of motivational readiness for change are as follows:

For those who are not physically active, Precontemplation includes those who do no physical activity and do not intend to start in the next six months. This can be characterised as the "I won't' stage.

Those in the Contemplation stage do not participate in physical activity but intend to start in the next six months. This can be characterised as the "I might" stage.

Those in Preparation (the "I will" stage) have a strong intention to change in the near future (often the next 30 days) and may participate in some occasional but irregular physical activity.

The Action stage (the "I am" stage) includes those who currently participate in regular activity but have done so for less than 6 months.

The Maintenance stage entails the participation in regular physical activity for 6 months or longer ("I have" stage).

The Stages of Change construct has been applied as a component of intervention studies in exercise intervention trials (Marcus, Emmons, Simkin-Silverman et al, 1998) and in other studies of physical activity (Booth, Macaskill, Owen et al., 1993; Marcus & Owen, 1992; Marcus, Simkin, Rossi & Pinto, 1996: Prochaska & Marcus, 1994).

Differences between different types of physical activity (see Section 1.2.2 Moderate-intensity and vigorous physical activity: a key distinction) have not generally been addressed in Stage of Change studies. In studies reporting adoption of physical activity the word 'exercise' has been used to denote general physical activity (Marcus, Banspach, Lefebvre et al., 1992; Marcus, Rakowski & Rossi, 1992; Marcus, Selby, Niaura et al., 1992). However, as the term 'exercise' is open to a wide range of interpretations by different individuals (vigorous activity, aerobic activity, moderate or incidental activity etc.), a good staging algorithm needs to explicitly state the discrete behaviour of interest to help individuals self-assess when answering stage questions (Reed, Velicer, Prochaska, Rossi, & Marcus, 1997). Defining the relevant type of exercise behaviour is likely to result in a more accurate staging measure.

Research comparing different staging algorithms has found that the stage construct is generally robust across many classification methods (Reed et al., 1997). The format for staging items can be either a single item or multiple questions. For example, in Australia, a single item motivational readiness instrument has been used in evaluations

of national campaigns (Booth et al., 1992; Owen et al., 1995, Bauman, Bellew, Owen & Vita, 2001).

It has been recommended that a staging measure should clearly state the criteria for frequency, duration, and intensity of physical activity (Reed et al., 1997). This is useful in assessing whether individuals are meeting current physical activity and health guidelines. The American College of Sports Medicine has established criteria for vigorous activity (ACSM, 1990), and the Center for Disease Control and the American College of Sports Medicine have established a criterion for lifestyle exercise (Pate et al., 1995). Both of these criteria can be used to estimate the proportions of the population that is meeting the required public health goals for physical activity.

Miilunpalo and colleagues (2000) applied the Transtheoretical Model to physical activity behaviour and examined stages of change in two different modes of health-enhancing physical activity (Miilunpalo, Nupponen, Latakari, Marttila & Paronen, 2000). Their study used "outdoor aerobic exercise" as an example of fitness activity and "everyday commuting activity" to represent lifestyle physical activity. Using data from a cross-sectional survey, they found that respondents were able to distinguish between different physical activity behaviours when assessing their Stages of Change. A significant proportion of people were in different stages for different modes of physical activity at the same time (Miilunpalo et al., 2000).

Social-cognitive models, including the Transtheoretical Model, have been influential in efforts to understand and integrate studies of the determinants of physical activity. The study by Miilunpalo et al. (2000) demonstrates a further application of the Transtheoretical Model, and shows the utility of differentiating between different types of physical activity.

Within the Behavioural Epidemiological framework (see Section 1.1.4), social-cognitive models, including the Transtheoretical Model, are helpful in integrating studies of factors associated with physical activity. These theoretical models should be helpful in understanding of the particular factors that may be associated with physical activity behaviour in young adults. Identifying which factors are potentially important influences is a key step in translating the findings of research into practice through

public health approaches. Social-cognitive models have been particularly influential in shaping the physical activity research agenda and in building links between behavioural studies, interventions and policy (Marcus & Sallis, 1997; Sallis & Owen, 1999; USDHHS, 1996).

1.5 Research Objectives and Specific Research Questions

Chapter 1 has reviewed selected research findings and cognitive approaches that I have argued to be relevant to assessing and understanding physical activity patterns in young adults. It discussed physical inactivity as a public health problem and described the apparent decline in physical activity participation that occurs across the lifespan. This observed decline is most usually inferred from the decreased prevalence of physical activity participation (for both moderate-intensity and vigorous activity) in successive age groups in cross-sectional studies. It is supported by a modest body of longitudinal data for adolescents and young adults.

Findings on physical activity participation among young adults were considered with reference to the current recommendations and guidelines for physical activity. The measurement of physical activity in population studies was examined, making clear the distinction between moderate-intensity and vigorous physical activity. The use of self-report measures to classify levels of physical activity into categories relevant for health-related research was presented. The use of such measures in Australian population surveys was discussed as background for the measures that are used to assess physical activity in this thesis.

The rationale for studying young adults' physical activity behaviour was examined, with reference to the findings on the patterns of physical activity in young adults. Differences between males and females were identified. Findings of studies on the factors associated with physical activity in young adults were reviewed and social cognitive models of physical activity behaviour, including the Transtheoretical Model, were described.

In this context, the overall focus of this thesis is on the patterns and correlates of physical activity and inactivity in young adults. The broad objectives are:

1. To examine the *prevalence* of participation in physical activity in young adults.
2. To examine the *factors associated with* being 'insufficiently' active for long-term health benefits and with participation in moderate-intensity and vigorous physical activity in young adults.
3. To discuss *implications for influencing* physical activity in young adults.

The specific research questions (identified below by their relevant chapters in this thesis) are:

Chapter 2: Age-related differences in the physical activity levels of young adults

Research question 1: *What are the age-related patterns for walking, moderate-intensity and vigorous physical activity and being insufficiently active for young adults; how do they differ for males and females?*

Chapter 3: Personal, social and environmental factors associated with young adults being insufficiently active

Research question 2: *What are potentially modifiable personal, social and environmental factors associated with young adults being insufficiently active; how do they differ for males and females?*

Chapter 4: Insufficiently active young adults' physical activity preferences, sources of assistance and motivators

Research question 3: *What are the preferred activities, sources of assistance, and motivators for insufficiently active young adults; how do they differ for males and females?*

Chapter 5: Correlates of Stages of Change for moderate-intensity and vigorous physical activity in young adults

Research question 4: *What modifiable factors are related to Stages of Change for moderate-intensity and vigorous physical activity in young adults; how do they differ for males and females?*

CHAPTER 2

AGE-RELATED DIFFERENCES IN PHYSICAL ACTIVITY LEVELS OF YOUNG ADULTS [1]

The study reported in this chapter uses data on young adults from two representative population samples and one campus-based survey study. Patterns of age-related differences in physical activity are described and compared for three different types of physical activity (moderate-intensity activity, vigorous activity and walking) in young adults aged between 18 and 30 years. Data from the measures used are also integrated to derived obtain estimated energy expenditure from all leisure-time physical activity. This allows data to be classified in terms of whether respondents are achieving or not achieving the threshold for obtaining a health benefit from physical activity.

Data from a campus-based study (the Active Recreation on Tertiary Education Campuses [ARTEC] project), is compared to data from an earlier Australian population study – the Pilot Survey of the Fitness of Australians [PSFA], and the more recent Active Australia [AA] Baseline Survey conducted by the Australian Sports Commission. Patterns for vigorous and moderate-intensity activity, walking and physical activity sufficient to obtain health benefits are presented and compared for males and females aged between 18 and 30 years. Data for males and females in the different types of activity are compared across three age bands (18 to 19 years, 20 to 24 years, and 25 to 29 years).

The data presented here are used to set the context for the later campus-based studies in Chapters 4 & 5 and also to establish that the physical activity characteristics of a randomly selected campus-based sample of young adults can provide comparable prevalence estimates and patterns to those of surveys of young adults in broader population samples. Data from the campus-based survey form the basis for the studies

[1] The study reported here has been published as Leslie E, Fotheringham MJ, Owen N, Bauman A. (2001). Age-related differences in physical activity levels of young adults. *Medicine and Science in Sports and Exercise,* 33(2): 255-258.

of factors associated with being insufficiently active that are reported in Chapters 3 and 4.

2.1 Introduction and Aims

As was shown in Chapter 1 (See Section 1.3.1 Evidence on the physical activity habits of young adults; Section 1.3.2 Gender differences in moderate-intensity and vigorous physical activity in young adults), physical activity levels of males and females decrease during the teenage years and young adulthood, while the prevalence of inactivity rises. Declines are observed in light-moderate activity and in vigorous activity in males and females between the ages of 12 and 21 years (USDHHS, 1996). Data from cross-sectional and prospective studies indicate that the decline in physical activity is steepest between the ages of 13 and 18 years (Sallis, 2000). Prevalence rates reported for vigorous activity are higher among males than females at all ages, with females showing a decline at an earlier age than do males (USDHHS, 1996).

While the decline in physical activity during the teenage yearsis generally greater for males than for females, males are more active overall (Sallis, 2000). Adult population surveys from Australia and other industrialized countries report declines in physical activity through young adulthood and beyond (Bauman, Owen & Rushworth, 1990; Owen & Bauman, 1992). In pooled Australian population data, the reported prevalence of 'sedentariness' was 14% for those aged less than 25 years and 24% for those aged 25-39 years (Owen & Bauman, 1992).

The planning and implementation of effective public health physical activity strategy can be influenced by a more-detailed understanding of the decreases in physical activity that are seen with age. The broader age group categories (often ten or more years) that have generally been reported for population surveys (Bauman, Owen & Rushworth, 1990; Booth et al., 1996b; Owen & Bauman, 1992; USDHHS, 1996) do not provide a sufficiently fine-grained perspective on age-specific prevalences and trends within the early years of adulthood. It has been argued in this thesis that during this transitional period, significant changes in life circumstances may be strongly influencing physical activity patterns (See Section 1.1.3 Age-related patterns of physical activity participation). In particular, the patterns for the years around the time of finishing

school and either entering the workforce or starting tertiary studies have not been documented. Nor have the patterns between the early adult years (where individuals are often gaining increased independence), and later phases of young adulthood when other responsibilities may impinge on discretionary time use.

The main aim of this chapter is to examine the relationship between reported leisure-time physical activity and age, for young adults aged between 18 and 29 years, using data from three recent Australian surveys. Trend data for males and females in vigorous and moderate-intensity activity, walking and physical activity sufficient for health benefits across three age bands (18 to 19 years, 20 to 24 years, and 25 to 29 years) are reported.

2.2 Data Sets Used

The data used for this study came from three separate data sets, with data being collected in 1991, 1996 and 1997/8. These were obtained from The Pilot Survey of the Fitness of Australians [PSFA] (see Appendix B), the Active Recreation on Tertiary Education Campuses project [ARTEC], (see Appendix C), and the Active Australia baseline survey for Victoria [AA] (see Appendix D). Data from each of these surveys have been previously published (Bauman, Owen & Rushworth, 1990; Booth et al., 1996a; Booth et al., 1996b; Leslie, Owen, Salmon et al., 1999; Leslie, Owen & Sallis, 1999; Owen & Bauman, 1992). A summary of the data sets used and the year of collection is presented in Table 2.1. The leisure-time physical activity items used in each of the surveys are comparable for each category, with only some minor differences that will be noted. These measures are described more fully in Section 2.3.

Table 2.1: Summary overview of the data sets.

Survey	ARTEC	AA	PSFA
Sample sizes 18-29 years (total sample)	 2085 (2,729)	 585 (2,500)	 435 (2,300)
type	self-completed survey	household random sample telephone survey	home-based face-to-face interviews

The PSFA survey was conducted in 1991 as the first representative population study of both the physical activity and measure of fitness levels of adult Australians, funded by the Commonwealth Department of the Arts, Sport, Environment and Territories (DASET, 1991). Methods for this survey have previously been described in detail (Gore et al., 1993; Booth et al., 1997). The sample was randomly selected from metropolitan Adelaide, South Australia, using a three-stage sampling procedure generated by the Australian Bureau of Statistics (ABS) of electoral rolls with 2,300 adults, aged 20 to 69 years participating (response rate 75%). All participants provided written informed consent and the project was approved by the University of Adelaide Human Ethics Committee (Gore et al., 1993). The leisure-time physical activity items in this survey used the past two-week recall period that was current at the time (see Section 1.2.1 Assessing physical activity by self-report; Questions 34 – 40 Appendix B).

The ARTEC survey was funded by the Commonwealth Department of Health and Family Services in 1995 as part of an implementation strategy to reduce the prevalence of cardiovascular disease (CDHSH, 1994). This project was undertaken jointly by the Victoria Council for Fitness and General Health (Vicfit) and Deakin University to investigate the physical activity patterns of tertiary-education students and the availability of on-campus facilities. 2,729 students (mean age 24 years) from four campuses (response rate of 58%) completed a cross-sectional self-report survey conducted in 1996. A more detailed account of the methods used is presented in Chapter 3. This survey used physical activity items that were modified from the PSFA items (see Section 2.3). A complete copy of the ARTEC questionnaire has been included in Appendix C.

The AA survey was conducted in 1997/8 in order to provide a national estimate of physical activity participation. This was later used as a benchmark to measure the effects of the national Active Australia campaign (Armstrong, Bauman & Davies, 2000). This survey was funded by the Commonwealth Department of Health and Family Services, the Australian Sports Commission and a range of other state and local agencies. The methods for the AA survey comprised a computer assisted telephone interview system, using random household sampling that targeted adults aged 18 to 75 years (response rate of 81%). Data was weighted to reflect the population estimates of proportions of males and females. Final sample weighted data consisted of 2500 adults.

This survey used past week recall for the physical activity items. The physical activity questions used in the AA survey are included in Appendix D.

2.3 Measures of Moderate-Intensity, Vigorous Activity and Walking

The self-report measures used in this study come from the three different surveys used (refer to Appendices B, C, D). Both the PSFA survey and the ARTEC survey used the past two weeks as the recall period, while the AA survey used the past week only. The three surveys contain similar measures for the leisure-time physical activity items of walking, moderate-intensity, and vigorous physical activity, with only slight differences in wording.

The Pilot Survey of the Fitness of Australians asked participants to recall their participation in physical activity over the past two weeks (Department of Art, Sport, the Environment and Territories [DASET], 1992). In this survey, the wording for the three classes of activity used was vigorous, less vigorous, and walking. For the ARTEC survey, the wording was modified slightly to reflect current terminology. For the "less vigorous" class of activity, the words "moderate exercise" were used to replace less vigorous. The walking question was also expanded to ask more broadly about walking for "recreation, health or fitness". In addition, a second walking question was included to ask about walking "to get to or from places or as a means of transport for at least 10 minutes consecutively", to reflect walking that is not strictly part of leisure-time physical activity but which is most likely to be associated with a health benefit [i.e. moderate or brisk paced walking of sufficient duration (8 to 10 minutes) to achieve a health benefit] (Pate et al., 1995). This form of "incidental" and transport-related walking is now identified as being an important component of total walking time (Armstrong et al., 2000).

The modifications described above have resulted in subtle differences between the measures used to obtain comparative data. Thus, the PSFA survey has a walking measure that does not include walking for transport. The AA survey asked the moderate activity question at the end of the survey, after parceling out gardening and chores, which were included in the moderate measures for the other two surveys. In the case of the PSFA and the ARTEC surveys, written consent was obtained. For the AA

survey all contact was by telephone and all of those who took part gave verbal informed consent, consistent with relevant Australian legislation and guidelines.

Table 2.2 summarises the leisure-time physical activity items used in the three different surveys analysed. The items used in the ARTEC survey (Appendix C) are the same as those used for the subsequent studies described in Chapters 3 and 4.

Table 2.2: Summary of physical activity measures used for the surveys reported.

Survey measures	ARTEC[a]	AA[b]	PSFA[c]
vigorous	vigorous exercise which made you breathe harder or puff and pant	vigorous physical activity which made you breathe harder or puff and pant	vigorous exercise – exercise which made you breathe harder or puff and pant
moderate	moderate exercise which did not make you breathe harder or puff and pant	any other more moderate physical activity that you haven't already mentioned*	less vigorous exercise – which did not make you breathe harder or puff and pant
walking	walk to get to or from places or as a means of transport for at least 10 minutes, or walking for exercise or recreation	walked continuously for at least 10 minutes for recreation or exercise, or to get to or from places	walk for recreation or exercise
sufficient activity	estimated energy expenditure $\geq$ 800 kcal/week (total of vigorous, moderate and walking multiplied by frequency and intensity in METs)		

[a] ARTEC: Active Recreation on Tertiary Education Campuses (Leslie, Owen, Salmon et al., 1999; Leslie, Owen & Sallis, 1999)
[b] AA: Active Australia Baseline Survey (Booth et al., 1996a; Booth et al., 1996b)
[c] PSFA: Pilot Survey of the Fitness of Australians (Bauman, Owen & Rushworth, 1990; Owen & Bauman, 1992)

* In the AA survey, the walking item was administered before the moderate item

2.4 Categorising Physical Activity Levels as 'Sufficient' or 'Insufficient' for Health Benefits

In order to assess whether the survey respondents were achieving the threshold of physical activity considered necessary to obtain long-term health benefits, an estimate of total energy expenditure was derived from the frequency and duration of participation in walking, moderate-intensity, and vigorous exercise reported in the previous two weeks. The rate of energy expenditure for each type of activity, in metabolic equivalents, was multiplied by the total time engaged in the activity over the past two weeks. These values were then summed to yield total energy expenditure expressed as kcal per week, which was then used to classify respondents into *sufficient* ($\geq$ 800 kcal.week^{-1}) or *insufficient* (<800 kcal.week^{-1}).

Young adults were classified as sufficiently or insufficiently active for long-term health benefits, using categories derived from previous studies and based on estimated energy expenditures from leisure-time physical activity reported in the previous two weeks (Booth et al., 1997). The rationale for using the cut point of 800 kcal/week is presented in Section 1.2.4 (Categorising physical activity as 'insufficient' for health benefits). This amount of physical activity is approximately equal to the energy expended in performing 30 minutes of moderate intensity activity (such as brisk walking) per day, as per current recommendations. This is in accordance with the cutoff point used in previous Australian studies (Booth et al., 1996a; 1996b; Booth et al., 1997).

The rate of energy expenditure for each activity, in metabolic equivalents, or METs[2], was multiplied by the total time reported in each activity over the last two weeks (walking for recreation, walking for transport, moderate-intensity activity, vigorous activity). The resultant values were estimated energy expenditures due to each activity and were expressed as kcal/kg over 2 weeks. This was then divided by 2 (kcal/kg/week) and then multiplied by weight (kcal/week).

Walking and moderate activity was assigned a MET score of 3.5 kcal/kg/hour, and vigorous activity 9.0 kcal/kg/hour. The data were then summed to yield an estimate of

[2] One MET is defined as the energy expended while sitting quietly, which is 3.5 ml of oxygen per kilogram of body weight per minute (3.5 mL kg^{-1} min^{-1}).

total energy expenditure due to physical activity reported. Initially, four physical activity categories based on energy expenditure were created: sedentary, low, moderate, and vigorous. These were defined as follows: sedentary – less than 100 kcal/week, low– 100-799 kcal/week; moderate – greater than 800 kcal/week but not included in the vigorous category; vigorous – greater than 1600 kcal/week and at least 3 sessions of vigorous activity of at least 20 minutes. These four categories were then reduced to two energy expenditure categories, to create *insufficient* (sedentary/low – 0-799 kcal/week), and *sufficient* activity (moderate/vigorous – greater than 800 kcal/week) categories.

This method of categorising physical activity levels is summarised in table form in Appendix F. The cut point of 100 kcal/wk for the sedentary physical activity category above is slightly higher than the 80 kcal/wk cut point used by Bauman et al (1996) and Booth et al (1997) described in Section 1.2.3. This level of energy expenditure is still minimal (< 20 minutes of moderate-intensity activity per week) and would be considered as being sedentary for the young adult sample described in Chapter 2.

2.5 Data Management and Statistical Analysis

Separate analyses were conducted to examine patterns of leisure-time physical activity participation in each of the data sets. Age-related patterns of physical activity participation for walking, moderate-intensity activity, vigorous-intensity activity and participation in sufficient physical activity for long-term health benefits were examined using Chi-square tests for Linear Trend (χ^2_{LT}; Breslow & Day, 1980). Results are summarised in Figures 2.1 and 2.2. Gender differences in age-related patterns of physical activity participation were also examined using Chi-square tests (χ^2) for each physical activity category (Table 2.3)

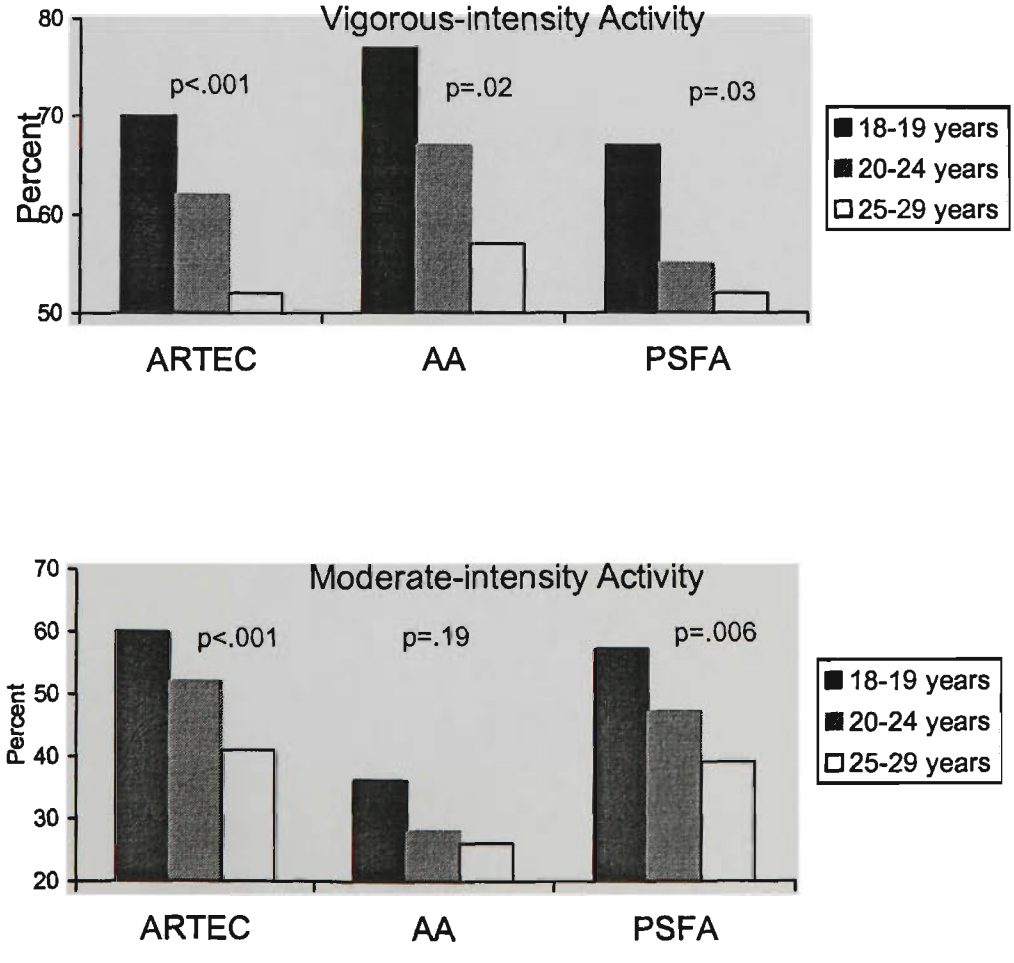
2.6 Results: Age-Related Differences in Physical Activity Participation

2.6.1 Prevalence of moderate-intensity and vigorous activity

For vigorous activity, overall participation rates are similar between the data sets. Chi-square tests for linear trend (χ^2_{LT}) revealed significant differences with age (ARTEC

χ^2_{LT}=26.7, *df=1*, *p*<.001; AA χ^2_{LT}=5.6, *df=1*, *p*=.02; PSFA χ^2_{LT}=4.7 *df=1*, *p*=.03; Figure 2.1). Participation rates for moderate-intensity activity showed the same trend with a slightly lower participation rate (not significant) for the AA data. Table 2.1 shows that the measure used for this survey used a more narrowly-defined question about moderate-intensity activity than the ARTEC or PSFA surveys (ARTEC χ^2_{LT} =25.1, *df=1*, *p*<.001; AA χ^2_{LT}=1.65, *df=1*, *p*=.19; PSFA χ^2_{LT}=7.4, *df=1*, *p*=.006; Figure 2.1).

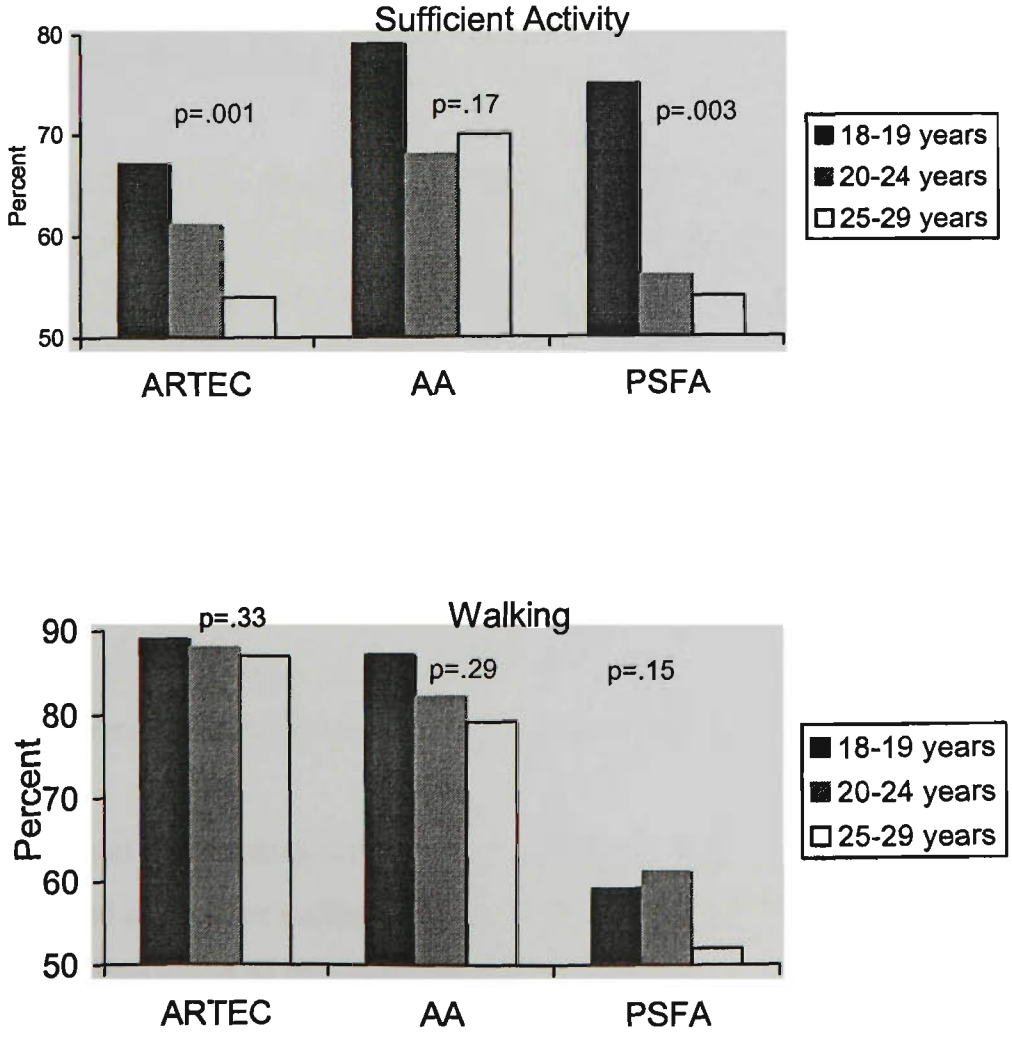
Figure 2.1: Prevalence of moderate-intensity and vigorous activity according to age group for three data sets: Active Recreation on Tertiary Education Campuses (ARTEC); Active Australia (AA); Pilot Survey of the Fitness of Australians (PSFA).



2.6.2 Prevalence of sufficient physical activity and walking

There were no significant differences in walking participation between age groups (ARTEC χ^2_{LT}=0.93, *df*=*1*, *p*=.33; AA χ^2_{LT}=1.1, *df*=*1*, *p*=.29; PSFA χ^2_{LT}=1.9, *df*=1, *p*=.15; Figure 2.2). PSFA data showed lower participation rates for walking, however Table 2.2 shows that this survey did not include walking for transport in the walking measure. There was a difference in the percentage of those who are sufficiently active across age groups, which was not significant for AA data (ARTEC χ^2_{LT}=12.13, *df*=*1*, *p*=.001; AA χ^2_{LT}=1.85, *df*=*1*, *p*=.17; PSFA χ^2_{LT}=8.6, *df*=*1*, *p*=.003; Figure 2.2).

Figure 2.2: Prevalence of sufficient physical activity and walking according to age group for three data sets: Active Recreation on Tertiary Education Campuses (ARTEC); Active Australia (AA); Pilot Survey of the Fitness of Australians (PSFA).



The ARTEC item asked about walking first, then about vigorous activity followed by walking. The PSFA item asked about vigorous activity first, then less vigorous exercise (which could have included some walking), followed by walking for recreation only, thus there may be some overlap in the walking and moderate-intensity reported.

2.6.3 Gender differences in patterns of physical activity in young adults

Comparison of prevalence rates separately for males and females highlighted a number of differences. Males consistently reported higher rates of participation within each of the age groups in vigorous- and moderate-intensity activity, and consequently had higher rates of sufficient activity than did females. Females however, reported higher rates of participation within each of the age groups for walking than did males. While both males and females consistently showed a difference between age groups for vigorous- and moderate-intensity activity, the decrease is greater for males over the entire age range. Furthermore, despite doing less physical activity overall than males, significant differences in sufficient activity were not observed for females through young adulthood (Table 2.3).

Males consistently showed a significant difference ($p<.05$) between age groups for vigorous-intensity activity. The same pattern of difference was also observed in females but is only statistically significant in the ARTEC data. There was a significant difference ($p<.05$) between age groups for moderate-intensity activity in males in two of the surveys and a statistically non-significant trend in the third (AA). Females show the same pattern of difference but the difference was only significant in the ARTEC data. There were no significant changes in the walking participation rates for either males or females. Males but not females showed significant differences ($p<.05$) for sufficient activity in two of the surveys and the same trend in the third (AA). There were no differences observed for walking amongst males or females.

Additional gender data, using only males and females in the sample that could be classified into either sufficiently or insufficiently active is reported in Appendix E. No further discussion of this data will be presented here.

Table 2.3: Proportions participating in vigorous activity, moderate-intensity activity, walking and sufficient activity for males (M) and females (F) by age category.

Survey	ARTEC		AA		PSFA	
	M %	F %	M %	F %	M %	F %
Vigorous activity						
18-19 yrs	75	66	86	68	78	58
20-24 yrs	70	56	77	57	61	49
25-29 yrs	58	46	65	50	56	50
	*	*	*		*	
Moderate activity						
18-19 yrs	60	60	43	30	56	58
20-24 yrs	55	50	37	21	54	39
25-29 yrs	34	48	34	18	37	42
	*	*			*	
Walking						
18-19 yrs	51	69	80	93	44	73
20-24 yrs	54	68	76	88	50	73
25-29 yrs	56	72	72	86	44	60
Sufficient activity						
18-19 yrs	77	60	89	70	85	65
20-24 yrs	71	53	81	56	63	48
25-29 yrs	59	50	76	65	60	49
	*				*	

* significant difference; χ^2 ; $p<.05$ between age groups

2.7 Summary of Findings

The findings presented here show significant age-related differences, with lower proportions of young adults in successive age groups participating in vigorous-intensity and moderate-intensity activity and being sufficiently active for long-term health benefits. The three surveys used similar measures, but in different modes: self report, telephone and interview administered. Nonetheless, the similarities across these data sets strengthen the evidence that the observed differences in physical activity behaviours among young adult populations are likely to be real. The similarities between prevalence rates for the various types of physical activity indicate that the representative sample used in the ARTEC study is comparable to broader population based samples.

For vigorous activity, overall participation rates were similar between the data sets, with significant differences between age groups. The same trend was shown for moderate-intensity activity, with lower rates of participation than for vigorous activity. There were no significant differences in walking participation between age groups but there were differences in the percentage of those who were sufficiently active across age groups. A number of differences emerged in prevalence rates between males and females, with males consistently reporting higher rates of participation within each of the age groups in moderate-intensity and vigorous activity. Males had higher rates of sufficient activity overall than did females.

Females however, reported higher rates of participation within each of the age groups for walking than did males. While both males and females consistently showed a difference between age groups for moderate-intensity and vigorous activity, the decrease was observed to be greater for males over the entire age range. Despite doing less physical activity overall than males, significant differences in sufficient activity were not observed for females between the age groups examined.

These different patterns of age-related declines in physical activity for males and females identified in this study have implications for the implementation of population-based physical activity promotion campaigns. These implications are discussed in

Chapter 6. The following sections of this thesis examine the modifiable determinants of physical activity for young adults.

In Chapters 3 & 4, a composite index of activity is used to examine the factors that are associated with being inactive in young adults. This is followed in Chapter 5 by separately examining factors that are associated with participating in moderate-intensity or in vigorous activity.

CHAPTER 3

PERSONAL, SOCIAL AND ENVIRONMENTAL FACTORS ASSOCIATED WITH YOUNG ADULTS BEING INSUFFICIENTLY-ACTIVE [1]

The reductions in rates of participation in physical activity that occur between adolescence and early adulthood (described in Section 1.3.2) may be related, in part, to young people leaving high-school environments and youth sport programs that facilitate physical activity (Calfas et al., 1994). While young adults attending university or college may gain increased control over their personal choices, they may not persist with regular physical activity, in part because they have limited access to physical activity facilities (Leslie, Mounsey & Owen, 1998). Although younger adults are more active than are older adults, many are nevertheless insufficiently active for long term health benefits (see Chapter 2; Leslie, Fotheringham, Owen & Bauman, 2001). Previous studies have reported that the average college student in the USA fails to meet the current physical activity recommendations of the American College of Sports Medicine (Dinger & Waigandt, 1997). Both students and alumni in another study in the USA reported that they perceive themselves becoming less active over time (Calfas et al., 1994).

This chapter examines the attributes of insufficiently active young adults. Little is known about the factors associated with physical activity that are specific to young adults, many of whom are moving through a major life transition by leaving school and attending a university or college (King et al., 1992). Young adults who attend a tertiary-education campus represent a major segment of the young adult population and their numbers are increasing. In 1995, students in tertiary education programs in Australia made up 39% of 15-24 year olds in the population (ABS, 1997). This student population comprises a significant subgroup of young adults.

---

[1] The study reported here is based on that published as Leslie E, Owen N, Salmon J, Bauman A, Sallis JF, Lo SK (1999). Insufficiently-active Australian college students: perceived personal, social and environmental influences. *Preventive Medicine*; 28(1): 20-27. That study also reported data from older participants. Thus, the findings reported here in Chapter 3 differ somewhat (but not substantially) from those reported in that paper.

3.1 Introduction and Aims

In this chapter, self-reported physical activity and personal, social and environmental characteristics are examined in a sample of 2,144 male and female young adults, aged between 18 and 29 years (mean age was 20.6 years), recruited from representative courses and year levels at four Australian tertiary-education campuses. This study employs the same sample as that described in Chapter 2. Physical activity is categorised as 'sufficiently' or 'insufficiently' active for health benefits, using estimates of energy expenditure (kcal/week) derived from self-reported physical activity (See Section 1.2.4 - Categorising physical activity as 'insufficient' for health benefits). Personal, social and environmental factors related to being insufficiently active for health benefits in young adults are described.

Personal factors (self-efficacy, job status, enjoyment), social factors (social support from family or friends), and environmental factors (awareness of facilities, gym membership) are examined. The gender differences in these correlates of physical activity are discussed.

The main aims of this study are: a) to examine associations of personal, social and perceived environment variables in relation to physical activity status, and b) to examine gender differences in the pattern of these associations.

3.2 Methods for the Study

The data reported here was collected as part of the Active Recreation on Tertiary Education Campuses [ARTEC] project, funded by the Commonwealth Department of Health and Family Services (Leslie et al., 1996; Leslie, Mounsey, Bauman & Owen, 1997; Leslie, Mounsey, Clavisi & Owen, 1998). Aspects of the study have been described in Chapter 2. The Deakin University Ethics Committee approved the study.

Students were recruited from two metropolitan university campuses and two rural colleges of technical and further education. Student numbers for these campuses were 6276, 6106 and 2130, 1425 respectively, and are of a typical size for rural and metropolitan campuses in Australia.

There was a similar participant selection procedure for all campuses. Heads of schools or departments were sent a letter of introduction to the project with a request for consent to administer the survey, followed by a telephone call to confirm permission. Agreement was obtained from all of the Heads of schools or departments approached. Class timetables were obtained from participating departments and schools across all year levels with details of lecture time, venue, number of students and the lecturer in attendance. At the two metropolitan campuses, classes of fifty or more students were randomly selected across thirty-one schools and departments. A selection of classes from the two rural further education colleges was made from a total of nineteen different schools.

Staff administering the survey briefly explained the project to each class during the distribution of the surveys, explained a raffle incentive to the participants, and emphasised the confidential nature of the survey procedures and the methods used to protect anonymity. Students were then requested to voluntarily complete the survey. At the two metropolitan campuses, most of the participants completed the questionnaire in their own time, and returned the surveys the following week in the same class. The two regional colleges allowed the majority of students to complete the questionnaires during class time, enabling immediate collection of the surveys. All participants who completed a survey were given a raffle ticket, and a $20 cash prize was drawn for each class.

3.2.1 Survey items

The survey was divided into six sections addressing demographic and personal attributes (age, sex, student and employment status, physical limitations), physical activity (two week physical activity recall), on-campus facilities (participation and awareness), and exercise-related enjoyment, social support and self-efficacy. While it would have been desirable to examine other potential influences on physical activity (such as work or school demands) included in broader population surveys, there were limitations in the amount of data that could be collected due to financial considerations.

Physical activity items were similar to those used in previous Australian studies (Booth et al., 1996a; 1996b; Bauman et al., 1996; Booth et al., 1997), and included questions on

walking for recreation or transport, engaging in moderate exercise and engaging in vigorous exercise. The questions used have been described fully in Chapter 2 (see Section 2.3; see also Appendix C). The walking question asked respondents if they had walked 'for recreation, health or fitness' or 'to get to or from places or as a means of transport for 10 minutes or more'. The moderate physical activity question asked about exercise 'for recreation, sport or health which did not make you breathe harder or puff and pant'. The vigorous physical activity question asked about 'exercise which made you breathe harder or puff and pant'. For each of these questions, participants were asked to describe the frequency and average duration of each activity. This measure of physical activity has been found to have acceptable reliability and validity (Booth et al., 1996a; 1996b).

Awareness of facilities was assessed by asking participants what, if any, on-campus physical activity facilities they were aware of, using a pre-determined list of possible facilities. Responses were categorised as unaware of any facility, or as aware of one or more facilities. For job status, students were categorised as employed if they took part in part-time, full time or casual work. The remainder (not working , home duties) were categorised as not working.

Self-efficacy items modified from a previously published scale (Sallis, Pinski, Grossman, Patterson & Nader, 1988) addressed confidence about exercising using three items; when feeling sad or highly stressed, when family and social commitments take a lot of time, or being able to set aside time for regular exercise, and were assessed using a five point scale (1= "I'm sure I cannot" to 5 = "I'm sure I can"). Respondents were categorised as low self-efficacy if the average score was less than or equal to 3 and high self-efficacy if their average score was greater than 3.

Social support from family and friends was assessed by responses to three items modified from a previously published scale (Sallis, Grossman, Pinski, Patterson & Nader, 1987) asking about family and friends; exercising with you, offering to exercise with you, and encouraging you to exercise, using a 5 point scale (0= "never" to 4= "very often"). Social support was categorised as low if respondents reported that other people 'never, rarely or only sometimes' exercised with them (average score less than or equal to 2); social support was categorised as high if others 'often or very often'

(average score greater than 2) exercised with them or encouraged them to exercise. Separate scores were calculated for family and friends social support.

Enjoyment ratings for 21 items describing different types of physical activity (from aerobics to yoga) were developed using a five-point scale (1="no enjoyment", to 5= "a lot of enjoyment"). Responses were coded as low enjoyment if the average scale score was less than or equal to 3, and high enjoyment if greater than 3.

3.2.2 Classification of physical activity levels

The methods used to categorise physical activity levels obtained from self report measures have been described more fully in Chapter 2 – a summary only is presented here.

Students were classified as sufficiently or insufficiently active for long-term health benefits, using categories derived from previous studies and based on estimated energy expenditures from leisure-time physical activity reported in the previous two weeks (Booth et al., 1997). "Sufficient" activity was based on current national physical activity and health guidelines (Pate et al, 1995; USDHHS, 1996; Bauman et al., 1996). Initially, four physical activity categories were created: sedentary; low; moderate; and vigorous (Bauman & Owen, 1991). These were then reduced to two energy expenditure categories, to create *insufficient* (sedentary/low– 0-799 kcal/week), and *sufficient* activity (moderate/vigorous– greater than 800 kcal/week) categories.

3.2.3 Data analyses

Data analyses were conducted using the Statistical Package for the Social Sciences (SPSS for Windows 9.01). Frequencies for all variables were examined for missing, unlikely, or out-of-range values and where detected were checked against the original data source.

Test-retest reliability for measures of self-efficacy, social support and enjoyment was assessed with a group of 51 students. For all measurements the Cronbach's alpha was

between 0.75 and 0.83, and intra-class correlation coefficients for test-retest measures ranged from 0.66 to 0.87 (mean 0.76).

The analyses presented here are cross-sectional and descriptive, focusing on the characteristics of the insufficiently-active students (estimated energy expenditure less than 800 kcal/week). A logistic regression model was developed to identify predictor variables significantly related to the presence or absence of the dichotomous dependent variable (insufficiently active versus being sufficiently active).

3.3 Attributes of Respondents

The data presented in this chapter are for young adults aged 18 to 29 years only (n=2144) from an original sample of 2,729 students attending four tertiary- education campuses, with a broader age range. The original sample of 2,729 (42.8% male, 57.2% female), reflects an overall response rate of 58.4% (Leslie, Owen, Salmon et al., 1999). The response rate for the two rural campuses were higher (82%, 91%) than for the metropolitan campuses (48%, 58%). The sex ratio for the overall sample was similar to that of the students enrolled at the four campuses. The young adult sample (derived from the original sample) comprised 43% males, with 44% aged 18 to 19 years, 46% aged 20 to 24 years and 10% aged 25 to 29 years.

Of this young adult sample, the majority of students reported that their ability to participate in physical activity was not limited (90% of respondents). A relatively small number of respondents reported that they were limited by a temporary illness (2%), a temporary injury (3%), a long-term illness (1%) or a long-term handicap or disability (4%). Over half (61%) of the respondents reported that they were employed in full-time, part-time, or casual work (10.2%, 47.5% and 3.3% respectively). A higher proportion of females had some form of employment (59% vs 41%). The majority of respondents were full-time or part-time undergraduate students (78% and 9%, respectively); 8% of the sample were postgraduate students. Fifty percent were first year students, 29% second year students, with the remainder third year students, fourth year or postgraduate students. Almost a quarter of the sample reported they belonged to a gymnasium or sports club. Rates of membership were similar by sex (24% males, 23% females).

3.4 Results: Correlates of Being Insufficiently Active in Young Adults

Based on the energy-expenditure criteria from self-reported activity (Booth et al., 1997; Bauman & Owen, 1991), thirty-seven percent of the sample did not participate in levels of physical activity sufficient to achieve long-term health benefits. Overall physical activity levels are described in Table 3.1. The data in Chapter 2 describe the proportions of males and females that were sufficiently active broken down by three age categories.

Females were more likely to be insufficiently active, with a higher proportion in the sedentary and low-activity categories than males (χ^2=86.2, df=3, p<.001). Of the insufficiently active group, significant differences were found for the amount of activity students perceived they did at university compared to high school, with 60.3% reporting less activity at university, 15.3% reporting more activity at university, and 24.4% the same amount of activity (p<.001). Results were similar for both males and females.

Table 3.1: Overall physical activity levels of young adults, based on energy-expenditure estimates from self-reported activity.

Levels of Physical Activity (n)	Male (732)	Female (996)	Total (1728)
Insufficiently Active Sedentary (<100 kcal/wk)	6%	10%	8.2%
Low (100-799 kcal/wk)	22%	35%	29.2%
Sufficiently Active Moderate (>800 kcal/wk, but not in the vigorous category)	43%	39%	40.3%
High (>1600 kcal/wk, and including at least 3x20 mins of vigorous activity)	29%	17%	22.3%

3.4.1 Comparisons between insufficiently and sufficiently active young adults

There were statistically significant differences on several variables between students who were classified as insufficiently active and sufficiently active for both males and females (see Tables 3.2 and 3.3).

Table 3.2: Comparisons of the characteristics of insufficiently active and sufficiently active females.

Variable	n	Insufficiently active (%)	Sufficiently active (%)	p
Age				
18-19 years	459	40.1	59.9	
20-29 years	537	47.7	52.3	.016
Awareness of campus facilities				
Unaware	270	50.0	50.0	
Aware	671	41.6	58.4	.019
Activity enjoyment				
Low	461	48.6	51.4	
High	253	32.0	68.0	<.001
Social support from family				
Low	614	46.6	53.4	
High	276	34.4	65.6	.001
Social support from friends				
Low	482	52.9	47.1	
High	418	29.7	70.3	<.001
Self-efficacy				
Low	435	61.4	38.6	
High	530	28.9	71.1	<.001
Employment				
Not working	274	55.8	44.2	
Employed	628	37.9	62.1	<.001
Gym membership				
No	742	52.6	47.4	
Yes	234	16.7	83.3	<.001

For females, those who had high enjoyment of activity, high social support from family and friends, high self-efficacy, are employed, and are members of a gym, were more likely to be sufficiently active. For males, those who had high social support from family and friends, high self-efficacy, and are members of a gym, were more likely to be sufficiently active.

Table 3.3: Comparisons of the characteristics of insufficiently active and sufficiently active males.

Variable	n	Insufficiently active (%)	Sufficiently active (%)	p
Age				
18-19 years	300	23.0	77.0	
20-29 years	432	31.7	68.3	.010
Awareness of campus facilities				
Unaware	273	30.8	69.2	
Aware	432	26.2	73.8	.184
Activity enjoyment				
Low	382	30.1	69.9	
High	134	19.4	80.6	.017
Social support from family				
Low	518	29.7	70.3	
High	125	12.0	88.0	<.001
Social support from friends				
Low	351	36.8	63.2	
High	310	16.1	83.9	<.001
Self-efficacy				
Low	267	43.8	56.2	
High	423	17.5	82.5	<.001
Employment				
Not working	273	31.9	68.1	
Employed	421	25.7	74.3	.075
Gym membership				
No	541	33.6	66.4	
Yes	172	11.6	88.4	<.001

3.4.2 Characteristics predictive of young adults being insufficiently active for health benefits

Characteristics of those who were insufficiently active were examined using a logistic regression model. There were interactions between sex and the independent variables ($p<.01$ for all interaction terms), and separate regressions were run for males and females.

Gymnasium membership and self-efficacy were excluded from the regression model as they are both strongly associated with higher levels of physical activity, and would be expected to have particularly strong and direct effects. These variables are highly correlated and have been excluded from cross-sectional analyses in previous studies (e.g. Sallis, Hovell, Hofstetter et al., 1989). Predictors of being in the insufficiently active category are presented in Table 3.4 for females and in Table 3.5 for males.

Table 3.4: Logistic regression examining the variables associated with females being in the insufficiently-active category.

Variable	Odds Ratio	95% Confidence Interval	p
Low social support from friends (reference: high support)	2.22	(1.51, 3.26)	.0000
Low enjoyment of activity (reference: high enjoyment)	1.79	(1.21, 2.64)	.0033
Low social support from family (reference: high support)	1.70	(1.11, 2.59)	.0143
Unaware of campus facilities (reference: aware of facilities)	1.15	(0.75, 1.75)	.5276
Age (reference: 18-19 years)	1.13	(0.79, 1.62)	.5068
Not working (reference: employed)	0.62	(0.41, 0.93)	.0205

Females who reported low social support from friends were significantly more likely to be insufficiently active, than were those who reported high social support from friends. Those with low social support from their family were significantly more likely to be insufficiently active than were those who reported high social support from family.

Females who were not working were significantly less likely to be insufficiently active than those who were employed. Females who reported low enjoyment of physical activity were significantly more likely to be insufficiently active than those with high enjoyment. For females, 65.3% were correctly classified for age, job status, awareness of facilities, social support from family and friends, and enjoyment of activity.

Table 3.5: Logistic regression examining the variables associated with males being in the insufficiently-active category.

Variable	Odds Ratio	95% Confidence Interval	p
Low social support from friends (reference: high support)	2.66	(1.61, 4.39)	.0001
Low social support from family (reference: high support)	1.86	(0.92, 3.79)	.0859
Low enjoyment of activity (reference: high enjoyment)	1.45	(0.81, 2.58)	.2099
Age (reference: 18-19 years)	1.35	(0.85, 2.14)	.1982
Unaware of campus facilities (reference: aware of facilities)	0.98	(0.61, 1.58)	.9427
Not working (reference: employed)	0.95	(0.60, 1.51)	.8250

Males who reported low social support from their friends were significantly more likely to be insufficiently active than those who had high social support from friends.

Overall, 73.5% of male participants were correctly classified by the combination of age, job status, awareness of facilities, social support from family and friends, and enjoyment of activity.

Variables significant in the bivariate analysis but which did not emerge as significant predictors in the multivariate analysis were awareness of facilities and age for females and social support from family, enjoyment and age for males .

It is of interest to note that the insufficiently active respondents gave high enjoyment ratings for only 7 of the 21 physical activities listed, compared to the sufficiently active who rated 12 activities highly. Activities with the highest enjoyment ratings for the insufficiently active were (from the highest down): netball, swimming, walking, tennis, disco dancing, cycling and aerobics (mean range = 3.07 to 4.07, SD = 1.23 to 2.91).

3.5 Summary of Findings

This study examined the characteristics of being insufficiently active in a sample of young adults aged 18 to 29 years using a self-report survey. Potentially modifiable determinants of insufficient physical activity were found to be similar for males and females. For both males and females, low levels of social support from family and friends and low enjoyment of activity, were the psychosocial attributes most strongly associated with being insufficiently active. There was also a strong positive association of gymnasium membership with being sufficiently active. For males and females, low social support from friends was a strong predictor of being insufficiently active. Low enjoyment of exercise, low social support from family and being unemployed were also predictors of being insufficiently active for females.

The insufficiently active rated only seven physical activities highly for enjoyment (netball, swimming, walking, tennis, disco dancing, cycling and aerobics), compared to 12 activities rated highly for the sufficiently active.

Awareness of facilities available on campus was not significantly associated with insufficient activity for either males or females. In this sample of young adults, 61% were employed, either in full-time or part-time jobs, with a higher proportion of females

in some form of employment. Employment status, when adjusted for other variables, was a significant predictor of levels of physical activity for females only, with those not working being more likely to be insufficiently active than those who were employed.

Implications of these findings and comments on their limitations are discussed more fully in Section 6.3 of Chapter 6 and in Chapter 6 more generally.

Thirty-seven percent of this young adult sample was not sufficiently active for long-term health benefits according to current physical activity recommendations. There is a need to better understand those factors that may influence regular participation. The study to be described in Chapter 4 investigates these factors further by examining preferences for physical activity, sources of assistance to become more active and motivators for physical activity in insufficiently-active young adults.

CHAPTER 4

INSUFFICIENTLY-ACTIVE YOUNG ADULTS' PREFERENCES FOR PHYSICAL ACTIVITY, SOURCES OF ASSISTANCE AND MOTIVATORS [1]

Chapter 2 of this thesis reported data on the prevalence of moderate-intensity and vigorous activity, as well as for walking and physical activity 'sufficient' for health benefits, for males and females over the young adult years. Chapter 3 examined the physical activity related attributes of young adults, and identified several factors associated with being insufficiently active for young adult males and females. In helping to determine what may be done to help influence physical activity levels in young adults who do not do sufficient activity, a more thorough understanding of the preferences for activity, assistance wanted, and motivators to being more active for this group is needed. The following section of the thesis uses data from the same sample as that described in Chapters 2 and 3 to examine personal attributes for insufficiently-active young adults.

Chapter 1 discussed the key distinction between moderate-intensity and vigorous activity (see Section 1.2.2). This distinction is important as activities of different intensity are associated with different health outcomes (Bouchard, 2001). There is evidence that young adults prefer more vigorous types of activities. For example, in a population sample of Australian adults (Booth et al., 1997), those in the youngest age group examined (18-39 years) were more likely to prefer vigorous activities such as swimming, team sports, jogging and going to the gym than were those in the older age groups. The older age groups were much more likely to prefer walking (a moderate-intensity activity), and the proportion of those who participated in vigorous or fitness training type activities decreased with age. Decreasing prevalence of vigorous activity was also demonstrated for the young adult samples examined in Chapter 2.

---

[1] The study reported here is based on that published as Leslie E, Owen N, Sallis JF (1999). Inactive Australian college students' preferred activities, sources of assistance and motivators. *American Journal of Health Promotion*; 13(4): 197-199. That study also reported data from older participants. Thus, the findings reported here in Chapter 4 differ somewhat (but not substantially) from those reported in that paper.

Young adults have higher rates of participation in vigorous activities than do older adults (USDHHS, 1996). However, the data on young adults examined in Chapter 2, shows a decrease in the prevalence of vigorous activity over the young adult years for both males and females. This decrease contributes to the overall decrease in those who are sufficiently active for health benefits, particularly for males who show steeper rates of decline for vigorous activity during the young adult years than do females. Thus it is important to consider how vigorous activity can be encouraged and maintained. While the current public health message for physical activity emphasises moderate-intensity activity on a population level, for groups such as young adults who enjoy and prefer vigorous activity, and for whom moderate-intensity activity may not provide the full range of health benefits due to their greater aerobic capacity (see Section 1.2.2), vigorous activity is an important contributor to total activity.

The behavioural epidemiology framework described in Chapter 1 (see Section 1.1.4), described how basic and applied research on physical activity can be used to inform the development of programs for promoting physical activity. Accurately measuring physical activity and identifying the factors that influence physical activity habits are two important phases within this framework. Thus obtaining good information on the preferences of young adults, together with knowledge of the different behaviour patterns for physical activity described in Chapter 2, can be used to develop approaches to assist young adults to maintain physical activity levels.

4.1 Introduction and Aims

In this chapter, I document the preferences for physical activity, preferred sources of assistance to exercise, and perceived motivators for regular physical activity among insufficiently-active young adults.

As young adults move through the transition from adolescence to adulthood they experience changing roles within family and peer groups and increased independence (see Chapter 1, Section 1.3.1). It is likely that during this life stage they will have specific preferences and expected outcomes for physical activity participation that may be different than those they had previously as adolescents attending high school.

As described earlier, there are different preferences for activity in younger compared to older adults (Booth et al., 1997). Studies of the factors associated with physical activity suggest that while there are some similarities between males and females, there are differences in preferences for specific types of activity (King et al., 1992). There are also reported differences in the motivators to be active. For example, Calfas and colleagues (1994) found that women reported body image factors (weight loss, dissatisfaction with body) to be more motivating factors, while young men rated strength (muscle gain, muscle tone) and social aspects (organised competition, meeting people) of physical activity more highly than did young women (Calfas et al., 1994). There is evidence that preferred sources of advice or assistance to exercise vary with age for insufficiently active adults (Booth et al., 1997). In this study, more than 50% of the oldest age group (60-78 years) wanted advice from a health professional, while the opportunity to exercise with a group was the most preferred source of support for the youngest age group (18-39 years).

Understanding the personal preferences for activity of insufficiently active young adults can help in designing strategies to address the decline in physical activity across the adult lifespan. Further, knowledge about the type of assistance wanted, and the personal motivators to becoming more active can help make such strategies more relevant.

The main aims of this study are to examine: a) preferences for physical activities; b) preferred sources of assistance to be more active; and, c) the perceived motivators for activity, in a sample of insufficiently active young adults. Particular attention is paid to differences between males and females.

4.2 Methods of the Study

This study used further data from the ARTEC survey described in Chapters 2 and 3. The ARTEC survey was administered to first through to fourth year students from representative courses at two metropolitan university and two rural technical and further education college campuses. The self-completed questionnaire included questions on demographics (age, sex, student and employment status, physical limitations), 2 week physical activity recall (see Sections 1.2.3 and 2.3 for methods; Leslie, Owen, Salmon et al., 1999; also Appendix C Questions 18 - 29), sources of assistance to exercise and

motivators to begin or continue exercise. Participants at the metropolitan campuses completed the questionnaire on their own time and returned them a week later. For the rural campuses, questionnaires were completed during class time and collected immediately.

This chapter uses data only for young adults aged 18 to 29 years (n=2144). This group was drawn from an original sample of 2,729 students attending four tertiary- education campuses, with a broader age range (see Section 3.3).

The data presented in this chapter are for those respondents who were classified as insufficiently active (n=646, 37% of the young adult sample; 32% males, 68% females) to achieve most of the health benefits associated with regular physical activity (see Chapter 2).

Survey Items

The physical activity questions used have been described fully in Chapter 2, and are the same items as those used in Chapter 3.

Briefly, respondents were asked to report on participation in leisure-time physical activity over the previous two weeks. This included walking for recreation and for transport, moderate-intensity activity and vigorous exercise (DASET, 1992; Booth et al., 1996a; 1996b). Respondents were asked to describe the frequency and average duration for each activity reported. Energy expenditure estimates were calculated by multiplying the rate (in METs) by the total time spent for each activity (walking, moderate, vigorous) and totaling these together to get total physical activity energy expenditure. The insufficiently active category was based on not meeting current recommendations of 30 minutes of moderate physical activity on most, preferably all, days of the week (USDHHS, 1996; Pate et al., 1995); this equates to 3.5 hours per week or 800-1000 kcal/wk.

Preferred activities: Respondents were asked what activities they would like to start or do more of on campus from a list of 21 activities (aerobics, athletics, badminton, basketball, circuit training, cricket, cycling, disco, ethnic dance, football, jogging,

martial arts, other dance, squash, swimming, table tennis, tennis, volleyball, walking, weight training, and yoga). Multiple responses could be made. These activities were derived from those used in previous Australian studies (Booth et al., 1996a; 1996b; DASET, 1992). Responses for dance, ethnic dance and other dance were combined and re-coded into a single category of 'any dance'. Responses for basketball, cricket, football, and volleyball were combined and re-coded into a single category of 'team sports'. Responses for badminton, squash, table tennis, and tennis were combined and re-coded into a single category of 'racquet sports'.

Preferred sources of assistance: Respondents were asked what help they would like to exercise more or to take up exercise, using questions modified from previous studies (DASET, 1992; Booth et al., 1997; Risk Factor Prevalence Study Management Committee, 1990). Twelve alternative responses were offered. Options included a course on campus for academic credit *(academic course)*, a course on campus not for academic credit *(course not for credit)*, an exercise kit with pamphlets and practical tips *(exercise kit)*, advice from a trainer or coach *(trainers advice)*, advice from student health services or a doctor *(doctors advice)*, a book on how to exercise *(exercise book)*, a group of people to exercise with on campus *(exercise group)*, a course sent through the mail *(mail course)*, more facilities on campus *(more facilities)*, a video tape on exercise *(video)*, advice over the telephone *(phone advice)*, and no form of assistance *(no form of assistance)*. Multiple responses could be made.

Motivators for activity: Respondents were asked to indicate how motivating each of 11 reasons were for getting them to begin or continue a routine of regular physical exercise, on a 5 point scale (1= "not motivating at all" to 5 = "extremely motivating"). Items were modified from a list of benefits/motivators used in a previous study (Calfas, et al., 1994). Items included weight loss *(weight loss)*, improved muscle tone *(improved muscle tone)*, muscle gain *(muscle gain)*, increased energy level *(increased energy)*, organised competition *(organised competition)*, to feel good about myself *(feel good about self)*, to look better *(look better)*, to socialise or meet people *(socialise)*, to decrease stress levels *(decrease stress)*, enjoyment/personal satisfaction *(enjoyment)*, and the ability to exercise in or close to home *(exercise near home)*. Responses were coded as the percentage who reported they were 'very motivated' for each item (scale 4 or 5).

4.3 Attributes of Respondents

Twenty-eight percent of males and 44% of females from the young adult sample (n=646; 206 males; 440 females; 88% between 18 and 24 years) were insufficiently active. Of this sample, 84% were full-time students. Over half the sample (54%) was in some form of employment (46.4% were in part-time or in casual work). The majority of the sample (49%) were in their first year of study, while there were 29%, 17%, and 5% respectively in their second, third and fourth/graduate years. Ninety percent of the sample reported no physical limitations to activity.

4.4 Results: Factors Related to Being Insufficiently Active, by Gender

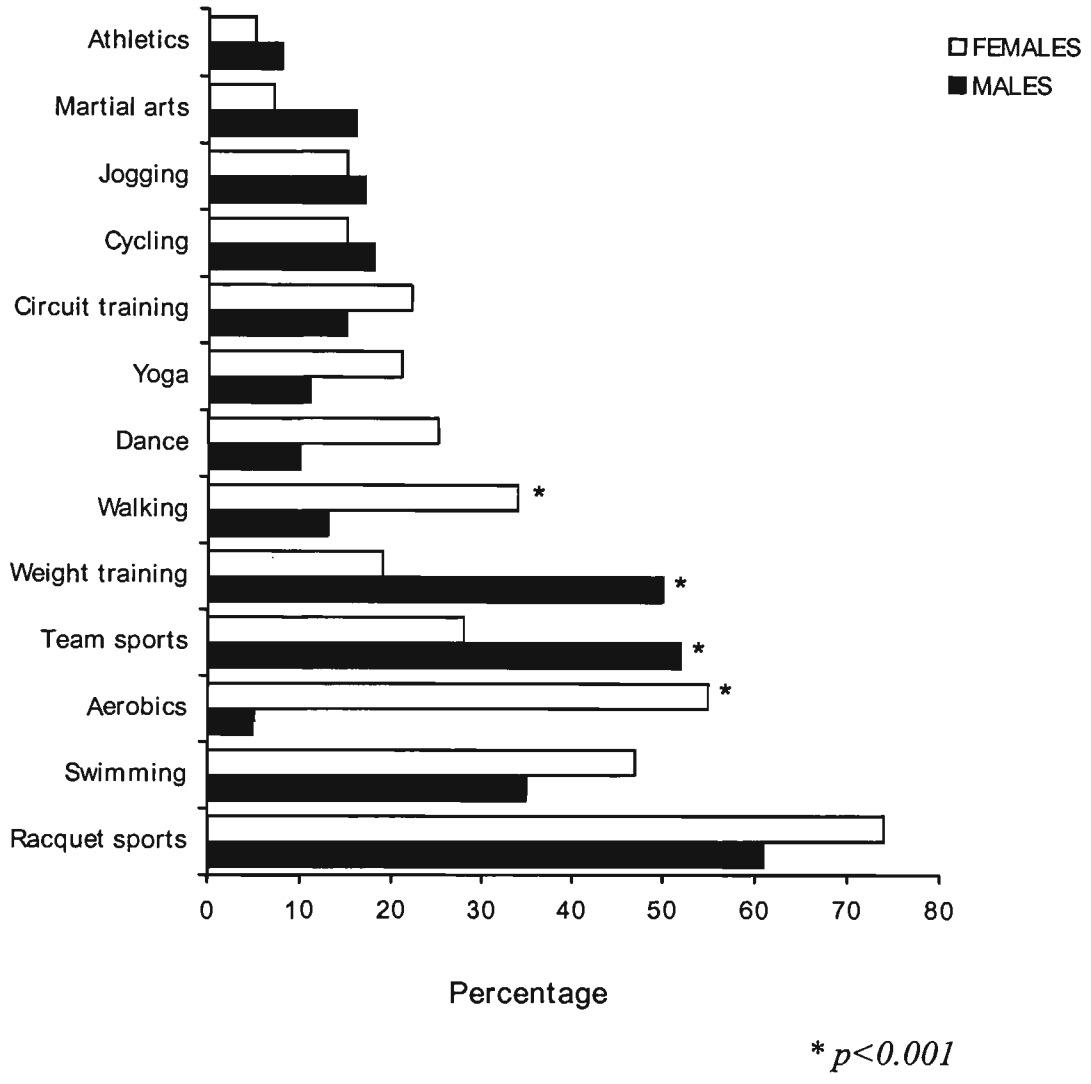
The analyses presented here are cross-sectional and descriptive, focusing on the characteristics of the insufficiently-active students (estimated energy expenditure less than 800 kcal/week). All results are reported as percentages, with Chi-squared analysis used to determine the differences in rates for males and females.

4.4.1 Activity preferences

The preferences for physical activity chosen by males and females are shown in Figure 4.1. Racquet sports were chosen by 70% of all respondents as their most preferred activity. The next five most popular choices overall were swimming, aerobics, team sports, weight training, and walking (selected by 43%, 39%, 35%, 29%, and 28% of respondents respectively).

Of the remaining activities, none were selected by more than 20% of all respondents. The five most popular choices for females were in descending order, racquet sports, aerobics, swimming, walking and team sports. The five most popular choices for males were in descending order, racquet sports, team sports, weight training, swimming, and cycling.

Figure 4.1: Preferred activities of insufficiently active males and females.



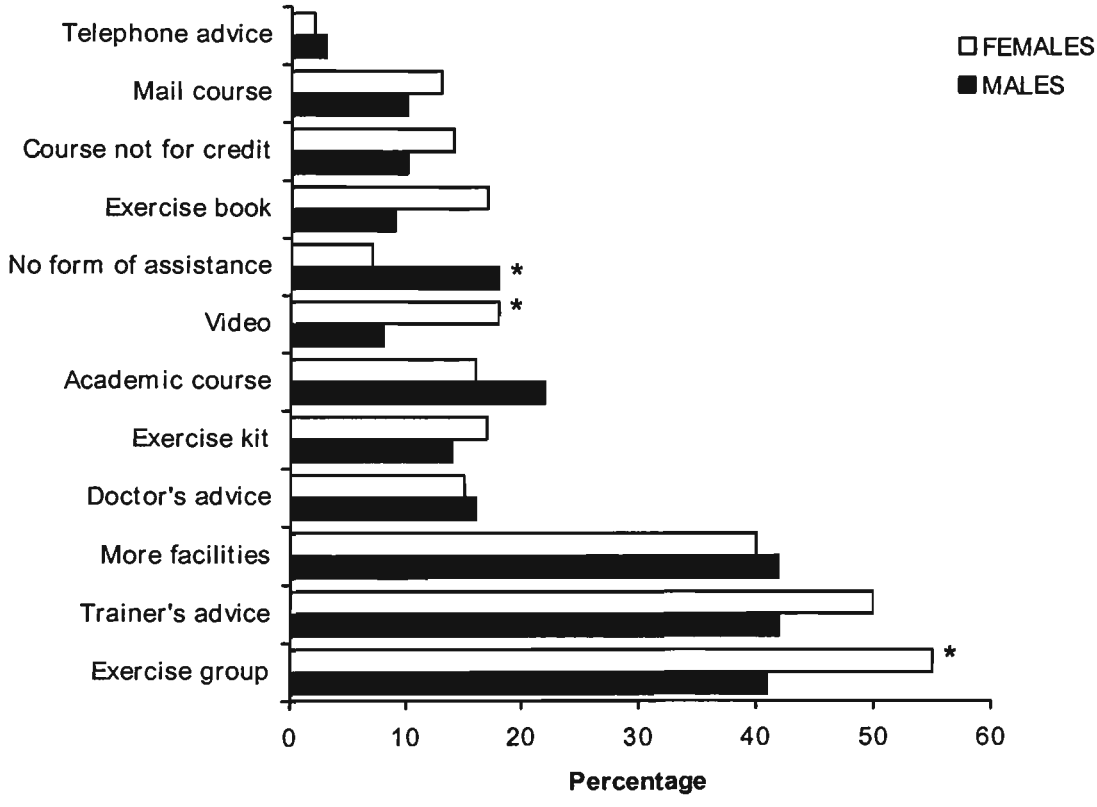
More males than females tended to select weight training and team sports, and more females than males selected aerobics, walking, dance and yoga. The differences between males and females were largest for aerobics (χ^2=111.9, *df*=1, p < .001), weight training (χ^2=50.0, *df*=1, p < .001), team sports (χ^2=28.2, *df*=1, p < .001) and walking (χ^2=23.7, *df*=1, p < .001).

4.4.2 Preferred sources of assistance

The preferred sources of assistance for being more physically active chosen by males and females are shown in Figure 4.2. The strongest preferences overall were for a group to exercise with, trainer's advice and more facilities. More females than males wanted a

group to exercise with but the differences between males and females was small. Males were more likely to choose no form of assistance than were females (χ^2=15.9, *df*=1, p < .001) while females were more likely to choose a video (χ^2=11.4, *df*=1, p < .001) or a group to exercise with (χ^2=10.7, *df*=1, p < .001). There was only a small difference between males and females in the percentage choosing doctor's advice, or more facilities. Telephone advice was the least preferred source of assistance by both males and females.

Figure 4.2. Preferred sources of assistance to exercise for insufficiently active males and females.



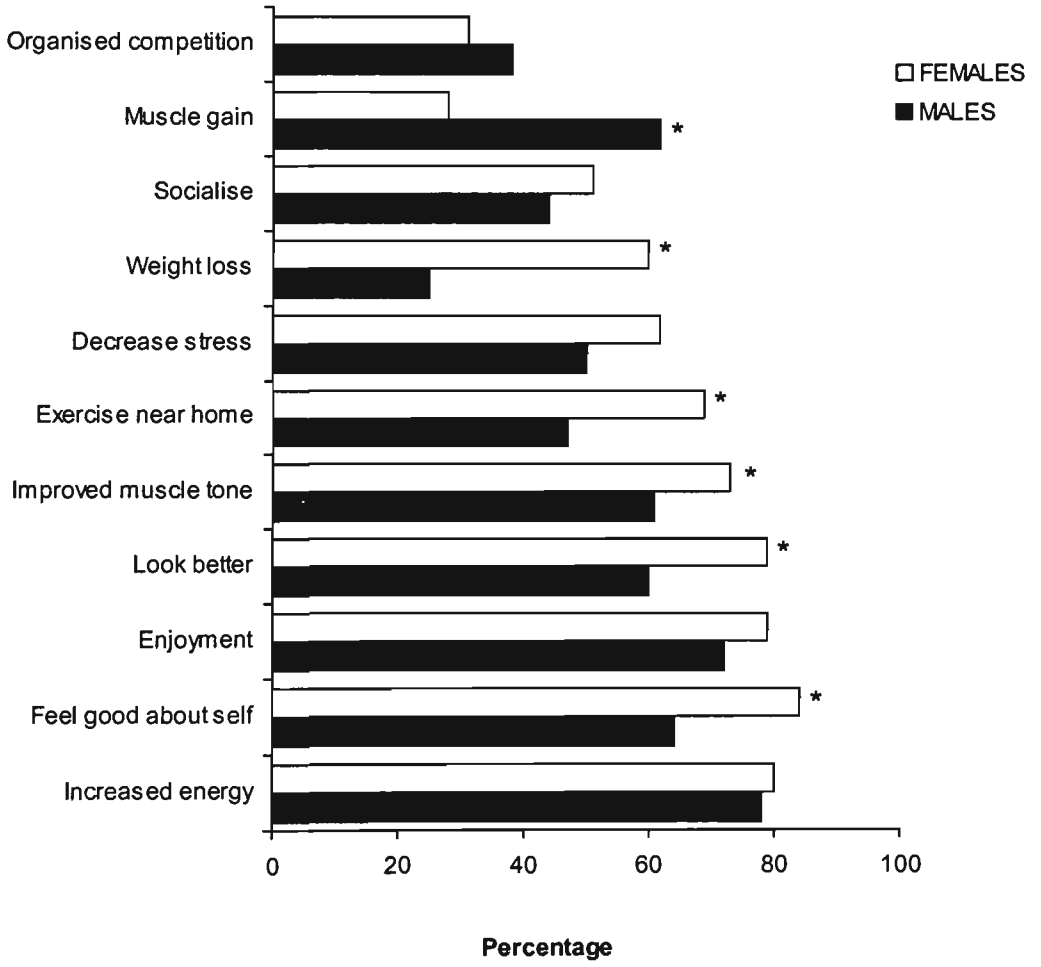
* *p<0.001*

4.4.3 Motivators

The preferences for motivators to be more active chosen by males and females are shown in Figure 4.3. Overall, respondents were most highly motivated by increased energy (80% of respondents choosing high motivation), feeling good about yourself (78%), enjoyment/satisfaction (77%), and looking better (73%). The least motivating

item was organised competition (33%). Males were more likely to be motivated by muscle gain (χ^2=62.9, *df*=1, p < .001) than were females. Females were more likely to be motivated by weight loss (χ^2=59.5, *df*=1, p < .001), exercising close to home (χ^2=27.6, *df*=1, p < .00), feeling good (χ^2=27.1, *df*=1, p < .00), and looking better (χ^2=22.6, *df*=1, p < .001) than were males.

Figure 4.3. Reported motivators that would encourage insufficiently active males and females to commence or maintain regular physical activity.



** p<0.001*

4.5 Summary of Findings

Insufficiently active males and females differ in their preferences for physical activity and motivators, but express similar needs for assistance to be active.

The most-preferred physical activity choice by both males and females was racquet sports. The next most preferred activities were, in descending order, swimming, aerobics, team sports, weight training, and walking. There were clear gender differences with females significantly more likely to prefer aerobics, walking, any dance and yoga, and males preferring weight training and team sports.

The strongest preferences overall for sources of assistance to be active were a group to exercise with, a trainer's advice and more facilities. Males were more likely to choose no assistance than were females, and females were more likely to choose a video tape on exercise. Both males and females indicated a strong desire for others to exercise with (exercise group), but females were more likely to choose this. Similar proportions of males and females chose having more facilities available on campus.

Overall, the highest proportions reported for strong motivators by both males and females were increased energy, feeling good, enjoyment and looking better. For males, the highest proportions reported for strong motivators were increased energy, enjoyment, feeling good and muscle gain. For females, the highest proportions reported for strong motivators were feeling good, increased energy and looking better. Significantly more males than females chose muscle gain as being a strong motivator. Significantly more females than males chose weight loss, muscle tone, exercising close to home, feeling good and looking better.

There were a number of differences between males and females in both their preferences for activities, and factors that motivated them to be active. There were smaller differences between males and females for sources of assistance to be active, with similar requirements for an exercise group, a trainer's advice and more facilities.

Physical activity behaviour patterns for young adults were described in Chapter 2, with differences observed between males and females being highlighted. Factors associated

with young adult males and females being insufficiently active were described in Chapter 3. In Chapter 4, the personal attributes of insufficiently active males and females were described. In order to better understand factors associated with being insufficiently active, the following chapter of this thesis (Chapter 5) makes use of the Stages of Change construct from the Transtheoretical Model (see Section 1.4.3). This construct has been successfully used as a component of physical activity intervention trials, and has been used to differentiate between different types of physical activity (Miilunpalo et al., 2000). Motivational readiness for both moderate-intensity and vigorous activity is used in Chapter 5 to focus on the barriers and motivators to being more active for young adults. Differences in stage membership and these factors are examined for males and females.

CHAPTER 5

CORRELATES OF STAGES OF CHANGE FOR MODERATE-INTENSITY AND VIGOROUS PHYSICAL ACTIVITY[1]

5.1 Introduction and Aims

Chapter 1 (Section 1.1.4) of this thesis reviewed findings on the patterns of age-related decline for males and females for moderate-intensity and for vigorous activity. Chapter 2 presented analyses of representative population data sets to document the prevalence and changes over the young adult years, for moderate-intensity and vigorous activity, as well as for walking and for physical activity 'sufficient' for health benefits.

Males were found to have higher rates of overall moderate-intensity and vigorous leisure-time physical activity than did females in each of the age groups examined (18-19 years; 20-24 years; 25-29 years), and consequently had higher rates of sufficient physical activity than did females. Females however, reported higher rates of participation within each of the age groups for walking than did males. While for both males and females there were decreases in rates of participation across these age groups, the decrease was greater for males over the entire (18 to 29 years) age range.

In Chapters 3 and 4 of this thesis, further studies examining the physical activity related attributes of young adults using the ARTEC data set (see Chapter 2) were reported. Factors related to being insufficiently physically active for health benefits among young adults were specifically examined.

In Chapter 3, a social learning perspective based on Sallis & Hovell's (1990) model was applied to identify potentially modifiable factors related to physical activity in a large sample of young adults. For females, predictors of being insufficiently active were lower social support from family and friends, lower enjoyment of activity and being

[1] Data from the study reported here were accepted as a refereed abstract for presentation at the Cooper Institute Conference Series: Innovative Approaches to Understanding and Influencing Physical Activity, October 4-6, Dallas, Texas (see Appendix M).

unemployed. For males, the only significant predictor of being insufficiently active was lower social support from friends.

Chapter 4 examined data from the ARTEC study on reported preferences for types of physical activity, assistance to be more active and motivators for activity. For insufficiently active young adults, there were strong gender differences in preferences for activities. Males and females preferred similar sources of assistance. These were particularly focussed on having someone to exercise with, a trainer's advice, and having more facilities being made available. Males were motivated to be active by weight gain, while females were motivated by weight loss, opportunities for exercising closer to home, looking better and feeling good.

Barriers and motivators have been identified as potentially important factors for young adults' physical activity behaviours. Barriers are factors that can act to inhibit or discourage participation in physical activity. Motivators can act to facilitate or encourage participation in physical activity. Barriers and motivators for physical activity would be expected to vary between males and females, given the differences in patterns of participation described in Chapter 2; males had higher rates of participation in moderate-intensity and vigorous activity than did females. In Chapter 3, the factors significantly associated with being insufficiently active for health benefits differed in several ways between males and females. It is likely therefore that the barriers and motivators reported by males and females may also be different for various types of physical activity. For example, the specific barriers that were reported for walking (a moderate-intensity activity) were different to those reported for vigorous sport and fitness activities in a sample of young adults (see Appendix J).

Chapter 5 uses a new data set to examine in more detail barriers and motivators to being more active for young adults in campus settings, using the construct of Stages of Change from the Transtheoretical Model (see Section 1.5). This approach is used to help provide possible insights into the barriers and motivators related to young adults' readiness to participate in moderate-intensity and vigorous physical activity.

The Stages of Change can be used to categorise levels of motivational readiness to participate in physical activity. The findings in Chapter 2 show differences in the

prevalence of moderate-intensity and vigorous activity over the young adult years. Theoretically, while the distinction between moderate-intensity and vigorous activity may at times be blurred (for example, walking is considered a moderate-intensity activity but some people may walk at a somewhat higher intensity) these behaviours can be considered as distinct (see Chapter 1, Section 1.2.2). There are also some clear differences in the prevalence for each of these types of activity for young males and females (see Chapter 2). Males have higher rates of participation for both moderate-intensity and vigorous activity than do females. It is possible that the same person may be in different stages of motivational readiness for moderate-intensity or for vigorous activity. Thus, Stages of Change will be examined, using separate intensity-specific definitions of participation in either moderate-intensity or in vigorous activity.

Previously, a number of different staging algorithms used in the physical activity literature have been modified for various purposes (Reed et al., 1997). Earlier staging algorithms asked about intention to 'exercise' (Marcus, Rakowski & Rossi et al., 1992). This wording was later modified to 'physical activity' (Marcus, Rossi, Selby, Niaura & Abrams, 1992) to reflect current public health and exercise science terminology. The amount of physical activity necessary to be considered 'regular exercise' was subsequently quantified, with the inclusion of the words 'regular physical activity is defined as participation in three sessions of vigorous activity per week for at least 20 minutes per time' (Marcus, Selby, et al., 1992; Marcus, Simkin, Rossi & Pinto, 1996). This definition of regular exercise reflected the earlier recommendations for exercise (ACSM ,1990). This type of Stages of Change measure has been applied to young adults (Wallace-Silver et al., 2000), but does not assess motivational readiness for vigorous and moderate-intensity activity separately.

In the study reported here in Chapter 5, an explicit definition of the specific type of physical activity behaviour of interest is used. The aim is to separately assess Stages of Change for moderate-intensity and for vigorous physical activity. Thus, separate Stages of Change items are used for the intention to engage in either moderate-intensity or in vigorous physical activity. The defining criteria for these two types of physical activity are based on the frequency, duration, and intensity recommended for vigorous and for moderate-intensity activity (ACSM, 1990; Pate et al., 1995). Both moderate-intensity

and vigorous activity are now recognised as being important in achieving and maintaining public health goals (see Section 1.1.2).

It is possible that these activities are influenced by different sets of factors, although there are few findings on the factors associated with moderate-intensity activity, as most studies to date have assessed vigorous activity or total physical activity. The moderate-intensity and vigorous dimensions have tended not to be strongly distinguished from each other (Marcus & Sallis, 1997; Sallis & Owen, 1999).

Thus, the main aims of the study reported in this chapter are: a) to examine Stages of Change for moderate-intensity and vigorous activity in a sample of young adults; and, b) to examine whether the barriers and motivators for activity differ between stages, for moderate-intensity and for vigorous physical activity.

5.2 Methods of the Study

5.2.1 Survey method and attributes of respondents

The data used in this study were from a survey administered to volunteer participants recruited from randomly selected second-year classes at a metropolitan university campus. This survey was conducted three years subsequent to and separate from the ARTEC survey reported in Chapters 2, 3, and 4.Those who completed the survey did so during a designated period within normal lecture time. The Deakin University Ethics Committee approved the study.

A total of 784 questionnaires were distributed; 697 were returned (89% response rate). The sample included a higher proportion of females (69%) when compared to the proportion of females enrolled at the campus (57%). The mean age was 20.7 years (age range 18 to 30 years), with 78% of the sample aged less than 21 years. Two-thirds of the sample was in the healthy weight range category for Body Mass Index (61%), and a large proportion (77%) was employed part time. Eighty-six percent of the sample reported no physical limitations to activity.

5.2.2 Survey items

The survey form included questions on demographics (age, sex, student and employment status, physical limitations), motivators to begin or continue regular physical activity, barriers to being physically active on campus, and stages of motivational readiness assessed separately for moderate-intensity and for vigorous physical activity (see Appendix H for the complete survey form).

5.2.3 Assessing Stages of Change for moderate-intensity and vigorous activity

Motivational readiness for physical activity was assessed using a modified short-form five-stage response question (Marcus, Rossi, et al., 1992; Reed et al., 1997). Separate questions were used to assess Stages of Change for moderate-intensity and vigorous physical activity, with different examples of each activity given to help with self-assessment. The criterion for vigorous activity was based on earlier definitions of vigorous exercise (ACSM, 1990). The criterion for moderate-intensity activity was based on the guidelines for lifestyle activity, which advocate more frequent less intense bouts of activity (Pate et al., 1995).

The Stages of Change questions (see Appendix H, page 12) combined a prevalence question with a stage suffix. Stages of change for moderate-intensity physical activity (MPA) was assessed by asking 'do you participate in moderate physical activity such as recreational or incidental activity (e.g. brisk walking, cycling) five times a week for at least 30 minutes each time?' Stages of change for vigorous physical activity (VPA) was assessed by asking 'do you participate in vigorous physical activity such as sport or fitness activities (e.g. aerobics, running etc.) three times a week for at least 20 minutes each time?'

For each staging question above, participants were asked to choose from the following options: (1) yes, I have been for more than six months; (2) yes, I have been, but for less than six months; (3) no, but I intend to in the next 30 days; (4) no, but I intend to in the next 6 months; (5) no, and I do not intend to in the next 6 months.

The responses were used to classify respondents into one of five stages: (1) Maintenance; (2) Action; (3) Preparation; (4) Contemplation; and (5) Precontemplation.

5.2.4 Assessing barriers to physical activity

Participants were asked to indicate how strongly each of twenty barrier items applied to them not being physically active on campus, using a five-point Likert scale (1 = "Does not apply" to 5 = "Applies strongly"). Items were adapted from those used in the Pilot Survey of the Fitness of Australians (DASET, 1992), with the addition of new items to address potential context-specific environmental barriers to on-campus physical activity, consistent with ecological/environmental frameworks (Sallis & Owen, 1997; Owen, Leslie, Salmon, & Fotheringham, 2000). The new items were derived from findings from a qualitative study examining the barriers to physical activity in a campus setting (see Appendix A-7 and Appendix I). A summary of the barrier items and their abbreviated labels used in the text is presented in Table 5.1.

To explore the underlying structure in the items assessing perceived barriers, an exploratory factor analysis of the barrier items was conducted using principal components analysis. A correlational matrix was computed for all variables. This showed a large number of coefficients with values greater than .3, indicating evidence of reasonable correlations between variables (Tabachnik & Fidell, 1996).

The Bartlett test of sphericity was 2941.34, with a significance level of <0.001 indicating that the data were from a mutilvariate normal population (Tabachnik & Fidell, 1996). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.760, indicating an acceptable index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients (Kaiser, 1974).

Using the default settings for principal components analysis, six factors with eigenvalues greater than one explained 58% of the variance. Catell's Scree test (Catell, 1966) was used to help determine which factors contribute the most in explaining the variance in the data. An examination of the scree plot of the total variance associated with each factor (with eigenvalues set at 1.0 for derived factors) showed a gradual

leveling off effect from the fourth factor onwards. A 4-factor solution was tried but four variables loaded on more than one item. Finally, a 3-factor solution explaining 42% of the variance was found to be the most interpretable model.

Table 5.1: Summary of barriers to physical activity on campus items.

Barriers	Abbreviated label
I haven't got any free time while on campus	No free time
There's no one to do it with	No one to do it with
There are no suitable facilities	No suitable facilities
I am not interested in being active on campus	Not interested
I don't like the facilities available on campus	Don't like facilities
I prefer to sit and socialise with friends	Prefer to socialise
I need to study/go to the library in my spare time	Need to study
I am here to study, not to exercise	Not here to exercise
I am too lazy/not motivated/can't get started	Too lazy
I am too fat	Too fat
I don't like spending time on campus	Don't like spending time
I do enough exercise off campus	Do enough
I haven't got the energy	No energy
I don't know where physical activity facilities are located	Don't know location
I cannot access the physical activity facilities	Can't access facilities
The facilities offered for physical activity are not attractive/pleasant	Facilities not attractive
There is no encouragement to be active	No encouragement
I do not have the experience/skills to be active	No experience
The facilities are too expensive to use	Too expensive
There are no programs/services for physical activity	No programs

Varimax rotation was performed to assist with the interpretation of the initial factor matrices and to achieve a simple structure (Pallant, 2001). After rotation, the coefficient for 'don't know location' continued to load on both factor 1 and factor 2 (.444 and -.427 respectively). The coefficient for 'do enough off campus' continued to load on factor 2

and factor 3 (.543 and .371 respectively). This variable was difficult to interpret relative to the factor groupings. It was therefore removed and treated as a single item.

The final factors (see Table 5.2) were interpreted as measures of: (1) 'environmental barriers'; (2) 'personal barriers'; and, (3), 'competing demands'. These highlight the overall construct reflected by the items manifest within the factor, consistent with the review of factors associated with physical activity that have been summarised in Section 1.4.2 – Factors influencing physical activity in young adults. Previous studies of barriers have tended to focus on personal and social factors, but specific environmental obstacles (such as 'lack of facilities') and time constraints (such as 'need to study') are expected to be particularly relevant for young adults attending campus settings.

Factor 1 (environmental barriers) reflects perceived characteristics of the campus environment, including both subjective (e.g. facilities are not attractive) and objective features (e.g. no programs). Factor 2 (personal barriers) reflects perceived personal barriers to doing physical activity on campus. Factor 3 (competing demands) reflects perceived time/effort barriers that relate to the primary purpose for young adults attending campus.

These factors are consistent with reviews that identify factors associated with physical activity in terms of their environmental, personal and social qualities (Dishman & Sallis, 1994; Sallis & Owen; 1999).

Internal consistency (alpha) coefficients for these factors ranged from 0.77 (good) to 0.53 (fair).

Using the factor structure obtained, factor scores were created by summing the raw scores of each of the items in each factor and were used in subsequent analyses of variance.

Table 5.2: Final factor solution for barriers to physical activity items.

Factor 1	Factor 2	Factor 3
Environmental barriers	***Personal barriers***	***Competing demands***
Can't access facilities	No experience	Not interested
Facilities not attractive	No energy	No free time
No programs	No one to do it with	Prefer to socialise
No encouragement	Too fat	Need to study
No suitable facilities	Too lazy	Not here to exercise
Don't like facilities	Too expensive	Don't like spending time
Don't know location		
Alpha = 0.77	***Alpha = 0 .67***	***Alpha = 0.53***

5.2.5 Assessing motivators for regular physical activity

Respondents were asked to rate sixteen motivators to begin or continue a routine of regular physical activity, on a 5 point scale (1= "Not motivating at all" to 5 = "Extremely motivating"). Items were modified from those used in the Active Recreation on Tertiary Education Campuses project (see Appendix C). These items were originally derived from a list of benefit and motivator items reported by Calfas et al., 1994. A summary of the motivator items and their abbreviated labels used in the text is presented in Table 5.3.

To help explore the underlying dimensional structure in the perceived motivators, an exploratory factor analysis of the motivator items was conducted using principal components analysis. A correlational matrix was computed for all of the motivator variables. There was good evidence for correlations between variables, with a large number of coefficients with values greater than .3 (Tabachnik & Fidell, 1996). The highest variable correlations with at least one other variable in the set ranged from 0.111 to 0.583. The majority of the coefficients were greater than 0.2 in absolute value.

The Bartlett test of sphericity was 3584.88 with a significance level of <0.001 indicating that the data were from a mutilvariate normal population (Tabachnik & Fidell, 1996).

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.856, indicating an excellent index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients (Kaiser, 1974).

Table 5.3: Summary of motivators for regular physical activity items.

Motivators	Abbreviated label
Fun/enjoyment	Fun
Weight loss	Weight loss
Facilities that are convenient to use (eg. showers)	Convenient facilities
Improved muscle tone	Muscle tone
Muscle gain	Muscle gain
Increased energy level	More energy
Safe facilities for activity (well-lit paths, away from traffic)	Safe facilities
Organised competition	Competition
To feel good about myself	Feel good
To look better	Look better
A more suitable climate	Suitable climate
To socialise or meet people	Socialise
To decrease stress levels	Decrease stress
Ability to exercise in or close to home	Exercise close to home
Suitable physical activity facilities	Suitable facilities
Someone to exercise with	Exercise partner

Initial principal component analysis using all 16 motivator items listed yielded four factors that were difficult to interpret as a number of factors loaded on more than one item. A higher level of agreement (Chronbach's alpha = 0.86) was obtained for the motivator items without including weight loss and competition, thus the subsequent factor analysis was conducted without these two items.

Using the default settings for principal components analysis, four factors with eigenvalues greater than one explained 58% of the variance in the items. Catell's Scree test (Catell, 1966) was used to help determine which factors contribute the most in

explaining the variance in the data. An examination of the scree plot of the total variance associated with each factor (with eigenvalues set at 1.0 for derived factors) showed a gradual leveling off effect from the third factor onwards. A 3-factor solution explained 54% of the variance but four variables loaded on more than one item. Of these, the variable 'decrease stress' was difficult to interpret relative to the factor groupings and was thus removed. Finally, a 2-factor solution explaining 47% of the variance was found to be the most interpretable model.

Varimax rotation was performed to assist with the interpretation of the initial factor matrices and to achieve a simple structure (Pallant, 2001). After rotation, the coefficient for 'fun/enjoyment' continued to load on both factor 1 and factor 2 (.362 and .372 respectively) and was not included in the factors, but was treated as a separate item.

The final factors (see Table 5.4) were interpreted as measures of: (1) 'environmental motivators'; and, (2) 'personal motivators'. These highlight the overall construct reflected by the items manifest within the factor.

The conceptualisation of physical activity determinants as motivating factors with personal or environmental qualities (Dishman & Sallis, 1994; Sallis & Owen, 1999) is apparent in the factor groupings.

Table 5.4: Final factor solution for motivators for regular physical activity items.

Factor 1	**Factor 2**
Environmental motivators	***Personal motivators***
Convenient facilities	Muscle tone
Suitable facilities	Muscle gain
Safe facilities	More energy
Exercise close to home	Feel good
Socialise	Look better
Suitable climate	
Exercise partner	
Alpha = 0.80	***Alpha = 0.76***

Internal consistency (alpha) coefficients for the two factors was 0.80 and 0.76 respectively, which represented 'very good' to 'excellent' internal consistency of these scales.

Using the factor structure obtained, factor scores were created by summing the raw scores of each item in each factor and were used in subsequent analyses of variance.

5.2.6 Test-retest reliability of Stages of Change measures for moderate-intensity and vigorous physical activity

The moderate-intensity and vigorous Stages of Change measures were administered to 123 participants using a mail out survey (see Appendix G for Questionnaire) on two occasions to third-year students attending two campuses of a metropolitan university. Names and addresses were randomly selected from the student database. A letter from the university Administrative Division accompanied the survey form and an invitation to participate. The Deakin University Ethics Committee approved the study. On return of Survey 1, Survey 2 was sent out within two days. Survey 2 was returned within two weeks of receiving the first survey for all respondents.

Results for the proportions of respondents in each stage for Survey 1 and Survey 2 are provided in Appendix K. Test-retest reliability of the stage category questions was assessed by calculating the kappa coefficient. The value of kappa for moderate-intensity activity was .358, which indicates fair test-retest reliability. For vigorous activity kappa was .592, indicating moderate test-retest reliability.

To determine how many participants in each sample were classified in the same category by the method being compared (Stages of Change for moderate-intensity or vigorous activity), the categorical data were analysed by calculating the percent agreement (Average Correct Classification, ACC). ACC for moderate-intensity was 52%, for vigorous 71%.

5.2.7 Data analyses

Data analyses were conducted using the Statistical Package for the Social Sciences (SPSS for Windows 9.01). Respondents were classified as being in one of five stages of physical activity, separately for moderate-intensity and vigorous activity (see Section 5.2.3). The Pearson chi-square statistic was used to determine the relationship among the five Stages of Change for moderate-intensity and vigorous activity, and between males and females. Exploratory factor analysis (see Sections 5.2.4 and 5.2.5) utilising principal components analysis was used to create factors for the barrier and motivator items.

One-way analyses of variance (ANOVAs) were used to examine the relationship between the barrier and motivator factors and Stages of Change for both moderate-intensity and vigorous activity. ANOVAs were conducted separately for each of the barrier and motivator factors, by Stages of Change for both moderate-intensity and vigorous activity, to determine which factors differentiated between the five Stages of Change. In all analyses, the Scheffe test was used post hoc to examine the differences between means.

5.3 Results: Stages of Change for Moderate-Intensity and Vigorous Physical Activity

Chi-squared analyses were used to examine stage differences between males and females for moderate-intensity and vigorous activity. There were significant differences overall between males and females for stages by moderate-intensity (χ^2 =11.71, *df=4*, *p*=.020), and for stages by vigorous activity (χ^2 =48.5, *df=4*, *p*<.000). Table 5.5 shows the proportions of males and females by Stages of Change for moderate-intensity and vigorous activity. Overall, a correlation of .479 was found between the moderate-intensity and vigorous stage measures, significant at the 0.01 level.

The proportion of males in Maintenance for vigorous activity (56.9%) was much higher than the proportion in Maintenance for moderate-intensity activity (36.6%). There was a much smaller proportion of males in Precontemplation for vigorous activity (11.3%), compared to the proportion in Precontemplation for moderate-intensity activity (20.3%).

Females showed a similar breakdown in proportions in all Stages of Change for both moderate-intensity and vigorous activity.

Table 5.5: Percentages of males and females by Stages of Change for moderate-intensity and vigorous physical activity.

	Moderate-intensity		Vigorous	
	Males (n=202)	Females (n=462)	Males (n=204)	Females (n=470)
Precontemplation	20.3	17.3	11.3	14.5
Contemplation	13.9	22.5	11.8	21.1
Preparation	10.9	15.8	10.3	18.5
Action	18.3	15.4	9.8	17.0
Maintenance	36.6	29.0	56.9	28.9

For moderate-intensity activity, there were only small differences in the proportions within the same stage between males and females (see Figure 5.1). The largest difference (8.6%) was between males and females in the Contemplation category. The smallest difference (3.0%) was between males and females in the Precontemplation category.

For vigorous activity larger differences in proportions within the same stage between males and females were observed (Figure 5.2). The largest difference was in the Maintenance category (28%), where there was a greater proportion of males (56.9%) compared to females (28.9%) in Maintenance for vigorous activity.

Figure 5.1: Percentages of males and females by Stages of Change for moderate-intensity activity.

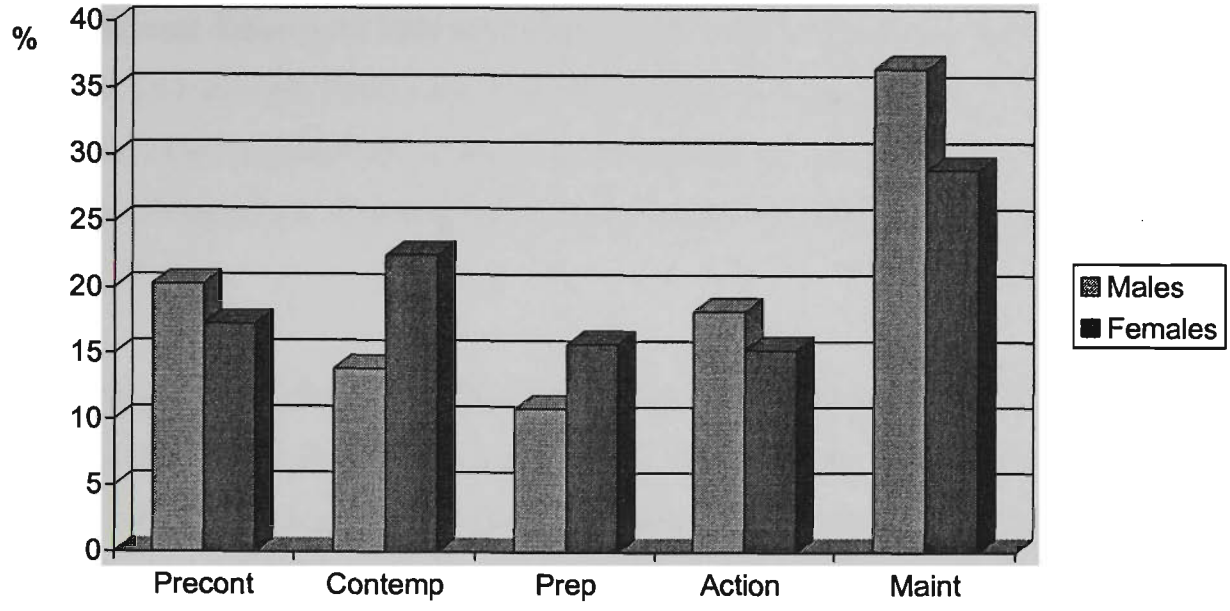
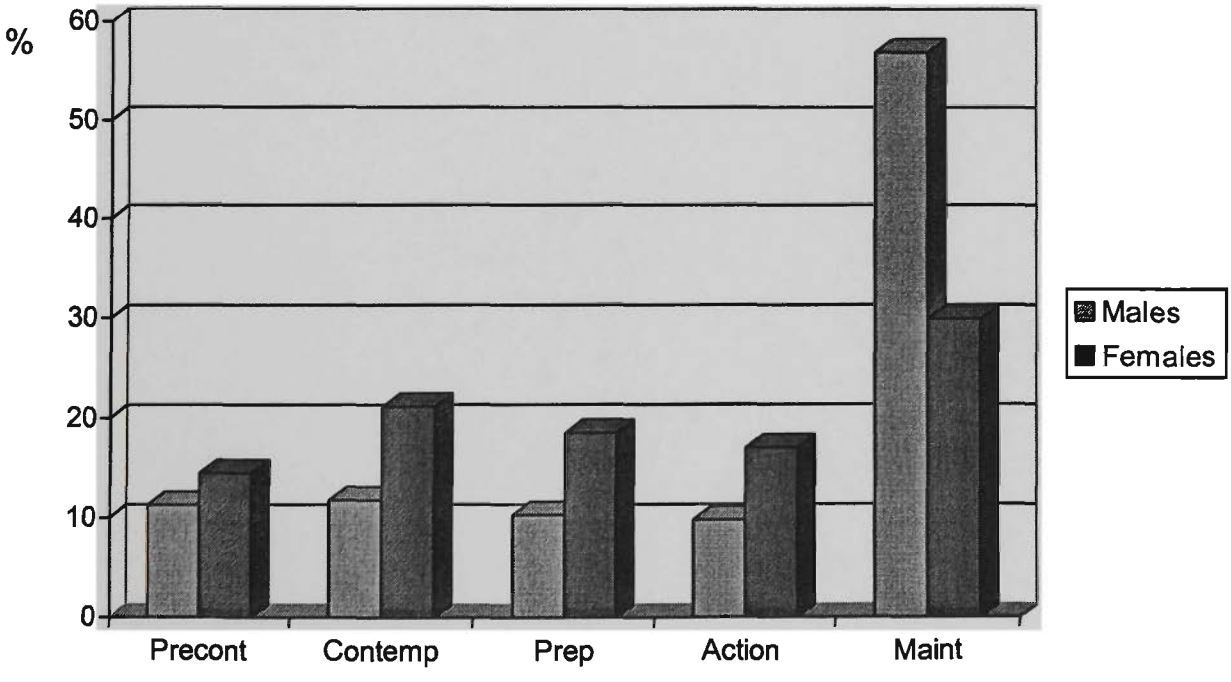


Figure 5.2: Percentages of males and females by Stages of Change for vigorous activity.



5.3.1 Barrier factors examined by Stages of Change

Examining the barrier factors by Stages of Change for moderate-intensity activity, there were significant differences between Stages of Change for the factor 'personal barriers' (see Table 5.6). For this factor, those in the Maintenance stage were less likely to agree that personal barriers prevented them from doing physical activity on campus than were those in the Preparation, Contemplation, Precontemplation and Action stages ($F_{(4, 641)} = 10.707$, $p < 0.001$).

Examining the barrier factors by Stages of Change for vigorous activity, there were significant differences between Stages of Change for the factor 'personal barriers' (see Table 5.7). For this factor, those in the Maintenance and Action stages were less likely to agree that personal barriers prevented them from doing physical activity on campus than were those in the Preparation, Contemplation, and Precontemplation stages ($F_{(4, 651)} = 20.810$, $p < 0.001$).

Table 5.6: Relationships of environmental barriers, personal barriers and competing demands to Stages of Change for moderate-intensity physical activity.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Factor	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental barriers	22.2 (20.99-23.43)	22.3 (21.31-23.30)	22.1 (21.06-23.05)	22.9 (21.74-24.13)	23.1 (22.25-23.89)	.800	
Personal barriers	14.3 (13.55-15.11)	15.2 (14.46-15.89)	14.7 (13.84-15.57)	14.1 (13.28-14.47)	12.3 (11.73-12.95)	10.707*	1,2,3,4 vs 5
Competing demands	19.1 (18.21-19.89)	18.8 (18.0-19.50)	17.8 (16.89-18.65)	18.5 (17.61-19.40)	18.4 (17.77-19.03)	1.170	

* $p < 0.001$

NB. *Range of scores for each factor:*

Factor 1 (range 7 to 35): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

Factor 2 (range 6 to 25): high scores mean stronger perceptions of personal barriers to being active on campus than do lower scores.

Factor 3 (range 6 to 30): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

Table 5.7: Relationships of environmental barriers, personal barriers and competing demands to Stages of Change for vigorous physical activity.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Factor	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental barriers	21.4 (20.02-22.86)	22.9 (21.81-23.99)	22.2 (21.16-23.14)	23.3 (22.20-24.45)	22.7 (21.90-23.48)	1.498	
Personal barriers	15.1 (14.17-16.08)	15.8 (14.98-16.54)	15.2 (14.45-16.02)	13.3 (12.45-14.14)	12.2 (11.69-12.72)	20.810*	1,2,3 vs 4,5
Competing demands	18.6 (17.71-19.56)	18.6 (17.81-19.29)	18.2 (17.39-18.93)	18.4 (17.31-19.51)	18.7 (18.10-19.26)	0.273	

* $p < 0.001$

NB. *Range of scores for each factor:*

Factor 1 (range 7 to 35): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

Factor 2 (range 6 to 28): high scores mean stronger perceptions of personal barriers to being active on campus than do lower scores.

Factor 3 (range 6 to 30): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

Gender differences

When the barrier factors and Stages of Change for moderate-intensity activity were examined separately for males and females, significant differences emerged between the Stages of Change on the personal barriers factor for females, but not for males (see Appendix L for full analysis tables). For females, those in the Maintenance stage were less likely to agree that personal barriers prevented them from doing physical activity on campus than were those in the Action, Preparation, Contemplation, and Precontemplation stages ($F_{(4, 447)} = 7.317$, $p < 0.001$). There were no significant differences between Stages of Change for moderate-intensity activity and any of the barrier factors for males.

When the barrier factors and Stages of Change for vigorous activity were examined separately for males and females, significant differences emerged between Stages of Change on the personal barriers factor for both males and females (see Appendix L).

For females, those in Maintenance and Action stages were less likely to agree that personal barriers prevented them from doing physical activity on campus than were those in the Preparation, Contemplation, and Precontemplation stages ($F_{(4, 455)} = 13.959$, $p < 0.001$). For males, those in the Maintenance stage were less likely to agree that personal barriers prevented them from doing physical activity on campus than were those in the Preparation, Contemplation, Precontemplation and Action stages ($F_{(4, 191)} = 4.428$, $p < 0.01$).

5.3.2 Motivator factors examined by Stages of Change

Examining the motivator factors by Stages of Change for moderate-intensity activity, there were significant differences between Stages of Change for 'environmental motivators' and for 'personal motivators' (see Table 5.8). For Factor 1 (environmental motivators) those in the Precontemplation stage were less likely to agree that the environmental items motivated them to do more physical activity than were those in the Contemplation and Action stages ($F_{(4, 650)} = 4.618$, $p < 0.01$). For Factor 2 (personal motivators) those in the Precontemplation stage were less likely to agree that the personal items motivated them to do more physical

activity than were those in the Preparation, Action and Maintenance stages ($F_{(4, 652)} = 6.015$, $p < 0.001$).

Examining the motivator factors by Stages of Change for vigorous activity, there were significant differences between Stages of Change for 'environmental motivators' and for 'personal motivators' (see Table 5.9). For Factor 1 (environmental motivators) those in the Precontemplation stage were less likely to agree that environmental items motivated them to do more physical activity than were those in all other stages ($F_{(4, 659)} = 7.067$, $p < 0.001$). For Factor 2 (personal motivators) those in the Precontemplation stage were less likely to agree that personal items motivated them to do more physical activity than were those in all other stages ($F_{(4, 662)} = 12.744$, $p < 0.001$).

Table 5.8: Relationships of environmental and personal motivators to Stages of Change for moderate-intensity physical activity.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Factor	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental motivators	23.9 (22.70-25.06)	26.0 (25.12-26.88)	25.9 (24.9-26.96)	26.8 (25.90-27.67)	25.5 (24.80-26.29)	4.618*	1 vs 2,4
Personal motivators	18.1 (17.40-18.89)	19.6 (18.93-20.29)	19.9 (19.23-20.67)	20.3 (19.64-20.97)	20.0 (19.49-20.59)	6.015**	1 vs 3,4,5

* $p < 0.01$
** $p < 0.001$

NB. *Range of scores for each factor:*

Factor 1 (range 7 to 35): high scores mean stronger perceptions of environmental motivators for being more active on campus than do lower scores.

Factor 2 (range 5 to 25): high scores mean stronger perceptions of personal motivators for being more active on campus than do lower scores.

Table 5.9: Relationships of environmental and personal motivators to Stages of Change for vigorous physical activity.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Factor	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental motivators	23.1 (21.79-24.46)	26.4 (25.50-27.78)	26.9 (25.89-27.81)	25.9 (24.86-26.95)	25.5 (24.87-26.20)	7.067*	1 vs 2,3,4,5
Personal motivators	17.1 (16.25-17.99)	19.7 (18.98-20.32)	20.1 (19.44-20.75)	20.5 (19.78-21.30)	20.1 (19.62-20.57)	12.744*	1 vs 2,3,4,5

* $p < 0.001$

NB. *Range of scores for each factor:*

Factor 1 (range 7 to 35): high scores mean stronger perceptions of environmental motivators for being more active on campus than do lower scores.

Factor 2 (range 5 to 25): high scores mean stronger perceptions of personal motivators for being more active on campus than do lower scores.

Gender differences

When the motivator factors and Stages of Change for moderate-intensity activity were examined separately for males and females, significant differences emerged between the Stages of Change for both motivator factors for females, but not for males (see Appendix L for full analysis tables).

For females, those in the Precontemplation stage for moderate-intensity activity were less likely to agree that the environmental items motivated them to do more physical activity than were those in the Action and Maintenance stages ($F_{(4, 451)} = 3.885$, $p < 0.01$). Females in the Precontemplation stage were less likely to agree that the personal items motivated them to do more physical activity than were those in the Preparation, Action and Maintenance stages ($F_{(4, 452)} = 5.548$, $p < 0.001$) (see Appendix L).

When the motivator factors and Stages of Change for vigorous activity were examined separately for males and females, significant differences emerged between the Stages of Change for both motivator factors for females, but not for males.

For females, those in the Precontemplation stage for vigorous activity were less likely to agree that the environmental items motivated them to do more physical activity than were those in the Contemplation, Preparation, Action and Maintenance stages ($F_{(4, 458)} = 6.646$, $p < 0.001$). For females, those in the Precontemplation stage were less likely to agree that the personal items motivated them to do more physical activity than were those in the Contemplation, Preparation, Action and Maintenance stages ($F_{(4, 460)} = 13.589$, $p < 0.001$) (see Appendix L).

5.4 Summary of Findings

In this study, Stages of Change were assessed separately for moderate-intensity and vigorous activity. The test-retest reliability for these measures was acceptable, but low for the moderate-intensity staging measure. There was a moderate correlation between the two

measures, with a number of differences emerging between the proportions in Stages of Change for moderate-intensity and vigorous activity, for males and females.

For vigorous activity, there was a much higher proportion of males than females in Maintenance, but a lower proportion of males than females in all of the other stages. For moderate-intensity activity, there were more males than females in Precontemplation, Action and Maintenance. There were also a greater proportion of males in Maintenance for vigorous activity than there was in Maintenance for moderate-intensity activity.

Exploratory factor analysis was used to obtain a dimensional structure for perceived barriers and motivators for physical activity in the campus setting. This resulted in a three-factor solution for barriers (*'environmental barriers'* – can't access facilities, facilities not attractive, no programs, no encouragement, no suitable facilities, don't like facilities, don't know location; *'personal barriers'* – no experience, no energy, no one to do it with, too fat, too lazy, too expensive; and *'competing demands'* – not interested, no free time, prefer to socialise, need to study, not here to exercise, don't like spending time). A two-factor solution for motivators (*'environmental motivators'* – convenient facilities, suitable facilities, safe facilities, exercise close to home, socialise, suitable climate, exercise partner; and *'personal motivators'* – muscle tone, muscle gain, more energy, feel good, look better) was used. One-way analyses of variance were used to examine the relationship between Stages of Change for moderate-intensity and vigorous activity and these factors.

The findings revealed significant differences in the 'personal barriers' factor between Stages of Change for both moderate-intensity and vigorous activity. When staged by moderate-intensity activity, those in the Maintenance stage perceived fewer personal barriers than did those in all other stages. When staged by vigorous activity, those in the Maintenance and Action stages perceived fewer personal barriers than did those in the other stages.

When examined separately by gender, females showed significant differences between the Stages of Change for moderate-intensity activity on personal barriers, but males did not.

For females, those in the Maintenance and Action stages perceived fewer personal barriers than did those in the other stages. However, both males and females showed significant differences between the Stages of Change for vigorous activity on personal barriers. For males, those in the Maintenance stage perceived fewer personal barriers than did those in all other stages and for females, those in the Maintenance and Action stages perceived fewer personal barriers than did those in the other stages.

The findings revealed significant differences between Stages of Change for moderate-intensity and vigorous activity for both of the motivator factors. When staged by moderate-intensity activity, those in the Precontemplation stage perceived fewer environmental motivators than did those in Preparation, Action or Maintenance, and fewer personal motivators than did those in the Contemplation or Action stages. When staged by vigorous activity, those in the Precontemplation stage perceived fewer environmental and personal motivators than did those in all the other stages.

Only females showed significant differences between Stages of Change for moderate-intensity and for vigorous activity on the environmental and personal motivator factors. The general pattern of findings indicated that females in Precontemplation perceived fewer environmental and personal motivators than did females in the later stages.

Overall, the personal barrier factor, and the personal and environmental motivator factors, showed differentiation by the staging measures for both moderate-intensity and vigorous activity in females. For males there were no stage-related differences for barriers or motivators for moderate-intensity, but significant stage-related differences for personal barriers for vigorous activity.

CHAPTER 6

DISCUSSION

This chapter summarises the findings for each of the studies reported in Chapters 2, 3, 4 and 5, together with a discussion of their main limitations. The relevance of the findings and their implications for the promotion of physical activity in young adults are then considered. Directions for future research are then discussed.

6.1 Age-Related Differences in Physical Activity Levels of Young Adults

In Chapter 2, patterns of age-related differences in the leisure-time physical activity levels of young adults were examined for three cross-sectional samples of young Australian adults (Leslie et al., 2001). There were significant age-related differences, with lower proportions of young adults in successive age groups participating in moderate-intensity and vigorous activity, and being sufficiently active for long-term health benefits. The age ranges were 18 to 19, 20 to 24 and 25 to 29 years. There was a 15% age-related decrease in vigorous leisure-time physical activity from the 18 to 19 year old group to the 25 to 29 year old group, and a 10% age-related decrease in moderate leisure-time physical activity. Rates of walking showed slight downward trends with age (less than 8%), but were not significant.

These findings are consistent with other cross-sectional studies which show an apparent 'decline' in rates of physical activity participation during the teenage and young adult years (Caspersen et al., 2000; Stephens, et al., 1985; Stephens & Caspersen, 1994; Stone et al., 1998). Cross-sectional data, while showing decreased rates of participation across successive age groups, cannot provide direct evidence of a decline in activity levels of individuals. Prospective studies have provided more-direct evidence for a decline in the proportion of young adults who have become inactive over time (van Mechelen et al., 2000; Telama & Yang, 2000).

Public health action may require more specific interventions in early adulthood in order to promote the adoption and maintenance of both moderate-intensity and vigorous physical activity. Such interventions will require knowledge of modifiable determinants

that are relevant to this age group. To date, studies of the factors related to participation in physical activity have mainly used vigorous exercise or a measure of total physical activity as outcomes. The determinants of moderate-intensity activity and walking are less well-understood (Sallis & Owen, 1999).

It may be that the patterns of age-related difference observed in these descriptive data are in part due to the changing lifestyle patterns that accompany the transition in personal circumstances as individuals move from adolescence into young adulthood. This life stage often involves competing demands on time associated with starting employment or tertiary study. The accompanying changes that occur to proximal physical environments at the same time may not be supportive of being active. Previously, physical activity campaigns have targetted inactive groups such as middle-aged and older adults (Bauman et al., 2001; Owen et al., 1995). However, it may be pertinent to address the decrease in activity earlier in adult life, before physical inactivity becomes habitual in young adults and they establish what in many cases may be life-long patterns of habitual sedentariness. The period of young adulthood represents a potential preventive window, within which lifelong physical activity habits and behaviours may be positively influenced.

The pattern of reducing proportions of both males and females participating in moderate-intensity and vigorous activity in the older age groups identified in this study have implications for the implementation of population-based physical activity promotion campaigns. Differences between males and females are particularly pertinent.

Strategies that take into account gender differences in physical activity may be more likely to be efficacious than are those that fail to address these differences. For example, males are more likely to engage in vigorous physical activity, while females are much more likely to engage in walking. However, the steep decreases in vigorous activity reported here and elsewhere for males (Sallis, 2000) may indicate that, when males stop doing vigorous sporting and fitness activities, they may be unlikely to replace these with more-moderate forms of activity such as walking, cycling or domestic activities. At the same time, females report doing more walking than do males. Despite having lower

levels of activity overall, females are more likely to maintain sufficient levels of physical activity as their age increases in early adulthood.

The findings reported in Chapter 2 emphasise the importance of considering the young adult years, where there is evidence of a decline in the prevalence of participation in physical activity in successive age groups, for both moderate-intensity and vigorous activity. There are consistent findings across survey types that rates of physical activity participation decline sharply during the adolescence and young adult years (Caspersen et al., 2000; Stone et al., 1998). It can be argued that during the transitional period of moving into young adulthood, many health behaviours, including physical activity, are being consolidated. There may also be relationships between physical activity and other behaviours that are related to chronic diseases, such as smoking, alchohol use or diet (Ball, Leslie, Fotheringham, Clavisi & Owen, 2000; Johnson, Nichols, Sallis, Calfas & Hovell, 1998).

Potentially there can be flow-on effects as this age group grows older, as arresting the decline in physical activity participation earlier may well impact on longer-term health outcomes. Young adults are a legitimate group to target specifically in physical activity interventions. Evidence from other Australian campaigns suggests that designing specific messages for defined population groups can be effective components of mass-media strategies (Bauman et al., 2001; Booth et al., 1992).

The findings in Chapter 2 also indicate potential opportunities for public health strategies intended to promote the maintenance of physical activity throughout adult life. The absence of a declining prevalence of walking with age during the young adult years suggests that this form of activity may be more readily maintained. Campaigns and environmental strategies that either reinforce these patterns or facilitate complementary activities could be helpful. Specifically, these could encourage males to adopt forms of moderate physical activity, and females to adopt other forms of moderate activity to complement walking.

Two important limitations of the study reported in Chapter 2 are the use of the kcal method for estimating energy expenditure, and the assignment of a threshold for achieving health benefits. The rationale for the use of 800kcal/week as a threshold for

achieving most of the health benefits associated with regular physical activity was presented in Section 1. 2.4 (Classifying physical activity as 'insufficient' for health benefits). At the time the studies in this thesis were conducted, this was a cut-point in common use. However, the nature of the dose-response relationship indicates that there is a graded improvement in health outcomes with increased time spent in activity (Haskell, 1994). Thus, the use of a specific threshold may disregard those who are achieving some benefits from activity. In addition, the issue of which is the most important for health benefits, the time spent in physical activity, or actual energy expenditure associated with physical activity, is not resolved (Lamonte & Ainsworth, 2001).

The use of weight (in kg) to derive this estimate of energy expenditure from self-reported physical activity measures and to determine categories of sufficient and insufficient physical activity may lead to some misclassification of respondents (Brown & Bauman, 2000). For example, for a woman who weighs only 60 kg but who reports 30 minutes of moderate-intensity activity on five days per week, the estimated energy expenditure [2.5(hrs/week) X 4 (METs) X 60 (kg) = 600 kcal/week] would not reach the threshold of 800 kcals/week required for sufficient activity. Thus having a relatively low body weight can result in being classified as insufficiently active, despite meeting the recommended behavioural guidelines for physical activity.

An alternative method proposed by Brown & Bauman (2000), uses an equation calculated without weight resulting in a unit of Mets.minutes. This method results in a lower threshold for being sufficiently active [based on 30 mins of moderate activity (4 METs) on five days each week = 600 Mets.mins] and may avoid some misclassification. Using this method, in the example given above, the 60 kg woman would be classified as being above the threshold. The relative misclassification which may occur using the kcal method is however small. There is reasonable agreement between both methods when used to compare the same data, with reported kappa values of 0.94 for men, and 0.83 for women (Brown & Bauman, 2000). It is likely that the use of the kcals method may slightly exaggerate the differences between genders, but as the 800 kcal is a conservative estimate, the number of individuals misclassified in large data sets is likely to be a small proportion of the total sample. The general patterns of differences, with females being less active than males, would be expected to be similar.

The study reported in Chapter 2 is limited to inferences drawn from secondary analyses of Australian population data surveys. Data were obtained from three surveys that used similar measures, but in different modes: self report, telephone and face-to-face interview. Nonetheless, the similarities across these data sets strengthen the evidence that the observed age-related and gender differences among young adults are likely to be real.

6.2 Personal, Social and Environmental Correlates of Physical Activity

In Chapter 3, characteristics of insufficiently physically active young adults were examined by describing personal, social and environmental variables factors associated with physical activity.

The potentially modifiable factors associated with insufficient physical activity were found to be generally similar for males and females. In particular, social support from friends and family emerged as important correlates of levels of physical activity in young adults. For males and females, low levels of social support for exercise from friends was the strongest psychosocial attribute associated with being insufficiently active. Social factors such as a lack of peer encouragement to exercise may contribute to the decline in levels of participation in physical activity (Dishman & Sallis, 1994; Sallis & Hovell, 1990). For females, friend support was found to be a stronger predictor than family support. Low enjoyment of exercise was a significant predictor of being insufficiently active for females but not for males. Social support, self-efficacy and enjoyment have been found to be consistently related to physical activity in other studies of a variety of adult population samples (USDHHS, 1996; Dzewaltowski, Noble & Shaw, 1990; Sallis, Haskell, Fortman et al., 1986; Marcus & Sallis, 1997).

These modifiable factors can be targeted for change in programs directed at young adults. For example, there were significant differences between the insufficiently and sufficiently active young adults and their rated enjoyment of 21 different physical activities. The finding that the insufficiently active rated only seven physical activities highly for enjoyment (compared to 12 for the sufficiently active) indicates the challenges for developing relevant types of physical activity interventions for this group. These findings reduce the saliency of implementing physical activity

interventions that incorporate a too-broad variety of activity options for the insufficiently active. It would make better sense to target those physical activities that the insufficiently active rate highest for enjoyment, for example, netball, swimming, walking, and tennis.

Age was found to be significantly associated with activity levels in males or females in the bivariate analysis but did not emerge as a significant predictor in the multivariate analysis. This may be partly due to the age distribution of the sample, with 44% of the sample in the youngest age group (18 to 19 years), and 90% under the age of 24 years.

Awareness of facilities available was significantly negatively associated with insufficient activity for females in the bivariate analysis but did not emerge as a significant predictor in the multivariate analysis. Those who choose to be active may choose to exercise in other settings or environments, which may also be more convenient and attractive to use. In this study the awareness question related specifically to what was available in the campus setting from which the sample was obtained. The assessment of campus facilities was limited to students' perceptions of what was available. Other aspects of campus programs need to be studied, including attractiveness of facilities, convenience of programs, and barriers to use.

Enjoyment was a predictor of being insufficiently active for females but not for males. Interestingly, netball was rated as having the highest overall enjoyment rating for the insufficiently active, reflecting the popularity of this activity for females.

The strong positive association of gymnasium membership and with being sufficiently active reflects the natural association of joining a gym with the desire to be active. This variable would be expected to coincide with being active, as would self-efficacy. Findings from both cross-sectional and prospective studies have indicated that higher levels of self-efficacy are related to higher levels of physical activity, and the present findings support the strong role of self-efficacy in physical activity. (USDHHS, 1996; Dzewaltowski, Noble & Shaw, 1990; Sallis, Haskell, Fortman et al, 1986; Leighton & Swerison, 1995).

An important aspect of the transition from adolescence to adult responsibilities is the competing demands on time, through family, social or work demands, which may influence opportunities to be physically active. Lack of time for activity is frequently cited as a barrier to participation. In this sample of young adults, 61% were employed, either in full-time or part-time jobs, with a higher proportion of females in some form of employment. Interestingly, employment status, when adjusted for other variables, was a significant predictor of levels of physical activity for females only, with those not working being more likely to be insufficiently active than those who were employed. Being employed may be associated with being more organised and able to manage time better, which facilitates physical activity. Possibly, young adults who are employed may use physical activity for stress reduction.

Limitations of this study include the nature of the sample, which was not a randomly selected group, and reliance on self-report measures. These measures, and the categorisation methods, have been used to obtain estimates of energy expenditure in previous Australian studies (Booth et al., 1996a; 1996b), and have shown acceptable reliability and validity. (Limitations of the method used to derive energy expenditure were discussed in Section 6.1). However, self-report measures can have high levels of measurement error. Since measurement error tends to suppress associations, the relationships obtained in the regression analysis may be regarded as potentially robust (Sallis, Hovell, Hofstetter et al., 1989). While the use of four campuses only may not be representative of the entire population of tertiary-education students, these campuses were typical of a major component of the tertiary-education sector in Australia in their size and physical features (see Leslie, Mounsey & Owen, 1998). There was a higher proportion of females, but this reflected the sex ratio of those enrolled on the campus from which the sample was collected. The attributes of the non-responders is not known and therefore cannot be compared to those who returned the survey. It is likely that non-responders may have been less active, and thus this sample may have a smaller group of insufficiently active respondents, than it would have been if the response rate was higher than the 58% that was achieved. Nevertheless, as was shown in Chapter 2, prevalence estimates for this sample of young adults were found to be similar to those obtained for young adults in population samples.

In the group of young adults examined in this study, 37% were insufficiently active for long-term health benefits according to current physical activity recommendations. Females were more likely than males to be insufficiently active, with a higher proportion in the sedentary and low-activity categories than males (45% compared to 28%). These findings are similar to those of a recent Australian population survey (Bauman et al., 1996) which found that females were 50% more likely to be insufficiently physically active than males. This is also consistent with findings from studies in the USA, in which males reported more physical activity than did females during the adolescent years (Kelder, Perry, Peters, Lytle & Klepp, 1995; Robinson & Killen, 1995). These consistent differences indicate a particular need to develop physical activity interventions for young women.

The findings in Chapter 3 may aid the understanding of the reasons for the decline in physical activity that was shown to occur in early adulthood described in Chapter 2. Physical activity promotion strategies and programs could usefully be directed at inactive subgroups of this age group, who may be at risk of maintaining sedentary habits for a lifetime. For example, tailoring interventions to specific subgroups such as chronically sedentary women, may be more feasible and have more of an impact than matching strategies to individuals within a diverse group.

Potentially, campus based physical activity promotion strategies can be used to target inactive young adults (see Appendix A-8). Published studies on campus-based physical activity are few and they show only modest impacts (Leslie, Fotheringham, Veitch & Owen, 2000; Leslie, Sparling & Owen, 2001; Sallis, Calfas, Nichols et al., 1999). However, the student population in tertiary-education campuses comprises a large subgroup of young adults who appear to have similar physical activity attributes as do young adults in the broader population (see Chapter 2). Young adults who attend a tertiary-education campus are not merely a population of convenience for health behaviour studies (Patrick, 1988), but represent a major segment of the young adult population with their numbers increasing. As the most educated segment of the population they are also future social opinion leaders and decision-makers. In 1995, students in tertiary education in Australia made up 39% of 15-24 year olds in the population (ABS, 1997), with the trend upward. Other studies have also found that the

average university student does not meet established public-health recommendations for physical activity (Pate et al., 1995; USDHHS, 1996).

Although campus-based physical activity promotion as an area of research is relatively new, there are potential public health benefits in using tertiary-education campus settings to positively influence the physical activity habits of inactive young adults (see Appendix A-4: Leslie, Sparling & Owen, 2001). Promoting physical activity in young adults through the campus setting is discussed more fully in Section 6.5 - Implications for Promoting Physical Activity: Focusing on Young Adults.

6.3 Preferences, Sources of Assistance and Motivators to be Active

In Chapter 4, preferences for physical activity, sources of assistance to be more active and motivators for being physically active were examined for insufficiently-active young adults. Both males and females were found to express similar choices for assistance to be more active. At the same time, males and females expressed different preferences for physical activity, and different motivators to being more active. While the overall most-preferred physical activity choice was racquet sports, there were strong gender differences for activities. Females preferred aerobics and walking, and males preferred weight training and team sports. The gender preferences for activity were consistent with other studies (Pinto & Marcus, 1995). Promoting participation in physical activity for this segment of the population should focus on the distinct preferences indicated by females and by males.

The major motivator to be active for males was muscle gain. It appears logical then that males would choose activities such as weight training as their most-preferred activity options. Females were much more strongly motivated by weight loss than were males. Together with their strong preference for having a group to exercise with, the choice of racquet sports and aerobics as the most-preferred activity choices is not surprising. These findings are consistent with those of previous studies with college students in the USA (Calfas et al., 1994; Leslie, Sparling & Owen, 2001).

With regard to possible sources of assistance to becoming more active, males and females indicated a strong desire to exercise with others. This reflects the psychosocial

attributes of this age group, where social support from friends is an important determinant of physical activity participation (King et al., 1992; Sallis, Simons-Morton, Stone & Corbin, 1992). Previous studies of the insufficiently-active have shown that being able to exercise with a group was important for younger age groups and tended to decrease in importance with increasing age (Booth et al., 1997).

The preference indicated by both males and females for obtaining advice from a trainer or coach may also be an important strategy in designing approaches for young adults. Both males and females indicated a desire for more facilities. This may reflect the fact that those facilities for the specific activities that young adults want to do may not be available in the campus environment where they spend much of their time. Observations and interviews related to this study revealed that the campuses where the study was conducted had few or no facilities for student physical activity (Leslie et al., 1996; Leslie et al., 1997; Leslie, Mounsey, Clavisi et al., 1998). It was also found in a study reported elsewhere that these campuses had relatively few facilities compared to other Australian university campuses of similar size (see Appendix A-5; Leslie, Mounsey, & Owen, 1998).

Limitations of the study reported in Chapter 4 includes the recruitment of students at only four campuses, which may not be representative of students on all Australian campuses. Other limitations were the reliance on self-report measures (albeit previously validated; Booth et al., 1996a; 1996b) and some differences in response rates between the urban and the rural campuses. As only leisure-time physical activity was reported, physical activity levels may have been underestimated for those students who were employed. It should also be noted that the survey item for preferred activities did not include the activity of netball, despite this activity being rated as having the highest enjoyment ratings in the findings reported in Chapter 3. It is likely that this exclusion from the possible choices that could have been selected, may mean that the combined category of team sports may not accurately reflect the actual preferences for females.

Young adults have particular preferences for activity, and identify motivators to exercise that are different from older adults. The findings presented here particularly highlight how different males and females are in their preferences and their motivation to be active, yet they have similar requirements for sources of assistance. Thus, physical

activity programs that have common elements of assistance, yet which provide distinct activities for males and females are more likely to be effective in targeting insufficiently-active young adults to be more active. Matching young adults' preferences for activity with motivators to be active may result in more appealing options for males and females than those provided within broad community wide groups (Bauman et al., 2001; Booth et al., 1992; Marcus et al., 1998; Owen et al., 1995).

Given the large proportion of young adults now attending tertiary-education campuses, campus settings may be key settings for potentially influencing physical behaviour in inactive young adults. The development of facilities and programs that address the needs described above within the campus setting may be a worthwhile approach in helping to achieve this. Future research should examine whether facilities that are generally available in the campus setting match the preferences for activity in this age group and whether providing facilities and programs that student's request results in increased physical activity. These issues are discussed more fully in Sections 6.5 and 6.6.

Additional factors to those described in Chapters 3 and 4 need to be considered in designing physical activity intervention strategies to influence campus-based physical activity participation. In particular, how barriers and motivators are related to motivational readiness for moderate-intensity and vigorous activity for males and females can usefully be examined.

6.4 Correlates of Stages of Change for Moderate-Intensity and Vigorous Physical Activity

The Transtheoretical Model has been applied widely to various physical activity programs, ranging from self-help individual programs to mass reach interventions (Calfas et al., 1997; Dunn et al., 1997; Marcus et al., 1998). The Stages of Change construct, which is central to the Transtheoretical Model, has been used to categorise levels of motivational readiness to engage in physical activity for young adults (Pinto & Marcus, 1995; Myers & Roth, 1997; Wyse, Mercer, Ashford, Buxton, & Gleeson, 1995). The stages for physical activity participation can be used to develop stage-

matched interventions to increase physical activity levels (eg., Marcus, Rakowski & Rossi, 1992: Marcus et al., 1998).

In Chapter 5, the Stages of Change construct was used to examine the physical activity related attributes of young adults. Stages of Change were assessed for both moderate-intensity and vigorous activity, according to guidelines for health related benefits. This approach provides additional insights to what was found in the studies reported in Chapters 3 and 4. By examining factors separately by Stages of Change there may be particular subgroups of males and females that are more important to target. The development of targetted interventions around the period of decreasing rates of participation in physical activity observed for young adults may help to promote the adoption and maintenance of physical activity.

The influence of barriers and motivators on moderate-intensity and vigorous physical activity is not well-understood. A qualitative study examining the perceived environmental influences on young adult's physical activity identified different barriers to moderate-intensity and vigorous physical activity in a campus setting (see Appendix I). Both males and females identified a lack of suitable facilities for vigorous activity and a lack of showers, change rooms and lockers as restricting walking and cycling for transport to campus. Females reported a lack of awareness of attractive options for walking and safety issues as barriers.

The proportions of young adults in the different Stages of Change for moderate-intensity and vigorous activity were reported by gender in Chapter 5. Similar proportions in each category have been described in five independent surveys from the USA and Australia (Laforge, Velicer, Richmond & Owen, 1999). The general patterns observed were also similar, with more males than females in the Maintenance stage for both moderate and vigorous activity. There was a greater proportion of males (57%) than females (29%) in the Maintenance category for vigorous activity. There was a higher proportion of males in Maintenance for vigorous activity (57%), compared to males in Maintenance for moderate-intensity activity (37%). This finding is not surprising, given the population data reported for patterns of physical activity for males and females in Chapter 1, and the findings reported in Chapter 2.

Compared to the Laforge et al. (1999) findings, there was a much higher proportion of males in Maintenance for vigorous activity in this sample of young adults. This is to be expected given the increased likelihood of doing vigorous activity for younger age groups (see Section 1.1.3), and the patterns of findings for males and females, with higher proportions of males than females reporting both moderate-intensity and vigorous activity. There were also fewer males in the earlier stages (Precontemplation, Contemplation and Preparation) for vigorous activity than there were females, which reflects the increased likelihood of males being in Action and Maintenance for vigorous activity than are females in this age group.

Comparisons of barrier and motivator factors across the stages for vigorous physical activity revealed more differences across stages than was apparent for the moderate-intensity staging measure. This suggests that the moderate-intensity staging measure may not be as sensitive to differences between stages. It may be that young adults do not think as specifically about intention to engage in moderate-intensity activity as they do for vigorous activity. Moderate-intensity activities like walking are less prevalent in this age group compared to older groups, especially for males who prefer vigorous activities like weight training or team sports (see Section 6.3; Leslie, Owen & Sallis, 1999). The perception that moderate-intensity activities do not qualify as "exercise" was found to be particularly strong for males in a qualitative study examining the perceptions of environmental influences for young adults in campus settings (see Appendix I). This could be because they relate any intention to do physical activity around the more traditional definitions of exercise, which require efforts of higher intensity for fitness gain.

The vigorous staging measure showed some distinct differences between stages and the barrier and motivator sub-scales. Vigorous activity may be more psychologically influenced and volitional than is moderate-intensity activity, which often can occur without conscious planning. The Stages of Change construct assumes that the performance of behaviour is under volitional control. However, moderate-intensity physical activity can occur as 'incidental' behaviour, such as walking to the bus stop or using the stairs. The choices to be moderately active may be partly due to the alternatives available, necessity, or even habitual behaviour (for example, driving rather than walking to the shops). Thus, the vigorous measure may be interpreted more

accurately. The kappa values for the staging measures suggest less measurement error for the vigorous staging measure than for the moderate-intensity measure.

Recent physical activity campaigns have reported data for adults which indicate that the perception that 'three sessions of vigorous activity for at least 20 minutes each' are required for health benefits is still prevalent in the community (Bauman et al., 2001). The recognition of the 'moderate 30 minutes a day' message may not yet be generally reflected in high school physical education curricula, where traditional team sports and vigorous activities such as running and fitness activities such as aerobics very probably have been the majority of activities available. Thus, young adults may have had limited experience and exposure to more moderate-intensity activities, such as golf or walking. These activities tend to be picked up later in adulthood when opportunities for participation in team sports becomes less frequent.

These factors may be particularly important for young males, among whom the culture of physical activity is largely built around sporting participation. It may be that with males' preferences for activity in early adulthood being for more vigorous activities (see Chapter 4), when they stop doing vigorous activities they may not replace them with moderate-intensity activities. Perception that moderate-intensity is not a worthwhile activity (see Appendix I) may lead to them to simply stop physical activity altogether once they can no longer participate in vigorous activity. The result may be that for males, regular vigorous activity becomes less prevalent into middle age, and without increasing levels of moderate-intensity activity they become less active overall (see Chapter 2).

When staged by the vigorous physical activity measure, both males and females showed significant differences between Stages of Change for the personal barriers factor. Those in Action and Maintenance (those participating regularly in vigorous activity) perceived fewer barriers than did those in the earlier stages.

When staged by the moderate-intensity activity measure, only females showed significant differences between Stages of Change on the personal barriers factor.

For both the vigorous and moderate-intensity activity measures, only females showed significant differences between Stages of Change on the personal and environmental motivator factors. Those in Precontemplation (not thinking about doing activity) identified fewer motivators than did those in the Preparation, Action and Maintenance stages.

There was little differentiation by stage for males when using the moderate-intensity measure. There were significant differences by stage for males when using the vigorous activity measure, for personal barriers only. The moderate-intensity stage measure may not have relevance for males, or it may be harder to detect differences with the smaller number of males in the sample. However, the finding that females appear to be more sensitive than males to barriers and motivators by stage for both moderate-intensity and vigorous activity may be one reason that they do less overall activity than do males at all ages.

The findings reported in Chapter 5 should be interpreted with some cautions. The separate staging measures used for moderate-intensity and vigorous activity provided some interesting comparisons and patterns for barriers and motivators, and the differences between males and females. There was evidence of concurrent validity, with an increase in reported minutes of moderate-intensity and vigorous activity by Stages of Change, with higher scores reported by those in Maintenance and the lowest scores reported by those in Precontemplation (see Table 1, Appendix M). However, the Stages of Change measure for moderate-intensity activity showed relatively poor test-retest reliability. There are a number of problems associated with self-reports of moderate-intensity activity, which generally produce relatively low reliability when compared to vigorous activity recall (Sallis & Saelens, 2000). This is likely to be due to the low salience of moderate-intensity activities (Durante & Ainsworth, 1996).

In the staging measure used for moderate-intensity activity, the use of the word 'incidental' activity may not have been well understood, and people may generally have more difficulty recalling this aspect of their physical activity. Certainly in the case of males who are more likely to report participation in vigorous than moderate-intensity activity, the current measure was not very informative. However, for females who prefer moderate activities like walking (see Chapter 4), the measure may be more

useful. The moderate-intensity staging measure needs further development before it is used more extensively.

6.5 Implications for Promoting Physical Activity: Focusing on Young Adults

The findings reported in Chapter 2 and other findings based on analyses of large cross-sectional data sets strongly support the case that there is an age-related decline in physical activity participation levels during young adulthood (Caspersen et al., 2000). Gender differences in the prevalence of moderate and vigorous activity in young adults have also been documented (Douglas et al., 1997; Pratt, Macera & Blanton, 1999; USDHHS, 1996). On average, males have considerably higher rates of vigorous activity than do females at the same ages (USDHHS, 1996). In addition, physical activity declines start earlier in females, particularly for vigorous activities (Sallis, 2000). The decline is inferred from the decreased prevalence of physical activity participation (for both moderate-intensity and vigorous activity) in successive age groups in cross-sectional studies and is supported by longitudinal data for adolescents and young adults.

There is now compelling evidence linking sedentary lifestyle with increased risk for coronary artery disease and other chronic and prevalent diseases (USDHHS, 1996). An important public-health objective is to increase physical activity levels among all persons including adolescents and young adults (USDHHS, 1996; 2000). Evidence of heart disease has been found in young adults with an increase in prevalence and extent with age through the oldest (30 to 34 years) age group (Strong et al., 1999). A relatively high prevalence of heart disease risk factors has been reported for a college student sample in the USA (Sparling, Beavers & Snow, 1999; Sparling, Snow & Beavers, 1999).

It is well established that atherosclerosis, obesity, non-insulin-dependent diabetes and osteoporosis are diseases that develop over many years. Yet, as the evidence base continues to accumulate, results indicate that the initiation of these diseases may begin as early as the second and third decades of life. Although this evidence on the development of disease provides a good rationale for targeting younger age groups, national-level physical activity campaigns have not focused on young adults. Rather,

their target groups have been middle-aged and older adults (Booth et al., 1992; Marcus, Owen et al., 1998; Owen et al., 1995). Campaigns have often emphasized walking, an activity that has less appeal to both younger adults (Booth et al., 1997) and to men (Leslie, Owen & Sallis, 1999). Moreover, activities such as walking may be a biological stimulus of relatively weak intensity for many young adults (Shephard, 1997).

This decline in physical activity participation during young adulthood plausibly can be explained by changes in priorities (e.g., new time constraints as a consequence of entering the workforce or starting a family), other associated increased demands on time, or additional environmental barriers related to convenience, accessibility and cost. Recent longitudinal data from the USA on the transition from college student to young alumnus support the trends observed in cross-sectional studies for age-related declines in levels of physical activity for young adults (Calfas, Sallis, Nichols et al., 2000; Sparling & Snow, in press). There is a need for more longitudinal studies that track levels of physical activity throughout the young adult years.

The studies in this thesis identified a number of factors that were found to be associated with young adults being insufficiently active. These included personal and social factors such as lower social support and enjoyment of activity and different preferences for activity (see Chapters 3 and 4). The findings related to barriers and motivators for physical activity and Stages of Change for both moderate-intensity and vigorous activity appear to have particular relevance for females (see Chapter 5). These factors can be used to tailor interventions to specific subgroups, such as chronically sedentary women (Precontemplators), or previously active men (Relapsers) who by stopping participation in vigorous sports have become insufficiently active. Suitable physical activity promotion strategies and programs that target such groups could feasibly be designed within campus settings.

There is a case to be made for promoting physical activity in young adults through campus settings (see Appendix A-4; Leslie, Sparling & Owen, 2001). As described earlier, a large proportion of young adults attend tertiary-education campuses, making this a key setting for conducting interventions. There is considerable potential for public health benefit by using campus settings to positively influence the physical activity

habits of young adults. Campus-based programs, particularly if integrated with local community approaches and attractive on-campus facilities, have the potential to provide an excellent setting to promote lifestyle physical activity among young adults.

The use of campus-based programs is still in its early stages and few campus-based physical activity intervention studies have been published. Stone and colleagues (1998) have reviewed physical activity intervention studies carried out in youth. Appendix A-4 (Leslie, Sparling & Owen, 2001) provides a review of two of these studies that have been conducted in college or university settings – Projects ARTEC and GRAD. These two studies are discussed briefly here to identify some of the difficulties and challenges in providing campus-based programs and the relevant issues for further research.

In the ARTEC (Active Recreation on Tertiary Education Campuses) Project, a quasi-experimental study design was used to promote on-campus and total physical activity amongst inactive students attending a single Australian university campus (Leslie et al., 2000). The intervention consisted of a program of activity classes being made available free to students on campus (e.g., aerobics, weight training), as well as providing demonstrations of various activities, fitness assessments, swimming vouchers to a nearby facility, and media promotion on-campus. Prior to the intervention, the ARTEC project assessed self-reported physical activity for a large sample of university students to determine factors relevant to inactivity.

While there are limitations due to the quasi-experimental design, this intervention illustrates that matching interventions to student preferences has the potential to influence physical activity in the campus setting. Further studies are needed to assess if this type of program can influence maintenance of physical activity over time. In the perspective of Environmental/Ecological models of physical activity behaviour (Sallis & Hovell, 1990; Sallis & Owen, 1997; Owen, Leslie, Salmon & Fotheringham, 2000), the provision of convenient and accessible exercise facilities may encourage students to participate in physical activity during their time on campus. While still in the early stages of research, several perceived environmental characteristics appear to be relevant to physical activity participation. Aesthetics, convenience and company have been associated with walking in adults (Ball, Bauman, Leslie & Owen, in press) and access

and safety have been associated with physical activity in older adults (Booth et al., 2000). However, it is not yet known if having physical facilities available actually results in increased rates of physical activity.

Appendix A-5 (Leslie, Mounsey & Owen, 1998) reports the results of a survey of all sport and physical activity facilities and services available on all Australian university campuses. Some 60,000 Australian university students (10%) are on small campuses (< 3000 students), some 146,000 (24%) on medium campuses (3000 - 8000 students), and some 408,000 (66%) are on large campuses (> 8000 students). Students attending small campuses have fewer on-campus physical activity facilities available. This immediately removes the vast majority of activity options except walking, jogging and other activities not requiring infrastructure, designated areas or tailored surfaces with appropriate markings and equipment.

Students attending medium and large-sized campuses have access to a greater range of facilities and hence a broader range of physical activity, sport and active recreation options. Those campuses in rural or lower socio-economic areas of large cities tend to be small or medium-sized campuses, and are therefore less well equipped in terms of physical activity facilities. It is likely that students attending these smaller campuses have access to fewer opportunities to be active. In addition, the most frequently preferred activities as identified in Chapter 4, are less likely to be available on smaller campuses than they are on medium or larger campuses.

The 'Project GRAD' (Graduate Ready for Activity Daily) study (see Calfas et al., 1994; Calfas et al., 2000; Saelens et al., 2000; Sallis, Calfas, Alcaraz, Gehrman & Johnson, 1999; Sallis, Calfas, Nichols et al., 1999; Sarkin, Marshall, Larson, Calfas & Sallis, 1998), was a randomised trial conducted with 338 senior (final year) college students in a for-credit classroom setting in a west-coast campus in the USA. Those in the intervention group were taught behaviour change skills to help them adopt and maintain physical activity. Those in the control group were taught general health knowledge-oriented information only. Project GRAD was delivered as a 15-week course by physical education staff through a series of weekly lectures and peer-led laboratory sessions. Students were encouraged to plan for structured, moderate activity; to

increase and maintain their "lifestyle" activity; and to incorporate muscle strengthening and flexibility exercises in their routine (Sallis, Calfas, Nichols et al., 1999).

The Project GRAD intervention had no immediate effects on physical activity patterns of young men. It had only modest effects among women, with increases in total leisure-time physical activity, strengthening and flexibility exercises. Only the initially active women increased physical activity, while the initially inactive women showed no change. The effects were statistically significant but small, and likely to have minimal health impacts (Sallis, Calfas, Nichols et al., 1999). The intervention group also received behaviourally-oriented telephone and mail follow-up for 18 months after course completion; however, there were no significant intervention effects on physical activity outcomes at a two year follow-up for men or women (Calfas et al., 2000).

There are a number of methodological constraints in conducting interventions such as the ARTEC and Project GRAD studies described above. For example, in measuring physical activity, both studies relied on self-reports as the primary means of assessment. While self-report measures can provide valid and reliable behavioural data, they are indirect and subjective compared to other measures that can be used. Given this limitation, the associations between the hypothesised psychosocial mediators and exercise behaviour must be interpreted with caution, due to possible inaccurate measurement of the primary outcome variable. The investigators acknowledge this limitation and recognize the need for concurrent validity with an objective measure such as motion sensors or direct observation. The cost of making objective measurements in large samples is, however, not insignificant (Sallis & Saelens, 2000).

The recruitment of participants to any intervention strategy also presents challenges. In Project GRAD, recruitment into the for-credit courses was low (9% and 4% of those eligible) and dropout rates were high. In the Australian ARTEC project, when students were asked about assistance to be more physically active, only 13% of males and 18% of females identified for-credit courses (Leslie, Owen & Sallis, 1999). The question thus arises as to whether these options are too limited. Perhaps there may be advantages to a more general strategy of making physical activity programs available to all students and putting resources into promoting them widely on campus (Leslie et al., 2000).

6.6 Directions for Future Research

There is a need to further develop the theoretical base for understanding the physical activity habits of young adults. There is initial evidence for the usefullness of social cognitive frameworks and the Transtheoretical Model (Myers & Roth, 1997; Pinto & Marcus, 1995). The campus-based interventions described earlier - Projects ARTEC and GRAD - used a social cognitive perspective to help identify and target relevant behaviours. For the ARTEC project, social learning theory (Sallis & Hovell, 1990) was used to help identify modifiable determinants of physical activity (Leslie, Owen, Salmon et al., 1999: Leslie, Owen & Sallis, 1999). These findings were then used to structure intervention components, by matching program offerings to students' preferences for physical activities, motivators to be active and the types of assistance perceived to be important (Leslie et al., 2000; Leslie, Owen & Sallis, 1999). Elements of social support and enjoyment that were identified as being important were also incorporated.

The Project GRAD study was based on both Social Cognitive Theory and the Transtheoretical Model of behaviour change (Calfas et al., 2000; Saelens et al., 2000; Sallis, Calfas, Alcaraz et al., 1999; Sallis, Calfas, Nichols et al., 1999). Self-monitoring, goal setting, problem solving, self-instruction, and relapse prevention concepts were used to shape the content and teaching approach in the delivery of the intervention.

These approaches to promoting physical activity within the campus setting have so far produced modest results. The ARTEC intervention (Leslie et al., 2000) was relatively short (eight weeks), and was associated with a significant increase in the proportion of students reporting high levels of physical activity, categorized using an index of weekly energy expenditure (Leslie, Owen, Salmon et al., 1999). However, due to the quasi-experimental nature of the study design, it is not clear whether inactive students became more active, or whether those who were already active increased their activity levels.

The Project GRAD intervention had no immediate effects on physical activity patterns of young men. It had only modest effects among women, with increases in total leisure-time physical activity, strengthening and flexibility exercises. Only the initially active

women increased physical activity, while the initially inactive women showed no change. The effects were statistically significant but small, and likely to have minimal health impacts (Sallis, Calfas, Nichols et al., 1999). The intervention group also received behaviourally-oriented telephone and mail follow-up for 18 months after course completion; however, there were no significant intervention effects on physical activity outcomes at a two year follow-up for men or women (Calfas et al., 2000).

In addition to research on promoting physical activity, there is the need to consider sedentary behaviours of young adults as a distinct construct. Many young adults spend considerable time in settings (such as campuses and workplaces) that promote sedentary behaviour (particularly computer and Internet use). For instance, for those young adults attending university, the growth of computer use on campuses and the parallel development of the Internet have been unprecedented. Students have now become immersed in technology in nearly all aspects of everyday living (e.g., beepers, mobile telephones, digital organizers) and are increasingly spending more time sitting. In a sample of Australian university students, this behaviour pattern has been found to be associated with spending less time in leisure-time physical activity (Fotheringham, Wonnacott & Owen, 2000). The lasting influence of these opposing "exposures" on physical activity patterns is not known (Owen, et al., 2000). The understanding of the natural history of exercise behaviours in young adults is incomplete, particularly within the context of a rapidly changing, technologically-driven environment.

It has been argued that environments which promote and often mandate long periods of physical inactivity are likely to contribute to shaping persistent and potentially long-term sedentary behaviour patterns (Sallis & Owen, 1999; Sallis, Bauman & Pratt, 1998; Owen et al., 2000). If sedentary activity patterns are developed and reinforced during young adulthood, it is probable that they will persist through adult life. There is therefore a need to consider the possible environmental factors that may influence young adults' physical activity behaviour. Of all the possible determinants of physical activity, environmental influences are the least understood. Factors such as convenient facilities (Sallis et al., 1992) and time of the year (Uitenbrock, 1993) have been found to be associated with physical activity participation. Recent research on physical activity behaviour has included the development of new measures to try to understand how environmental factors may influence physical activity habits (Bauman, Smith, Stoker,

Bellew & Booth, 1999; Brownson et al., 2000: King et al., 2000; Wilcox, Castro, King, Houseman & Brownson, 2000).

Understanding the influence of environmental influences requires the development and application of relevant theory (as outlined by the Behavioural Epidemiology framework; see Section 1.1.4) to guide environmental and policy approaches into research on possible modifiable factors (Owen et al., 2000; Bauman, Sallis & Owen, in press). The use of social cognitive models needs to be extended to broader ecological models that include the multiple levels of influence that occur for different physical activities in different settings (Owen et al., 2000) and to help to identify other potentially modifiable factors related to physical activity. Ecological models, which take into account the context of physical activity behaviour, can potentially be used to help understand the specific links between particular setting attributes, physical activity behavioural "choices" and the attributes of those who spend time in a particular settings.

Campus-based physical activity promotion is focused on an important environmental context for young adults and is an area of research that is relatively new. Promoting the adoption and maintenance of healthful levels of physical activity in young adults in this setting requires that additional carefully designed applied research be conducted. Additional theory-based studies will help us better understand the links between physical activity behaviour and its hypothesized mediators.

A number of research questions on how best to understand and influence physical activity in young adults remain to be addressed (Leslie et al., 2001). These include;

- Can physical activity interventions delivered in campus settings actually influence levels of habitual physical activity?

- Do campus environments promote and reinforce sedentary behaviour to such an extent that the overall effect may be to reinforce a lifelong pattern of sedentariness?

- Are physical activity and sporting facilities that are typically available on tertairy education campuses providing attractive and accessible opportunities for a high

proportion of students, particularly those with no interest in competitive sport or rigorous training?

- Do structured instructional courses on fitness and sporting skills that exist on some campuses actually have a lasting impact on physical activity patterns?

- Are campus opportunities and facilities that provide choices to be active more likely to have a positive longer-term impact?

These and other questions are part of a field of physical activity related research that has thus far had only limited attention.

6.7 Summary and Conclusions

Chapter 1 of this thesis presented the background and rationale for studying the physical activity patterns of young adults. Chapter 2 presented data on the prevalence of moderate-intensity and vigorous activity, as well as for walking and 'sufficient' physical activity during the young adult years. Males were found to have higher rates of overall moderate-intensity and vigorous leisure-time physical activity than did females in each of the age groups and consequently had higher rates of sufficient physical activity than did females. Females however, reported higher rates of participation within each of the age groups for walking than did males. While both males and females showed decreases in participation across these age groups, the decrease was greater for males over the entire (18 to 29 years) age range.

Chapters 3 and 4 reported factors related to being insufficiently active for young adults. In Chapter 3, a social learning perspective based on Sallis & Hovell's model (1990) was applied to identify potentially modifiable determinants of physical activity in a large sample of young adults. Predictors of being insufficiently active were lower social support from family and friends, lower enjoyment of activity, and being unemployed for females, and for males, lower social support from friends.

Chapter 4 reported preferences for types of physical activity, assistance to be more active and motivators for activity. For insufficiently active students, there were strong

gender differences in preferences for activities. Males and females preferred similar sources of assistance. These were particularly focussed on having someone to exercise with, a trainer's advice and more facilities being made available. Males were motivated to be active by weight gain, while females were motivated by weight loss, opportunities for exercising closer to home, feeling good and looking better.

Chapter 5 examined barriers and motivators to being more active for young adults using the Stages of Change construct from the Transtheoretical Model. This approach was used to help identify factors related to participation in moderate-intensity and vigorous physical activity. The findings related to these factors and Stages of Change for both moderate-intensity and vigorous activity appear to have particular relevance for females. Females who were in the Action and Maintenance stages had significantly higher perceptions of personal and environmental motivators for activity, and lower perceptions of personal barriers to physical activity.

The findings reported in this thesis have implications for promoting physical activity in young adults. Thus far, physical activity research and public-health interventions have paid limited attention to young adults.

The young adult years are a time when patterns of behaviour are changing and many health related behaviours are being established. This life stage represents a window of opportunity to influence physical activity behaviour patterns that is not being addressed as extensively as it might be. Addressing decreases in physical activity participation earlier in adult life through physical activity campaigns that target inactive groups of young adults may help to prevent the development of chronic disease in later life. Promoting physical activity to this group has the potential to influence rates of physical inactivity in adults and what in many cases may become life-long patterns of habitual sedentariness. The period of young adulthood represents a potential preventive window in which lifelong physical activity habits and behaviours may be positively influenced.

REFERENCES

Ainsworth BE, Haskell WL, Leon AS, Jacobs DR, Montoye HJ, Sallis JF, & Paffenbarger RS. (1993). Compendium of physical activities: classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise,* 25(1), 71-80.

Ainsworth B, Haskell WL, Whitt MC, Irwin ML, Swart AM, Strath SJ, O'Brien WL, Bassett DR, Schmitz KH, Emplaincourt PO, Jacobs DR, & Leon AS. (2000). Compedium of physical activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise,* 32(9), S498-S516.

Ainsworth BE, Montoye HJ, & Leon AS. (1994). Methods of assessing physical activity during leisure and work. In Bouchard C, Shephard RJ & Stephens T (Eds.), *Physical activity, fitness and health: a consensus of current knowledge* (pp. 146-159). Champaign, IL: Human Kinetics.

American College of Sports Medicine. (1978). The recommended quantity and quality of exercise for developing and maintaining fitness in healthy adults. *Medicine and Science in Sports and Exercise,* 10, vii-x.

American College of Sports Medicine. (1990). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. *Medicine and Science in Sports and Exercise,* 22, 265-274.

American College of Sports Medicine. (1991). *ACSM's guidelines for exercise testing and prescription* (4th ed.). Philadelphia: Lea and Febiger.

American College of Sports Medicine. (1998). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Medicine and Science in Sports and Exercise,* 30(6), 975-991.

American College of Sports Medicine and the US Centers for Disease Control. (1993). Summary Statement - Workshop on physical activity and Public Health. *Sports Medicine Bulletin,* 28(4), 7.

Andersen RE, Crespo CJ, Bartlett SJ, Cheskin LJ, & Pratt M. (1998). Relationship of physical activity and television watching with body weight and level of fatness among children: Results from the third National Health and Nutrition Examination Survey. *Journal of the American Medical Association,* 279, 938-942.

Anderssen N, Jacobs DR, Sidney S, Bild DE, Sternfeld B, Slattery ML, & Hannan P. (1996). Change and secular trends in physical activity patterns in young adults: a seven-year longitudinal follow-up in the coronary artery risk development in young adults study (CARDIA). *American Journal of Epidemiology,* 143(4), 351-362.

Armstrong CA, Sallis JF, Alcaraz JE, Kolody B, McKenzie TL, & Hovell MF. (1998). Children's television viewing, body fat, and physical fitness. *American Journal of Health Promotion,* 12(6), 363-368.

Armstrong T, Bauman A, & Davies J. (2000). *Physical activity patterns of Australian adults*. Canberra: Australian Institute of Health and Welfare (CVD-10).

Australian Bureau of Statistics [ABS]. (1991). *1989-90 ABS National Health Survey* (Catalogue No. 4364.0). Canberra: Australian Bureau of Statistics.

Australian Bureau of Statistics [ABS]. (1997). *Australia at a glance.* (Catalogue No. 4309.0). Canberra: Australian Bureau of Statistics.

Australian Bureau of Statistics [ABS]. (1999). *Participation in sport and physical activity in Australia* (Catalogue No. 4177.0). Canberra: Australian Bureau of Statistics.

Australian Institute of Health and Welfare [AIHW]. (2000). *Australia's health 2000: the seventh biennial health report of the Australian Institute of Health and Welfare.* Canberra: Australian Institute of Health and Welfare.

Baker EA, Brennan LK, Brownson R, & Houseman RA. (2000). Measuring the determinants of physical activity in the community: current and future directions. *Research Quarterly for Exercise and Sport,* 71(2), 146-158.

Ball K, Bauman A, Leslie E, & Owen N. (in press). Perceived environmental aesthetics and convenience and company are associated with walking for exercise in Australian adults. *Preventive Medicine.*

Ball K, Leslie E, Fotheringham MJ, Clavisi O, & Owen N. (2000). Campus settings and health promotion: overweight, physical inactivity, smoking and unsafe alcohol use in metropolitan university and rural TAFE students. *Health Promotion Journal of Australia,* 10(3), 255-258.

Bandura A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall.

Bauman A, Bellew B, Booth M, Hahn A, Stoker L, & Thomas M. (1996). *Towards best practice for the promotion of physical activity in the areas of NSW*: NSW Health Department, Centre for Disease Prevention and Health.

Bauman A, Owen N, & Rushworth RL. (1990). Recent trends and socio-demographic determinants of exercise participation in Australia. *Community Health Studies,* 14(1), 19-26.

Bauman A, & Owen N. (1991). Habitual physical activity and cardiovascular risk factors. *Medical Journal of Australia,* 154, 22-28.

Bauman A, & Owen N. (1999). Physical activity of adult Australians: epidemiological evidence and potential strategies for health gain. *Journal of Science and Medicine in Sport,* 2(1), 30-41.

Bauman A, Owen N, & Leslie E. (2000). Physical activity and health outcomes: epidemiological evidence, national guidelines and public health initiatives. *Australian Journal of Nutrition and Dietetics,* 57(4), 229-231.

Bauman A, Sallis JF, & Owen N. (in press). Environmental and policy measurement in physical activity research. In Welk G & Dale D (Eds.), *Physical activity assessment for health related research.* Champaign, IL: Human Kinetics.

Bauman A, Smith B, Stoker L, Bellew B, & Booth M. (1999). Geographical influences upon physical activity participation: evidence of a 'coastal effect'. *Australian and New Zealand Journal of Public Health,* 23(3), 322-324.

Bauman AE, Bellew B, Owen N, & Vita P. (2001). Impact of an Australian mass media campaign targeting physical activity in 1998. *American Journal of Preventive Medicine,* 21(1), 41-47.

Blair SN, & Connelly JC. (1994). How much physical activity should we do? The case for moderate amounts and intensities of physical activity. In Killoran AJ & Fentem P & Caspersen C (Eds.), *Moving on: International perspectives on promoting physical activity* (pp. 18-34). London UK: Health Education Authority.

Blair SN, Kohl HW, Gordon NF, & Paffenbarger RS. (1992). How much physical activity is good for health? *Annual Review of Public Health,* 13, 99-126.

Booth M. (2000). Assessment of physical activity: an international persepective. *Research Quarterly for Exercise and Sport,* 71(2supp), S114-S120.

Booth M, Bauman A, Oldenburg B, Owen N, & Magnus P. (1992). Effects of a national mass-media campaign on physical activity participation. *Health Promotion International,* 7(4), 241-247.

Booth M, Macaskill P, Oldenburg B, Marcus B, & Bauman A. (1993). The descriptive epidemiology of stages of change in physical activity. *Health Education Quarterly,* 20, 431-440.

Booth ML, Bauman A, Owen N, & Gore CJ. (1997). Physical activity preferences, preferred sources of assistance, and perceived barriers to increased activity among physically inactive Australians. *Preventive Medicine,* 26, 131-137.

Booth ML, Owen N, Bauman A, Clavisi O, & Leslie E. (2000). Social-cognitive and perceived environmental factors associated with physical activity in older Australians. *Preventive Medicine,* 31, 15-22.

Booth ML, Owen N, Bauman A, & Gore CJ. (1996a). Relationship between a 14-day recall measure of leisure time physical activity and a submaximal test of physical work capacity in a population sample of Australian adults. *Research Quarterly for Exercise and Sport,* 67(2), 221-227.

Booth ML, Owen N, Bauman A, & Gore CJ. (1996b). Retest reliability of recall measures of leisure-time physical activity in Australian adults. *International Journal of Epidemiology,* 25(1), 153-159.

Borg GA. (1982). Psychophysical bases of perceived exertion. *Medicine and Science in Sports and Exercise,* 14, 377-381.

Bouchard C. (2001). Physical activity and health: introduction to the dose-response symposium. *Medicine and Science in Sports and Exercise,* 33(6), S347-S350.

Brawley LR, Martin KA, & Gyurcsik NC. (1998). Problems in assessing perceived barriers to exercise: confusing obtacles with attributions and excuses. In Duda JL (Ed.), *Advances in Sport and Exercise Psychology Measurement* (pp. 337-350). Morgantown,WV: Fitness Information Technology.

Breslow NE, & Day NE. (1980). *Statistical methods in cancer research. The analysis of case-control studies.* (Vol. 1). Lyon, France: International Agency for Research on Cancer.

Brown WJ, & Bauman A. (2000). Comparison of estimates of population levels of physical activity using two measures. *Australian and New Zealand Journal of Public Health,* 24(5), 520-525.

Brown WJ, Fuller B, Lee C, Cockburn J, & Adamson L. (1999). Never too late: Older people's perceptions of physical activity. *Health Promotion Journal of Australia,* 9(1), 55-63.

Brownson RC, Houseman RA, Brown DR, Jackson-Thompson J, King AC, Malone BR, & Sallis JF. (2000). Promoting physical activity in rural communities-walking trail access, use, and effects. *American Journal of Preventive Medicine,* 18(3), 235-241.

Brownson RC, Jones DA, Pratt M, Blanton C, & Heath GW. (2000). Measuring physical activity with the behavioral risk factor surveillance system. *Medicine and Science in Sports and Exercise,* 32(11), 1913-1918.

Calfas K, Sallis JF, Nichols JF, Sarkins JA, Johnson MF, Caparosa S, Thompson S, Gehrman CA, & Alcaraz JE. (2000). Project GRAD: Two-year outcomes of a randomized controlled physical activity intervention among young adults. *American Journal of Preventive Medicine,* 18(1), 28-37.

Calfas KJ, Sallis JF, Lavoto CY, & Campbell J. (1994). Physical activity and its determinants before and after college graduation. *Medicine, Exercise, Nutrition and Health,* 3, 323-334.

Calfas KJ, Sallis JF, Oldenberg B, & Ffrench M. (1997). Mediators of change in physical activity following an intervention in primary care: PACE. *Preventive Medicine,* 26, 297-304.

Caspersen C, & Merritt RK. (1995). Physical activity trends among 26 states, 1986-1990. *Medicine and Science in Sports and Exercise,* 27, 713-720.

Caspersen C, Merritt RK, & Stephens T. (1994). International activity patterns: a methodological perspective. In Dishman RK (Ed.), *Advances in exercise adherence* (pp. 73-110). Champaign, IL: Human Kinetics.

Caspersen C, Pereira MA, & Curran KM. (2000). Changes in physical activity patterns in the United States, by sex and cross-sectional age. *Medicine and Science in Sports and Exercise,* 32(9), 1601-1609.

Caspersen CJ. (1989). Physical activity epidemiology: concepts, methods, and applications to exercise science. *Exercise and Sports Sciences Reviews,* 17, 423-473.

Caspersen CJ, Powell KE, & Christenson GM. (1985). Physical activity, exercise, and fitness: definition and distinctions for health-related research. *Public Health Reports,* 100, 126-131.

Catell RB. (1966). The scree test for number of factors. *Multivariate Behavioral Research,* 1, 245-276.

Centers for Disease Control and Prevention [CDCP]. (1997). Youth Risk Behavior Surveillance: National College Health Risk Behavior Survey - United States, 1995. *Morbidity and Mortality Weekly Report,* 46(SS-6), 1-56.

Clark DO, & Northwehr F. (1999). Exercise self-efficacy and its correlates among socioeconomically disadvantaged older adults. *Health Education and Behavior,* 26, 535-546.

Commonwealth Department of Health and Aged Care [CDHAC]. (1999). National physical activity guidelines for Australians. Canberra: Australian Government Publishing Service.

Commonwealth Department of Health and Family Services [CDHFS]. (1998). Developing an Active Australia: A framework for action for physical activity and health. Canberra: Australian Government Publishing Service.

Commonwealth Department of Human Services and Health [CDHSH]. (1994). *Better health outcomes for Australians. National goals, targets and strategies for better health outcomes into the next century.* Canberra: Australian Government Publishing Service.

Corti B, Donovan RJ, & Holman C. (1996). Factors influencing the use of physical activity facilities: results from qualitative research. *Health Promotion Journal of Australia,* 6(1), 16-21.

Courneya KS. (1995). Understanding readiness for regular physical activity in older individuals: an application of the theory of planned behavior. *Health Psychology,* 14, 80-87.

Courneya KS, & McAuley E. (1994). Are there different determinants of the frequency, intensity, and duration of physical activity? *Journal of Behavioral Medicine,* 20, 84-90.

Courneya KS, & McAuley E. (1995). Cognitive mediators of the social influence-exercise adherence relationship: a test of the theory of planned behavior. *Journal of Behavioral Medicine,* 18, 499-515.

Department of Art, Sport, the Environment and Territories [DASET]. (1992). *Pilot Survey of the Fitness of Australians*. Canberra: Australian Government Publishing Service.

Department of Environment, Sport and Territories [DEST]. (1995). *Active and inactive Australians*. Canberra: Australian Government Printing Service.

Dinger MK, & Waigandt A. (1997). Dietary intake and physical activity behaviors of male and female college students. *American Journal of Health Promotion,* 11(5), 360-362.

Dishman RK. (1988). Exercise adherence in children and youth: Implications for adulthood. In Dishman RK (Ed.), *Exercise adherence. Its impact on public health* (pp. 155-200). Champaign, IL: Human Kinetics.

Dishman RK. (1990). Determinants of participation in physical activity. In Bouchard C & Shephard RJ & Stephens T & Sutton JR & McPherson BD (Eds.), *Exercise, Fitness and Health: A consensus of current knowledge* (pp. 75-101). Champaign, IL: Human Kinetics.

Dishman RK, & Buckworth J. (1996). Increasing physical activity: a quantitative synthesis. *Medicine and Science in Sports and Exercise,* 28(6), 706-719.

Dishman RK, & Dunn AL. (1988). Exercise adherence in children and youth: implications for adulthood. In R. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 155-200). Champaign, IL: Human Kinetics.

Dishman RK, & Sallis JF. (1994). Determinants and interventions for physical activity and exercise. In Bouchard C & Shephard RJ & Stephens T (Eds.), *Physical activity, fitness and health: International proceedings and consensus statement* (pp. 214-238). Champaign, IL: Human Kinetics.

Dishman RK, Sallis JF, & Orenstein DR. (1985). The determinants of physical activity and exercise. *Public Health Reports,* 100(2), 158-171.

Dishman RK, & Steinhardt M. (1990). Health locus of control predicts free-living, but not supervised, physical activity: a test of exercise-specific control and outcome-expectation hypotheses. *Research Quarterly for Exercise and Sport,* 61, 383-394.

Douglas KA, Collins JL, Warren C, Kann L, Gold R, Clayton S, Ross JG, & Kolbe LJ. (1997). Results from the National College Health Risk Behavior Survey. *Journal of American College Health,* 46, 55-66.

Duncan TE, Duncan SC, & McAuley E. (1993). The role of domain and gender-specific provisions of social relations in adherence to a prescribed exercise regimen. *Journal of Sport and Exercise Psychology,* 15, 220-231.

Duncan TE, & McAuley E. (1993). Social support and efficacy cognitions in exercise adherence: a latent growth curve analysis. *Journal of Behavioral Medicine,* 16, 199-218.

Dunn AL, Marcus BH, Kampert JB, Garcia ME, Kohl HW, & Blair SN. (1997). Reduction in cardiovascular disease risk factors: 6 month results from Project Active. *Preventive Medicine,* 26, 883-892.

Durante R, & Ainsworth B. (1996). The recall of physical activity: using a cognitive model of the question-answering process. *Medicine and Science in Sports and Exercise,* 28(10), 1282-1291.

Dzewaltowski DA, Noble JM, & Shaw JM. (1990). Physical activity participation: Social cognitive theory versus the theories of reasoned action and planned behavior. *Journal of Sport and Exercise Psychology,* 12, 388-405.

Eaton CB, Lapane KL, Garber CA, Assaf AR, Lasater TM, & Carleton RA. (1995). Sedentary lifestyle and risk of coronary heart disease in women. *Medicine and Science in Sports and Exercise,* 27, 1535-1539.

Fotheringham MJ, Wonnacott RL, & Owen N. (2000). Computer use and physical inactivity in young adults:public health perils and potentials of new information technologies. *Annals of Behavioral Medicine,* 22(4), 269-275.

Godin G. (1994). Social-cognitive models. In Dishman RK (Ed.), *Advances in exercise adherence* (pp. 113-136). Champaign, IL: Human Kinetics.

Godin G, Desharnais R, Valois P, Lepage L, Jobin J, & Bradet R. (1994). Differences in perceived barriers to exercise between high and low intenders: observations among different populations. *American Journal of Health Promotion,* 8(4), 279-285.

Godin G, Valois P, Jobin J, & Ross A. (1991). Prediction of intention to exercise of individuals who have suffered from coronary heart disease. *Journal of Clinical Psychology,* 47, 762-772.

Godin G, Valois P, & Lepage L. (1993). The pattern of influence of perceived behavioral control upon exercising behavior: an application of Ajzen's theory of planned behavior. *Journal of Behavioral Medicine,* 16, 81-102.

Gore CJ, Owen N, Bauman A, & Booth M. (1993). Methods of the Pilot Survey of the Fitness of Australians. *Australian Journal of Science and Medicine in Sport,* 25(3), 82-85.

Green LW, & Kreuter MW. (1999). *Health promotion planning. An educational and ecological approach* (3rd ed.). Mountain View, CA: Mayfield.

Hahn A, & Craythorn E. (1994). Inactivity and the physical environment in two regional centres. *Health Promotion Journal of Australia,* 4(2), 43-45.

Hall AE. (1998). Perceived barriers to and benefits of physical activity among black and white women. *Women in Sport and Physical Activity Journal,* 7(2), 1-32.

Haskell WL. (1994). Health consequences of physical activity: understanding and challenges regarding dose-response. *Medicine and Science in Sports and Exercise,* 26(6), 649-660.

Hofstetter CR, Hovell MF, Macera C, Sallis JF, Spry V, & Barrington E. (1991). Illness, injury, and correlates of aerobic exercise and walking: a community study. *Research Quarterly for Exercise and Sport,* 62, 1-9.

Hovell MF, Sallis JF, Hofstetter CR, Spry VM, Faucher P, & Caspersen CJ. (1989). Identifying correlates of walking for exercise: an epidemiologic prerequisite for physical activity promotion. *Preventive Medicine,* 18, 856-866.

Howley ET. (2001). Type of activity: resistance, aerobic and leisure versus occupational physical activity. *Medicine and Science in Sports and Exercise,* 33(6), S364-S369.

Johnson MF, Nichols JF, Sallis JF, Calfas KJ, & Hovell MF. (1998). Interrelationships between physical activity and other health behaviours among university women and men. *Preventive Medicine,* 27, 536-544.

Kaiser H. (1974). An index of factorial simplicity. *Psychometrika,* 39, 31-36.

Kelder SH, Perry CL, Peters RJ, Lytle LL, & Klepp K. (1995). Gender differences in the class of 1989 study: the school component of the Minnesota Heart Health Program. *Journal of Health Education,* 26(2), S36-S44.

Kelley DE, & Goodpaster BH. (2001). Effects of exercise on glucose homeostatis in Type 2 diabetes mellitus. *Medicine and Science in Sports and Exercise,* 33(6), S495-S501.

Kendzierski D. (1994). Schema theory: an information processing focus. In Dishman RK (Ed.), *Advances in exercise adherence* (pp. 137-160). Champaign, IL: Human Kinetics.

Kesaniemi YA, Danforth E, Jensen MD, Kopelman PG, Lefebvre P, & Reeder BA. (2001). Dose-response issues concerning physical activity and health: an evidence-based symposium. *Medicine and Science in Sports and Exercise,* 33(6), S351-S358.

Killoran A, Fentem P, & Caspersen C. (1994). *Moving on. International perspectives on promoting physical activity.* London, UK: Health Education Authority.

King AC. (1994). Clinical and community interventions to promote and support physical activity participation. In Dishman RK (Ed.), *Advances in Exercise Adherence* (pp. 183-212). Champaign, IL: Human Kinetics.

King AC, Blair SN, Bild DE, Dishman RK, Dubbert PM, Marcus BH, Oldridge NB, Paffenbarger RS, Powell KE, & Yeager KK. (1992). Determinants of physical activity and interventions in adults. *Medicine and Science in Sports and Exercise,* 24(6), S221-236.

King AC, Castro C, Wilcox S, Eyler AA, Sallis JF, & Brownson RC. (2000). Personal and environmental factors associated with physical inactivity among different racial-ethnic groups of U.S. middle-aged and older-aged women. *Health Psychology,* 19(4), 354-364.

King AJC, & Coles B. (1992). *The health of Canada's youth: Views and behaviours of 11-, 13-, and 15-year olds from 11 countries*. Ottawa, Canada: Minister of National Health and Welfare.

Kohl KW. (2001). Physical activity and cardiovascular disease: evidence for a dose response. *Medicine and Science in Sports and Exercise,* 33(6), S472-S483.

Kriska AM, & Caspersen CJ. (1997). Introduction to a collection of physical activity questionnaires. *Medicine and Science in Sports and Exercise,* 29(6), S5-S9.

Kuczmarski RJ, Flegal KM, Campbell SM, & Johnson CM. (1994). The increasing prevalence of overweight among US adults: The National Health and Nutrition Examination Surveys, 1960 to 1991. *Journal of the American Medical Association,* 272, 205-211.

Laforge RG, Velicer WF, Richmond RL, & Owen N. (1999). Stage distributions for five health behaviors in the United States and Australia. *Preventive Medicine,* 28, 61-74.

Lamonte MJ, & Ainsworth BE. (2001). Quantifying energy expenditure and physical activity in the context of dose response. *Medicine and Science in Sports and Exercise,* 33(6), S370-S378.

Last JM. (1988). *A dictionary of epidemiology* (2nd ed.). Oxford: Oxford University Press.

Lee C. (1993). Attitudes, knowledge and stages of change: a survey of exercise patterns in older Australian women. *Health Psychology,* 12(6), 476-480.

Lee I-M, & Paffenbarger RS. (2000). Associations of light, moderate, and vigorous intensity physical activity with longevity. *American Journal of Epidemiology,* 151(3), 293-299.

Lee I-M, & Skerrett PJ. (2001). Physical activity and all-cause mortality: what is the dose-response relation? *Medicine and Science in Sports and Exercise,* 33(6), S459-S471.

Leighton D, & Swerissen H. (1995). Correlates of vigorous physical activity in young adults during school transition. *Australian Psychologist,* 30(2), 113-118.

Leslie E, Bassett S, & Owen N. (2001). Qualitative findings identifying environmental influences on young adult's physical activity in campus settings. *Health Promotion Journal of Australia,* 11(1), 73-74.

Leslie E, Bauman A, Salmon J, Veitch J, Owen N, & Sallis JF. (1996). *Active Recreation on Tertiary Education Campuses (ARTEC). Phase 1 Report.* Melbourne: School of Human Movement, Deakin University.

Leslie E, Fotheringham M, Owen N, & Bauman A. (2001). Age-related differences in physical activity levels of young adults. *Medicine and Science in Sports and Exercise,* 33(2), 255-258.

Leslie E, Fotheringham M, Veitch J, & Owen N. (2000). A university campus physical activity promotion program. *Health Promotion Journal of Australia,* 10(1), 51-54.

Leslie E, Mounsey S, Bauman A, & Owen N. (1997). *Active Recreation on Tertiary Education Campuses (ARTEC). Phase 2 Report.* Melbourne: School of Human Movement, Deakin University.

Leslie E, Mounsey S, Clavisi O, & Owen N. (1998). *Active Recreation on Tertiary Education Campuses (ARTEC). Phase 3 Report. University Campuses as Settings for Physical Activity.* Melbourne: School of Human Movement, Deakin University.

Leslie E, Mounsey SM, & Owen N. (1998). University campuses as settings for health promotion: physical activity. *Health Promotion Journal of Australia,* 8(2), 136-139.

Leslie E, Owen N, & Sallis JF. (1999). Inactive Australian College students' preferred activities, sources of assistance, and motivators. *American Journal of Health Promotion,* 13(4), 197-199.

Leslie E, Owen N, Salmon J, Bauman A, Sallis JF, & Sing KL. (1999). Insufficiently-active Australian college students: perceived personal, social, and environmental influences. *Preventive Medicine,* 28, 20-27.

Leslie E, Sparling P, & Owen N. (2001). University campus settings and the promotion of physical activity in young adults: lessons from research in Australia and the USA. *Health Education,* 101(3), 116-125.

MacDougall C, Cooke R, Owen N, Willson K, & Bauman A. (1997). Relating physical activity to health status, social connections and community facilities. *Australian and New Zealand Journal of Public Health,* 21, 631-637.

Macera C, & Pratt M. (2000). Public health surveillance of physical activity. *Research Quarterly for Exercise and Sport,* 71(2), 97-103.

Marcus BH, Banspach SW, Lefebvre RC, Rossi JS, Carleton RA, & Abrams DB. (1992). Using the stages of change model to increase the adoption of physical activity among community participants. *American Journal of Health Promotion,* 6(6), 424-429.

Marcus BH, Dubbert PM, King AC, & Pinto BM. (1995). Physical activity in women: current status and future directions. In Stanton A & Gallant S (Eds.), *Women's health.* Washington, DC: American Psychological Association.

Marcus BH, Eaton CA, Rossi JS, & Harlow LL. (1994). Self-efficacy, decision-making, and stages of change: an integrative model of physical exercise. *Journal of Applied Social Psychology,* 24(6), 489-508.

Marcus BH, Emmons KM, Simkin-Silverman L, Linnan LA, Taylor ER, Bock BC, Roberts MB, Rossi JS, & Abrams DB. (1998). Evaluation of motivationally

tailored vs. standard self-help physical activity interventions at the workplace. *American Journal of Health Promotion,* 12(4), 246-253.

Marcus BH, & Owen N. (1992). Motivational readiness, self-efficacy and decision-making for exercise. *Journal of Applied Social Psychology,* 22(1), 3-16.

Marcus BH, Owen N, Forsyth LH, Cavill NA, & Fridinger F. (1998). Physical activity interventions using mass media, print media, and information technology. *American Journal of Preventive Medicine,* 15(4), 362-378.

Marcus BH, Pinto BM, Simkin LR, Audrain JE, & Taylor ER. (1994). Application of theoretical models to exercise behavior among employed women. *American Journal of Health Promotion,* 9, 49-55.

Marcus BH, Rakowski W, & Rossi JS. (1992). Assessing motivational readiness and decision making for exercise. *Health Psychology,* 4, 257-261.

Marcus BH, Rossi JS, Selby VC, Niaura RS, & Abrams DB. (1992). The stages and processes of exercise adoption and maintenance in a worksite sample. *Health Psychology,* 11(6), 386-395.

Marcus BH, & Sallis JF. (1997). Determinants of physical activity behavior and implications for interventions. In Leon RS (Ed.), *Physical Activity and Cardiovascular Health. A National Consensus* (pp. 193-201). Illinois: Human Kinetics.

Marcus BH, Selby VC, Niaura RS, & Rossi JS. (1992). Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport,* 63(1), 60-66.

Marcus BH, & Simkin LR. (1993). The stages of exercise behavior. *The Journal of Sports Medicine and Physical Fitness,* 33(1), 83 - 88.

Marcus BH, & Simkin LR. (1994). The transtheoretical model: applications to exercise behaviour. *Medicine and Science in Sports and Exercise.,* 26(11), 1400-1404.

Marcus BH, Simkin LR, Rossi JS, & Pinto BM. (1996). Longitudinal shifts in employees' stages and processes of exercise behavior change. *American Journal of Health Promotion,* 10(3), 195-200.

McAuley E. (1991). Efficacy, attributional, and affective responses to exercise participation. *Journal of Sport and Exercise Psychology,* 13, 382-393.

Miilunpalo S, Nupponen R, Laitakari J, Marttila J, & Paronen O. (2000). Stages of change in two modes of health-enhancing physical activity: methodological aspects and promotional implications. *Health Education Research,* 15(4), 435-448.

Montoye HJ, Kemper HCG, Saris WHM, & Washburn RA. (1996). *Measuring physical activity and energy expenditure*. Champaign, IL: Human Kinetics.

Montoye HJ, & Taylor HL. (1984). Measurement of physical activity in population studies: a review. *Human Biology,* 56(2), 195-216.

Myers AM, Weigel C, & Holiday PJ. (1989). Sex- and age-linked determinants of physical activity in adulthood. *Canadian Journal of Public Health,* 80, 256-260.

Myers RS, & Roth DL. (1997). Perceived benefits of and barriers to exercise and stage of exercise adoption in young adults. *Health Psychology,* 16(3), 277-283.

National Health and Medical Research Council [NHMRC]. (1997). *Acting on Australia's weight: a strategic plan for the prevention of overweight and obesity.* Canberra: Australian Government Publishing Service.

National Institutes of Health Consensus Development Panel on Physical Activity and Cardiovascular Health. (1996). Physical activity and cardiovascular health. *Journal of the American Medical Association,* 276, 241-246.

Oman RF, & King AC. (1998). Predicting the adoption and maintenance of exercise participation using self-efficacy and previous exercise participation rates. *American Journal of Health Promotion,* 12(3), 154-161.

Owen N, & Bauman A. (1992). The descriptive epidemiology of a sedentary lifestyle in adult Australians. *International Journal of Epidemiology,* 21(2), 305-310.

Owen N, Bauman A, Booth M, Oldenburg B, & Magnus P. (1995). Serial mass-media campaigns to promote physical activity: reinforcing or redundant? *American Journal of Public Health,* 85(2), 244-248.

Owen N, Leslie E, Salmon J, & Fotheringham M. (2000). Environmental determinants of physical activity and sedentary behaviour. *Exercise and Sports Science Reviews,* 28(4), 153-158.

Pallant J. (2001). *SPSS survival guide: a step by step guide to data analysis using SPSS.* Maryborough, Victoria: McPherson's Printing Group.

Pate R, Pratt M, Blair S, Haskell W, Macera C, Bouchard C, Buchner D, Ettinger W, Heath G, King A, Kriska A, Leon A, Marcus B, Morris J, Paffenbarger R, Patrick K, Pollock M, Rippe J, Sallis J, & Wilmore J. (1995). Physical Activity and Public Health. A recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. *Journal American Medical Association,* 273(5), 402-407.

Patrick K. (1988). Student health: medical care within institutions of higher education. *Journal of the American Medical Association,* 260(22), 3301-3305.

Pinto BM, & Marcus BH. (1995). A stages of change approach to understanding college students' physical activity. *Journal of American College Health,* 44, 27-31.

Powell KE, & Blair S. (1994). The public health burdens of sedentary living habits: theoretical but realistic estimates. *Medicine and Science in Sports and Exercise,* 26(7), 851-856.

Pratt M, Ainsworth B, Booth M, & Craig C. (1999). Can public health surveillance of physical activity be standardized internationally? *Medicine and Science in Sports and Exercise,* 31(5), S389 [Abstract].

Pratt M, Macera CA, & Blanton C. (1999). Levels of physical activity and inactivity in children and adults in the United States: current evidence and research issues. *Medicine and Science in Sports and Exercise,* 31(11), S526-S533.

Prochaska JO, & DiClemente CC. (1983). Stages and processes of self-change of smoking: toward an integrative model of change. *Journal of Consulting and Clinical Psychology,* 51(3), 390 - 395.

Prochaska JO, & DiClemente CC. (1984). *The transtheoretical approach: crossing traditional boundaries of therapy.* Pacific Grove, California: Brooks/Cole.

Prochaska JO, DiClemente CC, & Norcross JC. (1992). In search of how people change: applications to addictive behaviors. *American Psychologist,* 47(9), 1102-1114.

Prochaska JO, & Marcus BH. (1994). The transtheoretical model: applications to exercise. In Dishman RK (Ed.), *Advances in Exercise Adherence* (pp. 161-180). Illinois: Human Kinetics.

Public Health Association of Australia [PHAA]. (2000). Physical activity policy statement, *Policy Statements 2000* (pp. 123-124). Canberra: Pirrie Printers.

Raitakari OT, Porkka KVK, Taimela S, Telama R, Räsänen L, & Viikari JSA. (1994). Effects of persistent physical activity and inactivity on coronary risk factors in children and young adults: the cardiovascular risk in young Finns study. *American Journal of Epidemiology,* 140(3), 195-205.

Reed GR, Velicer WF, Prochaska JO, Rossi JS, & Marcus BH. (1997). What makes a good staging algorithm: examples from regular exercise. *American Journal of Health Promotion,* 12(1), 57-66.

Risk Factor Prevalence Study Management Committee. (1990). *Risk Factor Prevalence Study: Survey No. 3 1989.* Canberra: National Heart Foundation of Australia and Australian Institute of Health.

Robinson TN, & Killen JD. (1995). Ethnic and gender differences in the relationships between television viewing and obesity, physical activity, and dietary fat intake. *Journal of Health Education,* 26(2), S91-97.

Rodgers WM, & Gauvin L. (1998). Heterogeneity of incentives for physical activity and self-efficacy in highly active and moderately active women exercisers. *Journal of Applied Social Psychology,* 28, 1016-1029.

Saelens BE, Gehrman CA, Sallis JF, Calfas KJ, Sarkin JA, & Caparosa S. (2000). Use of self-management strategies in a 2-year cognitive-behavioral intervention to promote physical activity. *Behavior Therapy,* 31(2), 365-379.

Sallis J, Bauman A, & Pratt M. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine,* 15(4), 379-397.

Sallis JF. (1991). Self-report measures of children's physical activity. *Journal of School Health,* 61(5), 215-219.

Sallis JF. (2000). Age-related decline in physical activity: a synthesis of human and animal studies. *Medicine and Science in Sports and Exercise,* 32(9), 1598-1600.

Sallis JF, Calfas KJ, Alcaraz JE, Gehrman C, & Johnson MF. (1999). Potential mediators of change in a physical activity promotion course for university students: Project GRAD. *Annals of Behavioral Medicine,* 21(2), 149-158.

Sallis JF, Calfas KJ, Nichols JF, Sarkin JA, Johnson MF, Caparosa S, Thompson S, & Alcaraz JE. (1999). Evaluation of a university course to promote physical activity: Project GRAD. *Research Quarterly for Exercise and Sport,* 70(1), 1-10.

Sallis JF, Grossman RM, Pinski RB, Patterson TL, & Nader PR. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine,* 16, 825-836.

Sallis JF, Haskell WL, Fortman SP, Vranizan KM, Taylor CB, & Solomon DS. (1986). Predictors of adoption and maintenance of physical activity in a community sample. *Preventive Medicine,* 15, 331-341.

Sallis JF, Haskell WL, Wood PD, Fortmann SP, & Vranizan KM. (1986). Vigorous physical activity and cardiovascular risk factors in young adults. *Journal of Chronic Disease,* 39(2), 115-120.

Sallis JF, Hofstetter CR, Hovell MF, Elder JP, Caspersen CJ, Hackley M, & Powell KE. (1990). Distance between homes and exercise facilities related to the frequency of exercise among San Diego residents. *Public Health Reports,* 105(2), 179-185.

Sallis JF, & Hovell MF. (1990). Determinants of exercise behaviour. In Holloszy JO & Pandolf KB (Eds.), *Exercise and Sports Sciences Reviews*, 18 (pp. 307-330). Baltimore MD: Williams and Wilkins.

Sallis JF, Hovell MF, Hofstetter CR, & Barrington E. (1992). Explanation of vigorous physical activity during two years using social learning variables. *Social Science and Medicine,* 34(1), 25-32.

Sallis JF, Hovell MF, Hofstetter CR, Faucher P, Elder JP, Blanchard J, Caspersen CJ, Powell KE, & Christenson GM. (1989). A multivariate study of determinants of vigorous exercise in a community sample. *Preventive Medicine,* 18, 20-34.

Sallis JF, Hovell MF, & Hofstetter CR. (1992). Predictors of adoption and maintenance of vigorous physical activity in men and women. *Preventive Medicine,* 21, 237-291.

Sallis JF, & Owen N. (1997). Ecological models. In Glanz K, Lewis FM & Rimer BK (Eds.), *Health Behaviour and Health Education. Theory, research and practice* (2nd ed., pp. 403-424). San Francisco: Jossey-Bass.

Sallis JF, & Owen N. (1999). *Physical activity and behavioral medicine.* Thousand Oaks, CA: Sage.

Sallis JF, Owen N, & Fotheringham MJ. (2000). Behavioral epidemiology: a systematic framework to classify phases of research on health promotion and disease prevention. *Annals of Behavioral Medicine,* 22(4), 294-298.

Sallis JF, Pinski RB, Grossman RM, Patterson TL, & Nader PR. (1988). The development of self-efficacy scales for health related diet and exercise behaviors. *Health Education Research,* 3(3), 283-292.

Sallis JF, Prochaska JJ, & Taylor WC. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise,* 32(5), 963-975.

Sallis JF, & Saelens BE. (2000). Assessment of physical activity by self-report: status, limitations, and future directions. *Research Quarterly for Exercise and Sport,* 71(2), 1-14.

Sallis JF, Simons-Morton BG, Stone EJ, & Corbin CB. (1992). Determinants of physical activity and interventions in youth. *Medicine and Science in Sport and Exercise,* 24(6), S248-257.

Salmon J, Bauman A, Crawford D, Tempiero A, & Owen N. (2000). The association between television viewing and overweight among Australian adults participating in varying levels of leisure-time physical activity. *International Journal of Obesity,* 24(5), 600-606.

Sarkin JA, Marshall SJ, Larson KA, Calfas KJ, & Sallis JF. (1998). A comparison of methods of recruitment to a health promotion program for university seniors. *Preventive Medicine,* 27(4), 562-571.

Sarkin JA, Nichols JF, Sallis JF, & Calfas KJ. (2000). Self-report measures and scoring protocols affect prevalence estimates of meeting physical activity guidelines. *Medicine and Science in Sports and Exercise,* 32, 149-156.

Shephard RJ. (1997). What is the optimal type of physical activity to enhance health? *British Journal of Sports Medicine,* 31, 277-284.

Shephard RJ. (2001). Absolute versus relative intensity of physical activity in a dose-response context. *Medicine and Science in Sports and Exercise,* 33(6), S400-S418.

Smith JR, Owen N, Leslie E, & Bauman A. (1999). *Active For Life: Physical Activity Patterns and Health Impacts in Victoria 1998.* Melbourne, Victoria: Victorian Department of Human Services.

Sparling P, Beavers B, & Snow TK. (1999). Prevalence of coronary heart disease (CHD) risk factors in a college population. *Medicine and Science in Sports and Exercise,* 31, S254 (abstract).

Sparling PB, Owen N, Lambert EV, & Haskell WL. (2000). Promoting physical activity: the new imperative for public health. *Health Education Research,* 15, 367-376.

Sparling PB, & Snow TK. (in press). Physical activity patterns in recent college alumni. *Research Quarterly for Exercise and Sport.*

Sparling PB, Snow TK, & Beavers BD. (1999). Serum cholesterol levels in college students: opportunities for education and intervention. *Journal of American College Health,* 48, 123-127.

SPSS. (1993). *SPSS for Windows base system user's guide.* Chicago, Illinois.

Steinhardt MA, & Dishman RK. (1989). Reliability and validity of expected outcomes and barriers for habitual physical activity. *Journal of Occupational Medicine,* 31, 536-546.

Stephens T. (1987). Secular trends in adult physical activity: exercise boom or bust? *Research Quarterly for Exercise and Sport,* 38, 94-105.

Stephens T, & Caspersen C. (1994). The demography of physical activity. In Bouchard C & Shephard RJ & Stephens T (Eds.), *Physical activity, fitness, and health* (pp. 204-213). Champaign, IL: Human Kinetics.

Stephens T, Jacobs DR, & White CC. (1985). A descriptive epidemiology of leisure-time physical activity. *Public Health Reports,* 100(2), 147-158.

Sternfeld B, Ainsworth BE, & Quesenberry CP. (1999). Physical activity patterns in a diverse population of women. *Preventive Medicine,* 28, 313-323.

Stokols D. (1992). Establishing and maintaining healthy environments: toward a social ecology of health promotion. *American Psychologist,* 47(1), 6-22.

Stone EJ, McKenzie TL, Welk GJ, & Booth ML. (1998). Effects of physical activity interventions in youth. Review and synthesis. *American Journal of Preventive Medicine,* 15(4), 298-315.

Strong JP, Malcom GT, McMahan CA, Tracy RE, Newman WP, Herderick EE, & Cornhill JF. (1999). Prevalence and extent of atherolsclerosis in adolescents and young adults. *Journal of the American Medical Association,* 281, 727-735.

Tabachnick BG, & Fidell LS. (1996). *Using multivariate statistics* (3rd ed.). New York: Harper Collins.

Telama R, & Yang X. (2000). Decline of physical activity from youth to young adulthood in Finland. *Medicine and Science in Sports and Exercise,* 32(9), 1617-1622.

Thune I, & Furberg A. (2001). Physical activity and cancer risk: dose-response and cancer, all sites and site-specific. *Medicine and Science in Sports and Exercise,* 33(6), S530-S550.

Treiber FA, Baranowski T, Braden DS, Strong WB, Levy M, & Knox W. (1991). Social support for exercise: relationship to physical activity in young adults. *Preventive Medicine,* 20, 737-750.

Uitenbrock DG. (1993). Seasonal variation in leisure time physical activity. *Medicine and Science in Sports and Exercise,* 25(6), 755-760.

United States Department of Health and Human Services. (1996). *Physical Activity and Health: A Report of the Surgeon General.* Atlanta, GA: Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

United States Department of Health and Human Services. (2000). *Healthy People 2010: Understanding and Improving Health.* Washington, DC: US Government Printing Office.

Van Mechelen W, & Kemper HCG. (1995). Habitual physical activity in longitudinal perspective. In H. Kemper (Ed.), *The Amsterdam Growth Study: A longitudinal analysis of health, fitness, and lifestyle* (pp. 135-158). Champaign, IL: Human Kinetics.

Van Mechelen W, Twisk JWR, Post B, Snel J, & Kemper HCG. (2000). Physical activity of young people: the Amsterdam Longitudinal Growth and Health Study. *Medicine and Science in Sports and Exercise,* 32(9), 1610-1616.

Veitch J, Owen N, Burns J, & Sallis JF. (1997). Physical activity promotion for male factory workers:a realistic option? *Health Promotion Journal of Australia,* 7(3), 169-174.

Vuori IM. (2001). Dose-response of physical activity and low back pain, osteoarthritis, and osteoporosis. *Medicine and Science in Sports and Exercise,* 33(6), S551-S586.

Wallace-Silver L, Buckworth J, Kirby TE, & Sherman WM. (2000). Characteristics of exercise behaviour among college students: application of social cognitive theory to predicting stage of change. *Preventive Medicine,* 31, 494-505.

Wilcox S, Castro C, King AC, Houseman R, & Brownson RC. (2000). Determinants of leisure-time physical activity in rural compared with urban older and ethnically diverse women in the United States. *Journal of Epidemiology and Community Health,* 54, 667-672.

Williamson DF, Kahn HS, Remington PL, & Anda RF. (1990). The 10-year incidence of overweight and major weight gain in U.S. adults. *Archives of Internal Medicine,* 150, 665-672.

Wyse J, Mercer T, Ashford B, Buxton K, & Gleeson N. (1995). Evidence for the validity and utility of the Stages of Exercise Behaviour Change scale in young adults. *Health Education Research,* 10(3), 365-377.

Wilmore JH, & Costill DL. (1994). *Physiology of sport and exercise*. Champaign, IL: Human Kinetics.

APPENDIX A:

Published papers associated with this thesis

A-1

Leslie E, Fotheringham MJ, Owen N, Bauman A. (2001). Age-related differences in physical activity levels of young adults. *Medicine and Science in Sports and Exercise,* 33(2): 255-258.

A-2

Leslie E, Owen N, Salmon J, Bauman A, Sallis JF, Lo SK (1999). Insufficiently-active Australian college students: perceived personal, social and environmental influences. *Preventive Medicine*, 28(1): 20-27.

A-3

Leslie E, Owen N, Sallis JF (1999). Inactive Australian college students' preferred activities, sources of assistance and motivators. *American Journal of Health Promotion*, 13(4): 197-199.

A-4

Leslie E, Sparling P, Owen N. (2001). University campus settings and the promotion of physical activity in young adults: Lessons from research in Australia and the USA. *Health Education,* 101(3): 116-125.

A-5

Leslie E, Mounsey S, Owen N. (1998). University campuses as settings for health promotion: physical activity. *Health Promotion Journal of Australia*, 8(2):136-139.

A-6

Leslie E, Fotheringham M, Veitch J, Owen N. (2000). A university campus physical activity promotion program. *Health Promotion Journal of Australia*, 10(1): 51-54.

A-7

Leslie E, Bassett S, Owen N. (2001). Qualitative findings identifying environmental influences on young adult's physical activity in campus settings. *Health Promotion Journal of Australia,* 11(1): 73-74.

A-1

Leslie E, Fotheringham MJ, Owen N, Bauman A. (2001). Age-related differences in physical activity levels of young adults. ***Medicine and Science in Sports and Exercise,*** **33(2): 255-258.**

(This paper relates to the findings presented in Chapter 2: Age-related differences in the physical activity levels of young adults).

Please see print copy for this article

A-2

Leslie E, Owen N, Salmon J, Bauman A, Sallis JF, Lo SK (1999). Insufficiently-active Australian college students: perceived personal, social and environmental influences. *Preventive Medicine*, 28(1): 20-27.

(This paper is related to the findings presented in Chapter 3: Personal, social and environmental factors associated with young adults being insufficiently active. The data reported here include older participants and differ somewhat, but not substantially, from that reported in Chapter 3).

Please see print copy for this article

A-3

Leslie E, Owen N, Sallis JF (1999). Inactive Australian college students' preferred activities, sources of assistance and motivators. ***American Journal of Health Promotion*****, 13(4): 197-199.**

(This paper is related to the findings presented in Chapter 4: Insufficiently active young adults' preferences, sources of assistance and motivators to be active. The data reported here include older participants and differ somewhat, but not substantially, from that reported in Chapter 4).

Please see print copy for this article

A-4

Leslie E, Sparling P, Owen N. (2001). University campus settings and the promotion of physical activity in young adults: Lessons from research in Australia and the USA. *Health Education,* 101(3): 116-125.

(This paper relates to the discussion presented in Chapter 6).

Please see print copy for this article

A-5

Leslie E, Mounsey S, Owen N. (1998). University campuses as settings for health promotion: physical activity. *Health Promotion Journal of Australia*, 8(2):136-139.

(This paper relates to the discussion presented in Chapter 6).

Please see print copy for this article

A-6

Leslie E, Fotheringham M, Veitch J, Owen N. (2000). A university campus physical activity promotion program. *Health Promotion Journal of Australia*, 10(1): 51-54.

(This paper relates to the discussion presented in Chapter 6).

Please see print copy for this article

A-7

Leslie E, Bassett S, Owen N. (2001). Qualitative findings identifying environmental influences on young adult's physical activity in campus settings. ***Health Promotion Journal of Australia,*** **10(1): 73-74.**

(This letter to the editor relates to the study presented in Chapter 5. A full version of the study that is described here is presented in Appendix I).

Please see print copy for this article

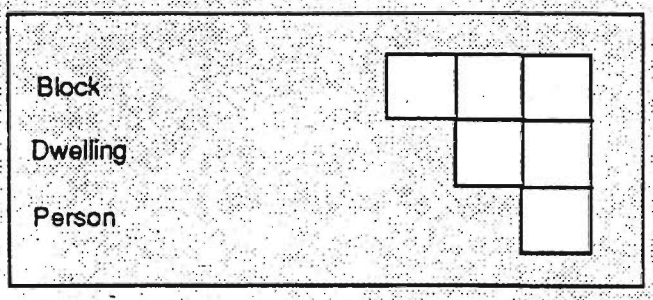
APPENDIX B:

Pilot Survey of the Fitness of Australians (PSFA) Questionnaire

AUSTRALIAN FITNESS SURVEY

1990-1991

HEALTH DEVELOPMENT FOUNDATION



SOCIODEMOGRAPHIC

1. **Postcode** *(complete during editing)*

2. **Sex**

Male	1
Female	2

3. **The first few questions are for background information.**

What was your age last birthday?

Years

4. **What is your marital status?**

Married	1
De facto	2
Separated	3
Divorced	4
Widowed	5
Never married	6

5. **In which country were you born?**

Australia	1
U.K. and Ireland	2
Italy	3
Greece	4
Other European	5
Asia	6
Other (*specify*)	7

.....

6. *SEQUENCE GUIDE*

If born in Australia (Go to Q.8)	1
Otherwise (Go to Q.7)	2

7. **In what year did you arrive in Australia?**

Year

8. **How many people live in this household?**

Number (*specify*)

9. **How many (of the people living in this household) are aged 15 years or under?**

Number (*specify*)

10. At what age did you leave school or are you still attending?

Never went to school *(Go to Q.13)*	1
Under 14 years	2
14 years	3
15 years	4
16 years	5
17 years	6
18 years or more	7
Still attending *(Go to Q. 13)*	8

11. Since leaving school have you obtained a trade qualification, certificate, diploma, degree or any other qualification?

Yes	1
No *(Go to Q.13)*	2

12. *(show Prompt card 1).*
Which of these groups best describes the highest qualification you have obtained?

1. Bachelor degree or higher	1
2. Trade/apprenticeship	2
3. Certificate/Diploma	3
4. Other	4

13. *SEQUENCE GUIDE*

If aged 65 years or more (Go to Q.25)	1
Otherwise (Go to Q.14)	2

14. Are you currently taking any course of study at a Technical College, College of Advanced Education, University or other educational institution?

Yes	1
No *(Go to Q.16)*	2

15. Are you studying full-time or part-time?

Full-time	1
Part-time	2
Correspondence	3

16. Do you currently work in any job, business or farm?

Yes	1
No *(Go to Q.23)*	2
Permanently unable to work *(Go to Q.25)*	3

17. Do you currently have more than one job?

Yes	1
No *(Go to Q.19)*	2

18. I would like to ask you about your <u>main</u> job, that is the job in which you usually work the most hours.

19. What kind of work do you do?

.....

.....

.....

20. Do you work

For an employer for wages or salary? ☐ 1

In your own business -

with employees? ☐ 2

with no employees? ☐ 3

Without pay in a family business? ☐ 4

What are your working arrangements?

Payment in kind ☐ 5

Unpaid voluntary work *(Go to Q.23)* ☐ 6

21. Including any paid or unpaid overtime, how many hours a week do you usually work in your main job?

Hours (*specify*) ☐☐

22. *Go to Q.25*

23. At any time during the last 4 weeks have you been looking for full-time work?

Yes *(Go to Q.25)* ☐ 1

No ☐ 2

24. Have you been looking for part-time work at any time during the last 4 weeks?

Yes ☐ 1

No ☐ 2

HEIGHT AND WEIGHT

25. How tall are you without shoes?

Centimetres ☐☐☐ cm

or Feet / inches ☐☐ ☐☐

Don't Know ☐ 999

26. How much do you weigh without clothes and shoes?

Kilograms ☐☐☐ Kg

or Stone / pounds ☐☐ ☐☐

Don't know ☐ 999

OPINIONS ON EXERCISE

27. *(show Prompt card 2).*
We would like to find out about your feelings and opinions concerning exercise. Which number best describes your rating of the following statements?

	Strongly disagree	Disagree	No Opinion	Agree	Strongly agree
I would be healthier if I exercised more regularly	☐1	☐2	☐3	☐4	☐5
I would probably be sore and uncomfortable if I exercised more regularly	☐1	☐2	☐3	☐4	☐5
If I exercised more regularly, my family and friends would get to spend less time with me	☐1	☐2	☐3	☐4	☐5
I would feel better about myself if I exercised more regularly	☐1	☐2	☐3	☐4	☐5
Other people would respect me more if I exercised more regularly	☐1	☐2	☐3	☐4	☐5
I would feel that I was wasting my time if I exercised more regularly	☐1	☐2	☐3	☐4	☐5

28. *(show Prompt card 3).*
We would also like to find out how confident you are that you could exercise in each of the following situations.
Which number best describes your confidence rating for these situations?

	Not at all confident	Slightly confident	Moderately confident	Confident	Very confident
I could exercise when I am tired	☐1	☐2	☐3	☐4	☐5
I could exercise when I am in a bad mood	☐1	☐2	☐3	☐4	☐5
I could exercise when I feel I don't have time	☐1	☐2	☐3	☐4	☐5
I could exercise when I am on holidays	☐1	☐2	☐3	☐4	☐5
I could exercise when it is raining	☐1	☐2	☐3	☐4	☐5
I could exercise even when it takes a lot of effort	☐1	☐2	☐3	☐4	☐5

29. *(show Prompt card 4).*
Considering your own lifestyle, how likely is it that you will get heart disease?

Not at all	1
Slightly	2
Moderately	3
Very	4
Already have heart disease	5

ACTIVITY

30. **The next few questions are concerned with your average physical activity over the last 6 months.**

On average how many times a week do you exercise vigorously for a period of at least 20 minutes? 'Vigorously' means exercise which makes you breathe harder or puff and pant, and includes such activities as swimming, tennis, netball, athletics and running?

None at all *(Go to Q.32)*	1
1 or 2 times a week *(Go to Q.32)*	2
3 or more times a week	3

31. **For how long have you been doing this level of activity?**

Less than 3 months	1
More than 3 months but less than 1 year	2
More than 1 year but less than 5 years	3
5 years or more	4

32. **On average how many times a week do you engage in less vigorous exercise for recreation, sport or health and fitness purposes, which did not make you breathe harder or puff and pant. This includes activities such as bike riding, dancing, etc?**

None at all	1
1 or 2 times a week	2
3 or more times a week	3

33. **On average how many times a week do you walk for recreation or exercise?**

None at all	1
1 or 2 times a week	2
3 or more times a week	3

34. **The next few questions are about the past 2 weeks only.**

In the past 2 weeks, did you engage in vigorous exercise - exercise which made you breathe harder or puff and pant? (e.g. vigorous sports such as football, netball, tennis, squash, athletics, jogging or running, keep-fit exercises, vigorous swimming, etc.)

Yes	1
No *(Go to Q.37)*	2

35. **How many sessions of vigorous exercise did you have over the 2 week period?**

36. Please estimate the Total Time spent exercising vigorously during the past 2 weeks.

hours : minutes

37. In the past 2 weeks, did you engage in less vigorous exercise for recreation, sport or health-fitness purposes which did not make you breathe harder or puff and pant?

Yes 1

No *(Go to Q.39)* 2

38. How many sessions of less vigorous exercise did you have over the 2 week period?

39. In the past 2 weeks, did you walk for recreation or exercise?

Yes 1

No *(Go to Q.41)* 2

40. How many times did you walk for recreation or exercise?

41. VIGOROUS TASKS AT WORK AND AROUND THE HOUSE
(Paid & unpaid work)

In the past 2 weeks, did you engage in vigorous activity, apart from exercise, which made you breathe harder or puff and pant? (e.g. carrying loads, heavy gardening, chopping wood, labouring ---at home, during employment or anywhere else.)

Yes 1

No *(Go to Q.44)* 2

42. How many sessions of these types of vigorous activity did you have over the 2 week period?

Number(*specify*)

43. Please estimate the Total Time spent in these types of vigorous activity during the past 2 weeks.

hours : minutes

ATTITUDES/BARRIERS/KNOWLEDGE

44. *(show Prompt card 5).*
Compared to others of your age and sex, would say you are:

- Much less active ☐ 1
- Somewhat less active ☐ 2
- About as active ☐ 3
- Somewhat more active ☐ 4
- Much more active ☐ 5

45. *(show Prompt card 6).*
Compared to others of your age and sex, would you say you are:

- Much fitter ☐ 1
- A little fitter ☐ 2
- About the same ☐ 3
- Somewhat less fit ☐ 4
- Much less fit ☐ 5

46. *(show Prompt card 7).*
Which line best describes how much you <u>now</u> exercise and how much you <u>intend</u> to exercise in the <u>future</u>?

- Do not exercise and do not intend to start ☐ 1
- Do not exercise but am thinking of starting ☐ 2
- Exercise occasionally and am not thinking of doing more ☐ 3
- Exercise occasionally but am thinking of doing more ☐ 4
- Exercise regularly and intend to continue ☐ 5
- Some other (*specify*) ☐ 6

47a. *(show Prompt card 8).*
Which of these reasons for not exercising (more) applies to you?

- I haven't got time (1) ☐
- My health is not good enough (2) ☐
- There's no-one to do it with (3) ☐
- I can't afford it (4) ☐
- I'm too old (5) ☐
- I have an injury or disability that stops me (6) ☐
- I'm too shy or embarrassed (7) ☐
- I'm not the sporty type (8) ☐
- There's no suitable facilities nearby (9) ☐
- I need to rest and relax in my spare time (10) ☐
- I've got young children to look after (11) ☐
- I'm too lazy/not motivated/ can't get started (12) ☐
- I might get injured or damage my health (13) ☐
- I don't enjoy physical activity (14) ☐
- I haven't got the right clothes or equipment (15) ☐
- I'd never keep it up (16) ☐
- I'm too fat (17) ☐
- I haven't got the energy (18) ☐
- OTHER (*specify*) (19) ☐

47b. Which is the main reason for you not exercising more? *(Use codes above).*

Main reason ☐☐

48. *(show Prompt card 9).*
If you wanted to exercise more or take up exercise, what type of exercise would you prefer?

Jogging or running	☐ 1
Cycling	☐ 1
Walking	☐ 1
Swimming	☐ 1
An aerobics or exercise class	☐ 1
Training with weights and equipment in a gymnasium	☐ 1
Organized team sports	☐ 1
Raquet sports	☐ 1
Other *(specify)*	☐ 1

.....

49. *(show Prompt card 10).*
If you wanted help to exercise more or take up exercise, what type of help would you prefer?

Advice from a doctor or other health professional	☐ 1
A group of other people to exercise with	☐ 1
Advice over the telephone	☐ 1
A video tape on exercise	☐ 1
A book on how to exercise	☐ 1
An exercise "kit" with pamphlets and practical tips	☐ 1
A course sent through the mail	☐ 1
Other *(specify)*	

.....

No form of assistance ☐ 2

50. *SEQUENCE GUIDE*

If female aged 50 years or less (Go to Q.51) ☐ 1

Otherwise (Go to Q.52) ☐ 2

51. The next question is for women 50 years and under only.

Have you been taking the oral contraceptive pill for at least the last 3 months?

Yes ☐ 1

No ☐ 2

SMOKING

52. I would now like to ask you some questions about smoking.

Do you currently smoke?

Yes ☐ 1

No *(Go to Q.55)* ☐ 2

53. How many cigarettes do you usually smoke a day?

Number ☐☐

54. *Go to Q.57*

55. Have you ever smoked cigarettes regularly?

Yes ☐ 1

No *(Go to Q.57)* ☐ 2

56. How old were you when you last gave up smoking cigarettes?

Age ☐☐

ALCOHOL

57. How often do you usually drink alcohol?

Don't drink alcohol *(Go to Q.59)* ☐ 1

Less than once a week ☐ 2

On 1 or 2 days a week ☐ 3

On 3 or 4 days a week ☐ 4

On 5 or 6 days a week ☐ 5

Every day ☐ 6

58. On a day when you drink alcohol, how many drinks do you usually have?

1 or 2 drinks ☐ 1

3 or 4 drinks ☐ 2

5 to 8 drinks ☐ 3

9 to 12 drinks ☐ 4

13 to 20 drinks ☐ 5

More than 20 drinks ☐ 6

ACTIVITY

59. The next few questions are to obtain details of your physical activities in the last two weeks.

QUESTIONS	ACTIVITIES		
	1st *(specify)*	2nd (specify)	3rd (specify)
59a. *(show Prompt card 11)* **In the last 2 weeks, which, if any, of these activities have you done?**	.... □□	.... □□	.... □□
59b. In the last 2 weeks, about how many times altogether have you played/been/done ...*(say each activity)*?	Number *(specify)* □□	Number *(specify)* □□	Number *(specify)* □□
59c. In the last 2 weeks, how much time, on average, did you spend ...*(say each activity)*?	Amount *(specify)* □□ : □□ hours minutes	Amount *(specify)* □□ : □□ hours minutes	Amount *(specify)* □□ : □□ hours minutes
59d. *(show prompt card 12)* **When you play/go/do ...** *(say each activity)*, **would you say you are usually** **1. Very vigorous** **2. Fairly vigorous** **3. Not very vigorous** **4. Not at all vigorous** *(Circle corresponding number)*	Vigorous *(circle)* 1 2 3 4	Vigorous *(circle)* 1 2 3 4	Vigorous *(circle)* 1 2 3 4

ACTIVITIES (continued)

4th *(specify)*	**5th** *(specify)*	**Other** (specify)	**Other** (specify)
....	....	....	....
Number *(specify)*	**Number** *(specify)*	**Number** *(specify)*	**Number** *(specify)*
Amount *(specify)* hours : minutes	**Amount** *(specify)* hours : minutes	**Amount** *(specify)* hours : minutes	**Amount** *(specify)* hours : minutes
Vigorous *(circle)* 1 2 3 4	**Vigorous** *(circle)* 1 2 3 4	**Vigorous** *(circle)* 1 2 3 4	**Vigorous** *(circle)* 1 2 3 4

60. For all of the above exercises, in the past 2 weeks, how many times have you done these activities at

A sporting club	
A health or fitness centre	
A recreation centre	
A local hall	
With friends	
Alone	

DIET/NUTRITION

61. *(show Prompt card 13).*
How often do you eat the following foods?
(Circle the corresponding number).

	Never or few times a year	About once a month	Several times a month	Once a week	Few times a week	Once a day	Few times a day
1. Fresh fruits and vegetables	1	2	3	4	5	6	7
2. Frozen meals (eg McCain's meals)	1	2	3	4	5	6	7
3. Pastries (pie, cake, biscuits, sweet rolls, donuts)	1	2	3	4	5	6	7
4. Poultry	1	2	3	4	5	6	7
5. Fish and seafood	1	2	3	4	5	6	7
6. Eggs	1	2	3	4	5	6	7
7. Red meats (beef, pork, lamb, lunch meats)	1	2	3	4	5	6	7
8. Salty snacks (chips, peanuts, corn chips)	1	2	3	4	5	6	7
9. Add table salt to your cooked food	1	2	3	4	5	6	7
10. Whole milk, ice cream, hard cheese, butter	1	2	3	4	5	6	7
11. Whole grains and cereals	1	2	3	4	5	6	7
12. Take aways or at fast food restaurants	1	2	3	4	5	6	7
13. The fat on meat	1	2	3	4	5	6	7

Below is a list of words that describe feelings people have. Please read each one carefully. Then for each, circle the number which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

The Numbers refer to these phrases:
1 = Not at all
2 = A little
3 = Moderately
4 = Quite a bit
5 = Extremely

		Not at all	A little	Moderately	Quite a bit	Extremely
1.	Tense	1	2	3	4	5
2.	Angry	1	2	3	4	5
3.	Worn	1	2	3	4	5
4.	Unhappy	1	2	3	4	5
5.	Lively	1	2	3	4	5
6.	Sorry for things done	1	2	3	4	5
7.	Shaky	1	2	3	4	5
8.	Listless	1	2	3	4	5
9.	Peeved	1	2	3	4	5
10.	Sad	1	2	3	4	5
11.	Active	1	2	3	4	5
12.	On edge	1	2	3	4	5
13.	Grouchy	1	2	3	4	5
14.	Blue	1	2	3	4	5
15.	Energetic	1	2	3	4	5
16.	Panicky	1	2	3	4	5
17.	Hopeless	1	2	3	4	5
18.	Relaxed	1	2	3	4	5
19.	Unworthy	1	2	3	4	5
20.	Spiteful	1	2	3	4	5
21.	Uneasy	1	2	3	4	5
22.	Restless	1	2	3	4	5
23.	Fatigued	1	2	3	4	5

		Not at all	A little	Moderately	Quite a bit	Extremely
24.	Annoyed	1	2	3	4	5
25.	Discouraged	1	2	3	4	5
26.	Resentful	1	2	3	4	5
27.	Nervous	1	2	3	4	5
28.	Lonely	1	2	3	4	5
29.	Miserable	1	2	3	4	5
30.	Cheerful	1	2	3	4	5
31.	Bitter	1	2	3	4	5
32.	Exhausted	1	2	3	4	5
33.	Anxious	1	2	3	4	5
34.	Ready to fight	1	2	3	4	5
35.	Gloomy	1	2	3	4	5
36.	Desperate	1	2	3	4	5
37.	Sluggish	1	2	3	4	5
38.	Rebellious	1	2	3	4	5
39.	Helpless	1	2	3	4	5
40.	Weary	1	2	3	4	5
41.	Alert	1	2	3	4	5
42.	Deceived	1	2	3	4	5
43.	Furious	1	2	3	4	5
44.	Full of pep	1	2	3	4	5
45.	Bad-tempered	1	2	3	4	5
46.	Worthless	1	2	3	4	5
47.	Carefree	1	2	3	4	5
48.	Terrified	1	2	3	4	5
49.	Guilty	1	2	3	4	5
50.	Vigorous	1	2	3	4	5
51.	Uncertain about things	1	2	3	4	5
52.	Bushed	1	2	3	4	5

APPENDIX C:

Active Recreation on Tertiary Education Campuses (ARTEC) Questionnaire

Active Recreation on Tertiary Education Campuses (ARTEC) Project

Student Physical Activity Questionnaire

This survey is to gather information on the physical activity and exercise habits of tertiary education students, and on some related attitudes and beliefs. It is the first stage of a project (Active Recreation on Tertiary Education Campuses) funded by the Commonwealth Department of Human Services and Health as part of the current Implementation Strategy for National Health Goals and Targets for Cardiovascular Disease.

The Chief Investigator for this project is Neville Owen, Professor of Human Movement Science at Deakin University.

The surveys are completely anonymous and confidential. The findings will be reported as averages and percentages. Individual responses will not be identified or reported. Completion of the survey is voluntary.

A sample of 1000 students from randomly-selected classes at Deakin Burwood and Victoria University of Technology Footscray Campus, and 500 students from Wangaratta TAFE and Loddon Campaspe College Bendigo Campus are being surveyed.

If 75% of the class returns the survey a lottery for a cash prize of $20.00 will be drawn for all students who have returned their survey. To ensure that only students who have completed the survey are eligible for the prize, you will be given a raffle ticket for the lottery when you hand in your completed survey.

Students will be informed of the survey findings on the campuses through a report on the findings in the student newspaper and newsletter.

For further information please contact Jenny Veitch on 03 9244-6980.

Thank you for taking the time to help us with this important study.

DEMOGRAPHICS

1. **Which Campus do you attend?** *(please circle ONE response)*

   1. Deakin University, Burwood Campus
   2. Wangaratta TAFE
   3. Victoria University of Technology, Footscray Campus
   4. Loddon Campaspe College, Bendigo

2. **What is your sex?** *(please circle appropriate response)*

   1. Male
   2. Female

3. **What is your age?**

   ☐☐ Years

4. **How tall are you without shoes?** *(if unsure please state best guess)*

   ☐☐☐ cm
   or
   ☐☐ ☐☐ feet / inches

5. **How much do you weigh without clothes and shoes?**
   (if unsure please state best guess)

   ☐☐☐ kg
   or
   ☐☐ ☐☐ stone / pounds

6. **What is your student status?** *(please circle ONE response)*

   1. Part-time undergraduate
   2. Full-time undergraduate
   3. Part-time graduate
   4. Full-time graduate
   5. Other (please specify)_____

7. **What is your mode of study?** *(please circle ONE response)*

   1. On campus
   2. Off campus
   3. Both on and off campus

8. **What is your current year of study?** *(please circle ONE response - if studying part time, please state your full time equivalent year)*

1. 1st year
2. 2nd year
3. 3rd or final year
4. 4th or final year
5. Graduate

9. **What is your employment status?** *(please circle ONE response)*

1. Work full-time
2. Work part-time
3. Not employed
4. Homeworker
5. Other (please specify) _____

10. **Do you need to limit your physical activity because of an illness, injury or handicap?** *(please circle ONE response)*

1. No
2. Yes, because of temporary illness
3. Yes, because of long-term illness
4. Yes, because of temporary injury
5. Yes, because of long-term injury or handicap

YOUR PHYSICAL ACTIVITY HISTORY

11. **On average which of the following statements best describes your level of physical activity at University / TAFE compared with your level of physical activity during secondary school?** *(please circle ONE response)*

1. More active at University / TAFE than at Secondary School
2. Less active at University / TAFE than at Secondary School
3. Activity levels are very similar

Physical Activity Over The Last 6 Months

The next few questions are concerned with your average level of physical activity over the last 6 months.

12. **On average how many times a week do you WALK for recreation or exercise?**

☐☐ times per week (if 'zero' go to Q.14)

13. **On average how much time each week would you spend WALKING for recreation or exercise?**

☐☐ hours ☐☐ minutes per week

14. **On average how many times a week do you exercise VIGOROUSLY for a period of at least 20 minutes? "Vigorously" means exercise which makes you breathe harder or puff and pant, and includes such activities as swimming, tennis, team sports, athletics and running.**

☐☐ times per week (if 'zero' go to Q.16)

15. **On average how much time each week would you spend doing VIGOROUS exercise?**

☐☐ hours ☐☐ minutes per week

16. **On average how many times a week do you engage in MODERATE exercise for recreation, sport or health and fitness purposes, which did not make you breathe harder or puff and pant? This includes activities such as bike riding, dancing etc.**

☐☐ times per week (if 'zero' go to Q.18)

17. **On average how much time each week would you spend doing MODERATE exercise?**

☐☐ hours ☐☐ minutes per week

Physical Activity Over The Last 2 Weeks

The next few questions are about the past 2 weeks only.

18. **In the past 2 weeks, how many times did you walk to get to or from places or as a means of transport for at least 10 minutes consecutively?**

☐☐ times per week (if 'zero' go to Q.21)

19. **Please estimate the total time that you spent walking in this way in the past 2 weeks.**

☐☐ hours ☐☐ minutes

20. **When you walked this way, did you usually walk?**
(please circle ONE response)

1. Not at all vigorously
2. A little vigorously
3. Moderately vigorously
4. Very vigorously

21. **In the past 2 weeks, how many times did you walk for recreation, health or fitness?**

☐☐ times per week (if 'zero' go to Q.24)

22. **Please estimate the total time that you spent walking in this way in the past 2 weeks.**

☐☐ hours ☐☐ minutes

23. **When you walked this way, did you usually walk?**
(please circle ONE response)

1. Not at all vigorously
2. A little vigorously
3. Moderately vigorously
4. Very vigorously

24. **In the past 2 weeks, did you engage in VIGOROUS exercise - exercise which made you breathe harder or puff and pant? (eg. vigorous sports such as football, netball, tennis, squash, athletics, jogging or running, keep-fit exercises, vigorous swimming etc.)** *(please circle ONE response)*

1. Yes
2. No (if 'no' go to Q.27)

25. **How many sessions of VIGOROUS exercise did you have over the 2 week period?**

☐☐

26. **Please estimate the total time spent exercising VIGOROUSLY during the past 2 weeks?**

☐☐ hours ☐☐ minutes

27. **In the past 2 weeks, did you engage in MODERATE exercise for recreation, sport or health and fitness purposes which did not make you breathe harder or puff and pant?**

1. Yes
2. No (if 'no' go to Q.30)

28. **How many sessions of MODERATE exercise did you have over the 2 week period?**

☐☐

29. **Please estimate the total time spent exercising MODERATELY during the past 2 weeks?**

☐☐ hours ☐☐ minutes

Physical Activity Over The Past 2 Weeks <u>On Campus</u>

30. **Have you done any of the following activities in the PAST TWO WEEKS <u>ON CAMPUS</u>? Please indicate how many times you did each activity and how many minutes you did the activity EACH TIME.**

a.	Aerobics	_____ Times	_____ Minutes each time
b.	Athletics	_____ Times	_____ Minutes each time
c.	Badminton	_____ Times	_____ Minutes each time
d.	Basketball	_____ Times	_____ Minutes each time
e.	Circuit training	_____ Times	_____ Minutes each time
f.	Cricket	_____ Times	_____ Minutes each time
g.	Cycling	_____ Times	_____ Minutes each time
h.	Football	_____ Times	_____ Minutes each time
i.	Gymnastics	_____ Times	_____ Minutes each time
j.	Jogging	_____ Times	_____ Minutes each time
k.	Martial arts	_____ Times	_____ Minutes each time
l.	Netball	_____ Times	_____ Minutes each time
m.	Other dancing	_____ Times	_____ Minutes each time
n.	Popular / disco dancing	_____ Times	_____ Minutes each time
o.	Softball	_____ Times	_____ Minutes each time
p.	Squash	_____ Times	_____ Minutes each time
q.	Swimming	_____ Times	_____ Minutes each time
r.	Table Tennis	_____ Times	_____ Minutes each time
s.	Tennis	_____ Times	_____ Minutes each time
t.	Volleyball	_____ Times	_____ Minutes each time
u.	Walking	_____ Times	_____ Minutes each time
v.	Weight training	_____ Times	_____ Minutes each time
w.	Yoga / Meditation	_____ Times	_____ Minutes each time
x.	NONE OF THE ABOVE (please tick)	☐	
	Others (please specify)		
y.	_____	_____ Times	_____ Minutes each time
z.	_____	_____ Times	_____ Minutes each time

31. Compared to others of your age and sex, would you say you are? *(please circle ONE response)*

1. Much less active
2. Somewhat less active
3. About as active
4. Somewhat more active
5. Much more active

32. The following statements are about the amount of physical activity you intend to do in the near future. Compared to what you have been doing in the last 2 weeks, choose ONE statement which best describes how you feel at present.

1. I intend to become more active sometime over the next six months
2. I intend to become more active over the next month
3. I do not intend to be more active in the next six months

33. Are you a member of a health club or gym? *(please circle ONE response)*

1. Yes
2. No

ON CAMPUS FACILITIES

34. Here is a list of physical activity facilities available on some tertiary education campuses. Please tick if these facilities are available on your campus. If these facilities are available, please indicate number of times you have used them in the last 6 months:

		On campus (please tick)	If facility is on campus what is the average number of times you would use it each month
a.	Aerobics studio	☐	_____Times per month
b.	Basketball courts	☐	_____Times per month
c.	Bike lanes or trails	☐	_____Times per month
d.	Dance studio	☐	_____Times per month
e.	Exercise machines (eg. bike, stepper, treadmill)	☐	_____Times per month
f.	Free weights or resistance equipment	☐	_____Times per month
g.	Martial arts studio	☐	_____Times per month
h.	Netball courts	☐	_____Times per month

i.	Playing field (soccer, softball etc.)	☐	_____Times per month
j.	Running track	☐	_____Times per month
k.	Squash courts	☐	_____Times per month
l.	Swimming pool	☐	_____Times per month
m.	Tennis courts	☐	_____Times per month
	Other (please specify)		
n.	_____	☐	_____Times per month
o.	_____	☐	_____Times per month
p.	_____	☐	_____Times per month

DOING MORE EXERCISE

35. If you were to increase your exercise which of the following activities would you like to start or do more of ON CAMPUS?
(please tick all that apply)

a.	Aerobics	☐
b.	Athletics	☐
c.	Badminton	☐
d.	Basketball	☐
e.	Circuit training	☐
f.	Cricket	☐
g.	Cycling	☐
h.	Disco dancing	☐
i.	Ethnic dancing	☐
j.	Football	☐
k.	Jogging	☐
l.	Martial arts	☐
m.	Other dancing	☐
n.	Squash	☐
o.	Swimming	☐

p. Table Tennis ☐

q. Tennis ☐

r. Volleyball ☐

s. Walking ☐

t. Weight training ☐

u. Yoga / Meditation ☐

Other (please specify)

v. _____ ☐

w. _____ ☐

x. _____ ☐

y. NOT INTERESTED IN ANY EXERCISE ON CAMPUS ☐

36. **Please rate the amount of enjoyment you get, or THINK you may get, from participating in EACH of the following activities (please circle the appropriate number). Also tick the box if you have done the activity at least once in the last 6 months.**

		No enjoyment		Some enjoyment		A lot of enjoyment	Did in last 6 months
a.	Aerobics	1	2	3	4	5	☐
b.	Badminton	1	2	3	4	5	☐
c.	Basketball	1	2	3	4	5	☐
d.	Circuit training	1	2	3	4	5	☐
e.	Cricket	1	2	3	4	5	☐
f.	Cycling	1	2	3	4	5	☐
g.	Disco dancing	1	2	3	4	5	☐
h.	Ethnic dancing	1	2	3	4	5	☐
i.	Football	1	2	3	4	5	☐
j.	Jogging	1	2	3	4	5	☐
k.	Martial arts	1	2	3	4	5	☐
l.	Netball	1	2	3	4	5	☐
m.	Other dancing	1	2	3	4	5	☐

n.	Squash	1	2	3	4	5	☐
o.	Swimming	1	2	3	4	5	☐
p.	Table Tennis	1	2	3	4	5	☐
q.	Tennis	1	2	3	4	5	☐
r.	Volleyball	1	2	3	4	5	☐
s.	Walking	1	2	3	4	5	☐
t.	Weight training	1	2	3	4	5	☐
u.	Yoga / Meditation	1	2	3	4	5	☐
	Other (please specify)						
v.	_____	1	2	3	4	5	☐
w.	_____	1	2	3	4	5	☐
x.	_____	1	2	3	4	5	☐

37. If you wanted help to exercise more or take up exercise, what type of help would you prefer? *(please tick all that apply)*

a.	A course on campus for academic credit	☐
b.	A course on campus not for academic credit	☐
c.	An exercise kit with pamphlets and practical tips	☐
d.	Advice from a trainer or coach	☐
e.	Advice from student health services or a doctor	☐
f.	A book on how to exercise	☐
g.	A group of people to exercise with on campus	☐
h.	A course sent through the mail	☐
i.	More facilities on campus	☐
j.	A video tape on exercise	☐
k.	Advice over the telephone	☐
l.	No form of assistance	☐
	Other (please specify)	
m.	_____	☐
n.	_____	☐

38. What would motivate you to begin or continue a routine of regular physical activity? Rate EACH ONE of the following as not motivating at all (1) to extremely motivating (5) *(please circle the most appropriate number)*

		Not motivating at all		Somewhat motivating		Extremely motivating
a.	Weight loss	1	2	3	4	5
b.	Improved muscle tone	1	2	3	4	5
c.	Muscle gain	1	2	3	4	5
d.	Increased energy level	1	2	3	4	5
e.	Organised competition (team sport)	1	2	3	4	5
f.	To feel good about myself	1	2	3	4	5
g.	To look better	1	2	3	4	5
h.	To socialise or meet people	1	2	3	4	5
i.	To decrease stress levels	1	2	3	4	5
j.	Enjoyment / personal satisfaction	1	2	3	4	5
k.	Ability to exercise in or close to home	1	2	3	4	5

SOCIAL SUPPORT AND CONFIDENCE

39. For each item, please indicate whether during the past three months your family (or members of your household) or friends: *(please circle the number that best describes you)*

			Never	Rarely	Some times	Often	Very often
a.	Exercised with you	Family	0	1	2	3	4
		Friends	0	1	2	3	4
b.	Offered to exercise with you	Family	0	1	2	3	4
		Friends	0	1	2	3	4
c.	Gave you encouragement to exercise	Family	0	1	2	3	4
		Friends	0	1	2	3	4

40. For each item, please indicate how sure you are that you would exercise in that situation *(circle ONE number for each item)*

	I'm sure I cannot		Maybe I can		I'm sure I can
a. I would exercise even though I am feeling sad or highly stressed	1	2	3	4	5
b. I would stick to my exercise program even when family or social life takes a lot of my time	1	2	3	4	5
c. I will set aside time for regular exercise	1	2	3	4	5

41. For each item, please circle the number that best describes you *(circle ONE number for each item)*

	Always	Usually	Often	Sometimes	Rarely	Never
a. I eat sweets and carbohydrates without feeling guilty	1	2	3	4	5	6
b. I think about dieting	1	2	3	4	5	6
c. I feel extremely guilty after overeating	1	2	3	4	5	6
d. I am terrified of gaining weight	1	2	3	4	5	6
e. I exaggerate or magnify the importance of weight	1	2	3	4	5	6
f. I am preoccupied with the desire to be thinner	1	2	3	4	5	6
g. If I gain a kilogram, I worry that I will keep gaining	1	2	3	4	5	6

42. Discretionary time is when you have the time to choose what you would LIKE to do, as opposed to working, studying, home duties. Please estimate how much discretionary time on AVERAGE you have EACH weekday or weekend day.

a. AVERAGE time per weekday _____Hours

b. AVERAGE time per weekend day _____Hours

NON-PHYSICAL FREE TIME ACTIVITIES DURING THE LAST WEEK

43. We are interested how you spend your free time when you are not working or studying. Below is a list of things you might do. On an average or typical day, ESTIMATE how many hours you would spend doing each of these activities. Please include things you did on and off campus separately for weekdays and weekend days.

		Average or typical weekday (hours)	Average or typical weekend day (hours)
a.	Hobbies (eg. arts/crafts, work on car, play musical instruments)	_____	_____
b.	Read (books, papers, magazines)	_____	_____
c.	Sit and socialise with friends and family (at home, pubs, restaurants)	_____	_____
d.	Sit or lie and listen to music/radio	_____	_____
e.	Talk on the telephone	_____	_____
f.	Go shopping (personal NOT grocery)	_____	_____
g.	Watch TV / videos	_____	_____
h.	Play the computer/video games	_____	_____
i.	Computer use (NOT including games)	_____	_____
j.	Travel (eg. car, public transport NOT including cycling, walking)	_____	_____
k.	Relaxing, thinking, resting (not including sleep)	_____	_____

44. Please rate the amount of enjoyment you get, or THINK you may get, from participating in EACH of the following activities (please circle appropriate number). Also tick the box if you have done the activity at least once in the last 6 months.

		No enjoyment		Some enjoyment		A lot of enjoyment	Did in last 6 months
a.	Hobbies (eg. arts/crafts, work on car, play musical instruments)	1	2	3	4	5	☐
b.	Reading (books, papers, magazines)	1	2	3	4	5	☐
c.	Sitting and socialising with friends and family (at home, pubs, restaurants)	1	2	3	4	5	☐
d.	Sitting and listening to music / radio	1	2	3	4	5	☐
e.	Going to nightclubs (time NOT dancing)	1	2	3	4	5	☐
f.	Talking on the telephone	1	2	3	4	5	☐
g.	Going shopping (personal NOT grocery)	1	2	3	4	5	☐
h.	Watching TV / videos	1	2	3	4	5	☐
i.	Playing the computer/video games	1	2	3	4	5	☐
j.	Spectating at live sporting events (eg. football)	1	2	3	4	5	☐
k.	Going to arts/theatre events (eg. concerts, plays, dance)	1	2	3	4	5	☐
l.	Going to the movies	1	2	3	4	5	☐
m.	Computer use (NOT including games)	1	2	3	4	5	☐
n.	Going for a drive	1	2	3	4	5	☐
o.	Relaxing, thinking, resting (not including sleep)	1	2	3	4	5	☐

SMOKING AND DRINKING

45. Do you currently smoke? *(please circle ONE response)*

1. Yes
2. No (if 'no' go to Q.47)

46 How many cigarettes do you usually smoke a day?

☐☐

47. How often do you usually drink alcohol?

☐☐ days per week

48. On a day when you drink alcohol, how many drinks do you usually have?

☐☐ number of drinks

APPENDIX D:

Active Australia Baseline Questionnaire

Hunter Valley RESEARCH Foundation

1998 Physical Activity Survey

Victoria

Coding manual and questionnaire

Prepared for the

Victorian Department of Human Services

By

The Hunter Valley Research Foundation
A.C.N. 000 185 393
Downie Street, Maryville, NSW 2293
Telephone: (049) 69 4566
Facsimile: (049) 61 4981

March 1998

We would like to ask you about the physical activity you did in the last week:

Question: **Q8. IN THE LAST WEEK how many times have you walked continuously, for at least 10 minutes, for recreation/exercise or to get to or from places?**
Field name: Q8
Field type: Numeric
Content: Number of times
99 = Don't know - use as an absolute last resort

Skip: If Q8 = 0, go to Q7D

Question: **Q9. In total, how much time do you estimate you spent walking in this way IN THE LAST WEEK?** [INTERVIEWER: THIS IS `CONTINUOUS' WALKING]

Field name:	Q9M	**Field name:**	Q9H
Field type:	Numeric	**Field type:**	Numeric
Content:	Minutes	**Content:**	Hours
	77 = Don't know		777 = Don't know

Question: **Q7d. Can you tell me on how many days OVER THE PAST WEEK you climbed AT LEAST ONE flight of stairs?** [MINIMUM FLIGHT = 10 STEPS - SAME FOR LADDERS]
Field name: Q7D
Field type: Numeric
Content: Number of days, in last the week, on which at least one flight of stairs was climbed
98 = Don't know
99 = Refused

Skip: If Q7D = 0 OR Q7D > 7, go to Q10

Question: **Q7n. On those days, how MANY flights of stairs did you climb ON AVERAGE?** [MINIMUM FLIGHT = 10 STEPS - SAME FOR LADDERS]
Field name: Q7N
Field type: Numeric
Content: Number of flights climbed each day, on average.
98 = Don't know
99 = Refused]

The next question does not include gardening.

Question: **Q10. IN THE LAST WEEK how many times did you do any vigorous household chores which made you breathe harder or puff and pant?**
Field name: Q10
Field type: Numeric
Content: Number of times, in the last week, in which vigorous household chores were done.

99 = Don't know - use as an absolute last resort.

Skip: If Q10=0, go to Q12

Question: **Q11. How long would you estimate that you spent doing these vigorous household chores IN THE LAST WEEK?**

Field name:	Q11M		**Field name:**	Q11H	
Field type:	Numeric		**Field type:**	Numeric	
Content:	Minutes		**Content:**	Hours	
	77	= Don't know		777	= Don't know

Question: **Q12. IN THE LAST WEEK how many times did you do any vigorous gardening or heavy work around the yard which made you breathe harder or puff and pant?**

Field name: Q12
Field type: Numeric
Content: Number of times, in the last week, spent doing vigorous activity in the yard
99 = Don't know - use as an absolute last resort

Skip: If Q12=0, go to Q14

Question: **Q13. IN THE LAST WEEK how long would you estimate that you spent doing vigorous gardening or heavy work around the yard?**

Field name:	Q13M		**Field name:**	Q13H	
Field type:	Numeric		**Field type:**	Numeric	
Content:	Minutes		**Content:**	Hours	
	77	= Don't know		777	= Don' know

The next question excludes household chores or gardening:

Question: **Q14. IN THE LAST WEEK, how many times did you do any vigorous physical activity which made you breathe harder or puff and pant?** (eg. tennis, jogging, cycling, keep fit exercises)

Field name: Q14
Field type: Numeric
Content: Number of times doing vigorous physical activity
99 = Don't know - use only as an absolute last resort

Skip: If Q14=0, go to Q16

Question: **Q15. How long would you estimate that you spent doing this vigorous physical activity IN THE LAST WEEK?**

Field name:	Q15M		**Field name:**	Q15H
Field type:	Numeric		**Field type:**	Numeric
Content:	Minutes		**Content:**	Hours

77 = Don't know 777 = Don't know

This question excludes household chores or gardening:

Question: **Q16. IN THE LAST WEEK how many times did you do any other more moderate physical activity that you haven't already mentioned?** (eg. lawn bowls, golf, gentle swimming, etc)
Field name: Q16
Field type: Numeric
Content: Number of times doing moderate activities not already mentioned
99 = Don't know - use only as an absolute last resort

Skip: If Q16=0, go to QN9M

Question: **Q17. What do you estimate was the total time that you spent doing these activities IN THE LAST WEEK?**

Field name:	Q17M	**Field name:**	Q17H
Field type:	Numeric	**Field type:**	Numeric
Content:	Minutes	**Content:**	Hours
	77 = Don't know		777 = Don't know

APPENDIX E:

Additional Gender Data for Chapter 2:

Declines over the Young Adult Years in the Physical Activity Levels of Australians [1]

BACKGROUND:

The data in this appendix summarises an earlier study to that described in Chapter 2, presented to the American College of Sports Medicine 46th Annual Meeting, Seattle, June 2-5, 1999.

The study described here as Study 1 used the same data sets as those used in Chapter 2, but only used males and females who could be classified into either sufficient or insufficiently active in the sample. In Chapter 2 data from the full sample available was analysed for males and females, thus the sample sizes reported are different.

E-1

Decline data for three Australian data sets, by gender (Study 1)

E-2

Handout for poster presentation at the American College of Sports Medicine Annual General Meeting, Seattle, 1999 (Study 1 and Study 2)

[1] This study has been published as an abstract: Leslie E, Fotheringham MJ, Bauman A, Owen N. (1999). Declines in physical activity from late adolescence through young adulthood – four Australian data sets. *Medicine Science Sports and Exercise* 31(5), S165.

APPENDIX E-1
Decline data for three Australian data sets, by gender (Study 1 only)

ARTEC (n=1730)	% Vigorous Activity			% Moderate Activity			% Walking			% Adequately active		
	18-19	20-24	25-29	18-19	20-24	25-29	18-19	20-24	25-29	18-19	20-24	25-29
Males	75	70	58*	60	55	34*	86	87	82	77	71	59*
n	370	426	91	364	419	92	384	434	96	300	352	80
Females	66	56	46*	60	50	48*	91	89	89	60	53	50
n	544	539	115	533	524	111	555	554	119	459	449	88

*P<0.05

ACTIVE AUSTRALIA (n=402)	% Vigorous Activity			% Moderate Activity			% Walking			% Adequately active		
	18-19	20-24	25-29	18-19	20-24	25-29	18-19	20-24	25-29	18-19	20-24	25-29
Males	86	77	65*	43	37	34	80	76	72	89	81	76
n	56	97	126	56	96	126	55	97	125	53	94	124
Females	68	57	50	30	21	18	93	88	86	70	56	65
n	57	112	137	57	112	137	56	112	137	54	110	131

*P<0.05

PSFA (n=432)	% Vigorous Activity			% Moderate Activity			% Walking			% Adequately active		
	18-19	20-24	25-29	18-19	20-24	25-29	18-19	20-24	25-29	18-19	20-24	25-29
Males	78	61	56*	56	54	37*	44	50	44	85	63	60*
n	41	84	90	41	84	90	41	84	91	41	84	90
Females	58	49	50	58	39	42	73	73	60	65	48	49
n	45	76	99	45	74	98	45	75	99	43	75	99

*P<0.05

Declines over the young adult years in the physical activity levels of Australians

E. Leslie, MHN, **M.J. Fotheringham**, PhD., **N. Owen**, PhD, **A. Bauman**, PhD.
School of Health Sciences, Deakin University, Melbourne, Australia, & University of New South Wales, Sydney, Australia
Poster Presented at American College of Sports Medicine Annual Meeting June 1999. Email: evalesl@deakin.edu.au

Introduction

Physical activity levels of males and females decline during the teenage years and young adulthood, while the prevalence of inactivity rises. Adult population surveys from Australia report declines in physical activity through young adulthood and beyond. The decline in physical activity observed with age needs to be examined in more detail to help understand what periods of the life-cycle may precipitate circumstances that contribute to the decline. Data for age groups previously reported (<25 yrs, 25-39 yrs), do not allow examination of prevalence for the early years of adulthood where significant changes occurring to lifestyle habits may be strongly influencing physical activity patterns. We examined the relationship between leisure-time physical activity levels and age, for young adults aged between 18 and 29 years, in four Australian physical activity surveys.

Methods

We separately examined rates of participation in vigorous- and moderate-intensity activity, walking and "adequate" physical activity for young adults categorised into age ranges; 18-19 years; 20-24 years and 25-29 years in four independently-administered Australian representative surveys of physical activity. Data are presented together for three of the surveys in Study One, and separately for the fourth survey (that used different measures) in Study Two. Adequate activity equates to meeting current recommendations of 30 minutes of moderate physical activity on most, preferably all, days of the week.

Chi-square tests for linear trend (χ^2_{LT}) are reported for all data.

Table 1: Summary of Australian data sets used.

	STUDY 1			STUDY 2
SURVEY	ARTEC*	AA*	PSFA*	NHS*
Year	1996	1997/8	1991	1995
N=	1730	402	432	9645
Type	Cross-sectional survey	Household random sample telephone survey	Household random sample telephone survey	Household random sample telephone survey

* Full survey titles can be found in the Acknowledgements.

Table 2: Summary of physical activity measures used.

	STUDY 1			STUDY 2
SURVEY	ARTEC	AA	PSFA	NHS
Vigorous	Vigorous exercise which made you breathe harder or puff and pant	Vigorous physical activity which made you breathe harder or puff and pant	Vigorous exercise – exercise which made you breathe harder or puff and pant	Exercise which caused a large increase in your heart rate and breathing
Moderate	Moderate exercise which did not make you breathe harder or puff and pant	...any other more moderate physical activity that you haven't already mentioned	Less vigorous exercise – which did not make you breathe harder or puff and pant	Exercise which caused a moderate increase in your heart rate or breathing
Walking	Walk to get to or from places or as a means of transport for at least 10 minutes	Walked continuously for at least 10 minutes for recreation or exercise or to get to or from places	Walk for recreation or exercise	Walked for sport, recreation or fitness
Adequate	Estimated energy expenditure (total of vigorous, moderate and walking multiplied by frequency and intensity in METs) > 800 kcal/week			

Acknowledgments

- Active Recreation on Tertiary Education Campuses (ARTEC) project funded by the Commonwealth Department of Health and Family Services.
- Pilot Survey of the Fitness of Australians (PSFA) funded by the Department of Arts, Sport, Environment and Territories.
- Active Australia (AA) Victorian Surveys were funded by the Commonwealth Department of Health and Family Services, Australian Sports Commission and a range of state agencies.
- National Health Survey (NHS) conducted by the Australian Bureau of Statistics.

Adequate Activity

Figure 12: Males

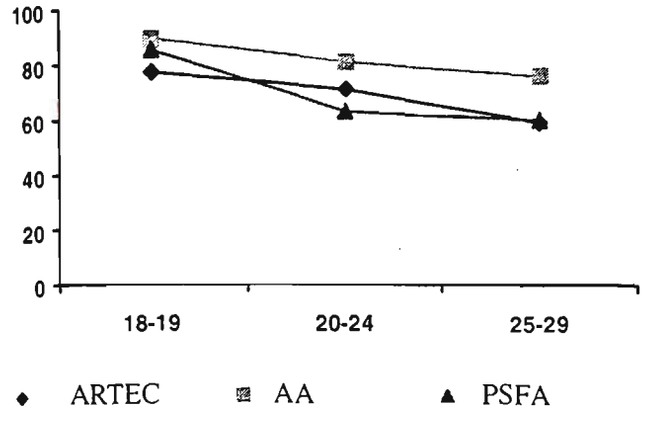
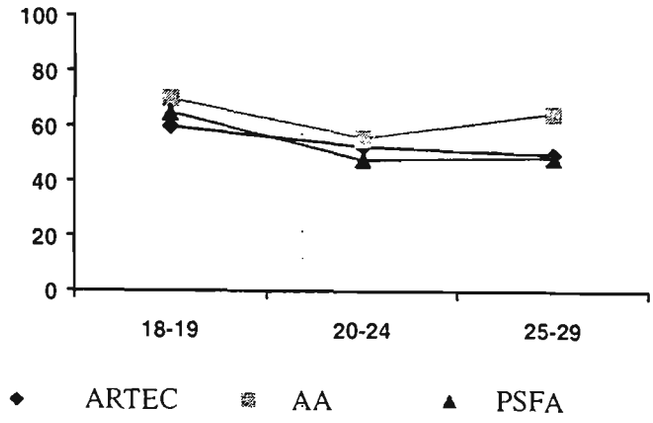


Figure 13: Females



Males but not females show significant declines ($p<0.05$) for adequate activity in two of the surveys and the same trend in the third (AA).

Gender Study 2

NHS Data by Gender

Figure 14: Males

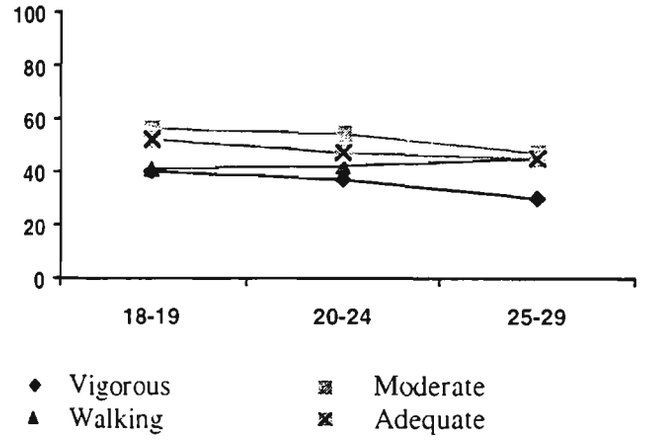
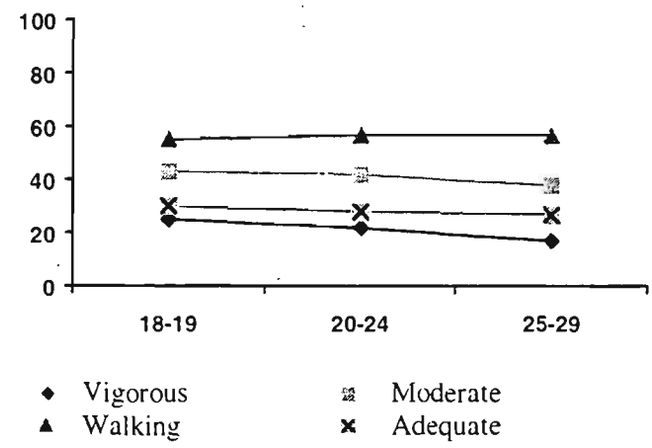


Figure 15: Females



In all age groups males have higher rates of vigorous- and moderate-intensity activity, and adequate activity than do females. However, females have higher rates of walking than do males in all age groups.

While there are significant declines in vigorous- and moderate-intensity activity for both males and females, only males show significant changes ($p<0.05$) in walking (an actual increase) and adequate activity (a decrease).

Summary

More detailed examination of the studies described show that there are differences in prevalence rates between males and females. Males have a higher prevalence of vigorous- and moderate-intensity activity than do females, but show greater rates of decline between the age groups. Across all age groups, the females in these surveys had higher prevalences of walking than the males. Males, but not females, showed statistically significant declines in adequate activity between age groups.

The differing patterns of physical activity declines for males and females have implications for the implementation of population-based physical activity promotion campaigns. Strategies which take into account gender differences in physical activity are more likely to be efficacious that strategies which fail to account for these differences. Males are more likely to engage in vigorous physical activity, females are more likely to engage in walking - campaign strategies which either reinforce these patterns or promote complementary activities should be implemented.

Related Publications

1. U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General.* Atlanta. GA: Centers for Disease Control.
2. Owen N, Bauman A. (1992). The descriptive epidemiology of a sedentary lifestyle in adult Australians. *Int J Epidemiol 21*:305-10.
3. Bauman A, Owen N, & Rushworth RL. (1990). Recent trends and socio-demographic determinants of exercise participation in Australia. *Comm Health Stud 14*:19-26.
4. Leslie E, Owen N, Salmon J, Bauman A, Sallis JF, and Lo SK. (1999). Insufficiently-active Australian college students: Perceived personal, social and environmental influences. *Prev Med 28*:20-7.
5. Leslie E, Sallis JF, Owen N. (1999). Inactive Australian College students' preferred activities, sources of assistance, and motivators. *Am J Health Prom 13*:197-9.

sis of the four data sets according to gender

Introduction

Physical activity levels of young adult males and females are thought to show differing patterns of decline. We separately examined patterns of physical activity decline of males and females in the four Australian survey data sets.

Methods

We separately examined rates of participation in vigorous- and moderate-intensity activity, walking and "adequate" physical activit for male and female young adults categorised into age ranges. Chi square tests are reported for all data.

Gender Study 1

Vigorous Activity

Figure 6: Males

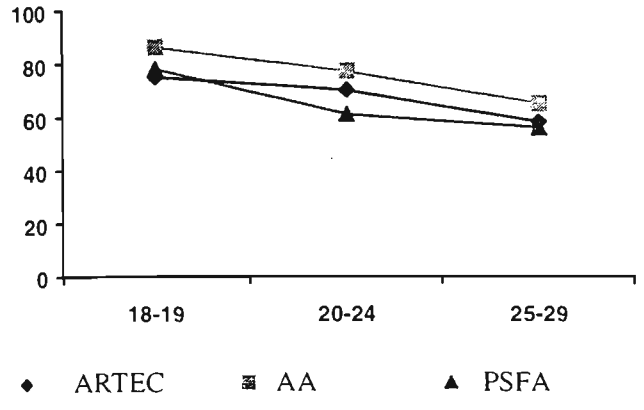
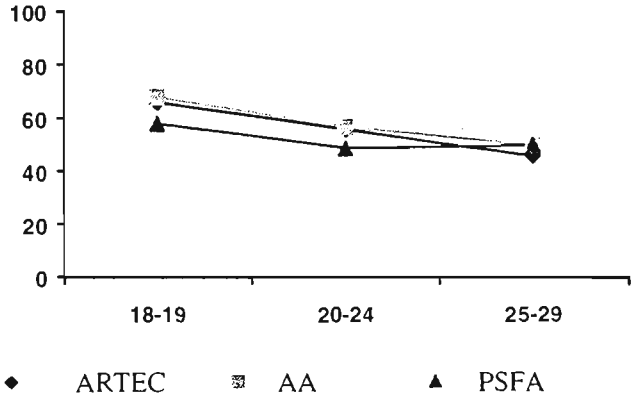


Figure 7: Females



Males consistently show a significant decline ($p<0.05$) between age groups for vigorous-intensity activity. The pattern of decline is also observed in females but is only significant in the ARTEC data.

Moderate Activity

Figure 8: Males

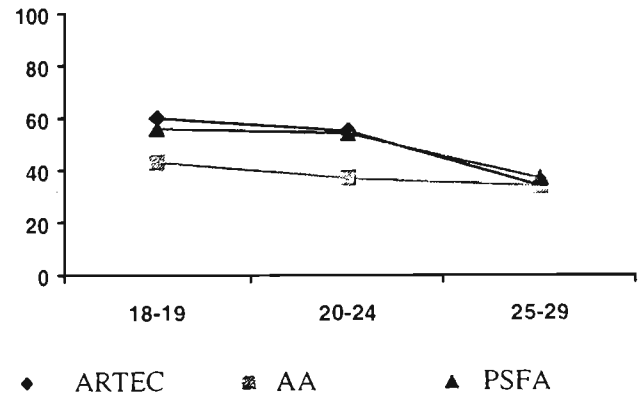
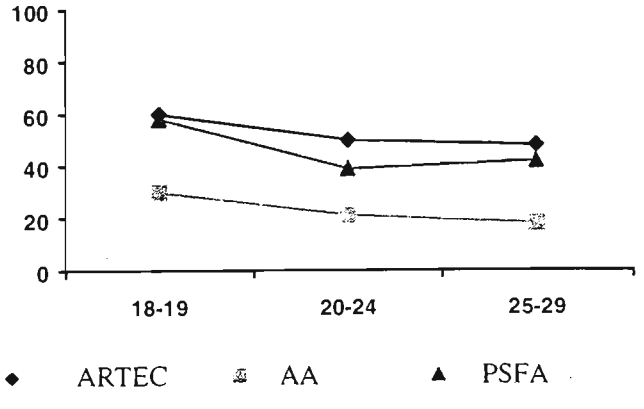


Figure 9: Females



There is a significant decline ($p<0.05$) in males between age groups for moderate-intensity activity in two of the surveys and the same trend in the third (AA). Females show the same pattern of decline but only the ARTEC data is significant.

Walking

Figure 10: Males

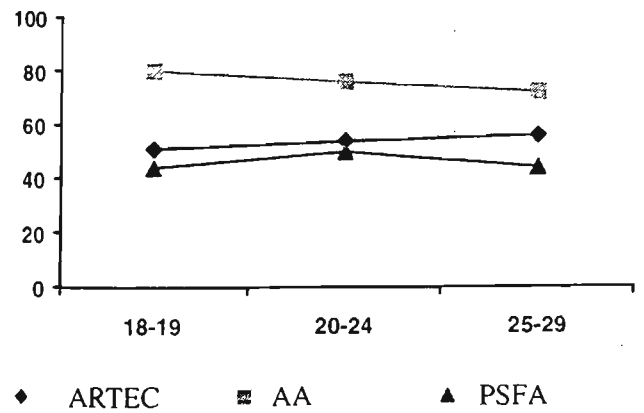
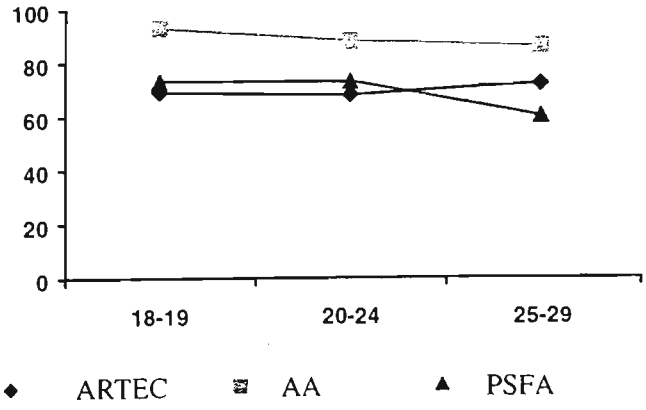


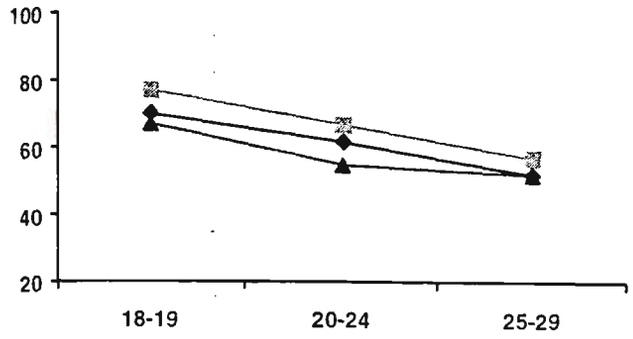
Figure 11: Females



There are no significant changes in any of the walking data for males or females.

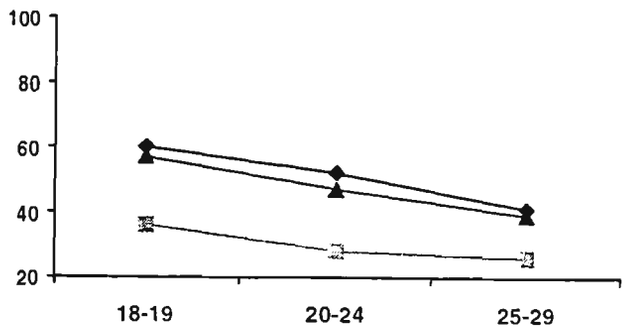
Results

Study 1: Figure 1: Vigorous Activity by Age Group



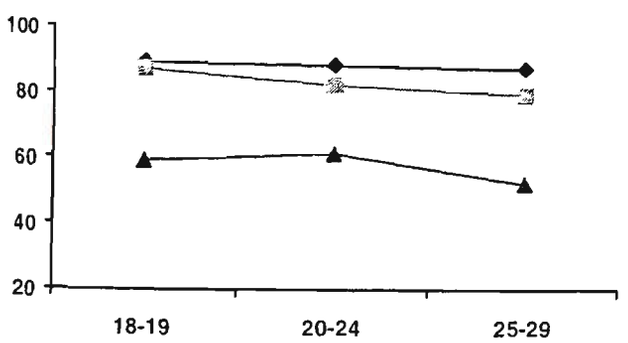
- ARTEC $\chi^2_{LT} = 26.7$, $df = 1$, $p < .001$
- AA $\chi^2_{LT} = 5.6$, $df = 1$, $p = .02$
- PSFA $\chi^2_{LT} = 4.7$, $df = 1$, $p = .03$

Figure 2: Moderate Activity by Age Group



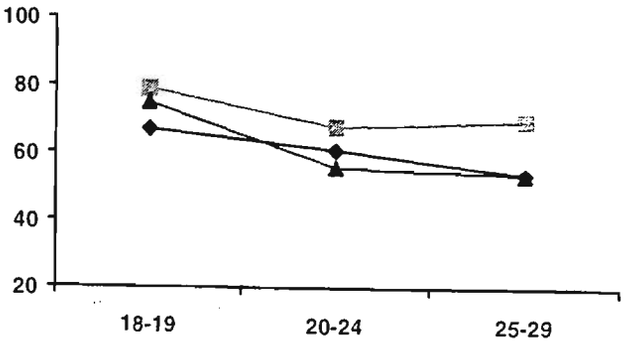
- ARTEC $\chi^2_{LT} = 25.1$, $df = 1$, $p < .001$
- AA $\chi^2_{LT} = 1.65$, $df = 1$, $p = .19$
- PSFA $\chi^2_{LT} = 7.4$, $df = 1$, $p = .006$

Figure 3: Walking by Age Group



- ARTEC $\chi^2_{LT} = 0.93$, $df = 1$, $p = .33$
- AA $\chi^2_{LT} = 1.1$, $df = 1$, $p = .29$
- PSFA $\chi^2_{LT} = 1.9$, $df = 1$, $p = .15$

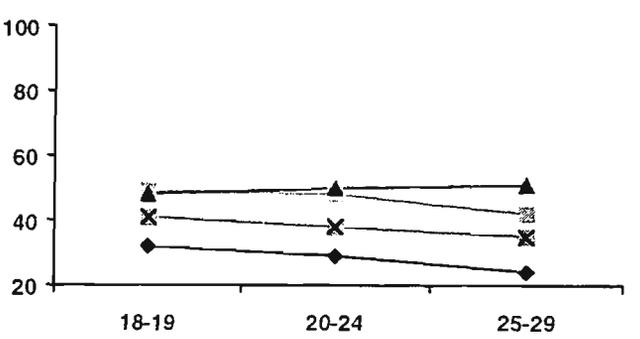
Figure 4: Adequate Activity by Age Group



- ARTEC $\chi^2_{LT} = 12.13$, $df = 1$, $p < .001$
- AA $\chi^2_{LT} = 1.85$, $df = 1$, $p = .17$
- PSFA $\chi^2_{LT} = 8.6$, $df = 1$, $p = .003$

- Prevalence rates for vigorous-intensity activity are similar between the data sets and decline with age (Figure 1).
- Prevalence rates for moderate-intensity activity show the same trend with a slightly lower prevalence rate for the AA data (Figure 2). This survey asked a more narrowly defined question about moderate-intensity activity.
- There are no significant differences in walking prevalence between age groups (Figure 3). PSFA data show lower prevalence rates (this survey did not include walking for transport).
- There is a decline in the percentage of those who are adequately active across age groups (Figure 4).

Study 2: Figure 5: NHS Data



- Vigorous $\chi^2_{LT} = 50.2$, $df = 1$, $p = .001$
- Moderate $\chi^2_{LT} = 31.05$, $df = 1$, $p < .001$
- Walking $\chi^2_{LT} = 5.5$, $df = 1$, $p < .01$
- Adequate $\chi^2_{LT} = 14.2$, $df = 1$, $p < .001$

Data for vigorous- and moderate-intensity activity, walking and adequate physical activity are presented together in Figure 5. Overall, there are large and significant declines in vigorous- and moderate-intensity activity, and adequate activity, across the three age groups. Although these data show lower prevalence rates they support the pattern of relationships seen in Study One.

Conclusion

Young adulthood represents a preventive window in which lifelong physical activity habits and behaviors can be positively influenced. Previous Australian campaigns have targeted inactive groups of the population and older adults. The decline in the proportions of young adults participating in both vigorous- and moderate-intensity activity and adequate physical activity indicates that they are an important group to target in physical activity campaigns. These findings indicate potential opportunities for public health strategies intended to promote the maintenance of physical activity into adulthood.

APPENDIX F:

Methods used to categorise physical activity levels using estimated energy expenditure from two-week recall measures

Source:

Bauman A, Bellew B, Booth M, Hahn A, Stoker L, Thomas M. (1996). NSW Health Promotion Survey 1994. Towards Best Practice for the promotion of physical activity in the areas of NSW. NSW Health Department, Centre for Disease Prevention and Health, page 60.

BOX 1

ACTIVITY DATA

NSW HPS questions on leisure time physical activity provide:

- respondent's weight in kg
- time /2 weeks on:

→ vigorous activity
→ moderate activity
→ walking

BOX 2

ENERGY CONVERSION

Time in hours reported on each category of physical activity was multiplied by weight (kg) and by the relevant rate of energy expenditure:

→ X 9.0 METs
→ X 3.5 METs
→ X 3.5 METs

BOX 3

ENERGY TOTAL

Energy expenditure was added up to give total estimated energy expenditure in kcal during previous 2 weeks

→ **Total energy expenditure for previous 2 weeks**

BOX 4

ESTIMATED ENERGY EXPENDITURE CLASSIFIED AS ADEQUATE/INADEQUATE

Category of estimated energy expenditure	Health benefit threshold	Corresponding energy expenditure (kcal/week)
High	'Adequate'	≥1600 AND participated in ≥1 hour of vigorous activity
Moderate		> 800 but did not engage in at least 1 hour of vigorous activity
Low	'Inadequate'	50-<800
Nil		0-<50

APPENDIX G:

University Physical Activity Questionnaire

FOR OFFICE USE ONLY – I.D. **BUR**

University Physical Activity Survey

This survey asks about your physical activity habits, intentions, and attitudes, about the attributes of your campus environment and its facilities for sport and recreation. It will provide valuable data on the determinants of physical activity in young adults. It will also help the university to develop facilities and services to better meet the needs of its rapidly expanding and changing student profile.

We are interested in your opinions, interests and attitudes and how often **you** do certain activities. There are **no** right or wrong answers. All information you give us will be treated in the strictest confidence and only aggregate data will be reported. Completion of the survey is voluntary. It will take about 15 minutes to complete.

The Chief Investigator for the project is Eva Leslie, Research Coordinator with the School of Health Sciences at Deakin University. For further information, please contact Eva Leslie on 9244 6685 or Sherryn Bassett on 9244 6944.

Thank you for taking the time to help us with this project.

Date:_____

Full Initials:_____

DEAKIN UNIVERSITY

ABOUT YOU

1. **What is your gender?** *(please tick the appropriate response)*

   ☐ Male
   ☐ Female

2. **What is your age?**

   ☐☐ Years

3. **How tall are you without shoes?** *(if unsure please state best guess)*

   ☐☐☐ cm

   or
   ☐☐ ☐☐ feet / inches

4. **How much do you weigh without clothes and shoes?**
   (if unsure please state best guess)

   ☐☐☐ kg

   or
   ☐☐ ☐☐ stone / pounds

5. **What is your student status?** *(please tick ONE response)*

   ☐ Part-time
   ☐ Full-time

6. **What is the name of the course that you are studying, and the School in which it is based?**
   (for example, Health Promotion – Health Sciences
   Multimedia Technology – Computing & Maths)

   _____ Course
   _____ School

7. **What was your <u>parents</u>' Australian postcode in your last year of high school?** | | | | |

<u>OR</u>

If your parents were not in Australia at this time, in what country did they live? _____

8. **What is your current year of study?** *(please tick ONE response - if studying part time, please state your full time equivalent year)*

- ☐ 1st year
- ☐ 2nd year
- ☐ 3rd year
- ☐ 4th or final year
- ☐ Post-graduate

9. **What is your employment status?** *(please tick ONE response)*

- ☐ Work full-time
- ☐ Work part-time/casual
- ☐ Do not work
- ☐ Other (please specifiy) _____

10. **Where are you currently living?** *(please tick ONE response)*

- ☐ At home with parents
- ☐ Out of home by yourself
- ☐ Out of home with friends
- ☐ Out of home with partner/spouse
- ☐ On-campus accommodation

11. **Do you need to limit your physical activity because of an illness, injury or disability?** *(please tick ONE response)*

- ☐ No
- ☐ Yes, because of temporary illness
- ☐ Yes, because of long-term illness
- ☐ Yes, because of temporary injury
- ☐ Yes, because of long-term injury or disability

12. **How far do you live from campus?**
(please tick ONE response)

- ☐ Less than 1 km
- ☐ Between 1–5 kms
- ☐ 5–15 kms [OR more than 20 minutes by car]
- ☐ Between 15–60 kms [OR more than 30 minutes by car]
- ☐ More than 60 kms [OR over 60 minutes by car]

13. **On the days that you come to campus, what form of transport do you <u>usually</u> use to travel to campus?**
(please tick ONE response)

- ☐ Walk/cycle
- ☐ Public transport (bus, tram, train)
- ☐ Combination of public transport and walking
- ☐ Car travel
- ☐ Motorbike
- ☐ Other (please specifiy) _____

PHYSICAL ACTIVITY

The following questions are to find out about the different types of physical activity you did over the past week. It is important that you answer *all parts* of this question.

Q. 1 **In the past week, how many times have you WALKED for recreation or exercise and/or to get to and from places for at least 10 minutes continuously?**

_____ times

Please estimate the *total* time you spent walking in the past week

_____ hours / _____ minutes

Q. 2 **In the past week, how many times did you do VIGOROUS exercise or other physical activity (in your leisure-time or at work) *which made you breathe harder or puff or pant*? (eg. jogging or running, heavy gardening, netball, chopping wood, vigorous swimming, heavy labouring)**

_____ times

Please estimate the *total* time you spent doing vigorous exercise or physical activity in the past week

_____ hours / _____ minutes

Q. 3 **In the past week, how many times did you do MODERATE exercise or other physical activity (in your leisure-time or at work) which *DID NOT make you breathe harder or puff and pant*? (eg. more moderate activities - digging in the garden, moderate cycling, raking leaves, dancing)**

_____ times

Please estimate the *total* time you spent doing moderate exercise or physical activity in the past week

_____ hours / _____ minutes

PHYSICAL ACTIVITY OVER THE PAST WEEK ON DEAKIN BURWOOD CAMPUS

1. How many times have you done any of the following activities in the PAST WEEK, when you were on campus? Please indicate how many times you did each activity and how many minutes you did the activity EACH TIME.

(a)	Aerobics	_____ Times	_____ Minutes each time
(b)	Basketball	_____ Times	_____ Minutes each time
(c)	Circuit training	_____ Times	_____ Minutes each time
(d)	Cycling to/from campus	_____ Times	_____ Minutes each time
(e)	Jogging	_____ Times	_____ Minutes each time
(f)	Popular / disco dancing	_____ Times	_____ Minutes each time
(g)	Table Tennis	_____ Times	_____ Minutes each time
(h)	Weight training	_____ Times	_____ Minutes each time
(i)	Walking	_____ Times	_____ Minutes each time
(j)	Yoga / Stretching class	_____ Times	_____ Minutes each time
(k)	Team sport (please specify)		
	_____	_____ Times	_____ Minutes each time
(l)	Social activity		
	(for example - kicking a footy, throwing a frisbee, shooting baskets)		
	_____	_____ Times	_____ Minutes each time
(m)	Other (please specify)		
	_____	_____ Times	_____ Minutes each time

2. On average which of the following statements best describes your level of physical activity at University compared with your level of physical activity during secondary school? *(please tick ONE response)*

- ☐ More active at University than at Secondary School
- ☐ Less active at University than at Secondary School
- ☐ Activity levels are very similar

3. **Do you walk to get to/get home from university?** *(please tick ONE response)*

- ☐ Most days
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

4. **If you do any walking to get TO OR FROM CAMPUS, how many times a week do you walk for at least 10 minutes continuously?** *(this includes walking to get to public transport, walking from carparks etc.)*

_____ times/week

5. **Do you walk for exercise or recreation DURING BREAKS between classes *(do not include walking from class to class)?*** *(please tick ONE response)*

- ☐ Most days
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

6. **If you walk for exercise or recreation DURING BREAKS, how many times a week do you walk for at least 10 minutes continuously?**

_____ times/week

7. **Do you use the stairs on campus instead of taking the lift?** *(please tick ONE response)*

- ☐ Most days
- ☐ Sometimes
- ☐ Rarely
- ☐ Never
- ☐ Not applicable (No stairs in your buildings)

WALKING IN AND AROUND THE DEAKIN BURWOOD CAMPUS

1. With regard to walking in and around your campus, *including travelling to campus*, do you (1) strongly agree, (2) agree, (3) not sure (4) disagree, (5) strongly disagree that:

(please circle ONE response for each listed item)

	Strongly Agree		Not Sure		Strongly Disagree
(a) It is safe walking during the night (e.g. Well lit)	1	2	3	4	5
(b) It is safe walking during the day	1	2	3	4	5
(c) I have someone to walk with	1	2	3	4	5
(d) The campus is an attractive/pleasant setting to walk in	1	2	3	4	5
(e) It takes too long/it is too far to walk to campus	1	2	3	4	5
(f) Traffic in and around the campus makes walking difficult	1	2	3	4	5
(g) There are adequate footpaths linking carparks and classrooms	1	2	3	4	5
(h) There are no changerooms/showers to use on campus	1	2	3	4	5
(i) There is a walking track that I can use in or on campus	1	2	3	4	5
(j) I am not interested in walking on campus	1	2	3	4	5
(k) There is somewhere I can walk to from campus (eg. shops nearby)	1	2	3	4	5

SPORT AND FITNESS ACTIVITIES ON THE DEAKIN BURWOOD CAMPUS

1. With regard to sport and fitness activity *(vigorous exercise which makes you sweat and breathe harder)* on <u>your</u> campus, do you (1) strongly agree, (2) agree, (3) not sure (4) disagree, (5) strongly disagree that:

(please circle ONE response for each listed item)

	Strongly Agree		Not Sure		Strongly Disagree
(a) It is not important for me to do any sport or fitness activity on campus	1	2	3	4	5
(b) It is too much trouble to do any sport or fitness activity on campus	1	2	3	4	5
(c) I am not interested in sport or fitness activity	1	2	3	4	5
(d) There are suitable facilities to use on campus	1	2	3	4	5
(e) There are no programs for sport or fitness activities on my campus	1	2	3	4	5
(f) I don't know where the facilities for sport or fitness are located	1	2	3	4	5
(g) There are convenient change rooms/showers on campus	1	2	3	4	5
(h) It is easy to get access to facilities for sport or fitness activities on campus	1	2	3	4	5
(i) I am usually too busy to find time to do sport or fitness activities on campus	1	2	3	4	5
(j) There are lockers for storing belongings on campus	1	2	3	4	5
(k) It is too expensive to do sport on campus or fitness activities on campus	1	2	3	4	5
(l) It is easy to do sport or fitness activities on campus if you want to	1	2	3	4	5

CONVENIENT PHYSICAL ACTIVITY FACILITIES ON CAMPUS

1. Please let us know YOUR INTERESTS in using on-campus activity facilities.
Assuming that you were on campus next year, and each of these facilities were to be available and accessible, <u>how often</u> do you think you might use it?

(Please circle ONE response for each listed item)

	NEVER (Not at all)	**SOMETIMES** (Once per month)	**REGULARLY** (Once per week)	**FREQUENTLY** (Twice or more/week)
(a) Aerobics room	1	2	3	4
(b) Basketball courts	1	2	3	4
(c) Dance studio	1	2	3	4
(d) Exercise machines (e.g. bikes, treadmills)	1	2	3	4
(e) Weights room	1	2	3	4
(f) Indoor courts (eg. badminton)	1	2	3	4
(g) Martial arts studio	1	2	3	4
(h) Multipurpose sports hall	1	2	3	4
(i) Outdoor courts (eg. netball)	1	2	3	4
(j) Playing fields (eg soccer, softball etc)	1	2	3	4
(k) Swimming pool	1	2	3	4
(l) Squash courts	1	2	3	4
(m) Table Tennis	1	2	3	4
(n) Walking/cycling track	1	2	3	4
(o) Change rooms/showers	1	2	3	4
(p) Lockers	1	2	3	4
(q) Bike racks	1	2	3	4
(r) Other (please specify) _____	1	2	3	4

2. **If a modern facility existed on campus that provided regular aerobics, electronic circuit equipment, weights equipment, modern change rooms etc., how often would you use it?**

- ☐ Never
- ☐ Sometimes (once per month)
- ☐ Regularly (once per week)
- ☐ Frequently (twice or more per week)

3. **If you would use a facility such as described above, how much would you be willing to pay for a YEARLY membership?**

- ☐ Less than $50
- ☐ $50 - $100
- ☐ $100 - $200
- ☐ $200 - $300
- ☐ I would only pay casual rates for occasional use
- ☐ I would not use the facility

4. **If you would use a facility such as described above, between what hours would you be MOST LIKELY to use it?**

- ☐ Between 7.00am – 9.00 am only (before lectures)
- ☐ Between 9.00am – 5.00 pm only (during the day)
- ☐ Between 5.00 pm – 9.00 pm only (in the evening)
- ☐ During lunchbreaks (12.00 –2.00 pm) only
- ☐ Between 12.00 – 5.00 pm on weekends only
- ☐ I would not use the facility

5. **If you would use a facility such as described above, do you think car parking would be a problem on your campus?**

- ☐ Yes
- ☐ No
- ☐ I would not use the facility

BARRIERS TO BEING ACTIVE

1. How much do each of the following reasons for NOT doing any physical activity ON CAMPUS apply to you? *(please circle ONE response for each listed barrier)*

	Does Not Apply		Not Sure		Applies Strongly
(a) I haven't got any free time while on campus	1	2	3	4	5
(b) There's no one to do it with	1	2	3	4	5
(c) I prefer to sit and socialise with friends	1	2	3	4	5
(d) I need to study/go to the library in my free time	1	2	3	4	5
(e) I am too lazy/not motivated	1	2	3	4	5
(f) I am too fat	1	2	3	4	5
(g) I don't like spending time on campus	1	2	3	4	5
(h) I do enough physical activity off campus	1	2	3	4	5
(i) I'm too tired/haven't got the energy	1	2	3	4	5
(j) I do not have the experience or skills to do the things I'd like to	1	2	3	4	5
(k) I do not enjoy being physically active1	2	3	4	5	
(p) I would rather be active off campus	1	2	3	4	5

2. How likely is it that you would do the following activities in your FREE TIME ON CAMPUS?

	Not very Likely				Most Likely
(a) Socialise with friends	1	2	3	4	5
(b) Go to the library or study	1	2	3	4	5
(c) Eat or have something to drink	1	2	3	4	5
(d) Play an active sport	1	2	3	4	5
(e) Do something to improve my fitness	1	2	3	4	5
(f) Leave the campus and go elsewhere	1	2	3	4	5
(g) Go for a walk	1	2	3	4	5

MOTIVATORS FOR BEING ACTIVE

1. **How motivating are each of these factors for you to begin or to continue a routine of regular physical activity?** Rate EACH ONE of the following as not motivating at all (1) to extremely motivating (5)
(please circle ONE response for each listed motivator)

		Not motivating at all		Somewhat motivating		Extremely motivating
(a)	Fun/enjoyment	1	2	3	4	5
(b)	Weight loss	1	2	3	4	5
(c)	Facilities that are convenient to use (e.g. showers, change rooms, bike racks)	1	2	3	4	5
(d)	Improved muscle tone	1	2	3	4	5
(e)	Muscle gain	1	2	3	4	5
(f)	Increased energy level	1	2	3	4	5
(g)	Safe environments for walking, cycling or jogging (well-lit paths, away from traffic)	1	2	3	4	5
(h)	Organised competition (team sport)	1	2	3	4	5
(i)	To feel good about myself	1	2	3	4	5
(j)	To look better	1	2	3	4	5
(k)	Better weather	1	2	3	4	5
(l)	To socialise or meet people	1	2	3	4	5
(m)	To decrease stress levels	1	2	3	4	5
(n)	Ability to exercise at or close to home	1	2	3	4	5
(o)	Easy access to sporting or fitness facilities	1	2	3	4	5
(p)	Someone to exercise with	1	2	3	4	5
(q)	Improved cardiovascular fitness	1	2	3	4	5
(r)	Weight maintenance	1	2	3	4	5

ATTITUDES TO HEALTH

1. **How important for YOUR long-term health do you think it is to do REGULAR VIGOROUS-INTENSITY activities (like running, aerobic classes, playing active sports such as football, netball or squash)?**

Not very Important		Not Sure		Very Important
1	2	3	4	5

2. **How important for YOUR long-term health do you think it is to do REGULAR MODERATE-INTENSITY activities (like walking, riding a bike, digging in the garden)?**

Not very Important		Not Sure		Very Important
1	2	3	4	5

3. **How important for long-term health is not gaining too much weight (say an extra 10 kilograms by the time you are 50 years old)?**

Not very Important		Not Sure		Very Important
1	2	3	4	5

MOTIVATIONAL READINESS FOR PHYSICAL ACTIVITY

The following questions are about your intentions to do various forms of physical activity

1. **Do you participate in VIGOROUS physical activity such as sport or fitness activities (e.g. aerobics, running etc) three times a week for at least 20 minutes each time?** *(please tick ONE box that best describes you)*

- ☐ YES, I have been for MORE than 6 months
- ☐ YES, I have been, but for LESS than 6 months
- ☐ NO, but I intend to in the next 30 days
- ☐ NO, but I intend to in the next 6 months.
- ☐ NO, and I do NOT intend to in the next 6 months

2. **Do you participate in MODERATE physical activity such as recreational or incidental activity (e.g. brisk walking, cycling) five times a week for at least 30 minutes each time?** *(please tick ONE box that best describes you)*

- ☐ YES, I have been for MORE than 6 months
- ☐ YES, I have been, but for LESS than 6 months
- ☐ NO, but I intend to in the next 30 days
- ☐ NO, but I intend to in the next 6 months.
- ☐ NO, and I do NOT intend to in the next 6 months

3. **Do you almost always use the stairs in preference to elevators in the buildings on campus?** *(please tick ONE box that best describes you)*

- ☐ YES, I have been for MORE than 6 months
- ☐ YES, I have been, but for LESS than 6 months
- ☐ NO, but I intend to in the next 30 days
- ☐ NO, but I intend to in the next 6 months.
- ☐ NO, and I do NOT intend to in the next 6 months

4. **Do you take opportunities to go for a walk between lectures or other commitments when you are on campus?** *(please tick ONE box that best describes you)*

- ☐ YES, I have been for MORE than 6 months
- ☐ YES, I have been, but for LESS than 6 months
- ☐ NO, but I intend to in the next 30 days
- ☐ NO, but I intend to in the next 6 months.
- ☐ NO, and I do NOT intend to in the next 6 months

5. **Do you go to the gym or participate in any sporting or fitness activities when you are on campus?** *(please tick ONE box that best describes you)*

- ☐ YES, I have been for MORE than 6 months
- ☐ YES, I have been, but for LESS than 6 months
- ☐ NO, but I intend to in the next 30 days
- ☐ NO, but I intend to in the next 6 months.
- ☐ NO, and I do NOT intend to in the next 6 months

Thank you for your time

APPENDIX H:

Student Physical Activity Questionnaire

Student Physical Activity Questionnaire

This survey asks about the physical activity habits of students, and attitudes to doing physical activity on campus. It will take about 10-15 minutes to complete.

The surveys are completely anonymous and confidential. The survey is voluntary, and you are free to withdraw from the survey at any time.

Students will be informed of the survey findings through a report in the Stringer newsletter.

For further information, please contact Dr. Michael Fotheringham on 9251 7309 or Rebecca Wonnacott on 9251 7236.

Thank you for taking the time to help us with this important study.

YOUR PHYSICAL ACTIVITY HISTORY

Physical Activity Over The Last 2 Weeks

(The next few questions are about the past 2 weeks only)

1. **In the past 2 weeks, how many times did you walk to get to or from places or as a means of transport for at least 10 minutes consecutively?**

   ☐☐ times per week (if 'zero' go to Q.4)

2. **Please estimate the total time that you spent walking in this way in the past 2 weeks.**

   ☐☐ hours ☐☐ minutes

3. **When you walked this way, did you usually walk?**
   (please tick ONE response)

   ☐ Not at all vigorously
   ☐ A little vigorously
   ☐ Moderately vigorously
   ☐ Very vigorously

4. **In the past 2 weeks, how many times did you walk for recreation, health or fitness?**

   ☐☐ times per week (if 'zero' go to Q.7)

5. **Please estimate the total time that you spent walking in this way in the past 2 weeks.**

   ☐☐ hours ☐☐ minutes

6. **When you walked this way, did you usually walk?**
   (please tick ONE response)

   ☐ Not at all vigorously
   ☐ A little vigorously
   ☐ Moderately vigorously
   ☐ Very vigorously

7. **In the past 2 weeks, did you engage in VIGOROUS exercise - exercise which made you breathe harder or puff and pant? (e.g. vigorous sports such as football, netball, tennis, squash, athletics, jogging or running, keep-fit exercises, vigorous swimming etc.)** *(please tick ONE response)*

☐ Yes
☐ No (if 'no' go to Q.10)

8. **How many sessions of VIGOROUS exercise did you have over the 2 week period?**

☐☐

9. **Please estimate the total time spent exercising VIGOROUSLY during the past 2 weeks?**

☐☐ hours ☐☐ minutes

10. **In the past 2 weeks, did you engage in MODERATE exercise for recreation, sport or health and fitness purposes which did not make you breathe harder or puff and pant? (e.g. golf, recreational cycling, swimming, etc.)**

☐ Yes
☐ No (if 'no' go to Q.13)

11. **How many sessions of MODERATE exercise did you have over the 2 week period?**

☐☐

12. **Please estimate the total time spent exercising MODERATELY during the past 2 weeks?**

☐☐ hours ☐☐ minutes

13. **On average which of the following statements best describes your level of physical activity at University compared with your level of physical activity during secondary school?** *(please tick ONE response)*

☐ More active at University than at Secondary School
☐ Less active at University than at Secondary School
☐ Activity levels are very similar

PHYSICAL ACTIVITY OVER THE PAST 2 WEEKS
ON CAMPUS

1. How many times have you done any of the following activities in the PAST TWO WEEKS ON CAMPUS? Please indicate how many times you did each activity and how many minutes you did the activity EACH TIME.

(a)	Aerobics	_____ Times	_____ Minutes each time
(b)	Athletics	_____ Times	_____ Minutes each time
(c)	Badminton	_____ Times	_____ Minutes each time
(d)	Basketball	_____ Times	_____ Minutes each time
(e)	Circuit training	_____ Times	_____ Minutes each time
(f)	Cricket	_____ Times	_____ Minutes each time
(g)	Cycling	_____ Times	_____ Minutes each time
(h)	Football	_____ Times	_____ Minutes each time
(i)	Gymnastics	_____ Times	_____ Minutes each time
(j)	Jogging	_____ Times	_____ Minutes each time
(k)	Martial arts	_____ Times	_____ Minutes each time
(l)	Netball	_____ Times	_____ Minutes each time
(m)	Other dancing	_____ Times	_____ Minutes each time
(n)	Popular / disco dancing	_____ Times	_____ Minutes each time
(o)	Softball	_____ Times	_____ Minutes each time
(p)	Squash	_____ Times	_____ Minutes each time
(q)	Table Tennis	_____ Times	_____ Minutes each time
(r)	Tennis	_____ Times	_____ Minutes each time
(s)	Volleyball	_____ Times	_____ Minutes each time
(t)	Walking	_____ Times	_____ Minutes each time
(u)	Weight training	_____ Times	_____ Minutes each time
(v)	Yoga / Meditation	_____ Times	_____ Minutes each time

Others (please specify)

(w)	_____	_____ Times	_____ Minutes each time
(x)	_____	_____ Times	_____ Minutes each time

2. **Do you walk to get to/get home from university?** *(please tick ONE response)*

- ☐ Most days
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

3. **Do you walk for recreation during breaks between classes (do not include walking from class to class)?** *(please tick ONE response)*

- ☐ Most days
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

4. **Do you use the stairs on campus instead of taking the lift?** *(please tick ONE response)*

- ☐ Most days
- ☐ Sometimes
- ☐ Rarely
- ☐ Never
- ☐ Not applicable (No stairs in your buildings)

WALKING IN THE DEAKIN BURWOOD CAMPUS

1. With regard to walking around your campus do you (1) strongly agree, (2) agree, (3) not sure (4) disagree, (5) strongly disagree that: *(please circle ONE response for each listed item)*

	Strongly Agree		Not Sure		Strongly Disagree
(a) It is safe walking during the night (e.g. Well lit)	1	2	3	4	5
(b) It is safe walking during the day	1	2	3	4	5
(c) I have someone to walk with	1	2	3	4	5
(d) My campus is an attractive setting to walk in	1	2	3	4	5
(e) I find it pleasant walking in my campus	1	2	3	4	5
(f) There is a lot of traffic around the campus	1	2	3	4	5
(g) There are adequate footpaths linking carparks and classrooms	1	2	3	4	5
(h) I am usually too busy to find time to go walking	1	2	3	4	5
(i) There is a park, or cycle path within walking distance	1	2	3	4	5
(j) I am not interested in walking on campus	1	2	3	4	5

CONVENIENT FACILITIES

1. Here is a list of physical activity facilities. For each of these facilities, please tick if these are available on campus:

		YES	NO	NOT SURE
(a)	Aerobics room			
(b)	Basketball courts			
(c)	Dance studio			
(d)	Exercise machines (e.g. Bike, treadmill)			
(e)	Weights room			
(f)	Indoor courts			
(g)	Martial arts studio			
(h)	Multipurpose sports hall			
(i)	Outdoor courts			
(j)	Playing fields (soccer, softball etc)			
(k)	Running track			
(l)	Swimming pool			
(m)	Walking/cycling track			
(n)	Change rooms			
(o)	Showers			
(p)	Lockers			
(q)	Bike racks			
(r)	Other (please specify) _____			

BARRIERS TO PHYSICAL ACTIVITY

1. How much do each of the following reasons for NOT being physically active ON CAMPUS apply to you? *(please circle ONE response for each listed barrier)*

	Does Not Apply		Not Sure		Applies Strongly
(a) I haven't got any free time while on campus	1	2	3	4	5
(b) There's no one to do it with	1	2	3	4	5
(c) There are no suitable facilities	1	2	3	4	5
(d) I am not interested in being active on campus	1	2	3	4	5
(e) I don't like the facilities available on campus	1	2	3	4	5
(f) I prefer to sit and socialise with friends	1	2	3	4	5
(g) I need to study/go to the library in my spare time	1	2	3	4	5
(h) I am here to study, not to exercise	1	2	3	4	5
(i) I am too lazy/not motivated/can't get started	1	2	3	4	5
(j) I am too fat	1	2	3	4	5
(k) I don't like spending time on campus	1	2	3	4	5
(l) I do enough exercise off campus	1	2	3	4	5
(m) I haven't got the energy	1	2	3	4	5
(n) I don't know where physical activity facilities are located	1	2	3	4	5
(o) I cannot access the physical activity facilities	1	2	3	4	5
(p) The facilities offered for physical activity are not attractive/pleasant	1	2	3	4	5
(q) There is no encouragement to be active	1	2	3	4	5
(r) I do not have the experience/skills to be physically active.	1	2	3	4	5
(s) The facilities are too expensive to use	1	2	3	4	5
(t) There are no programs/services for physical activity	1	2	3	4	5

MOTIVATORS FOR PHYSICAL ACTIVITY

1. **What would motivate you to begin or continue a routine of regular physical activity?** Rate EACH ONE of the following as not motivating at all (1) to extremely motivating (5) *(please circle ONE response for each listed motivator)*

		Not motivating at all		Somewhat motivating		Extremely motivating
(a)	Fun/enjoyment	1	2	3	4	5
(b)	Weight loss	1	2	3	4	5
(c)	Facilities that are convenient to use (e.g. showers, bike racks)	1	2	3	4	5
(d)	Improved muscle tone	1	2	3	4	5
(e)	Muscle gain	1	2	3	4	5
(f)	Increased energy level	1	2	3	4	5
(g)	Safe facilities for activity (well-lit paths, away from traffic)	1	2	3	4	5
(h)	Organised competition (team sport)	1	2	3	4	5
(i)	To feel good about myself	1	2	3	4	5
(j)	To look better	1	2	3	4	5
(k)	A more suitable climate	1	2	3	4	5
(l)	To socialise or meet people	1	2	3	4	5
(m)	To decrease stress levels	1	2	3	4	5
(n)	Ability to exercise in or close to home	1	2	3	4	5
(o)	Suitable physical activity facilities	1	2	3	4	5
(p)	Someone to exercise with	1	2	3	4	5

INACTIVE RECREATION

In the following section we want you to think about the inactive recreation you have done during your LEISURE-TIME including any FREE TIME you had ON CAMPUS in the LAST WEEK.

For example: watching television, reading, talking on the telephone, using a computer, lying down and resting etc.

1. PLEASE ESTIMATE THE TOTAL TIME FROM MONDAY TO FRIDAY, THEN FOR SATURDAY & SUNDAY you spent in INACTIVE RECREATION during the LAST WEEK.

	Total hours/mins Monday to Friday	**Totahours/mins Saturday+Sunday**
(a) Hobbies (eg. arts/crafts, work on car, play musical instruments)	_____	_____
(b) Reading (books, papers, magazines, studying, spending time in the library)	_____	_____
(c) Sitting and socialising/eating with friends & family (at home, at uni, pubs/restaurants)	_____	_____
(d) Sitting or lying and listening to music/radio	_____	_____
(e) Talking on the telephone	_____	_____
(f) Watching TV/videos (including video games)	_____	_____
(g) Using the computer (including games)	_____	_____
(h) Going for a drive	_____	_____
(i) Relaxing, resting (NOT including sleep)	_____	_____
(j) Other inactive recreation (please list):		
_____	_____	_____

COMPUTER USE AND COMPUTER GAMES

This section looks more-closely at the time you spend using computers.

1. How much time did you spend in the last week doing each of the following?

		Total hours/mins
(a)	Using computers or consoles **on campus** for study or for university course work	_____
(b)	Using computers or consoles **on campus** to access the Internet for recreational or entertainment purposes	_____
(c)	Using computers or consoles **on campus** for non-study purposes, non-entertainment purposes (paying bills, gathering information, etc)	_____
(d)	Using computers or consoles **off campus** for study or for university course work	_____
(e)	Using computers or consoles **off campus** to access the Internet for recreational or entertainment purposes	_____
(f)	Using computers or consoles **off campus** for non-study purposes, non-entertainment purposes (paying bills, gathering information, etc)	_____
(g)	Using computers or consoles (including Playstations, Nintendo 64s, etc) to play games	_____
(h)	Using computers or consoles for paid work	_____

		Never	Rarely	Some times	Often	Very often
		0	1	2	3	4
2.	**How often does using computers or consoles prevent you from using your time in more-active pursuits (e.g., fitness, sports, or active recreation)** *(Please circle ONE response)*					

3. If you could get the same information through computers or consoles or through books or pamphlets or journals, which would you most prefer?

- ☐ Most prefer computers or consoles
- ☐ Most prefer books / pamphlets / journals

SOCIAL SUPPORT AND CONFIDENCE

1. For each item, please indicate whether during the past three months your family (or members of your household) or friends: *(please circle the number that best describes you)*

		Never	Rarely	Some times	Often	Very often
(a) Exercised with you	Family	0	1	2	3	4
	Friends	0	1	2	3	4
(b) Offered to exercise with you	Family	0	1	2	3	4
	Friends	0	1	2	3	4
(c) Gave you encouragement to exercise	Family	0	1	2	3	4
	Friends	0	1	2	3	4

2. For each item, please indicate how sure you are that you would exercise in that situation *(please circle ONE number for each item)*

	I'm sure Icannot		Maybe I can		I'm sure I can
(a) I would exercise even though I am feeling sad or highly stressed	1	2	3	4	5
(b) I would stick to my exercise program even when family or social life takes a lot of my time	1	2	3	4	5
(c) I will set aside time for regular exercise	1	2	3	4	5

STAGE OF CHANGE

1. **Do you participate in VIGOROUS physical activity such as sport or fitness activities (e.g. aerobics, running etc) three times a week for at least 20 minutes each time?** *(please tick ONE box that best describes you)*

- ☐ YES, I have been for MORE than 6 months
- ☐ YES, I have been, but for LESS than 6 months
- ☐ NO, but I intend to in the next 30 days
- ☐ NO, but I intend to in the next 6 months.
- ☐ NO, and I do NOT intend to in the next 6 months

2. **Do you participate in MODERATE physical activity such as recreational or incidental activity (e.g. brisk walking, cycling) five times a week for at least 30 minutes each time?** *(please tick ONE box that best describes you)*

- ☐ YES, I have been for MORE than 6 months
- ☐ YES, I have been, but for LESS than 6 months
- ☐ NO, but I intend to in the next 30 days
- ☐ NO, but I intend to in the next 6 months.
- ☐ NO, and I do NOT intend to in the next 6 months

ABOUT YOU

1. **What is your gender?** *(please tick the appropriate response)*

- ☐ Male
- ☐ Female

2. **What is your age?**

☐☐ Years

3. **How tall are you without shoes?** *(if unsure please state best guess)*

☐☐☐ cm
or
☐☐ ☐☐ feet / inches

4. **How much do you weigh without clothes and shoes?**
(if unsure please state best guess)

☐☐☐ kg
or
☐☐ ☐☐ stone / pounds

5. **What is your student status?** *(please tick ONE response)*

- ☐ Part-time
- ☐ Full-time

6. **What is your current year of study?** *(please tick ONE response - if studying part time, please state your full time equivalent year)*

- ☐ 1st year
- ☐ 2nd year
- ☐ 3rd year
- ☐ 4th or final year
- ☐ Graduate

7. **What is your employment status?** *(please tick ONE response)*

- ☐ Work full-time
- ☐ Work part-time
- ☐ Not employed
- ☐ Other (please specify) _____

8. **Where are you currently living?** *(please tick ONE response)*

- ☐ At home with parents
- ☐ Out of home by yourself
- ☐ Out of home with friends

9. **Do you need to limit your physical activity because of an illness, injury or handicap?** *(please tick ONE response)*

- ☐ No
- ☐ Yes, because of temporary illness
- ☐ Yes, because of long-term illness
- ☐ Yes, because of temporary injury
- ☐ Yes, because of long-term injury or handicap

10. **What was your parents' postcode in your last year of high-school?** ☐☐☐☐

Thank you for your time

APPENDIX I:

Qualitative Study of Perceived Environmental Influences on Young Adult's Physical Activity in Campus Settings[1]

BACKGROUND:

This purpose of this qualitative investigation was to explore the perceptions of environmental barriers to moderate-intensity and vigorous sport and fitness activities in a tertiary-education campus setting. These were examined in separate discussion groups for males and females.

The findings from this study were used to help inform the modification of specific barrier items for use in the study reported in Chapter 5.

[1] A letter to the editor from this study has been published (see Appendix A-7): Leslie E, Bassett S, Owen N. (2001). Qualitative findings identifying environmental influences on young adult's physical activity in campus settings. *Health Promotion Journal of Australia,* 11(1): 73-74.

I.1 Introduction

Health benefits of regular physical activity are now well-established (Bauman & Owen, 1999; USDHHS, 1996). National physical activity guidelines in Australia and other countries now recommend doing at least 30 minutes per day of moderate-intensity activity, and additional vigorous activity for added health benefits (Commonwealth Department of Health & Family Services, 1999). Rates of participation in physical activity decline sharply during the teenage and young adult years (Sallis, 2000). Activity declines start earlier in females, particularly for vigorous activities (Sallis, 2000). There are gender differences in the prevalence of moderate- and vigorous-intensity activity in younger adults. Males have considerably higher rates of vigorous activity than do females at the same ages (USDHHS, 1996).

Physical activity patterns developed during early adulthood are likely to be lasting and to influence long-term risk of several inactivity-related diseases (Dinger & Waigandt, 1997), yet the physical activity habits of young adults are not well understood. For young adults, there are apparent changes to environments for physical activity, after completion of high school and on entering the workforce or going on to tertiary study. Active recreation and sporting opportunities in school environments cease to be available and settings for other forms of activity become more salient (Calfas et al., 1994).

A focus on "barriers" has been central to studies of the determinants of physical activity. For example, younger adults are twice as likely as are older adults to report "not having time" as a barrier to physical activity participation (Booth et al., 1997). Younger adults were also twice as likely to report "lack of motivation" as a barrier. However, studies of barriers have tended to focus on personal and social factors, with relatively few studies examining the influence of physical environment factors (Brawley, Martin & Gyurcsik, 1998; Sallis & Owen, 1999). Settings-based perspectives on health promotion take into account environmental barriers in workplaces, schools and communities (Green & Kreuter, 1990). "Ecological" models provide a theoretically anchored perspective and point strongly to the role of the physical and organisational environments as proximal determinants of healthy or unhealthy choices (Stokols, 1992; Sallis & Owen, 1999).

Applied to physical activity, ecological models point to the importance for health promotion strategy of understanding the specific links between particular settings attributes, particular behavioural "choices" and the attributes of those who spend time in the setting (Sallis, Bauman & Pratt, 1998; Sallis & Owen, 1999). Qualitative research has provided accounts and useful insights of perceived environmental barriers to physical activity in different settings. This has included worksite physical activity for blue-collar workers (Veitch, Owen, Burns et al., 1997), barriers in community settings for older adults (Brown, Fuller, Lee et al., 1999), and barriers to the use of community free and pay recreational facilities (Corti, Donovan & Holman, 1996). These studies found that environmental constraints, particularly lack of facilities, availability and suitability of activity choices, and proximity and accessibility of facilities generally were perceived to be important barriers to being more active.

While it may not be feasible to examine the plethora of potential physical activity environments that exist in communities and workplaces for young adults, tertiary-education campuses are one environment that has relatively fixed qualities with some common features. University students are not merely a population of convenience for research; they are in an environment that promotes sedentary behaviour (particularly computer and Internet use) and are being educated for sedentary occupations. A large proportion of young adults in Australia attend tertiary-education campuses [39% of 15-24 year olds in 1995] (Australian Bureau of Statistics, 1999). Thus campus settings can provide a unique opportunity to study a particular environment and how features of this environment may impact on opportunities to be active for young adults (Sallis, Bauman & Pratt, 1998; Sallis & Owen, 1999).

A wide range in the availability of physical activity facilities on Australian university campuses has been reported (Leslie, Mounsey & Owen, 1998), with larger campuses more likely to have more extensive physical activity facilities than do smaller campuses. Young adults in these settings report gender-specific preferences for activity, with weight training and team sports most popular for males, and aerobics and walking most popular for females (Leslie, Owen & Sallis, 1999). In terms of environmental constraints acting as barriers, females particularly are likely to have limited opportunities for their most preferred activity (aerobics) in university campus settings (Leslie, Mounsey & Owen, 1998).

Transcriptions of text from discussions with separate groups of young adult males and females in a tertiary-education campus setting were examined. The perceptions of barriers to moderate-intensity activity (particularly walking and cycling) on campus and for transport, and to vigorous sport and fitness activities on and off campus were explored.

I.2 Methods

Recruitment

Approaches were made to students in lectures and in the university cafeteria, who were then invited to attend a group discussion about physical activity on campus. Males and females took part in separate discussion groups, as previous studies have shown that they differ in their activity preferences and perceived barriers to activity (Booth, Bauman, Owen et al., 1997; Leslie, Owen & Sallis, 1999). As compensation for their time, participants received a five-dollar meal voucher to use in the cafeteria.

Setting of the Study

The study was carried out on a University campus that a previous study had found to have a limited range of physical activity facilities Leslie, Mounsey & Owen, 1998). Despite being classified as a 'large campus' (more than 8000 students), relative to other Australian University campuses of this size, this campus had few facilities for physical activity. These were limited to a walking track and two community sporting ovals adjoining the campus, one indoor basketball court, and a weight training facility that was largely inaccessible, other than for teaching. A previous study on the same campus indicated that student awareness of such facilities was poor (Leslie, Fotheringham, Veitch et al., 2000).

Characteristics of Participants

At the conclusion of each discussion session, a short questionnaire on socio-demographic and physical activity attributes was completed. Participants (15 female; 14 male; age range 19 to 27 years with a mean of 22 years) were drawn from a variety of courses of study in Arts/Science, Commerce, Commerce/Law, Food Science and Nutrition, Health Promotion, Health Science, Nutrition and Dietetics, and Park Management. A majority of participants were living at home with their parents (69%).

Procedures

One researcher (EL) facilitated the group discussion, while a research officer (SB) took notes. All sessions were recorded on audiotape. Ethical issues pertaining to being recorded and confidentiality were discussed and a signed consent form was obtained prior to the discussion. Participants were then asked to describe their moderate-intensity physical activity behaviours. A semi-structured discussion format was used to allow flexibility in questioning and conversation whilst remaining within the context of particular themes. The themes explored were structured and based on our interpretation of the relevant descriptive epidemiology and determinants studies that had been previously reviewed. We focussed particularly on gender and activity-type differences. The themes were sequenced such that participants began by discussing perceptions of environments for participating in moderate-intensity physical activity, and were then led into a discussion of vigorous-intensity sporting and fitness activities.

Moderate-intensity activity was defined during discussions as "exercise or activity that does not make you breathe harder or puff and pant, such as recreational or incidental activity". Examples given to participants were brisk walking, climbing stairs, lifting and carrying, and cycling and golf. Participants were asked to describe settings and any barriers to undertaking more moderate-intensity activity on campus; on the way to campus (methods of travel); and, away from campus. Discussions then focussed on whether they did any form of vigorous-intensity activity on- and off-campus. Vigorous-intensity activity was defined as "exercise or activity that makes you breathe harder or puff and pant, such as sport and fitness activities". Examples given were running, aerobic classes, and sports like football, netball, and squash.

Analyses

The tape recordings were transcribed by the research officer (SB) and checked for accuracy by the group discussion facilitator (EL). Each transcript was read in order to identify key themes. From these themes, a coding framework was developed. The text was then coded and sorted into relevant theme areas using the qualitative data software package Ethnograph v4.0. Statements that portrayed the strongest themes from the discussions are presented in the italicised quotations in the Results section.

I.3 Results

The group-discussion findings are reported as general themes and relevant examples that emerged. For several aspects of campus environmental barriers to moderate-intensity and vigorous activity, there was clear consistency between males and females. Where specific areas of difference emerged between males and females, these are identified as such.

Barriers to Moderate-Intensity Activities on Campus

The only on-campus activities of moderate-intensity reported were walking and stair climbing, with participants reporting that there was nothing else to do. There were few differences between males and females. Walking was done to and from classes and going to the cafeteria and library. Walking from campus car parks and streets near the campus, and in some cases, walking to and from bus stops and tram stops while using public transport were reported as a means of getting to and from places (transport), but were not identified as being for the purposes of exercise. Several males and females stated that they enjoyed walking, as they had to sit for a large part of the day when attending campus.

> *"I park over the road because there are no parks here and I like a bit of a walk.....and it's cheaper (to park there). At uni you're sitting down a lot of the time so it's good to have that walk".*

Many of the females expressed a desire to walk while on campus but were uncertain where they could go and did not identify settings that they found to be attractive; they also expressed safety concerns about the environment around the campus.

> *"I really can't go for a walk or run because of the (lack of) change facilities and I don't really want to go by myself because of safety issues and because I don't know the area well."*

For some male participants, moderate-intensity activity was considered boring, with the view that it was only worthwhile doing vigorous-intensity activity because it provided more fitness benefits and it was more enjoyable.

"It's pretty boring going for a walk really. I would prefer to do something like play basketball or something which makes the time go a bit quicker. With walking you just think of other stuff and you get bored and stop."

Barriers to Walking and Cycling for Transport

Most participants used private motor-vehicle transport to get to and from the campus, and most stated that they drove because it was quicker, more convenient and in many cases, public transport was not available. When asked about barriers that may prevent them walking or cycling to the campus, there was a general view by both males and females that a major barrier was the fact that there were no change rooms or showers to use upon arrival.

"I don't walk or cycle to uni because of lack of facilities at the end of it. You can't come here and have a shower and go to class which is pretty important."

Male participants in particular stated that they would be happy to walk or ride a bicycle to campus if it was possible, but for most the distance they lived from campus and the consequent time it would take made this too difficult.

Barriers to Vigorous Sport and Fitness Activities on Campus

No on-campus vigorous-intensity activity was reported by any participants. Consistent with our earlier studies (Leslie, Owen & Sallis, 1999; Leslie, Fotheringham, Veitch, et al., 2000), both male and female participants saw few opportunities for vigorous sporting and fitness activities in the campus. The main barriers to vigorous activity were the lack of suitable facilities to do any activity, the lack of change rooms and showers, and lack of time due to the competing demands of needing to study while on campus.

"Lack of facilities. If there were possibly some aerobics sort of classes offered or (if I could) go for a swim or go to a gym, if there were any sort of facilities (available). Basically you can't even go for a run because there is no showers or anything."

Participants (both male and female) reported that they had blocks of free time when they were on campus that could be conveniently used for doing activity if the facilities they wanted to use were there.

"It's so convenient to have a facility on campus. It saves that time- it takes time to get to places and if you are already coming then it just eliminates that. I think if it was in the one spot and you've got the time you would just go and do it."

There was a clear awareness for both males and females of the lack of facilities on campus, compared to facilities that they knew existed on other university campuses.

"I know at (other university) every single day before or in between or after classes I would go to the gym, every single day. They had the change rooms and the facilities and I would do something there every day."

There was general agreement that the lack of facilities and organised activities available on campus made it difficult to do any vigorous activity despite a desire to use free time in this way when on campus. Females wanted to be able to do aerobics, for which there were no facilities or organised programs. Males wanted to use a weights gym and also felt that having something social to do with their friends during their breaks on campus was important.

"I probably would go for it (using a gym on campus) because I assume it would be cheaper than getting your regular membership. That's probably why I would choose it over any other place..... it would be a good way to fill in gaps."

<u>Vigorous Sporting and Fitness Activities Off-Campus</u>

While not doing any vigorous-intensity activity on-campus males in particular tended to report involvement in vigorous activities off-campus, including activities such as running, going to the gym, and playing basketball, tennis or football. For females, vigorous activity was usually something in which they had participated in the past, or which they did during semester breaks, despite feeling it was important to them.

Participants generally commented that if there were opportunities for doing vigorous activity on campus they would find them convenient, as they would be able to fit the activity in with their other committments.

" I like doing study at home, I don't like doing it here. I feel like I'm wasting time sitting in the café for two hours and I would rather go and do exercise at that time in between classes if there were showers and stuff. I don't like studying here much. If I had a choice I would go and do exercise."

General Perspectives

Generally, participants focussed on the fact that the campus setting was not particularly conducive to doing the physical activity they would like to do and expressed concerns about the environmental barriers that existed.

"....we don't do as much activity as at secondary school. I used to do heaps more then. I guess we had to then, the environment was more suitable for it."

I.4 Discussion

Participants in the group discussions consistently identified particular features of the campus environment that acted as barriers to walking and cycling and to vigorous sport and fitness activities. Opportunities to be active on campus were restricted to incidental activity such as walking and stair-climbing, due to the limited availability of specific facilities. Key issues that emerged were i) a lack of facilities for doing preferred activities; ii) a lack of showers, change rooms, lockers to support doing activity on campus; and, iii) periods of time available while attending campus that would make being active on campus more convenient than doing activity elsewhere, if facilities were to be available.

These findings provide context and "texture" that potentially can inform further studies of factors influencing the physical activity of young adults in particular settings. Subsequent quantitative, prospective and intervention studies might usefully draw on what is reported here. There are however, limitations to the generalizability of these findings, in that they are derived from a small number of students on a particular campus. There is significant variability in the range of available facilities provided on Australian university campuses (Leslie, Mounsey & Owen, 1998). The views expressed by these students are specific to a campus that has only limited facilities. It is likely that responses would be different for those attending campuses that had a large range of

accessible facilities. Nevertheless, 50% of Australian tertiary-education campuses, particularly small and regional campuses, are generally similar to the setting for our study in their limited range of activity facilities (Leslie, Mounsey & Owen, 1998).

Participants described a wide range of physical activities in which they participated off-campus; however, they reported only incidental activities such as walking and stair-climbing on the campus itself, or connected with travelling to the campus. Barriers to activity on campus that emerged in discussions included lack of time available, lack of convenience, competing demands such as study, and "having nothing to do". The major barriers to walking and cycling for transport were convenience (distance and time factors) and the lack of change rooms and showers on campus. While our structured discussion format focussed on environmental barriers, the personal and social factors - for example time, or lack of company (Leslie, Owen, Salmon et al., 1999) that have been the subject of much "barriers" research (Brawley et al., 1998) did emerge.

Despite the need to attend lectures and perform study-related activities (such as going to the library) while on campus, participants clearly expressed interest in doing some activity between classes yet found that there were environmental constraints on the availability and suitability of their preferred activity choices. If appropriate facilities that matched student preferences (Leslie, Owen & Sallis, 1999) were actually available on campus, they may find them more convenient to use than trying to find extra time to do activity off-campus. In another Australian qualitative study (Hahn & Craythorn, 1994), the authors concluded most of the park and recreation land available was appropriate for organised team sports, despite the majority of residents in a general community sample preferring unstructured activities like walking and cycling.

Some informative gender differences emerged: Males reported doing regular vigorous sport and fitness activities off-campus such as participation in a team sport, going to the gym, running, and bicycle riding, but females reported only occasional participation. This finding is supported by cross-sectional and prospective studies that indicate that females show a decline in rates of vigorous-intensity activity at an earlier age than do males (Sallis, 2000). Females however, identified the campus environment as a setting in which they would like to incorporate some regular vigorous activity into their

routines. Females, but not males, identified walking for recreation off-campus, but considered safety and the lack of attractive options as barriers to walking on campus.

In addition to facilities, there may also be a need for promotional initiatives to encourage being active in these settings. University campuses have services and programs that support physical activity and provide prompts and incentives for participation such as inexpensive club memberships and equipment hire. The combination of support and the existence of actual facilities on campus may combine to form a physical activity 'culture' whereby students experience activity as part of campus life and expect to be active in this environment.

The university campus setting provides a context in which to examine attributes of physical activity environments relevant to young adults. While there is considerable variability in the facilities that may be available on Australian university campuses (Leslie, Mounsey & Owen, 1998), examining the factors that make such settings supportive of physical activity (particularly smaller campuses and those in regional areas) can be of practical public health importance. Identifying barriers to different types of physical activity (moderate-intensity and vigorous) can be helpful in designing interventions which can target modifiable environmental factors. More generally, this study helps to highlight how a better understanding of the influences of particular environmental attributes on the health-related behaviours of particular groups has the potential to inform settings-based health promotion strategies (Green & Kreuter, 1990; Sallis & Owen, 1997; Sallis & Owen, 1999).

APPENDIX J:

Personal and Environmental Barriers to Moderate-Intensity and Vigorous Sport and Fitness Activities for Young Adults in Campus Settings

BACKGROUND:

This purpose of this study was to examine the perceived barriers to moderate-intensity and vigorous sport and fitness activities on campus, in a sample of university students. Barriers are reported separately for males and females.

The results from this study were used to help inform the modification of the barrier items used in Chapter 5.

J.1 Introduction and aims

A focus on "barriers" has been central to studies of the factors that can influence physical activity. For example, younger adults are twice as likely as are older adults to report "not having time" as a barrier to physical activity participation (Booth et al., 1997). Younger adults were also twice as likely to report "lack of motivation" as a barrier. However, studies of barriers have tended to focus on personal and social factors, with relatively few studies examining the influence of physical environment factors (Brawley, Martin & Gyurcsik, 1998; Sallis & Owen, 1999). Settings-based perspectives on health promotion take into account environmental barriers in workplaces, schools and communities (Green & Kreuter, 1990). "Ecological" models provide a theoretically-anchored perspective and point strongly to the role of the physical and organisational environments as proximal determinants of healthy or unhealthy choices (Sallis & Owen, 1997; Stokols, 1992). Applied to physical activity, ecological models point to the importance for health promotion strategy of understanding the specific links between particular settings attributes, particular behavioural "choices" and the attributes of those who spend time in the setting (Sallis & Owen, 1997; Sallis, Bauman & Pratt, 1998).

Qualitative research has provided accounts of perceived environmental barriers to physical activity in different settings. This has included worksite physical activity for blue-collar workers (Veitch, Owen, Burns et al., 1997), barriers in community settings for older adults (Brown, Fuller, Lee et al., 1999), and barriers to the use of community free and pay recreational facilities (Corti, Donovan, & Holman, 1996). These studies found that environmental constraints, particularly lack of facilities, availability and suitability of activity choices, and proximity and accessibility of facilities generally were perceived to be important barriers to being more active.

In a qualitative study examining the perceived environmental influences on young adult's physical activity (see Appendix I) barriers to moderate-intensity and vigorous activity within the campus environment were identified. Males and females identified a lack of suitable facilities for vigorous activity and a lack of showers, change rooms and lockers as

restricting walking and cycling for transport to campus. Males reported doing regular vigorous activity off-campus while females did so only occasionally. Females reported a lack of awareness of attractive options for walking and identified safety issues as a barrier (see also Appendix A-7). These findings support the notion that there are different influences and barriers for moderate-intensity and vigorous activity.

Moderate-intensity activities that are likely to be carried out by young adults in the campus setting are primarily walking for transport in getting to and from campus, or walking during breaks for recreation. The opportunity to participate in any vigorous sport or fitness activities on campus is most likely related to the availability of specific facilities being available. Students attending large university campuses are more likely to have these facilities available than are those attending smaller and rural campuses (Leslie, Mounsey, & Owen, 1998).

The main aims of this study are to examine the barriers to participation in moderate-intensity (walking) and vigorous (sport and fitness) activities on campus, in a sample of young adults attending university. Barriers are reported separately for males and females. There is an emphasis on the possible environmental factors that may influence both walking and vigorous activities in the campus setting, taking into account broader ecological models (Sallis & Owen, 1994; Sallis, Bauman & Pratt, 1998).

J.2 Study sample

The data analysed in this study were obtained from a cross-sectional mail-out survey sent to third-year students attending two campuses of a metropolitan university. Names and addresses were randomly selected from the student database. The self-completed survey included questions on demographics (age, sex, student and employment status, physical limitations), past week physical activity recall (on and off campus), barriers to walking and sport and fitness activities on campus, and attitudes to health. Deakin University Ethics Committee and the University Administrative Division approved the study.

A total of 2000 questionnaires were mailed out; 340 were returned (response rate = 17%). Of those returned twenty-eight were over 30 years of age and so were excluded from the analyses. Of the 312 between 18 and 30 years of age, 216 (69%) were females, 96 (30.8%) were males. Mean age was 21.5 years, with 60.5% of the sample between 18 and 21 years. The sample included a higher proportion of females when compared with the percentage of females enrolled at the campus (57.0%). Three-quarters of the sample were in the normal weight category for Body Mass Index (BMI) (75%). A large proportion of the sample (79%) were employed part time. Eighty-eight percent of the sample reported no physical limitations to physical activity.

J.3 Methods for the study

The University Administrative Division provided 2000 randomly selected address labels for students who were listed as being in their third year. These were specifically requested in order to obtain subjects who had sufficient exposure to the university environment. There was no way of knowing whether students selected this way were enrolled as off or on-campus students. A letter from the University Administrative Division explaining their endorsement of the study was sent out in a package, together with a plain language statement outlining the study and the University Physical Activity Questionnaire (see Appendix G). Ethics approval for the study was obtained.

Previously reported barriers to physical activity were reviewed to help identify barriers in the campus setting. These were broadly classified into time/effort factors, personal factors and social and physical environment factors. The information gathered in the qualitative study (see Appendix I) on young adult's perceived barriers to moderate-intensity and vigorous activity was used to modify previously used barrier variables from the Pilot Survey of the Fitness of Australians (see Q 47a. Appendix B). These new items took into account the type of activity that students reported doing on campus. Moderate-intensity activity on campus was mainly related to walking for transport and for exercise while vigorous activity was related to doing sport and fitness activities on campus. Additional walking items were added from those used in the NSW Physical Activity Survey, 1994 (Bauman, Bellew, Booth et al., 1996).

J.4 Assessing barriers to walking on campus

Participants were asked to indicate how strongly a number of barriers applied in regard to walking in and around the campus, using a five-point Likert scale (1 = "Strongly agree" to 5 = "Strongly disagree"). Barrier items included it is not safe walking during the night, it is not safe walking during the day, there is no one to walk with, the campus is not attractive/pleasant, it takes too long /it is too far to walk, traffic in and around the campus makes walking difficult, there are inadequate footpaths linking carparks and classrooms, there are no change rooms/showers to use, there is no walking track, I'm not interested in walking on campus, there is nowhere to walk to from campus. Responses were coded as the percentage that reported they 'Strongly agreed' with each barrier item (scale 1 or 2).

J.5 Assessing barriers to sport and fitness activities on campus

Participants were asked to indicate how strongly a number of barriers applied in regard to doing sport and fitness activities on campus, using a five-point Likert scale (1 = "Strongly agree" to 5 = "Strongly disagree"). Barrier items included it is not important to do any sport and fitness activity on campus, it is too much trouble, I am not interested in sport and fitness activity on campus, there are suitable facilities to use, there are no programs for sport and fitness activity on campus, there are no change rooms/showers to use, it is hard to get access to facilities, I am usually too busy to find time, there are no lockers for storing belongings, it is too expensive, it is not easy to do. Responses were coded as the percentage that reported they 'Strongly agreed' with each barrier item (scale 1 or 2).

J.6 Barriers to walking on campus

Perceived barriers to walking in and around campus are presented in Table J.1. Barriers reported by at least a third of the sample were it takes too long/is too far (51.9%), I am not interested (44.7%), it is not safe walking at night (44.5%) and there is nowhere to walk to (34.4%). There were significant differences in the proportions of males and females reporting it is not safe walking at night and there is none to walk with ($p<.05$). Twice as many females reporting it is not safe walking at night as a barrier than did males. A higher

proportion of males reported there is none to walk with than did females. Having no walking track was reported by the smallest proportion of respondents overall (7.7%).

Table J.1: Barriers to walking in and around campus

Barriers	Overall	Males	Females
	(N=312)	31%	69%
It takes too long/is too far	51.9	47.9	53.8
I am not interested	44.7	50.0	42.3
It is not safe walking at night	44.5	24.0	53.7*
There is nowhere to walk to	34.4	38.5	32.6
There is no one to walk with	30.1	39.1	26.2*
There are no change rooms	29.9	28.1	30.7
There are no adequate footpaths	27.3	27.1	27.4
The campus is not attractive/pleasant	16.6	13.8	17.8
There is too much traffic	15.2	10.4	17.3
There is no walking track	7.7	6.3	8.4

*p<.05

J.7 Barriers to sport and fitness activities on campus

Perceived barriers to sport and fitness activities on campus are presented in Table J.2. Two-thirds of the sample reported being too busy to find time to do sport and fitness activities on campus (66.7%). Barriers reported by over 30% of the sample included it is too much trouble (52.6%), it is not important to do sport and fitness activities on campus (44.5%), no suitable facilities (42.7%), not easy to get access to facilities (32%), no convenient change rooms (31.7%), and not knowing where facilities are located (31.1%). The least reported barrier overall was not being interested in doing sport and fitness activities on campus (7.8%). Significant differences in proportions reported between males and females were it is too much trouble, there are no convenient change rooms and there are no lockers (p<.05).

Females were more likely to report it is too much trouble, while males were more likely to report the absence of change rooms, lockers or suitable facilities than were females.

Table J.2: Barriers to sport and fitness activities on campus

Barriers	Overall	Males	Females
	(n=312)	31%	69%
Too busy to find time on campus	66.7	60.0	69.6
Too much trouble	52.6	44.2	56.3*
Not important to do on campus	44.5	43.2	45.1
No suitable facilities	41.7	47.9	39.0
Not easy to get access to facilities	32.0	35.8	30.4
No convenient change rooms	31.7	43.2	26.6*
Don't know where facilities are located	31.1	26.3	33.2
No lockers available	23.6	32.6	19.6*
Not easy to do on campus	23.6	27.4	22.0
No programs on campus	19.3	17.9	19.9
Too expensive	11.0	9.5	11.7
Not interested in doing sport on campus	7.8	8.4	7.5

*p<.05

J.8 Summary of findings

Reported barriers to walking in and around campus were, in order of importance, it takes too long/is too far (51.9%), I am not interested (44.7%), it is not safe walking at night (44.5%) and there is nowhere to walk to (34.4%). There were significant differences between males and females, with twice as many females reporting it is not safe walking at night as a barrier than did males. More males than females reported there is none to walk with. Only a small proportion of respondents reported having no walking track as a barrier.

Reported barriers to sport and fitness activities on campus were, in order of importance, being too busy to find time to do sport and fitness activities on campus (66.7%), it is too

much trouble (52.6%), it is not important to do sport and fitness activities on campus (44.5%), no suitable facilities (42.7%), not easy to get access to facilities (32%), no convenient change rooms (31.7%), and not knowing where facilities are located (31.1%). Only a small proportion of respondents reported not being interested in doing sport and fitness activities on campus as a barrier. There were significant differences between males and females, with more females reporting it is too much trouble, while more males reported the absence of change rooms, lockers or suitable facilities than did females.

The barriers reported for walking comprised many environmental variables while those reported for sport and fitness activities were more related to personal factors. This may reflect the more volitional nature of vigorous activities, as compared to walking, which can often occur incidentally.

In this sample of young adults, a high proportion reported being not interested in walking on campus, with a low proportion reporting being not interested in doing vigorous activity on campus. This reflects the preferences of this age group, who are more interested in vigorous sport and fitness activities than they are in moderate-intensity activities like walking.

A limitation of this study is the low response rate to the mail-out survey. Compared to the studies reported in Chapters 3, 4, and 5 of this thesis, this is disappointing, but may be the result of the difficulty in obtaining current information on students through an administrative database and a lack of encouragement or incentive to respond.

APPENDIX K:

Test-retest reliability of stage measures for moderate-intensity and vigorous activity

APPENDIX K: Number and percentage (in parentheses) of respondents in each Stages of Change category at test (T1) and retest (T2) for moderate-intensity and vigorous activity.

	Moderate-intensity*		Vigorous**	
	T1	T2	T1	T2
Precontemplation	14 (11.5)	12 (9.8)	15 (12.2)	13 (10.6)
Contemplation	15 (12.3)	11 (9.0)	15 (12.2)	13 (10.6)
Preparation	25 (20.5)	14 (11.5)	22 (17.9)	16 (13.0)
Action	20 (16.5)	32 (26.2)	14 (11.4)	25 (20.3)
Maintenance	48 (39.3)	53 (43.4)	57 (46.3)	56 (45.5)
	122 (100)	122 (100)	123 (100)	123 (100)

* Kappa = .358 Average Correct Classification = 52%

** Kappa = .593 Average Correct Classification = 71%

APPENDIX L:

Additional gender data for Chapter 5:

Stages of Change analyses, by gender

APPENDIX L-1: Relationships of environmental barriers, personal barriers and competing demands to Stages of Change for moderate-intensity physical activity for males only.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Sub-scale	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental barriers	23.3 (21.43-25.06)	21.5 (19.07-23.89)	22.6 (20.07-25.08)	21.6 (19.39-23.86)	22.8 (21.32-24.34)	0.562	
Personal barriers	13.6 (12.06-15.04)	14.0 (12.55-15.45)	14.2 (12.25-16.21)	13.0 (11.54-14.52)	11.7 (10.84-12.74)	2.500	
Competing demands	18.9 (17.34-20.45)	18.4 (17.16-19.58)	17.5 (16.07-18.84)	17.2 (15.57-18.80)	17.3 (16.24-18.43)	1.136	

NB. *Range of scores for each sub-scale:*

Sub-scale 1 (range 7 to 35): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

Sub-scale 2 (range 6 to 25): high scores mean stronger perceptions of personal barriers to being active on campus than do lower scores.

Sub-scale 3 (range 6 to 29): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

APPENDIX L-2: Relationships of environmental barriers, personal barriers and competing demands to Stages of Change for vigorous physical activity for males only.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Sub-scale	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental barriers	22.2 (19.42-24.92)	23.2 (20.09-26.34)	21.4 (18.32-24.45)	23.5 (21.17-25.88)	22.4 (21.25-23.49)	0.387	
Personal barriers	15.2 (13.35-17.02)	14.4 (12.17-16.56)	14.1 (11.64-16.46)	13.3 (11.05-15.58)	11.9 (11.23-12.59)	4.428*	1 vs 5
Competing demands	18.2 (15.85-20.25)	17.9 (16.36-19.37)	17.7 (16.05-19.25)	15.8 (13.74-17.84)	18.0 (17.19-18.88)	1.112	

* $p < 0.01$

NB. *Range of scores for each sub-scale:*

Sub-scale 1 (range 7 to 35): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

Sub-scale 2 (range 6 to 25): high scores mean stronger perceptions of personal barriers to being active on campus than do lower scores.

Sub-scale 3 (range 6 to 29): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

APPENDIX L-3: Relationships of environmental and personal motivators to Stages of Change for moderate-intensity physical activity for males only.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Sub-scale	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental motivators	23.3 (21.30-25.20)	25.8 (23.96-27.69)	25.3 (23.54-27.03)	26.0 (24.32-27.66)	23.2 (21.98-24.46)	2.977	
Personal motivators	18.9 (17.69-20.11)	19.9 (18.55-21.31)	20.8 (19.17-22.36)	21.1 (19.83-22.34)	19.7 (18.73-20.67)	1.817	

NB. Range of scores for each sub-scale:

Sub-scale 1 (range 7 to 35): high scores mean stronger perceptions of environmental motivators for being more active on campus than do lower scores.

Sub-scale 2 (range 5 to 25): high scores mean stronger perceptions of personal motivators for being more active on campus than do lower scores.

APPENDIX L-4: Relationships of environmental and personal motivators to Stages of Change for vigorous physical activity for males only.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Sub-scale	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental motivators	22.9 (20.66-25.07)	25.0 (23.02-26.98)	26.4 (23.78-28.99)	24.9 (21.52-28.37)	24.1 (23.15-25.04)	1.408	
Personal motivators	18.7 (17.29-20.19)	20.1 (18.26-21.91)	20.6 (19.2-22.03)	20.6 (18.17-22.94)	20.0 (19.26-20.71)	0.815	

NB. *Range of scores for each sub-scale:*

Sub-scale 1 (range 7 to 35): high scores mean stronger perceptions of environmental motivators for being more active on campus than do lower scores.

Sub-scale 2 (range 5 to 25): high scores mean stronger perceptions of personal motivators for being more active on campus than do lower scores.

APPENDIX L-5: Relationships of environmental barriers, personal barriers and competing demands to Stages of Change for moderate-intensity physical activity for females only.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Sub-scale	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental barriers	21.7 (20.09-23.28)	22.5 (21.42-23.64)	21.9 (20.81-22.99)	23.6 (22.16-24.99)	23.2 (22.22-24.18)	1.590	
Personal barriers	14.7 (13.79-15.63)	15.5 (14.67-16.31)	14.8 (13.87-15.83)	14.7 (13.65-15.71)	12.6 (11.85-13.44)	7.317*	1,2,3,4 vs 5
Competing demands	19.1 (18.11-20.15)	18.8 (17.95-19.75)	17.9 (16.78-18.96)	19.2 (18.14-20.26)	19.0 (18.23-19.76)	1.060	

* $p < 0.001$

NB. *Range of scores for each sub-scale:*

Sub-scale 1 (range 7 to 35): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

Sub-scale 2 (range 6 to 24): high scores mean stronger perceptions of personal barriers to being active on campus than do lower scores.

Sub-scale 3 (range 6 to 30): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

APPENDIX L-6: Relationships of environmental barriers, personal barriers and competing demands to Stages of Change for vigorous physical activity for females only.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Sub-scale	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental barriers	21.2 (19.51-22.88)	22.8 (21.67-23.98)	22.3 (21.27-23.36)	23.3 (21.98-24.57)	23.1 (22.05-24.06)	1.539	
Personal barriers	15.1 (13.97-16.24)	16.1 (15.25-16.89)	15.5 (14.70-16.32)	13.3 (12.36-14.22)	12.5 (11.70-13.23)	13.959*	1,2,3 vs 4,5
Competing demands	18.8 (17.81-19.85)	18.7 (17.86-19.56)	18.3 (17.40-19.17)	19.1 (17.83-20.33)	19.3 (18.47-20.07)	0.675	

* $p < 0.001$

NB. *Range of scores for each sub-scale:*

Sub-scale 1 (range 7 to 35): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

Sub-scale 2 (range 6 to 26): high scores mean stronger perceptions of personal barriers to being active on campus than do lower scores.

Sub-scale 3 (range 6 to 30): high scores mean stronger perceptions of environmental barriers to being active on campus than do lower scores.

APPENDIX L-7: Relationships of environmental and personal motivators to Stages of Change for moderate-intensity physical activity for females only.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Sub-scale	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental motivators	24.2 (22.70-25.70)	26.0 (25.04-27.06)	26.1 (24.88-27.37)	27.2 (26.11-28.23)	26.9 (26.00-27.72)	3.885*	1 vs 4,5
Personal motivators	17.7 (16.80-18.70)	19.5 (18.73-20.31)	19.7 (18.89-20.53)	19.9 (19.14-20.69)	20.2 (19.55-20.90)	5.548**	1 vs 3,4,5

* $p < 0.01$
** $p < 0.001$

NB. *Range of scores for each sub-scale:*

Sub-scale 1 (range 7 to 35): high scores mean stronger perceptions of environmental motivators for being more active on campus than do lower scores.

Sub-scale 2 (range 5 to 25): high scores mean stronger perceptions of personal motivators for being more active on campus than do lower scores.

APPENDIX L-8: Relationships of environmental and personal motivators to Stages of Change for vigorous physical activity for females only.

	PRECONT Group 1	*CONT Group 2*	*PREPAR Group 3*	*ACTION Group 4*	*MAINT Group 5*	*F Ratio*	*Diff's*
Sub-scale	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*	*Mean (CI)*		*Scheffe's*
Environmental motivators	23.2 (21.56-24.85)	26.7 (25.73-27.74)	27.0 (25.92-28.01)	26.1 (25.06-27.19)	26.8 (25.94-27.70)	6.646*	1 vs 2,3,4,5
Personal motivators	16.6 (15.53-17.62)	19.5 (18.82-20.27)	20.0 (19.22-20.71)	20.5 (19.75-21.33)	20.2 (19.56-20.82)	13.589*	1 vs 2,3,4,5

* $p < 0.001$

NB. *Range of scores for each sub-scale:*

Sub-scale 1 (range 7 to 35): high scores mean stronger perceptions of environmental motivators for being more active on campus than do lower scores.

Sub-scale 2 (range 5 to 25): high scores mean stronger perceptions of personal motivators for being more active on campus than do lower scores.

APPENDIX M:

Conference presentation based on data from Chapter 5:

Stages of Change for Moderate-Intensity and Vigorous Physical Activity in Young Adults

BACKGROUND:

This appendix includes the accepted abstract and poster presentation for the Cooper Institute Conference Series: Innovative Approaches to Understanding and Influencing Physical Activity - Moderators and Mediators of Physical Activity, October 4-6, Dallas, Texas, 2001.

The study described here summmarises data for the barrier factors that were reported in Chapter 5, but does not include data for the motivator factors.

M-1

Accepted abstract

M-2

Handout for poster presentation at the Cooper Institute Conference: Moderators and Mediators of Physical Activity, Dallas, 2001

APPENDIX M-1

Stages of Change for moderate-intensity and vigorous physical activity in young adults

E. Leslie, N. Owen, A. Bauman, A. Marshall

Context: Among young adults, males have higher rates of participation for both moderate-intensity (MPA) and vigorous physical activity (VPA) than do females. The Stages of Change (SOC) construct has been used to target and tailor interventions. Staging items tend to use either 'regular exercise', or 'participation in three sessions of vigorous activity per week for at least 20 minutes per time' as a referent.

Objective: To assess SOC separately for MPA and VPA, examining stage prevalence for young adult males and females and associations of reported barriers to physical activity with stage.

Methods: We assessed SOC and related variables in a sample of 697 young adults (mean age=20.7 yrs; response rate of 89%). Test-retest repeatability of the MPA SOC item was fair (kappa=.358) and was moderate for VPA (kappa=.592).

Results: There were significant differences between males and females on MPA (χ^2 =11.75, *df=4*, *p*=.020) and VPA (χ^2 =48.5, *df=4*, *p*=.000) stage membership. The proportion of males in Maintenance for VPA (57%) was higher than for MPA (37%). There were fewer males in Precontemplation for VPA (11%) than for MPA (20%). For VPA, 57% of males and 29% of females were in Maintenance. For MPA, there were significant differences between stages on personal barriers for females, but not for males. For VPA, both males and females showed significant differences between stages on personal barriers, primarily between Action and Maintenance versus earlier stages.

Conclusions:
Differences in stage membership for males and females parallel findings on differential levels of participation in VPA and MPA. Lack of any stage related differences in barriers suggests that MPA may be a less salient behaviour pattern for males than it is for females. VPA may be more salient, as it showed clear stage differences in personal barriers for both genders.

Stages of Change for Moderate-Intensity and Vigorous Physical Activity in Young Adults

Eva Leslie [1], Neville Owen [1], Adrian Bauman [2], Alison Marshall [2]

[1] Faculty of Health & Behavioural Sciences, University of Wollongong, Australia.
[2] Epidemiology Unit, South West Sydney Area Health Service, Australia.

University of Wollongong

INTRODUCTION

Physical activity promotion strategies tend to focus on middle-aged or older adults (eg, Bauman et al., 2001). The young adult years are a neglected but potentially important preventive window. This is a time when adults' health related behaviour patterns are being established -- particularly life-long patterns of habitual sedentariness. There is an age-related decline in physical activity (Sallis, 2001; USDHHS, 1996). In the young adult years, there are decreases in both moderate-intensity (MPA) and vigorous physical activity (VPA). Males have higher rates of participation in MPA and VPA than do females (Leslie et al., 2001). Factors associated with being insufficiently active for health benefits differ in several ways between males and females (Leslie et al., 1999; Leslie, Owen & Sallis, 1999).

The Stages of Change (SOC) construct identifies different levels of motivational readiness for physical activity. However, staging algorithms have typically used a VPA criterion (3 sessions of 20min/wk; see Marcus et al., 1992). Current public-health recommendations emphasize MPA for 5 sessions of 30min/wk (Pate et al., 1995; USDHHS, 1996). Among young adults, the declines in MPA and VPA, the differing participation rates for males and females and the differing factors associated with being active and inactive require further investigation. Using the SOC construct and examining perceived barriers to physical activity may be informative in this regard.

OBJECTIVES

1. to assess MPA and VPA SOC for males and for females
2. to examine the reliability and validity of MPA and VPA SOC measures
3. to examine associations of barriers to physical activity with SOC for MPA and VPA

METHODS

Sample: Campus-based paper and pencil survey (response rate 89%) of 697 young adults (18 to 29 years; mean = 20.7 years; 31% male).

Stages of Change measures: A modified short-form five-stage response question (Marcus et al., 1992; Reed et al., 1997) was used for MPA and VPA, based on criteria for regular vigorous activity (ACSM, 1998) and moderate-intensity activity (Pate et al., 1995). SOC for MPA was assessed by asking *'do you participate in moderate physical activity such as recreational or incidental activity (e.g. brisk walking, cycling) five times a week for at least 30 minutes each time?'* SOC for VPA was assessed by asking *'do you participate in vigorous physical activity such as sport or fitness activities (e.g. aerobics, running etc.) three times a week for at least 20 minutes each time?'* Participants chose one of the following options:

- no, and I do not intend to in the next 6 months
- no, but I intend to in the next 6 months
- no, but I intend to in the next 30 days
- yes, I have been, but for less than six months
- yes, I have been for more than six months

Physical activity behavior measures: Self reported leisure-time physical activity (two week recall of walking, moderate-intensity and vigorous activity).

Reliability and validity of SOC measures: Test-retest reliability was assessed in a separate sample of 123 young adults using a mail-out survey. Validity was assessed by comparing self-reported minutes of MPA and VPA across the SOC (See Table 1).

Barriers measures: Participants rated 20 items on barriers to being more active on a 5-point likert scale.

Data analysis: Barrier item data were factor analysed using principal component analysis. Chi-square analysis was used to examine the differences between males and females on MPA and VPA stage membership (See Figures 1 and 2). One-way analyses of variance were used to examine relationships between reported minutes of MPA and VPA, and SOC for MPA and for VPA; and to examine relationships between the barrier factors and SOC for MPA and for VPA, separately for males and females. In all analyses, post hoc Scheffe tests were used to examine the differences between means (see Tables 1 and 2).

RESULTS

There were significant differences between males and females on SOC membership on MPA (χ^2 =11.75, *df* =4, *p* =.020) and VPA (χ^2 =48.5, *df* =4, *p* =.000). The proportion of males in Maintenance for VPA (57%) was higher than for MPA (37%). There were fewer males in Precontemplation for VPA (11%) than for MPA (20%). For VPA, 57% of males and 29% of females were in Maintenance.

Figure 1: Percentages of males and females by SOC for MPA

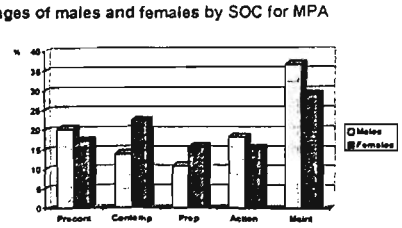
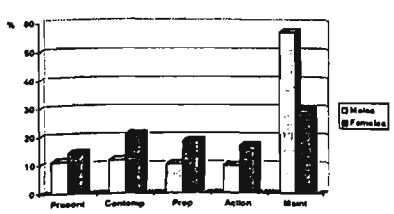


Figure 2: Percentages of males and females by SOC for VPA



Test-retest reliability of the MPA SOC item was fair (kappa =.358), and moderate for the VPA SOC item (kappa =.592). Average correct classification (ACC) was 52% for MPA, and 71% for VPA. There was an increase in reported minutes of MPA and VPA by SOC, with generally higher scores reported by those in Maintenance and the lowest scores reported by those in Precontemplation. SOC differences are shown in Table 1.

Table 1: Mean minutes for self-reported moderate and vigorous activity, by MPA and VPA SOC for males and females

	PRECONT	CONT	PREP	ACTION	MAINT	*F Ratio*	*Scheffe*
MPA FEMALES (424)	127	161	194	442	492	20.20**	1,2,3 VS 4,5
MPA MALES (175)	236	201	368	259	507	3.22	NS
VPA FEMALES (458)	53	52	82	213	422	31.36**	1,2 VS 4, 5 3,4 VS 5
VPA MALES (185)	54	183	75	358	585	8.95**	1,2,3 VS 5

*$p < 0.01$, **$p < 0.001$

Data for the barrier items produced three factors; environmental barriers, personal barriers, and competing demands. Internal consistency (alpha) coefficients for the barrier factors was 0.77 (good) for environmental barriers, 0.67 (moderate) for personal barriers, and 0.53 (fair) for competing demands.

There were no differences between stages for MPA or VPA and environmental barriers or competing demands. For MPA, there were significant differences between stages on personal barriers for females, but not for males. For VPA, both males and females showed significant differences between stages on personal barriers, primarily between Action and Maintenance versus earlier stages (see Table 2).

Table 2: Mean scores for personal barriers, by MPA and VPA SOC for males and females

	PRECONT	CONT	PREP	ACTION	MAINT	*F Ratio*	*Scheffe*
MPA FEMALES	14.7	15.5	14.8	14.7	12.6	7.317**	1, 2, 3, 4, VS 5
VPA FEMALES	15.1	16.1	15.5	13.3	12.5	13.959**	1, 2, 3 VS 4, 5
VPA MALES	15.2	14.4	14.1	13.3	11.9	4.428*	1 VS 5

*$p < 0.01$, **$p < 0.001$

(Personal barriers factor (range 6 to 25): higher scores mean stronger perceptions of personal barriers to physical activity than do lower scores).

DISCUSSION

Differences in SOC membership for males and females parallel findings from population data on differential levels of participation in VPA and MPA (USDHHS, 1996); males have higher participation rates for both MPA and VPA than do females at all ages. A higher proportion of males (57%) compared to females (29%) were in the Maintenance stage for VPA. There were also fewer males in the earlier stages (Precontemplation, Contemplation and Preparation) for VPA than there were females. This reflects the increased likelihood of males being in Action and Maintenance for vigorous activity than are females in this age group.

Lack of any stage-related differences between any of the barrier factors and MPA in males, suggests that MPA may be a less salient behavior pattern for males than it is for females. VPA showed clear stage differences in personal barriers for both genders. For males, those in the Maintenance stage perceived fewer personal barriers than did those in all other stages. For females, those in the Maintenance and Action stages perceived fewer personal barriers than did those in the other stages.

The MPA staging measure may not be sensitive to differences between stages. Moderate-intensity activities like walking are less popular in this age group compared to older age-groups, especially for males who prefer vigorous activities like jogging or team sports (Leslie et al., 1999). The preferences of young adult males may be one reason why when males age, and their rates of VPA decline, they become less active overall.

REFERENCES

ACSM (1998). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exerc, 30*, 975-991.

Bauman et al., (2001). Impact of an Australian mass media campaign targeting physical activity in 1998. *Am J Prev Med 21*, 41-47.

Leslie et al., (2001). Age-related differences in physical activity levels of young adults. *Med Sci Sports Exerc, 33*, 255-258.

Leslie, Owen & Sallis (1999). Inactive Australian College students' preferred activities, sources of assistance, and motivators. *Am J Health Prom, 13*, 197-199.

Leslie et al., (1999). Insufficiently-active Australian college students: perceived personal, social, and environmental influences. *Prev Med, 28*, 20-27.

Marcus et al., (1992). The stages and processes of exercise adoption and maintenance in a worksite sample. *Health Psych, 11*, 386-395.

Pate et al., (1995). Physical Activity and Public Health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA, 273*, 402-407.

Reed et al., (1997). What makes a good staging algorithm: examples from regular exercise. *Am J Health Prom, 12*, 57-66.

Sallis, 2000. Age-related decline in physical activity: a synthesis of human and animal studies. *Medicine and Science in Sports and Exercise, 32*, 1598-1600.

USDHHS (1996). *The Surgeon General's Report on physical activity and health*. Washington, DC: US Government Printing Office.