PHYSICAL ACTIVITY AND DEPRESSION FROM CHILDHOOD TO YOUNG ADULTHOOD

Charlotte Mary McKercher
BMus, BA(Psych)(Hons)

Submitted in fulfilment of the requirements for the Degree of Doctor of Philosophy (Medical Research)

Menzies Research Institute Tasmania
University of Tasmania
June 2012
Declaration of originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief no material previously published or written by any other person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

Signed: ……………………………………………………

Date: ……………………………………………………
Authority of Access

This thesis may be made available for loan. Copying of any part of this thesis is prohibited for two years from the date this statement was signed; after that time limited copying and communication is permitted in accordance with the Copyright Act 1968.

Signed: .......................... 

Date: ..........................
Statement regarding published work contained in thesis

The publishers of the papers comprising Chapter 3, Chapter 5 and Chapter 6 hold the copyright for that content and access to the material should be sought from the respective journals. The remaining non-published content of the thesis may be made available for loan and limited copying and communication in accordance with the Copyright Act 1968.

Signed: ............................................................

Date: ............................................................
Statement of ethical conduct

The research associated with this thesis abides by the international and Australian codes on human and animal experimentation, the guidelines by the Australian Government’s Office of the Gene Technology Regulator and the ruling of the Safety, Ethics and Institutional Biosafety Committees of the University of Tasmania.

Signed: ......................................................

Date: ............................................................
Abstract

Background: The trajectory from childhood to early adulthood is a critical developmental period when physical activity levels decline and depression risk increases. Epidemiological research indicates that physical activity is associated with decreased risk of depression however population-based studies examining the relationship between physical activity and depression from childhood to young adulthood are scant. Determining the efficacy of physical activity in the prevention of depression during this pivotal life stage would be an important advance in public health.

Aims: To investigate i) cross-sectional associations between physical activity and depressed mood in childhood; ii) cross-sectional associations between physical activity and depression, and depressive symptomatology in young adulthood; and iii) prospective associations between habitual physical activity from childhood to adulthood and risk of depression in young adulthood.

Methods: This dissertation utilises data from the Childhood Determinants of Adult Health study, a population-based prospective cohort study from Australia. Baseline data were collected from 6,070 school children participating in the 1985 Australian Schools Health and Fitness Survey, aged 9 to 15 years. Participants were followed-up in young adulthood approximately 20-years later (2004-2006), aged 26 to 36 years. Physical activity was assessed at both time-points via self-report and objectively at follow-up using pedometers. Depressed mood was self-reported at baseline and DSM-IV depression assessed at follow-up using the Composite International Diagnostic Interview.

Results: In childhood, increasing durations of school physical education in primary girls and increasing durations of total physical activity and discretionary sport in secondary boys were associated with decreased prevalence of depressed mood. In young adulthood, increasing ambulatory (pedometer steps/day) and leisure-time physical activity were associated with a decreased prevalence of depression. Increasing work-related physical activity was associated with increased prevalence of depression.
in women only. Depression in physically low/inactive young men and women was characterised by a unique depression symptom profile involving a higher prevalence of suicidal symptomatology. Finally, increasing or maintaining high levels of habitual discretionary physical activity from childhood to adulthood relative to one’s peers was prospectively associated with a decreased risk of depression in young adulthood.

**Conclusions:** The relationship between physical activity and depression in childhood and young adulthood appears to differ by gender, the type of activity and the domain in which it is assessed. Inverse associations between physical activity and depression appear to depend on physical activity being discretionary rather than non-discretionary, particularly in women. Results suggest that population-based strategies aimed at maintaining physical activity participation from childhood and initiating physical activity in young people have potential for reducing the morbidity and subsequent treatment burden of depression.
Table of contents

Declaration of originality ........................................................................................................... i
Authority of Access ................................................................................................................... ii
Statement regarding published work contained in thesis ......................................................... iii
Statement of ethical conduct ..................................................................................................... iv
Abstract ..................................................................................................................................... v
Table of contents ....................................................................................................................... vii
List of tables ............................................................................................................................... xi
List of figures .............................................................................................................................. xii
Acknowledgements................................................................................................................... xiii
Abbreviations ............................................................................................................................. xv
Statement of authorship ........................................................................................................... xvii
Publications ................................................................................................................................. xx
  Publications directly arising from the research described in this thesis ............................ xx
  Conference presentations arising from this thesis ............................................................... xxi
  Oral presentations ................................................................................................................. xxii
  Other presentations ............................................................................................................... xxii
  Poster presentations ............................................................................................................. xxiii
  Awards resulting from thesis material ................................................................................ xxiii
Chapter 1 Introduction ................................................................................................................ 24
  1.1. Epidemiology of depression ............................................................................................ 24
  1.1.1. Burden of depression ................................................................................................. 24
  1.1.2. Definition of depression ............................................................................................ 25
  1.1.3. Prevalence of depression ......................................................................................... 26
  1.1.4. Prognosis of depression ............................................................................................ 27
  1.2. Treatment of depression ................................................................................................. 27
  1.3. Physical activity ............................................................................................................. 29
  1.4. Evidence for an association between physical activity and depression ....................... 30
  1.4.1. The efficacy of exercise interventions in the treatment of depression .................... 30
  1.4.2. Proposed mechanisms for the beneficial effect of physical activity on depression ... 32
  1.5. Physical activity and depression from childhood to adulthood ..................................... 33
  1.6. Research aims ................................................................................................................ 34
  1.7. Summary ......................................................................................................................... 35
5.3.2. Procedure ........................................................................................................... 105
5.3.3. Measures ........................................................................................................... 106
5.3.4. Statistical analyses ............................................................................................ 109
5.4. Results .................................................................................................................. 110
5.5. Discussion ............................................................................................................ 116
5.6. Conclusion ............................................................................................................ 120
5.7. Postscript ............................................................................................................. 121
5.8. References ........................................................................................................... 122

Chapter 6 Validity of self-reported historical leisure physical activity in young adults
........................................................................................................................................ 126
6.1. Preface .................................................................................................................... 126
6.2. Introduction ............................................................................................................ 126
6.3. Methods ................................................................................................................ 128
6.3.1. Participants ....................................................................................................... 128
6.3.2. Measures ........................................................................................................... 128
6.3.3. Statistical analyses ............................................................................................ 131
6.4. Results .................................................................................................................. 132
6.5. Discussion ............................................................................................................ 137
6.6. Conclusion ............................................................................................................ 140
6.7. Postscript ............................................................................................................. 140
6.8. References ........................................................................................................... 141

Chapter 7 Physical activity from childhood to adulthood and depression in young adults
........................................................................................................................................ 144
7.1. Preface .................................................................................................................... 144
7.2. Introduction ............................................................................................................ 144
7.3. Methods ................................................................................................................ 145
7.3.1. Participants ....................................................................................................... 145
7.3.2. Measures ........................................................................................................... 146
7.3.3. Statistical analyses ............................................................................................ 150
7.4. Results .................................................................................................................. 153
7.5. Discussion ............................................................................................................ 160
7.6. Conclusions .......................................................................................................... 164
7.7. Postscript ............................................................................................................. 165
7.8. References ........................................................................................................... 166

Chapter 8 Discussion .................................................................................................. 170
8.1. Background .......................................................................................................... 170
8.2. Summary .............................................................................................................. 171
8.3. Limitations ............................................................................................................ 175
8.4. Public health implications ...................................................................................... 177
8.5. Future directions ................................................................................................... 180
8.6. Conclusion ............................................................................................................ 182
8.7. References ........................................................................................................... 184

Appendices .................................................................................................................. 189
<table>
<thead>
<tr>
<th>Appendix</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix A</td>
<td>190</td>
</tr>
<tr>
<td>Appendix B</td>
<td>219</td>
</tr>
<tr>
<td>Appendix C</td>
<td>224</td>
</tr>
<tr>
<td>Appendix D</td>
<td>232</td>
</tr>
<tr>
<td>Appendix E</td>
<td>236</td>
</tr>
</tbody>
</table>
List of tables

Table 2.1. Response frequencies and proportions for boys and girls aged 7 to 15 years, 1985 ASHFS .............................................................. 48
Table 2.2. Levels of participation in the CDAH study, 2004-2006 .................... 49
Table 3.1. Sociodemographic and health characteristics for men and women in the CDAH study, 2004-2006 .............................................................. 67
Table 3.2. Associations between pedometer steps/day, total physical activity, physical activity domains and depression for participants in the CDAH study, 2004-2006 .... 70
Table 3.3. Associations between moderate- and vigorous-intensity leisure and work physical activity and depression for participants in the CDAH study, 2004-2006 .... 72
Table 4.1. DSM-IV major depression symptoms for leisure physical activity, work physical activity and pedometer steps/day by physical activity level in men ........ 89
Table 4.2. DSM-IV major depression symptoms for leisure physical activity, work physical activity and pedometer steps/day by physical activity level in women .... 91
Table 4.3. Adjusted associations between physical inactivity by each physical activity domain and DSM-IV major depression symptoms for men ......................... 93
Table 4.4. Adjusted associations between physical inactivity by each physical activity domain and DSM-IV major depression symptoms for women ..................... 95
Table 5.1. Sociodemographic and health characteristics for boys and girls aged 9 to 15 years, ASHFS 1985 .................................................................. 111
Table 5.2. Adjusted prevalence ratios and 95% confidence intervals for total physical activity and physical activity domains, and depressed mood for primary school boys and girls, ASHFS 1985 .................................................. 113
Table 5.3. Adjusted prevalence ratios and 95% confidence intervals for total physical activity and physical activity domains, and depressed mood for secondary school boys and girls, ASHFS 1985 .................................................. 115
Table 6.1. Five most frequently reported activities in the Historical Leisure Activity Questionnaire in each age period by gender, CDAH study, 2004-2006 ............ 133
Table 6.2. Median (25th and 75th percentile) values (hours/week) for Historical Leisure Activity Questionnaire estimates of total, moderate and vigorous activity (including and excluding walking) by gender, CDAH study, 2004-2006 ............................................... 134
Table 6.3. Spearman’s rank correlation coefficients for Historical Leisure Activity Questionnaire estimates with past-week sports participation and the 1.6 km run/walk for children by age (9-12 years and 13-15 years) and gender, 1985 ASHFS ....................... 135
Table 6.4. Spearman’s rank correlation coefficients for Historical Leisure Activity Questionnaire estimates with past-week leisure physical activity (LPA), PWC170 and pedometer steps/day in adulthood by gender, CDAH study, 2004-2006 .................. 136
Table 7.1. Characteristics of the study population in childhood (1985) and adulthood (2004-2006) ................................................................. 154
Table 7.2. Relative risks and 95% confidence intervals for depression by leisure physical activity patterns from childhood to adulthood ....................... 156
Table 7.3. Relative risks and 95% confidence intervals for depression by historical leisure activity patterns from 15 years of age to adulthood ....................... 158
List of figures

Figure 1.1 The ten leading causes of burden of disease (DALYs), all ages, 2004 .......... 25
Figure 1.2. Prevalence of depressive disorders in Australia by age and gender, 1997... 26
Figure 1.3. Conceptual model of the relationships between physical activity and depression from childhood into adulthood................................................................. 33
Figure 2.1. Distribution of schools surveyed in 1985 ASHFS........................................ 44
Figure 2.2. Participants and response proportions in 1985 ASHFS; and participants, response proportions and loss to follow-up in the CDAH study, 2004-2006.................. 46
Figure 2.3. Distribution of CDAH participants according to postcode as of January, 2004.......................................................................................................................... 50
Figure 3.1. Smoothed probability density functions for mean pedometer steps/day by depression for i) men and ii) women in the CDAH study, 2004-2006.............................. 68
Figure 3.2. Prevalence of depression for women by leisure and work physical activity (hours/week), CDAH study, 2004-2006............................................................................. 73
Figure 6.1. Median values (hours/week) for change in relative cardiorespiratory fitness from childhood to adulthood for Historical Leisure Activity Questionnaire (HLAQ) estimates of total and vigorous activity for females (n=805) and males (n=840)........ 137
Acknowledgements

The research presented in this thesis has been facilitated by the generous support and encouragement I have received from colleagues, friends and family during the tenure of my candidature.

I would firstly like to express my sincere gratitude to my supervisory team. Heartfelt thanks to Professor Alison Venn, my primary supervisor, who has been a constant source of guidance, wisdom, motivation and inspiration. Thank you for your constant enthusiasm for my work, your constructive feedback and giving so generously of your time and expertise. Your mentoring has been invaluable. I would also like to express my appreciation to my co-supervisors Dr Kristy Sanderson and Associate Professor Michael Schmidt. Kristy, thank you for sharing your expertise and knowledge, and for your ongoing support, guidance and friendship during my candidature. Mike, thank you so much for your assistance in the early stages of my candidature, passing on the tools that have enabled me to develop my own skill base. Your timely feedback, statistical advice and words of encouragement have been greatly appreciated. To Professor George Patton, thank you for your valuable insights and for contributing your depth of experience and knowledge so generously. Thanks also to my Research Supervisor Associate Professor Leigh Blizzard for providing valuable statistical advice.

Sincere thanks to all the members of the CDAH analysis team for offering constructive criticism, practical advice and providing such a collegial working environment. Special thanks to the CDAH project manager Marita Dalton for her ongoing practical support as well as all the other project staff and volunteers for their enthusiasm and professionalism. I would particularly like to acknowledge the contributions of the study participants for their ongoing commitment to this project.

Special thanks to Petr Otahal for assistance with many a thorny analytical conundrum and for providing statistical advice in plain English. To the IT Crowd (Ben Duan and Alistair Chilcott), thanks for being there when turning it off and turning it on again didn’t work. Many thanks to all my fellow PhD candidates, past and present, for your camaraderie, empathy, advice and for providing plenty of good laughs. Special thanks
to Dr Verity Cleland and Dr Costan Magnussen for your assistance and patience during the early stages of my candidature and for inspiring me beyond.

Finally, I would like to thank my wonderful family and friends for your interest in my work and for egging me on from the sidelines, especially Ian for all your support and for my Mum and Dad for always allowing me to tread my own path.

**Funding**

The Australian Council for Health and Physical Education Research’s Australian Schools Health and Fitness Survey was jointly funded by the Commonwealth Department of Sport, Recreation and Tourism, the Commonwealth Schools Commission, the Commonwealth Department of Health and the National Heart Foundation of Australia. The Childhood Determinants of Adult Health study was funded by the National Health and Medical Research Council (211316), the National Heart Foundation (GOOH 0578), the Tasmanian Community Fund (D0013808) and Veolia Environmental Services. The author was funded by a Tasmania Graduate Research Scholarship and a Ruby Menzie Scholarship in Population Health Research. The author gratefully acknowledges the contribution of the study sponsors - Sanitarium, ASICS and Target.
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>ASHFS</td>
<td>Australian Schools Health and Fitness Survey</td>
</tr>
<tr>
<td>BMI</td>
<td>body mass index</td>
</tr>
<tr>
<td>CDAH</td>
<td>Childhood Determinants of Adult Health</td>
</tr>
<tr>
<td>CI</td>
<td>confidence interval</td>
</tr>
<tr>
<td>CIDI</td>
<td>Composite International Diagnostic Interview</td>
</tr>
<tr>
<td>DSM-IV</td>
<td>Diagnostic and Statistical Manual of Mental Disorders – 4th Edition</td>
</tr>
<tr>
<td>fMRI</td>
<td>functional magnetic resonance imaging</td>
</tr>
<tr>
<td>HLAQ</td>
<td>Historical Leisure Activity Questionnaire</td>
</tr>
<tr>
<td>HPA</td>
<td>hypothalamic-pituitary-adrenal</td>
</tr>
<tr>
<td>ICD-10</td>
<td>International Classification of Diseases – 10th revision</td>
</tr>
<tr>
<td>IPAQ</td>
<td>International Physical Activity Questionnaire</td>
</tr>
<tr>
<td>IRSD</td>
<td>index of relative socioeconomic disadvantage</td>
</tr>
<tr>
<td>LPA</td>
<td>leisure physical activity</td>
</tr>
<tr>
<td>MRIT</td>
<td>Menzies Research Institute Tasmania</td>
</tr>
<tr>
<td>NIMH</td>
<td>National Institute of Mental Health</td>
</tr>
<tr>
<td>PA</td>
<td>physical activity</td>
</tr>
<tr>
<td>PE</td>
<td>physical education</td>
</tr>
<tr>
<td>PR</td>
<td>prevalence ratio</td>
</tr>
<tr>
<td>PWC(_{170})</td>
<td>physical work capacity at a heart rate of 170 beats per minute</td>
</tr>
<tr>
<td>RCT</td>
<td>randomised controlled trial</td>
</tr>
<tr>
<td>RR</td>
<td>relative risk</td>
</tr>
<tr>
<td>SD</td>
<td>standard deviation</td>
</tr>
<tr>
<td>SE</td>
<td>standard error</td>
</tr>
<tr>
<td>SEIFA</td>
<td>Socioeconomic Index of Areas</td>
</tr>
<tr>
<td>SES</td>
<td>socioeconomic status</td>
</tr>
<tr>
<td>SMD</td>
<td>standardised mean difference</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
</tbody>
</table>
$VO_2_{\text{max}}$  maximal oxygen uptake

WHO  World Health Organization
Statement of authorship

A team of academic, administrative and fieldwork staff contributed to the development and implementation of the Australian Childhood Determinants of Adult Health (CDAH) study (2004-2006). As part of this team, the author (CM) played an ongoing role as a project team member and contributed in various ways including:

- Being a member of the data collection team in Western Australia and Victoria. Tasks included administration of the Composite International Diagnostic Interview, cardiorespiratory fitness exam, blood pressure assessment and lung function tests.
- Ongoing contributions to data entry, cleaning, analysis and data management decisions involving key measures including mental health and physical activity measures.
- Participating in project team meetings and contributing to routine tasks as requested (for example, contributing to the CDAH newsletter, website, assisting with mail-outs and related duties).
- This thesis includes chapters for which CM is not the sole author. CM took the lead in this research in that she designed the research, undertook all the data analyses and wrote the manuscripts however she was assisted by the co-authors. The contributions of each author are acknowledged below.

Chapter 3


The contribution of each author: CM conceptualised the manuscript, undertook all the data analyses, contributed to the interpretation of the data, drafted the manuscript and incorporated critical revisions of the manuscript; MS provided statistical expertise and contributed to the interpretation of the data and revision of the manuscript; KS contributed to the interpretation of the data and revision of the manuscript; GP contributed to the revision of the manuscript; TD was involved in the
conceptualisation of the study and contributed to the revision of the manuscript; AV was involved in the conceptualisation of the study, acquisition of the data and contributed to the interpretation of the data and revision of the manuscript.

Chapter 4


The contribution of each author: CM contributed to the conceptualisation of the manuscript, undertook all the data analyses, contributed to the interpretation of the data, drafted the manuscript and incorporated critical revisions of the manuscript; GP contributed to the interpretation of the data; MS contributed to the interpretation of the data and revision of the manuscript; AV was involved in the conceptualisation of the study, acquisition of the data and contributed to the interpretation of the data and revision of the manuscript; KS contributed to the conceptualisation of the manuscript, interpretation of the data and revision of the manuscript.

Chapter 5


The contribution of each author: CM conceptualised the manuscript, undertook all the data analyses, contributed to the interpretation of the data, drafted the manuscript and incorporated critical revisions of the manuscript; MS provided statistical expertise and contributed to the interpretation of the data and revision of the manuscript; KS contributed to the interpretation of the data and revision of the manuscript; TD was involved in the conceptualisation of the study and acquisition of the data; AV contributed to the interpretation of the data and revision of the manuscript.

Chapter 6

McKercher CM, Schmidt MD, Sanderson KA, Dwyer T, Venn AJ. Validity of self-reported historical leisure physical activity in young adults.
The contribution of each author: CM conceptualised the manuscript, cleaned and coded the data, undertook all the data analyses, drafted the manuscript and incorporated critical revisions of the manuscript; MS provided statistical expertise and contributed to the interpretation of the data and revision of the manuscript; KS contributed to the interpretation of the data and revision of the manuscript; TD was involved in the conceptualisation of the study, acquisition of the data and contributed to the revision of the manuscript; AV was involved in the conceptualisation of the study, acquisition of the data and contributed to the interpretation of the data and revision of the manuscript.

Chapter 7


The contribution of each author: CM conceptualised the manuscript, undertook all the data analyses, contributed to the interpretation of the data, drafted the manuscript and incorporated critical revisions of the manuscript; MS provided statistical expertise and contributed to the interpretation of the data and revision of the manuscript; KS contributed to the interpretation of the data and revision of the manuscript; PO provided statistical expertise and contributed to the interpretation of the data and revision of the manuscript; GP contributed to the interpretation of the data and revision of the manuscript; TD was involved in the conceptualisation of the study and contributed to the revision of the manuscript; AV was involved in the conceptualisation of the study, acquisition of the data and contributed to the interpretation of the data and revision of the manuscript.

Signed by primary supervisor, Professor Alison Venn

Signed: ..................................................     Date: ....................................
Publications

Publications directly arising from the research described in this thesis

Chapter 3


Chapter 4


Chapter 5


Chapter 6


Chapter 7

Other – not included in this thesis


Conference presentations arising from this thesis

*Presenting author

Oral presentations


**Other presentations**


**Poster presentations**


**Awards resulting from thesis material**

2007 Awarded an Australasian Epidemiological Association Student Travel award to attend the Joint Scientific Meetings of the Australasian Epidemiological Association and the International Epidemiological Association-Western Pacific Region.
Chapter 1 Introduction

Depression imposes an immense medical, social and economic burden on individuals, communities and health services worldwide. Accordingly, increasing interest in the role of behaviour in the prevention of mental disorders and mental health promotion has directed attention on physical activity in the aetiology and prevention of depression. Population-based research generally indicates that regular physical activity is associated with reduced risk of depression and depressive symptoms. However definitive conclusions are hindered by methodological limitations and gaps in the literature remain. Notably, how depression is associated with physical activity during the developmental trajectory from childhood to young adulthood is currently unclear. Clarifying the efficacy of physical activity in the prevention of depression during this critical life stage would be an important advance in public health. This thesis and the aims examined herein attempt to extend and contribute to the growing body of research examining this proposition. This chapter provides a brief overview of: the epidemiology of depression and physical activity; the efficacy of (prescribed) exercise in the treatment of depression; the proposed neurobiological and psychological mechanisms underlying the association between physical activity and depression; the essential literature relevant to the research aims examined as part of this thesis.

1.1. Epidemiology of depression

1.1.1. Burden of depression

Depression is considered among the most disabling clinical diagnoses in the world affecting more than 340 million people worldwide at any one time (Murray et al., 1996) and accounting for 4.3% of the total global burden of disease (65.5 million disability adjusted life years (DALYs) lost in total) (Figure 1.1) (World Health Organization, 2008). Major depressive disorder is currently the second leading cause of disease burden in young adults (World Health Organization, 2010a) and is predicted to be second only to ischemic heart disease in overall disease burden for all ages and both sexes by 2020 (World Health Organization, 2010a). In Australia, depressive disorders account for around 8% of all years lived with a disability and over AUS$3 billion
annually in direct and indirect costs including loss of productivity due to absenteeism and inefficiency at work (Mathers et al., 2000).

![Diagram of the ten leading causes of burden of disease (DALYs), all ages, 2004](image)

**Figure 1.1 The ten leading causes of burden of disease (DALYS), all ages, 2004**


### 1.1.2. Definition of depression

The World Health Organization (WHO) defines depression as a common mental disorder characterised by negative mood, loss of pleasure in usual activities (anhedonia), feelings of guilt, sleep difficulties, decreased appetite and energy and impaired concentration (Murray et al., 1996). Without treatment, depression has the tendency to assume a chronic course, to recur and to be associated with increasing disability over time. Depressive disorders are defined within the classification of mood disorders which are broadly divided into depressive disorders and bipolar disorders. Depressive disorders included a mild chronic form, dysthymia and a more severe form, major depressive disorder.
1.1.3. Prevalence of depression

The life-time prevalence of major depression worldwide is around 8% to 12% and appears to be increasing (Andrade et al., 2003). A survey of ten developed countries in North America, Latin America, Asia and Europe found that the 12-month prevalence of major depression varied in adults from 1.2% in Japan to 10% in the USA, with most rates between 1.9% and 3.9% (Andrade et al., 2003). In Australia, the most recent national survey of the prevalence of mental illness, the 2007 National Survey of Mental Health and Wellbeing (NSMHW), found a 12-month prevalence of depressive disorders of 5.4% in adults (Australian Bureau of Statistics, 2008b). Consistent with other developed nations, women reported a higher prevalence of depressive disorders than men (6.6% compared with 4.1%).

The community prevalence of depression increases from childhood with around 20% of the population experiencing a depressive episode by young adulthood (Newman et al., 1996). Likewise, data from the first NSMHW in 1997 (Australian Bureau of Statistics, 1998) show that prevalence of depressive disorders increased from childhood through adolescence with the highest prevalence in young women (Figure 1.2) (Sawyer et al., 2000).

![Figure 1.2. Prevalence of depressive disorders in Australia by age and gender, 1997](image)

1.1.4. Prognosis of depression

Depression is a chronic, recurrent and serious illness associated with substantial morbidity and all-cause mortality (Angst et al., 2002). Depression is connected to multiple chronic health problems, including osteoporosis, diabetes and cardiovascular disease (Druss et al., 2000; Krishnan et al., 2002), and appears to increase the risk of developing Alzheimer’s disease (Green et al., 2003) and cognitive decline (Jorm, 2000).

The onset of depression increases with age through adolescence and peaks in young adulthood (Blazer et al., 1994; Kessler et al., 2007). Even after recovery from an initial episode of depression, younger people are at increased risk of recurrence of episodes of depression (Paradis et al., 2006; Reinherz et al., 1999), as well as increased risk of comorbid psychiatric conditions (Kessler et al., 2003) and completed suicide (Brådvik et al., 2008). In Australia, for example, suicide is the leading cause of death in men and women under 34 years of age (Australian Bureau of Statistics, 2008a). The sequelae of depression involves poor psychosocial and physical functioning, lower life and career satisfaction, impaired occupational performance, greater interpersonal difficulties and increased need for social support (Paradis et al., 2006; Reinherz et al., 1999; Sanderson et al., 2006); those with a younger age of onset being particularly vulnerable (Zisook et al., 2007).

1.2. Treatment of depression

A number of empirically validated somatic and non-pharmacological treatments are available for depression including antidepressant medication, electro-convulsive therapy, psychotherapy and cognitive-behavioural therapy (Hollon et al., 2002). Recent reports indicate that depression can be reliably diagnosed in primary care and treated using pharmacology and psychotherapy with 60% to 80% success (Möller et al., 2005). In Australia however access to effective treatment is limited with only around 60% of those diagnosed with depression accessing healthcare services and around half of these patients receiving a potentially efficacious treatment such as antidepressant medication or psychotherapy (Sanderson et al., 2003).
Antidepressant medication is considered the treatment of choice for severe depression (Fournier et al., 2010). Despite this, between one- to two-thirds of patients will not respond to the first antidepressant prescribed and up to one-third will not respond to multiple interventions (American Psychological Association, 2000; Berlim et al., 2008; Cain, 2007). Further, compliance with antidepressant medication is poor with dropout rates of 12% to 40% within the initial 6 to 8 weeks of treatment in clinical trials (Cipriani et al., 2009; Kirsch et al., 2008) and up to 33% within the first month of treatment in patients in primary care (Lin et al., 1995). Pharmalological treatments are also associated with a range of negative side effects and drug-drug interactions which often deter individuals from commencing or continuing medication (Demyttenaere, 2003; Donoghue et al., 1996).

The cost of treatment also constitutes an impediment to individuals seeking treatment and has considerable financial implications for healthcare services. Further, while non-pharmacological interventions represent a viable alternative to antidepressant medication, traditional psychotherapy services are often difficult to access and associated with perceived social stigma. In Australia, the Better Outcomes in Mental Health Care program (2001-2005) was designed to facilitate affordable and timely access to mental health services. The most recent evaluation of this initiative indicated that certain patient groups appear to do better than others, with older patients, patients with a higher socio-economic status and those with no previous history of mental health care having greater levels of clinical improvement (Pirkis et al., 2010). This indicates that even where millions of dollars (around AUS$122.6 million) (Russell, 2008) are being invested on facilitating equitable access to treatment there is still a need for population-based preventative efforts.

Physical activity is increasingly being cited as a low-cost alternative or adjunct treatment for depression. Likewise research has increasingly focussed on the role of physical activity as a potential component in the prevention and/or management of depression and depressive symptoms (Paluska et al., 2000). Given the increasing burden of depression on mental and general health services, examining the potential
role of physical activity in the prevention of depression at the population level is timely.

1.3. Physical activity

The terms physical activity, exercise, fitness and energy expenditure are often used interchangeably, despite important distinctions among these constructs (Sallis et al., 1994). Physical activity can be defined as ‘bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level’ (Caspersen et al., 1985). Physical activity comprises four main dimensions: frequency (number of sessions/unit time), intensity (rate of energy expenditure), duration and domain (a qualitative descriptor). Exercise is a subset of physical activity that is planned, structured and repetitive, and has as a final or an intermediate objective the improvement or maintenance of physical fitness (Caspersen et al., 1985). In contrast, fitness is ‘a set of attributes that are either health or skill related’ and can be measured with specific tests (Caspersen et al., 1985, p 126). Fitness has a strong inherited component that is modifiable, within an individual’s range, by training. Finally, energy expenditure is the amount of energy (calories) that are consumed to meet bodily needs and includes the following components: resting energy expenditure, the thermic effect of food, activity energy expenditure and for children, the energy required for growth.

The health benefits of physical activity achieved international recognition following the publication of the 1996 US Surgeon General’s Report on Physical Activity and Health (US Department of Health and Human Services, 1996). Physical inactivity, defined variously as sedentariness or insufficient physical activity, is the fourth leading risk factor for global mortality (World Health Organization, 2010b) and is associated with increased risk of numerous chronic diseases including cardiovascular disease (Thompson et al., 2003), ischemic stroke (Gorelick et al., 1999), non-insulin-dependent (type 2) diabetes (Helmrich et al., 1991), colon cancer (Giovannucci et al., 1995) and osteoporosis (Kohrt et al., 1995). In Australia, the estimated annual direct cost of physical inactivity to the healthcare system is over AUS$650 million, representing 1.3% of total annual health sector costs (Cadilhac et al., 2011). The importance of physical activity in the treatment and prevention of a range of chronic diseases including
depression have been highlighted in recent publications including the Physical Activity
Guidelines Advisory Committee Report, 2008 (Physical Activity Guidelines Advisory
Committee, 2008) the Global Recommendations on Physical Activity for Health (World
Health Organization, 2010b) and Young Australians: their health and wellbeing 2011
(Australian Institute of Health and Welfare (AIHW), 2011).

1.4. Evidence for an association between physical activity and depression

1.4.1. The efficacy of exercise interventions in the treatment of depression

Interest in the use and evaluation of alternative or adjunct therapies has led to exercise
being the focus of a number of experimental trials to establish its efficacy as a treatment
for depression in clinical and non-clinical groups. Demonstrating the therapeutic
effects of (prescribed) exercise is important in establishing a proof of principle
regarding the potential of physical activity in the prevention of depression.

Numerous systematic reviews (Biddle et al., 2000; Byrne et al., 1993; Dunn et al., 1991;
Martinsen, 1990; Morgan, 1994; Phillips et al., 2003; Raglin et al., 2007; Salmon, 2001;
Sime, 1987; Stathopoulou et al., 2006; Taylor et al., 1985) and meta-analyses (Craft et al.,
1998; Krogh et al., 2011; Lawlor et al., 2001; McDonald et al., 1991; Mead et al., 2008;
North et al., 1990; Rethorst et al., 2009; Stathopoulou et al., 2006) examining the
effectiveness of exercise with depression have been published. Exercise components of
randomised controlled trials (RCTs) generally consist of aerobic exercise such as
running (Blumenthal et al., 1999; Greist et al., 1979; Klein et al., 1985; Veale et al., 1992),
treadmill walking (Blumenthal et al., 2007; Dunn et al., 2002), walking (Knubben et al.,
2007; McNeil et al., 1991) and aerobic training (Martinsen et al., 1985) as well as
resistance training (Singh et al., 2005). Aerobic and non-aerobic interventions involve
indoor exercise (Blumenthal et al., 2007; Dunn et al., 2002; Knubben et al., 2007; Singh
et al., 2005), outdoor exercise (McNeil et al., 1991), individual exercises (Blumenthal et
al., 2007; Dunn et al., 2002; Greist et al., 1979; Klein et al., 1985; McNeil et al., 1991),
group exercises (Blumenthal et al., 1999; Singh et al., 2005; Veale et al., 1992), aerobic
training with an instructor (Martinsen et al., 1985), and both supervised and home-
based exercise (Blumenthal et al., 2007). The literature generally concurs that exercise
interventions are effective in reducing depressive symptoms in adults with the effect being strongest for those with mild to moderate depression (Mead et al., 2008; National Institute for Health and Clinical Excellence, 2009). Exercise compares favourably to antidepressant medications as a first-line (Blumenthal et al., 2007; Blumenthal et al., 1999) and adjunct (Carek et al., 2011; Mather et al., 2002) treatment for adults with mild to moderate depression and may be effective in preventing the relapse of major depressive disorder (Babyak et al., 2000). Further, exercise has proved as efficacious as cognitive behavioural therapy in improving depressive symptoms (Dunn et al., 2005; Lawlor et al., 2001). There is also tentative evidence for a dose-response effect of exercise in the treatment of depression (Dunn et al., 2001).

Despite the evidence for the effectiveness of exercise as a treatment for depression, reviews have generally reiterated the methodological shortcomings of the literature including the use of non-blinded methodological designs, limited sample sizes and lengths of follow-up, absence of placebo or control groups and infrequent intention-to-treat analysis (Lawlor et al., 2001; Morgan, 1994; Penedo et al., 2005). Further, few trials have examined the social or interpersonal components of these programmes (Blumenthal et al., 2007) or have adequately controlled for these influences (Knubben et al., 2007; Martinsen et al., 1985; McNeil et al., 1991) so it is difficult to determine whether improvements in depression are mediated by social interaction. In addition, clinical trials have had highly variable exercise components so the correct therapeutic dose required for treatment effects is unclear (Penedo et al., 2005). These considerations have prevented some authors from drawing definitive conclusions about the utility of exercise as an effective treatment for depression. In contrast, others argue that intervention studies, taken together, offer considerable evidence for the therapeutic effects of exercise in patients with depressive disorders (Brosse et al., 2002; Ströhle, 2009).

Further, the majority of trials have included adults aged 18 and over, with a particular focus on older adults (Mead et al., 2008). However, trials including younger adults only also indicate that aerobic exercise may be efficacious in treating depression (Doyne et al., 1987; Klein et al., 1985; Nabkasorn et al., 2006) with a large-scale trial indicating that
aerobic exercise at doses consistent with public health recommendations is an effective treatment for major depression of mild to moderate severity in adults aged 20 to 45 years (Dunn et al., 2005). These results provide tentative evidence for the proposition that exercise and physical activity interventions may be beneficial in the prevention of depression in younger adults.

1.4.2. Proposed mechanisms for the beneficial effect of physical activity on depression

The proposed physiological and neurobiological mechanisms by which physical activity may reduce depression and depressive symptoms are well documented (Brosse et al., 2002; Ernst et al., 2006; Paluska et al., 2000; Peluso et al., 2005; van Praag, 2008). For example, increases in hippocampal neurogenesis (Ernst et al., 2006), endorphin secretion (Dishman et al., 2009) and monoamine neurotransmission (Paluska et al., 2000) similar to effects observed with antidepressant treatments (Dishman et al., 2006; van Praag, 2008; Yau et al., 2011) suggest that a common physiological mechanism is involved. Limited research utilising animal models provides support for a neurobiological pathway. For example, dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis functioning is often cited as an overarching mechanism of depression that may be influenced by exercise. Animal studies indicate that exercise training results in a physiological resilience or ‘toughness’ that is characterised by a delay in the HPA axis response to stress (Dienstbier, 1991). Exercise may therefore be effective in the prevention and treatment of depression by promoting regulatory adaptation of HPA systems (Dunn et al., 1991). Further, recent studies suggest that exercise stimulates growth of new nerve cells and release of proteins known to improve health and survival of nerve cells, e.g., brain-derived growth neurotrophic factor (Ernst et al., 2006; Russo-Neustadt et al., 2001; Zheng et al., 2006).

Non-biological mechanisms also may explain the causal link between physical activity and depression. Psychological pathways include: diversion or distraction from negative thoughts (Sachs, 1982); increased self-esteem (Motl et al., 2005); enhanced feelings of mastery (Bovier et al., 2004); increased self-efficacy (Bandura, 1977; Craft,
2005). Perceptions of social support via group or individual interaction may also be important (Lees et al., 1988). Despite considerable research attention, no single mechanism adequately explains the beneficial effects of physical activity on depression. However, the causes of depression are varied and complex so the antidepressant effects of physical activity are unlikely to be described by any one mechanism in isolation. An integrated model involving an interaction of multiple physiological, neurobiological and psychological mechanisms underlying, mediating and/or moderating these effects is likely to provide the most plausible explanation.

1.5. Physical activity and depression from childhood to adulthood

The relationship between physical activity and depression from childhood through to adulthood is complex and multi-directional (Figure 1.3). Physical activity in childhood may effect depression in adulthood via several pathways: directly, independent of adult physical activity and depression in childhood; indirectly, by influencing depression in childhood, which subsequently impacts on depression in adulthood; or again indirectly, by influencing adult physical activity, which then impacts on adult depression.

![Figure 1.3. Conceptual model of the relationships between physical activity and depression from childhood into adulthood](image)

While there is evidence for an association between physical activity and risk of depression in adulthood (Teychenne et al., 2008), there is limited data examining the prospective influence of habitual physical activity from childhood to adulthood in the prevention of depression. This is because long-term prospective cohort studies require
a large amount of financial and human resources, ongoing cohort maintenance and extended periods of follow-up. Prospective cohort studies have the capacity to complement experimental research by examining these developmental trajectories and elucidating the efficacy of long-term physical activity in the prevention of depressive disorders. Further, well-designed prospective research has the capacity to examine reverse causality, clarify dose-response relationships, consider multiple potential confounders and mediators and examine whether associations are due to bodily movement or the social context in which the physical activity is performed.

1.6. Research aims

This thesis makes use of data from the Childhood Determinants of Adult Health (CDAH) study, a population-based, prospective follow-up of the 1985 Australian Schools Health and Fitness Survey (ASHFS) conducted in Australia from 2004-2006. The specific research aims examined within this dissertation utilise these data and are outlined below:

1. To evaluate the association between physical activity and depression in young adults (Chapter 3).

2. To examine whether young adults with major depressive disorder who are physically low/inactive differ in their depressive symptom profile from those who are physically active (Chapter 4).

3. To examine the association between physical activity and depressed mood in children and adolescents (Chapter 5).

4. To evaluate the validity of self-reported retrospective physical activity in young adults (Chapter 6).

5. To examine the association between habitual physical activity from childhood to adulthood and risk of depression in young adulthood (Chapter 7).
1.7. Summary

The combined evidence from research examined in the preceding text including: the increasing social and economic burden of depression; difficulties with access, utilisation and effectiveness of existing treatments; experimental support for the effectiveness of exercise in the treatment of depression; and plausible neurobiological and psychological mechanisms for a causal link between physical activity and depression, provides empirical support for examining the effectiveness of physical activity in the prevention of depression. Growing interest in the promotion of physical activity in the treatment and prevention of depression is evidenced by recently published guidelines highlighting the importance of regular physical activity for the reduction of depressive symptoms and depression (World Health Organization, 2010; Australian Institute of Health and Welfare (AIHW), 2011; Physical Activity Guidelines Advisory Committee, 2008). However, recent reviews have highlighted the paucity of methodologically robust research examining the potential beneficial effects of physical activity in reducing depression and depressive symptoms (Biddle et al., 2011; Teychenne et al., 2008). The principal aim of this study therefore was to examine whether habitual physical activity from childhood to adulthood reduces the risk of clinical depression in young adulthood. Subsumed within this main aim, ancillary aims were to examine cross-sectional associations between physical activity and depression in young adulthood; differences in depression symptomatology in young adults who are physically low/inactive and physically active, cross-sectional associations between physical activity and depressed mood in childhood and the validity of self-reported retrospective physical activity in young adulthood.
1.8. References


Blumenthal, JA, Babyak, MA, Moore, KA, Craighead, WE, Herman, S, Khatri, P, et al. (1999) Effects of exercise training on older patients with major depression. *Archives of Internal Medicine, 159*, 2349-2356.


The International Physical Activity Questionnaire 2005 Available at http://www.ipaq.ki.se/ipaq.htm Accessed 1 September, 2011.


Chapter 2 Methods

This section provides an overview of the Childhood Determinants of Adult Health (CDAH) study and describes the methodological aspects central to this thesis.

2.1. The Childhood Determinants of Adult Health (CDAH) study

The CDAH study (2004-2006) is a population-based, prospective follow-up of the 1985 Australian Schools Health and Fitness Survey (ASHFS) that collected extensive lifestyle and biological measures on a representative sample of 8,498 Australian school children when aged 7 to 15 years. For convenience, participants in 1985 are termed ‘children’ though ages span both childhood and adolescence. The 1985 ASHFS aimed to obtain benchmark data on the fitness, health and physical performance of Australian school children which could be used to assess change over time. The primary aim of the CDAH study was to examine childhood predictors of adult cardiovascular disease and diabetes with long-term follow-up of the original ASHFS cohort over future decades. Secondary aims related to childhood predictors of mental health, women’s reproductive health, respiratory health and early deaths in young adulthood.

2.1.1. Sample selection and participants

Baseline (1985)

The sampling procedures utilised in the original ASHFS have been described in detail elsewhere (Dwyer et al., 1994; Pyke, 1985), but will be summarised here. The reference population was defined as all students aged 7 to 15 years on 30 September 1985 who were currently attending schools (primary or secondary, government, catholic, or independent) in every state and territory of Australia. The lower age limit of 7 years was chosen as below this age enrolment policies varied between the states and territories, influencing the numbers and ages of children available. The upper age limit of 15 years was chosen as a proportion of children in Australia leave school at 16 years and sampling these children from schools would not be representative of this age group in the whole population.
Participants were selected using a two-stage (school, then student) probability sampling process that was designed to yield a self-weighted sample (i.e., the data do not need to be weighted since the sample design gives each individual an equal chance of being selected). The first stage of sampling selected schools with probability proportional to enrolment numbers. Of the 121 schools selected, 90.1% \((N=109)\) agreed to participate. The distribution of schools surveyed is shown in Figure 2.1. The second stage utilised simple random sampling to select children within each age and gender category from the selected schools. Of the 12,578 students invited to participate in the study, 8,498 agreed to participate representing an overall response proportion of 67.5%.

Approval was granted to contact schools by the State Directors General of Education and parental and child consent were required for inclusion in the study.

**Figure 2.1. Distribution of schools surveyed in 1985 ASHFS**
Follow-up (2004-2006)

Between 2001 and 2004, 6,840 (81%) of the original participants were traced using the following methods: the Australian National Death Index, current and historical electoral rolls, electronic telephone and address directories, and school and family networks. The study was also publicised through a variety of media, including local newspapers, local radio and local television news. A variety of tracing methods were required as no contact information was collected in 1985. At the time of follow-up, 86 participants were deceased. The main causes of death were injury and poisoning (including suicide, 39 cases), accidents (8 cases), neoplasm (5 cases), and heart and circulatory diseases (4 cases). Of the 1,584 traced ASHFS participants that did not enrol, 817 did not respond to attempts to contact and 767 refused to participate in the study. Of the remainder of traced participants, 5,170 (61% of the original cohort) contributed data to the follow-up with 2,410 (28% of the original cohort) attending one of 34 health clinics held in every state and territory of Australia between May 2004 and May 2006. Figure 2.2 displays participation, response proportions and loss to follow-up in the 1985 ASHFS and CDAH (2004-2006) studies.

The follow-up survey was approved by the Southern Tasmania Health and Medical Human Research Ethics Committee and all participants provided written informed consent.
Figure 2.2. Participants and response proportions in 1985 ASHFS; and participants, response proportions and loss to follow-up in the CDAH study, 2004-2006
2.1.2. Data collection

**Baseline (1985)**

A team consisting of 10 data collectors and a field coordinator were recruited in each state and territory to administer the questionnaire and physical examinations. Blood samples were collected by qualified nurses with experience in venepuncture. All personnel underwent a period of training prior to the commencement of data collection. This included pilot testing of children in at least three age groups in a primary school. Personnel were allocated certain tasks to ensure a minimum amount of people were involved in collecting specific measurements throughout the survey, thereby limiting the potential of inter-measurer error. Registered site visits were undertaken by the principal investigators to maintain protocol standardisation throughout the survey.

Field clinics were used as the main method of data collection in 1985. Clinics were conducted at the participating school over consecutive school days. A range of measurements were collected during clinics including questionnaires, field, technical and laboratory-based tests. Field tests were completed by all participants aged 7 to 15 years while only participants aged 9 to 15 years completed questionnaires. Technical tests and blood samples were collected on those aged 9, 12 and 15 years. Of this sub-sample of 9, 12 and 15 year olds, 1,919 participants of the total eligible 2,809 (68.3% response proportion) consented to provide blood samples. The level of participation for each test category is displayed in Table 2.1. A strict testing protocol was adhered to, with anthropometric measure performed first, followed by fitness tests after a thorough warm-up. Questionnaires were then administered to all 9 to 15 year olds under the supervision of trained data collectors. Participants aged 9, 12 and 15 years attended the following day for the completion of technical tests. Fasting blood samples were collected at the school as soon as possible after the field and technical data collection had been completed.

All equipment was checked for accuracy before the data collection process and where possible, during the survey. Equipment was considered robust and only a few minor repairs were required during the survey period.
Table 2.1. Response frequencies and proportions for boys and girls aged 7 to 15 years, 1985
ASHFS

<table>
<thead>
<tr>
<th>Participants</th>
<th>Field and technical(a)</th>
<th>Questionnaire</th>
<th>Blood sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N)</td>
<td>%</td>
<td>Response (%)</td>
</tr>
<tr>
<td>BOYS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 years</td>
<td>475</td>
<td>11.0</td>
<td>71.5</td>
</tr>
<tr>
<td>8 years</td>
<td>490</td>
<td>11.4</td>
<td>75.0</td>
</tr>
<tr>
<td>9 years</td>
<td>482</td>
<td>11.2</td>
<td>71.1</td>
</tr>
<tr>
<td>10 years</td>
<td>492</td>
<td>11.4</td>
<td>77.0</td>
</tr>
<tr>
<td>11 years</td>
<td>489</td>
<td>11.4</td>
<td>68.9</td>
</tr>
<tr>
<td>12 years</td>
<td>494</td>
<td>11.5</td>
<td>66.0</td>
</tr>
<tr>
<td>13 years</td>
<td>465</td>
<td>10.8</td>
<td>65.4</td>
</tr>
<tr>
<td>14 years</td>
<td>467</td>
<td>10.9</td>
<td>65.5</td>
</tr>
<tr>
<td>15 years</td>
<td>450</td>
<td>10.5</td>
<td>63.3</td>
</tr>
<tr>
<td>Subtotal</td>
<td>4,304</td>
<td>100.0</td>
<td>69.3</td>
</tr>
<tr>
<td>GIRLS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 years</td>
<td>478</td>
<td>11.4</td>
<td>69.6</td>
</tr>
<tr>
<td>8 years</td>
<td>496</td>
<td>11.9</td>
<td>73.2</td>
</tr>
<tr>
<td>9 years</td>
<td>487</td>
<td>11.7</td>
<td>72.5</td>
</tr>
<tr>
<td>10 years</td>
<td>497</td>
<td>11.9</td>
<td>75.2</td>
</tr>
<tr>
<td>11 years</td>
<td>483</td>
<td>11.6</td>
<td>70.5</td>
</tr>
<tr>
<td>12 years</td>
<td>489</td>
<td>11.7</td>
<td>65.7</td>
</tr>
<tr>
<td>13 years</td>
<td>438</td>
<td>10.5</td>
<td>58.6</td>
</tr>
<tr>
<td>14 years</td>
<td>405</td>
<td>9.7</td>
<td>53.6</td>
</tr>
<tr>
<td>15 years</td>
<td>407</td>
<td>9.7</td>
<td>56.4</td>
</tr>
<tr>
<td>Subtotal</td>
<td>4,180</td>
<td>100.0</td>
<td>66.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8,484</td>
<td></td>
<td>67.5</td>
</tr>
</tbody>
</table>

\(a\)This table was reproduced from the original ASHFS report (Pyke, 1985), which included data for 8,484 participants, however data from a further 14 participants were identified in the dataset when follow-up was initiated and were included in the analyses.

\(b\)Field and technical tests included height, weight, girths, sit and reach, sit-ups, standing long jump, push-ups, 50m walk/run and 1.6 km run/walk.

\(b\)The original published table had the incorrect response proportions for blood sample measures and has been rectified here (incorrect 70.8% versus actual 68.3%).
Percentages may not add to 100 because of rounding.

Follow-up (2004-2006)
Field clinics were again used as the primary method for data collection at follow-up. Measures collected at follow-up included questionnaires, physical measurements and blood biochemistry. Participants unable to attend a clinic for physical measurements were offered alternate options to provide data involving completion of a short or full version of the self-report questionnaire and/or remote pathology. The enrolment
questionnaire was self-completed and returned by mail or completed by telephone interview when initial contact with participants was made between 2001 and 2004. The short or long questionnaire was administered to those that indicated at time of enrolment (2001-2004) their willingness to participate but who were unable to attend clinics when recontacted (2004-2006). Information on the number of participants who completed various components of the study is provided in Table 2.2.

**Table 2.2. Levels of participation in the CDAH study, 2004-2006**

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>n</td>
<td>N</td>
</tr>
<tr>
<td>Clinic</td>
<td>1,150</td>
<td>1,260</td>
<td>2,410</td>
</tr>
<tr>
<td></td>
<td>47.2</td>
<td>46.1</td>
<td>46.6</td>
</tr>
<tr>
<td>Enrolment data only*</td>
<td>620</td>
<td>604</td>
<td>1,224</td>
</tr>
<tr>
<td></td>
<td>25.4</td>
<td>22.1</td>
<td>23.7</td>
</tr>
<tr>
<td>Short questionnaire</td>
<td>445</td>
<td>464</td>
<td>909</td>
</tr>
<tr>
<td>(no clinic attendance)</td>
<td>18.3</td>
<td>17</td>
<td>17.6</td>
</tr>
<tr>
<td>Full questionnaire</td>
<td>159</td>
<td>278</td>
<td>437</td>
</tr>
<tr>
<td>(no clinic attendance)a</td>
<td>6.5</td>
<td>10.2</td>
<td>8.5</td>
</tr>
<tr>
<td>Remote pathology</td>
<td>62</td>
<td>122</td>
<td>184</td>
</tr>
<tr>
<td>(no clinic attendance)b</td>
<td>2.5</td>
<td>4.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Otherc</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>2,438</td>
<td>2,732</td>
<td>5,170</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*All participants completed the enrolment questionnaire; these values represent those participants from whom no other data were collected. Percentages may not add to 100 because of rounding.

aThe full questionnaire is provided in Appendix A.

bPathology and short or full questionnaire.

cPathology only.

Data collection teams for each state and territory consisted of eight locally recruited staff and three core staff. Core staff (project manager, trained phlebotomist, ultrasound technician) were maintained throughout fieldwork clinics. Locally recruited personnel participated in training workshops to ensure measures were collected according to standard procedure. Data collectors were mainly health science undergraduates or graduates. A central group of technicians travelled to each state and territory from the Menzies Research Institute Tasmania (MRIT) to conduct the training workshops. Personnel were trained to perform specific tasks, with compliance to standardised protocols monitored throughout data collection by the project manager.

Geographic Information Systems software was used to map participants’ current postcode (Figure 2.3) to identify local clinic sites that would be convenient and accessible to as many participants as possible. Clinic locations were selected to maximise the proportion of enrolled participants living within a 10 km radius (55% of
participants residing within this 10 km radius of the site ultimately attended clinics. Clinic venues included community halls, sport halls, church halls and schools. Field clinics were conducted between 7.00am and 2.00pm on weekday and weekends with around 15 to 30 participants attending daily.

![Figure 2.3. Distribution of CDAH participants according to postcode as of January, 2004](image)

Participants were contacted around two months prior to each clinic to arrange an appointment time. Participants were mailed self-administered questionnaires (general, physical activity and dietary) one to two weeks before their scheduled clinic visit, along with more detailed information about the clinic. Participants were requested to bring the completed questionnaires to the clinic and to fast for 12-hours prior to their appointment.

On arrival at the clinic, signed and witnessed consent were obtained and completed questionnaires received. Those with incomplete questionnaires were provided with a reply-paid envelope for return at their earliest convenience. The order of measurements followed a strict protocol and participants generally completed the clinic in around 2.5 to 3 hours. Anthropometric, blood pressure, vascular ultrasound examinations and fasting blood samples were collected prior to breakfast. Following
breakfast, participants completed a computer-administered mental health questionnaire, cardiorespiratory fitness bicycle ergometer test, lung function test, strength tests, ultrasound assessment of heel bone density and were issued a pedometer. Strength testing was administered after the bicycle ergometer test to ensure muscles were adequately warmed up. All relevant tests, questionnaires and consent forms were checked for completion before departure.

All data collected during fieldwork were manually recorded on a clinic record form, which was transported to a central processing unit at the MRIT. Clinic record forms, questionnaires and pedometer diaries were scanned electronically into a database using the computer program Verity TeleForm Version 9. After scanning, all data were manually verified using the TeleForm program and manually double-checked to ensure accuracy.

2.2. Measures

2.2.1. Baseline (1985)

At baseline, data from a range of field, technical, laboratory and blood tests, as well as a questionnaire, were collected. Field tests completed by all participants were height, weight, girths, sit and reach tests, sit-ups, standing long jump, push-ups, and a 50m and 1.6 km (1 mile) run/walk. Technical tests completed by 9, 12 and 15 year olds were muscular strength tests using dynamometers (hand, shoulder and leg strength), five skinfold thickness measures, blood pressure, lung function and cardiorespiratory fitness using the physical work capacity 170 bicycle ergometer test (PWC_{170}). Blood was taken to provide measures of serum cholesterol, triglycerides, high-density lipoprotein, iron, ferritin and transferrin concentrations. Laboratory tests included maximal oxygen uptake (VO_{2\text{max}}) and under-water weighing on a sub-sample of participants (n=290). Tests included were based on recommendations made by Coonan and Dwyer (1983), with minor alterations further detailed in the ASHFS handbook (Pyke, 1985).

Participants aged 9 to 15 years were surveyed about physical activity, psychological well-being, health status, enjoyment of school, scholastic ability, sleeping patterns,
smoking behaviours, alcohol consumption, breakfast consumption and demographic information (Appendix B). This questionnaire was designed to have some elements in common with the Canada Fitness Survey conducted in 1981 (Canada Fitness Survey, 1983). Information was also sought about the student’s family, including number of siblings, residential arrangements, physical activity and smoking behaviours of parents, parents’ country of birth and the language spoken at home. Questionnaires were administered to all 9 to 15 year olds in groups of four with supervision provided by data collectors. The data collectors read instructions to all age groups and worked through the first page of questions with each group. Participants were situated so that they could not observe other participants’ responses and were encouraged to ask questions when unsure about requirements.

The key baseline exposure and outcome measures relevant to the aims of this thesis are described in more detail below. A full description of other tests and protocols from the baseline survey can be found in the ASHFS handbook (Pyke, 1985).

**Physical activity**

The physical activity component of the ASHFS questionnaire (Appendix B) was designed to provide extensive information regarding different dimensions and domains of physical activity. To date, ASHFS is the only study to have assessed physical activity behaviour in a national representative sample of Australian school children. Only the questions relevant to the analyses in the following chapters are described here.

Participants were asked about all exercise and sport they had participated in during the last week. Questions related to frequency (How many times last week?), duration (How many hours and minutes were spent each session?) and intensity (Did you huff and puff?) of physical activity in several physical activity domains.

For each of these questions, minutes per week spent in each activity was calculated and summed to provide an estimate of total minutes of past-week physical activity in each domain; active commuting (walking and/or cycling to and from school), school physical education, school sport, and extracurricular sport and exercise. As intensity of
physical activity is highly subjective and likely to vary according to a range of variables, including weight status, gender, age and cardiorespiratory fitness levels, intensity was not factored into the estimates of physical activity. Total physical activity was calculated by summing the average weekly minutes of each physical activity domain.

**Depressed Mood**

Depressed mood was assessed using the Negative Affect Scale of the Affect Balance Scale (Appendix B), a measure of psychological well-being designed by Bradburn (1969) for use in population surveys (McDowell et al., 1982). Five items assessed feeling lonely, depressed/unhappy, bored, restless and upset due to criticism from others. Bradburn reported the test-retest reliability of the Negative Affect Scale to be 0.81 in a sample of 200 participants over a 3-day period (Bradburn, 1969). Regarding validity, the Negative Affect Scale has been shown to correlate with single item indicators of happiness at -0.33 and -0.38 respectively (Bradburn, 1969). More recent evidence indicates the Negative Affect Scale is a reliable and valid indicator of psychological distress in community-based participants aged 15-90 years when additional adjustment is made for the confounding effects of physical illness (Koopmans et al., 2005).

2.2.2. Follow-up (2004-2006)

At follow-up, a range of health and sociodemographic information was collected from participants, aged 26 to 36 years. Measures included questionnaires (current and historical physical activity, mental health, smoking habits, alcohol use, general health, personal and family medical history, socioeconomic status, social support, reproductive health and diet), physical measurements (cardiorespiratory and muscular fitness, anthropometry, blood pressure, lung function, bone density, ultrasound measurement of the carotid artery) and blood biochemistry. The key follow-up exposure and outcome measures relevant to the aims of this thesis are described in more detail below.
Physical activity

*International Physical Activity Questionnaire (IPAQ)*

Participants completed the self-administered long version of the International Physical Activity Questionnaire (IPAQ-L) (2005) to provide estimates of physical activity in the past week (Appendix C). The IPAQ-L is a standardised self-report instrument that measures the frequency, duration and level of intensity of physical activity across different domains (leisure, work, active commuting, household/garden) in the past seven days. Participants were asked to report those activities of moderate- or vigorous-intensity that they participated in for at least 10-minutes in duration.

Data from the IPAQ were used to estimate the number of minutes spent in physical activity both overall and for each domain during the past-week. Minutes per week were calculated by multiplying the duration (minutes per week) and the frequency (number of days per week) of each activity within each physical activity domain for moderate- and vigorous-intensity activities. The total number of minutes spent in each physical activity domain was then summed to provide an estimate of the total duration of moderate- and vigorous-intensity physical activity in the past-week.

The IPAQ is an internationally recognised survey developed by an expert committee for use in adults aged 18 to 65 years (Marshall et al., 2001; Timperio et al., 2002). The measurement properties of the IPAQ have been assessed across 12 countries, including Australia (Craig et al., 2003). To assess reliability, 1,880 participants completed the IPAQ-L and returned up to one week later to complete it again. Spearman correlation coefficients ranged from 0.46 in rural South Africa to 0.96 in the USA, with a pooled coefficient of 0.81 (95% confidence interval (CI) 0.79-0.82) indicating good levels of repeatability. To assess validity, 744 participants wore an accelerometer for 7-days between their first and second visit. The questionnaire was found to have fair to moderate validity when compared with accelerometer data, with a pooled coefficient of 0.33 (95% CI 0.26-0.39). While low, this level of validity is usual when comparing objective measures of physical activity to data obtained via self-report (Tudor-Locke et al., 2002) as physical activity questionnaires are generally not sensitive enough to measure incidental physical activity.
Pedometers

Participants were asked to wear a pedometer for 7-days and complete a pedometer diary. Consenting participants were issued with a Yamax Digiwalker SW-200 (Yamasa, Tokyo, Japan) and asked to position it on their belt or waistband in the midline of their right thigh. Using a pedometer diary, participants were instructed to record the date, the time the participant commenced wearing the pedometer, the time the pedometer was taken off, the total steps for the day, any time spent active while not wearing the pedometer (i.e., swimming), any activities participated in while not wearing the pedometer and any circumstances that may have affected the pedometer reading (i.e., travelling long distances on a bumpy road or illness). Inclusion criteria included a minimum wear time of 8-hours per day for at least 4-days. Where there was insufficient information to calculate wear time on a given day, an average of that participant’s other daily wear time values was calculated and the missing value imputed. Daily pedometer readings <500 and >45,000 were investigated for possible data entry errors and values >60,000 were deemed implausible and excluded.

Pedometers are non-invasive and inexpensive and are considered the method of choice for measuring physical activity in epidemiological studies (Bassett, 2000). They detect steps taken with acceptable accuracy (Bassett et al., 1996) and have shown evidence of reliability (Tryon et al., 1991) and convergent and discriminative validity (Tudor-Locke et al., 2001). However pedometers have several limitations including the inability to provide temporal information and capture activity intensity and insensitivity to activity that does not involve locomotion, isometric exercise or upper body movement (Crouter et al., 2003; Freedson et al., 2000). A systematic review of the literature confirmed the validity of pedometry as a means of assessing physical activity (Tudor-Locke et al., 2002). Pedometers were found to correlate strongly with accelerometers (median r=0.86) and time in observed activity (median r=0.82), moderately with different measures of energy expenditure (median r=0.68) and weakly with self-reported physical activity (median r=0.33). Pedometers are also recommended for measuring ambulatory activity (Tudor-Locke et al., 2001), as low-intensity activities such as walking tend to be less well recalled than activities of moderate- and vigorous-intensity (Bassett, 2000). Further, pedometers have demonstrated a relatively low
frequency of data errors when utilised in large population studies (Schmidt et al., 2007).

Composite International Diagnostic Interview

The Composite International Diagnostic Interview (CIDI) (Robins et al., 1988b) is a comprehensive, fully standardised interview used to generate prevalence estimates of major mental illnesses according to definitions and criteria of the tenth revision of the International Classification of Diseases (ICD-10) (World Health Organization, 1992-1994, 1993) and the fourth edition of the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association, 1994). The CIDI was developed by the World Health Organization and the US National Institutes of Health, and combines questions from the Diagnostic Interview Schedule and the Present State Examination. The CIDI is available in paper-and-pencil and computerised formats and may be self- or interviewer-administered.

In the current study participants completed the depression, anxiety and drug and alcohol use disorder modules from the self-administered computerised Composite International Diagnostic Interview (CIDI-Auto, version 2.1) (World Health Organization, 1997b). Participants were seated at a computer terminal and the purpose of the CIDI was explained to them by a trained research assistant. They were informed that all responses would be de-identified and asked to respond as honestly as possible. Prior to commencement, a series of tutorial screens informed the participant about how to complete the interview, the types of questions they would be asked and interactive examples were provided. They were also given simple written instructions on how to complete the questionnaire. A list of referral details for organisations that provide counselling services was also discretely provided. Participants were asked questions about symptoms pertaining to DSM-IV diagnoses of depression, anxiety and drug and alcohol use disorders during the previous 12-months. A research assistant was available at all times during the interview to assist the participant with any difficulties, but did not sit with the participant while they completed the interview.

The CIDI asks a series of questions related to symptoms, the severity of which is determined by progression through a series of probes documented in a flow chart.
Symptoms of sufficient intensity to result in objective distress are examined and if not due to physical illness, medication, drugs or alcohol, are coded as probable psychological symptoms. These symptoms responses are assessed against the diagnostic criteria using computer algorithms to generate diagnoses. In the current study, diagnoses for major depressive disorder and dysthymic disorder for the previous 12-months based on DSM-IV diagnostic criteria (American Psychiatric Association, 1994) were assessed.

A DSM-IV diagnosis of major depressive disorder requires at least one of the two core symptoms of depression i.e., depressed mood and/or loss of interest and pleasure (anhedonia), with at least three of the following symptoms to give a total of five or more diagnostic criteria: appetite/weight changes; sleep disturbance (insomnia or hypersomnia); psychomotor agitation or retardation; fatigue or loss of energy; feelings of worthlessness, or excessive or inappropriate guilt; diminished ability to concentrate or indecisiveness; recurrent thoughts of death or suicide. These symptoms must have been present most of the day, nearly every day for a minimum of two consecutive weeks and represent a change from previous functioning. A DSM-IV diagnosis of dysthymic disorder is characterised by depressed mood for the majority of days over the last two years. Depressed mood is accompanied by two or more of the following symptoms: decreased or increased appetite; sleep disturbance (insomnia or hypersomnia); fatigue or loss of energy; diminished ability to concentrate or indecisiveness; feelings of hopelessness; loss of self-esteem. Symptoms that can be attributed to grief, drug abuse or medication, or a medical condition are excluded from the differential diagnosis.

While the CIDI was designed primarily for use in cross-cultural epidemiological and comparative studies (Robins et al., 1988a), it has also been used extensively for other clinical and research purposes (World Health Organization, 1997a). The CIDI is particularly suitable for large epidemiological studies as it can be administered by lay interviewers, does not require outside informants or medical records and does not assume the presence of a current disorder (World Health Organization, 1997a). The test-retest reliability of the depression module has been found to be good to excellent.
(kappa values from 0.69 to 1.00) across a 1-6 day interval in the general population (Wacker et al., 1990). Further, validity studies indicate good validity for the depression module, with kappa values of 0.50 and above (Andrews et al., 1998; Wittchen, 1994).

2.3. Statistical analyses

Statistical analyses were performed using Stata version 9.2 (StataCorp, 2005), with statistical comparisons treated as significant at $\alpha=0.05$ (two-tailed). The statistical methods utilised to address the aims of this thesis are described in detail in subsequent chapters.
2.4. References


The following chapters have been removed for copyright or proprietary reasons

Chapter 3  Physical activity and depression in young adults

Chapter 4  Physical activity and depressive symptom profiles in young adults with major depressive disorder

Chapter 5  Physical activity and depressed mood in primary and secondary school children

Chapter 6  Validity of self-reported historical leisure physical activity in young adults

Chapter 7  Physical activity from childhood to adulthood and depression in young adults
Chapter 8 Discussion

8.1. Background

Depressive disorders make a considerable independent contribution to the global burden of disease (World Health Organization, 2008). Epidemiological research indicates that physical activity is associated with decreased risk of depression and depressive symptoms (Teychenne et al., 2008). However, research has focussed predominantly on middle and older aged populations. The onset of depression from adolescence to young adulthood is common (Blazer et al., 1994) and coincides with a pivotal period of physical and psychological development. Population-based strategies aimed at initiating and maintaining physical activity have the potential to reduce the morbidity and mortality associated with subsequent depression. However, little is known about how physical activity is associated with depression during this crucial maturational period. The central aim of this study therefore was to investigate the influence of habitual physical activity from childhood to adulthood on depression in young adulthood. This thesis utilised data from the Childhood Determinants of Adult Health (CDAH) study, a population-based, prospective follow-up of the 1985 Australian Schools Health and Fitness Survey (ASHFS) conducted in Australia from 2004-2006. The CDAH study is one of the few studies in the world with the capacity to meet this objective. In order to evaluate the prospective relationship between physical activity and depression, cross-sectional associations between physical activity and depression in childhood (baseline) and young adulthood (follow-up) were first examined. The validity of utilising self-reported retrospective physical activity at follow-up in order to bridge the time interval from adolescence to adulthood was also assessed. The research presented in this dissertation extends and progresses the evidence base examining the potential role of physical activity in the prevention of depressive disorders. The following sections provide a summary of the key findings presented in this thesis, the limitations of the current study, viable public health implications and possible directions for future research.
8.2. Summary

In summary, previous cross-sectional observational studies indicate that regular physical activity is associated with reduced symptoms of depression (Adams et al., 2007; Galper et al., 2006; Kritz-Silverstein, 2001; Mutrie et al., 2007; Weyerer, 1992; Wiles et al., 2007) and prospective studies have found a protective effect of physical activity on depression (Bernaards et al., 2006; Brown, 2005; Camacho et al., 1991; Farmer et al., 1988; Mobily et al., 1996; Motl et al., 2004; Paffenbarger et al., 1994; Strawbridge, 2002; Wise et al., 2006). Numerous systematic reviews (Byrne et al., 1993; Dunn et al., 1991; Martinsen, 1990; Morgan, 1994; Phillips et al., 2003; Raglin et al., 2007; Salmon, 2001; Sime, 1987; Stathopoulou et al., 2006; Taylor et al., 1985) and meta-analyses (Craft et al., 1998; Krogh et al., 2011; Lawlor et al., 2001; McDonald et al., 1991; Mead et al., 2008; North et al., 1990; Rethorst et al., 2009; Stathopoulou et al., 2006) have confirmed these observational studies, showing the effectiveness of physical activity interventions in improving depression and depressive symptoms.

While the current evidence of the beneficial effects of physical activity on depression appears convincing, findings are affected by methodological limitations and several gaps in the research literature remain. For example, prior population-based studies have relied exclusively on self-report assessment of physical activity often using only one or two questions (Goodwin, 2003; Katon et al., 2010; Kritz-Silverstein, 2001; Motl et al., 2004; Sacker et al., 2006; Sagatun et al., 2007; Ströhle et al., 2007; Weyerer, 1992), assessment of physical activity frequency only (Birkeland et al., 2009; Jerstad et al., 2010; Rees et al., 2010; Sacker et al., 2006; Ströhle et al., 2007) rather than both frequency and duration and, to our knowledge, none have utilised an objective measure of physical activity. Furthermore, few population-based studies have included measures that allow separate examination of how physical activity accumulated in various domains (leisure-time, work-related, transport-related and domestic) relates to depression (Desha et al., 2007; Prasad et al., 2009; Teychenne et al., 2008). This is important given that the current public health recommendations promoted in most developed countries including Australia (Commonwealth Department of Health and Aged Care, 1999) focus on movement and incidental activity, not just planned physical
activity. The null association between physical activity and depression seen in some observational studies (Cooper-Patrick et al., 1997; van Gool et al., 2003) may be due to physical activity being assessed as a combined ‘total’ measure of physical activity rather than different physical activity domains being examined separately.

Further, previous observational studies have generally used symptom subscales to assess depressive symptoms with only a few studies (Strawbridge, 2002; Ströhle et al., 2007) having used DSM-IV diagnostic criteria to assess clinical depression. These subscales include the Children’s Depression Inventory (CDI) (Kovacs, 1985), the Centre for Epidemiologic Studies Depression Scale (CESD-D) (Radloff, 1977) and the Hospital Anxiety and Depression Scale (Zigmond et al., 1983). While these scales are well-validated, the use of symptom subscales makes it difficult to compare results between studies and to assess the clinical and public health relevance of any associations found.

The current study adds to existing knowledge in this area by making several methodological improvements over previous studies. These include the use of Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (American Psychiatric Association, 1994) diagnostic criteria for the diagnosis of depression using a standardised psychiatric diagnostic interview. The use of pedometry to provide a more accurate objective measure of ambulatory activity (pedometer steps/day) also provides a novel addition to the literature. While pedometers have limitations as research tools (Freedson et al., 2000), they provide a valid and objective indicator of total ambulatory activity and are useful for distinguishing between groups that vary in their level of walking (Bassett, 2000). The additional use of the IPAQ at follow-up allowed for the provision of specific information regarding the duration of physical activity across different domains (leisure, work, active commuting, garden/household) and intensities (moderate, vigorous). Using an extensive physical activity questionnaire at baseline we were also able to examine physical activity across a range of domains (discretionary sport, school physical education, active commuting) in childhood. Finally, while gender differences in physical activity patterns and depression are well documented, few studies have reported results separately for males and females (Desha et al., 2007; Rothon et al., 2010;
Ströhle et al., 2007). The current study makes an important contribution to the literature by stratifying analyses by gender to identify and disentangle gender-specific patterns of association.

Using a range of physical activity assessment methods and analytical approaches the research presented in this thesis strengthens and extends the growing body of evidence examining the relationship between physical activity and depression from childhood to young adulthood. The key findings and contributions to the literature from this dissertation are as follows:

- This study was the first to examine associations between physical activity and depression using an objective measure of physical activity (pedometer steps/day) and one of the few to examine associations between physical activity and depression across different physical activity domains (Chapter 3). Results extend the literature by demonstrating that increasing work-related physical activity was associated with an elevated prevalence of depression in young women. Further, increasing ambulatory activity was associated with a decrease in depression prevalence, suggesting that incidental physical activity may be beneficial for mental health, particularly in young women.

- This study was the first to examine whether young men and women with DSM-IV major depressive disorder who are physically inactive differ in their depressive symptom profile from those who are physically active (Chapter 4). Depression in physically inactive young adults appeared to be differentiated by a unique depression symptom profile that was not explained by the inclusion of characteristics related to physical inactivity in the DSM-IV diagnostic system. While differences need to be examined across the general population, not just those with clinical depression, the current analysis suggests that observed associations between physical activity and depressive symptoms are not merely an artefact of the criteria used to diagnose depression.
• This was one of the first population-based studies to examine associations between physical activity and depressed mood in primary and secondary school children across different domains of physical activity (Chapter 5). Associations between physical activity and depressed mood when CDAH participants were children and adolescents were generally unsystematic, varying by gender, school-level and the domain in which the physical activity was performed. While this mixed pattern may be an indicator of the true variability in associations between physical activity and depression in youth it may also be an indication of the imprecision of the assessment measures utilised.

• This was one of the first studies to examine the validity of self-reported retrospective leisure activity for up to 21-years in the past (Chapter 6). Results confirmed that the Historical Leisure Activity Questionnaire had reasonable validity for ranking participants in the CDAH cohort by their level of retrospective leisure activity.

• Using both prospectively and retrospectively assessed physical activity, this study was the first in the world to examine the influence of leisure-time physical activity patterns from childhood to adulthood on depression in young adulthood over a 20-year follow-up (Chapter 7). Results demonstrated a beneficial effect of habitual leisure-time physical activity, consistent with public health recommendations, from childhood to adulthood on the risk of depression in both young men and women.

Viewed as a whole the current findings deepen our understanding of the complex relationship between physical activity and depression across the developmental trajectory from childhood to young adulthood. While the measurement methods utilised may account for the differing associations observed in childhood and adulthood in the current cohort, several broad themes consistently emerged. For instance, results suggest that the context in which the physical activity is performed may need to be discretionary rather than non-discretionary in order for individuals to derive mental health benefits. Positive associations between non-discretionary (work)
physical activity and depression in adulthood suggest that the discretionary nature of
the activity may be particularly salient for young women. The potential social benefits
derived from the social interaction accompanying the physical activity may also be an
important component of associations between depression and physical activity in
females. In contrast, intensity and duration appear to be particularly important
dimensions of physical activity influencing associations for males, with the beneficial
effect of discretionary (leisure) physical activity on depression appearing to depend on
the activity being of both a higher intensity and longer duration than that required to
see benefits in females. Results also suggest that the preventative effect of physical
activity in males may depend on the activity being structured in nature and/or
involving group activity, such as organised sport, particularly during adolescence. The
domain in which the physical activity is assessed also appears to be a determinant of
depressive outcomes, with diverse associations in young adulthood suggesting that
associations between depression and physical activity in various domains become
increasingly differentiated from childhood to adulthood.

8.3. Limitations

As in all observational epidemiological investigations, there are a number of possible
limitations relating to misclassification bias, selection bias and statistical power that
should be considered when interpreting the findings in this thesis.

Firstly, the collection of exposure and outcome data via self-report may have led to
misclassification in the current study. Measurement error would be expected to be
differential and leading to bias if the physical activity classification of those with
depression was different from the physical activity classification of those without
depression. For instance, it is possible that those with depression tended to over-report
their physical activity as it was subjectively perceived as being more laborious.
However, as described in Chapter 7, similar associations between subjectively and
objectively assessed physical activity were observed in those with and without
depression provide some assurance that self-reported physical activity in adulthood
was not substantially biased by depression. Further, self-reported physical activity
remains the most practical option in large epidemiological investigations. Physical
activity questionnaires are inexpensive, time efficient and can elicit information about
the behavioural aspects of physical activity which objective measures are unable to
assess. Conversely questionnaires may lack sensitivity, are often unable to distinguish
incidental activity and are prone to over-reporting (Shephard, 2003). The use of
categorical, instead of continuous, physical activity in analyses may have also led to a
loss of information. However, categorical data allows for measures of association which
translate more readily into concrete public health messages regarding the optimal
duration (dose) of physical activity required to obtain mental health benefits. Self-
report questionnaires to evaluate depression are also widely adopted for use in
population-based studies and remain the most convenient and least expensive way to
collect data in large populations (Foley et al., 2005). The CIDI is considered the ‘gold-
standard’ in the assessment of psychiatric diagnoses in epidemiological research and
has demonstrated good concordance with face-to-face psychiatric diagnoses (Reed et
al., 1998). Further, computerised administration is cost effective and time efficient, and
may assist in reducing errors in data entry and scoring.

Other limitations relate to the possibility of selection biases influencing the study
findings. Selection bias describes the systematic error that may arise from the
procedures used to select participants and from factors that influence participation
(Rothman, 2002). Selection bias due to differential loss to follow-up would have
occurred in the current study if participation in the CDAH study related to both
physical activity and depression status. As detailed in Chapter 7, the minor differences
in exposure and outcome measures between participants and non-participants at
baseline are unlikely to have significantly influenced results. Assessing the effect of
selection bias at follow-up is more difficult as the association between the exposure and
outcome measure in nonparticipants is unknown. Those who chose to participate in the
follow-up study may have been more health conscious than those who chose not to
participate. Conversely, those who participated may have volunteered because they
were particularly worried about their health. The potential biases arising from self-
selection tend to counteract one another, but because neither one is easy to quantify, the
overall bias remains unknown (Rothman, 2002). The extent to which these selection
biases influence associations (internal validity) has potential implications for the
generalizability (external validity) of the current findings. However, in regards to cross-sectional analyses, it is more important to consider the comparability of the sample with the general population and to have heterogeneity in the distribution of exposures, outcomes and covariates. A comparison of the CDAH cohort with population data for Australian adults aged 25 to 34 years shows that the prevalence of depressive disorders in CDAH participants was similar to young men and women in the general population (Australian Bureau of Statistics, 2008). While CDAH participants were somewhat more likely to be tertiary educated and married than the Australian population of the same age, the proportions of those who were overweight and current smokers were comparable, further pointing to the generalizability of the current findings. Further, due to the breadth of the covariates measured we were able to take account of these differences in the analyses.

Unmeasured potential confounders, inevitable in observational studies, may have also influenced results. For example, diet quality, which is inversely associated with both physical activity (Gillman et al., 2001) and depression (Jacka et al., 2010), was not examined. While BMI was examined as a potential confounder and/or mediator of the association between physical activity and depression in the current study, BMI does not adjust for the potential influence of dietary behaviour on depression or physical activity. So, while we identified and adjusted for the most salient potential confounders, the possibility of residual confounding remains.

Finally, while the prevalence of depression in the current study was comparable to the general population, the total number of participants with depression was low and the statistical power to examine associations between physical activity and depression was limited, particularly in men. For example, the small number of participants with depression in each physical activity category may have limited our ability to detect significant differences between physical activity groups.

### 8.4. Public health implications

It is now widely acknowledged that the growth of mental health disorders is exceeding the capacity of mental health services to meet the demand for traditional, individual
treatment services. This has led to growing international interest in promotion, prevention and early intervention for mental health. The research presented in this thesis makes a unique contribution to the expanding evidence base that will likely drive future policy decisions and investments in this area. The results of this work have implications regarding several areas of public health including the national recommendations for physical activity, the integration of physical activity into mental health prevention, promotion and treatment, enhanced economic productivity and equitable access to mental health services.

Several countries, including Australia, have national position statements and physical activity policy guidelines to guide practitioners and policy makers (Commonwealth Department of Health and Aged Care, 1999; United States Department of Health and Human Services, 2008; World Health Organization, 2010). Australia’s National Physical Activity Guidelines (Commonwealth Department of Health and Aged Care, 1999) outline the minimal levels of physical activity required to confer the maximal economic benefit in terms of population health. The current physical activity guidelines recommend at least 60 minutes per day of moderate- to vigorous-intensity physical activity for 12 to 18 year olds and at least 30 minutes of moderate- to vigorous-intensity on most, preferably all days, for adults. The results presented in this thesis provide additional evidence to support the premise that maintaining levels of discretionary physical activity, consistent with these public health recommendations, from childhood to adulthood is associated with a decreased risk of depression in young adulthood.

While still broad in scope, regulatory bodies are now beginning to take meaningful policy steps towards integrating physical activity into mental health prevention, promotion and treatment. In Australia, the Victorian Health Promotion Foundations’ (VicHealth) Together We Do Better campaign aimed to promote the importance of behavioural (including physical activity) and social factors related to positive mental health (Walker et al., 2004). The Act-Belong-Commit campaign currently being rolled out by the Western Australian government includes an objective to increase individuals’ participation in individual and community activities (including physical activity) that improve mental health and reduce vulnerability to mental health problems (Donovan et
Government funded research is also currently in progress to investigate the (cost) effectiveness of exercise and physical activity interventions for depression within primary health care. In the United Kingdom, the TReatment with Exercise Augmentation for Depression (TREAD) study (Baxter et al., 2010) is a National Institute of Mental Health (NIMH) funded RCT designed to assess exercise on prescription as a treatment for depression within the National Health Service. If effective the protocols from this study will be used to develop and promote exercise referral as a treatment for mild to moderate depression within primary health care across the United Kingdom.

The benefits of regular physical activity in enhancing workforce capacity and economic productivity further strengthen the argument for greater investment in disease prevention and health promotion with the promotion of physical activity within the workplace having the possibility of providing both physical and mental health benefits. Possible gains for governments and businesses include future savings in avoidable health care expenditure, increased income from taxation, fewer welfare payments, reduced absenteeism, and lower recruitment and training costs associated with replacing staff. A recent analysis indicates that a feasible reduction in the prevalence of physical inactivity in Australia could lead to total opportunity cost savings of AUS$258 million, with 36% of these savings arising from the health sector (Cadilhac et al., 2011).

Despite the prevalence and adverse outcomes of experiencing depression during young adulthood, young people are often reluctant to seek treatment (Rickwood et al., 2005) and are the least likely of all age groups to receive appropriate mental health care (Australian Bureau of Statistics, 2010; Australian Government Department of Health and Ageing, 2005). Physical activity may offer a low-stigma, accessible and acceptable intervention for this particularly vulnerable population (Rickwood et al., 2007; Tylee et al., 2007). If effective, physical activity interventions in this age group have the capacity to prevent the progression of early stages of depressive disorders to later and potentially more serious stages of psychopathology and to reduce the risk of persistence and recurrence of symptoms (Wells et al., 2005).
8.5. Future directions

Further research will likely continue to establish an evidence base for the use of physical activity interventions for the prevention of depression. In compiling this thesis, a number of directions for future research have become evident.

- The development and use of more valid measures of physical activity and depression are required to ensure they capture both constructs reliably and accurately, thereby elucidating the true quantification of effects. There is also a need to investigate the most effective ways to measure physical activity and depression at different developmental stages. Further research using more accurate assessment of physical activity and depression in childhood and adolescence will assist in clarifying the potential efficacy of physical activity in the prevention of depression in youth.

- Where feasible, the objective measurement of physical activity should also be incorporated into study designs. The methodological benefits of objectively assessed physical activity include eliminating potential reporting bias, minimising random error and the enhanced estimation of incidental physical activity. For example, studies utilising motion detectors such as accelerometers will facilitate the collection of temporal data to examine whether ambulatory activity accumulated in small amounts throughout the day or as a single session is beneficial for mental health.

- Future studies might also investigate sports team participation among children and adolescents to explore the potential of competitive and recreational team sports in mental health promotion. Distinguishing between competitive and recreational, and team and individual sporting activities may contribute to understanding how different types of participation relate to depression. Potential mediating mechanisms that may explain relationships between physical activity and depression during this maturational period, such as connectedness to adults
or prosocial peers, self-confidence, self-efficacy, and personal attitudes and beliefs regarding physical activity also require further exploration.

- Increased understanding of the dose-response relationship between physical activity and depression may contribute to more precise and robust public health recommendations for physical activity. Further observational studies examining whether increasing the frequency, intensity, or duration of physical activity is associated with a reduction of depression are required. Examining the influence of developmental stage (e.g., comparing children, adolescents and younger adults) and gender will also be important in formulating recommendations targeted towards subgroups within the population who are at particular risk of depression.

- Research examining the relationship between work-related physical activity and depression, particularly in women, is needed. The current study suggests that young women with high durations of occupational physical activity may be particularly vulnerable to depression. It is important to examine whether this association is due to a response bias in women with depression that results in perceptions of work being more physically arduous than it actually is. The next phase of the CDAH study will facilitate this by allowing us to examine the effect of occupational roles and job strain in relation to work-related physical activity and depression.

- Additional prospective analyses with increased statistical power and incorporating more frequent measurements of physical activity and depression are needed to verify and extend the findings reported in this thesis. Regular measurement of physical activity and depression during the trajectory from childhood to adulthood has the potential to reveal distinct and characteristic patterns of physical activity between those who do and who not develop depression and the developmental stage at which these changes occur. Further follow-up of the CDAH cohort will contribute further to our understanding of the
relationship between physical activity and depression from childhood into adulthood but associations should also be examined in other study populations.

- It is important to further elucidate the factors involved in the causal pathways that lead to changes in depression and depressive symptoms. Further RCTs and basic research in humans and animals may assist in identifying the precise physiological and neurological mechanisms by which physical activity is effective. For example, developments in noninvasive imaging, such as functional magnetic resonance imaging (fMRI) offer opportunities to examine possible neurobiological processes. The modification and development of animal paradigms will be important for investigating neurochemical and neuropharmacological pathways. An integrative approach utilising multiple methods is likely to be the most effective.

- In addition to observational studies, RCTs with large samples sizes and long-term follow-up are required to evaluate the effect of physical activity interventions on the incidence and course of depression over time. Well-designed RCTs may also help clarify the dose and type of physical activity required, and elucidate the causal mechanisms involved. Future trials should also examine whether combining physical activity interventions with antidepressant therapy and/or psychotherapy enhances treatment efficacy.

8.6. Conclusion

The high prevalence of depressive disorders in young people represents a major challenge to regulatory bodies, communities and service providers in Australia. The findings from this dissertation contribute to the growing body of preventative health research examining ways to reduce the public health burden posed by depressive disorders in this population. Findings indicate that regular participation in discretionary physical activity during the developmental trajectory from childhood to adulthood is associated with reduced risk of depressive disorder in young adulthood. Public health strategies aimed at encouraging regular physical activity from childhood,
through adolescence and into early adulthood as well as promoting activity in physically inactive young adults have potential for reducing the morbidity and subsequent treatment burden of depressive disorders. Identifying the most effective strategies and the most beneficial times to intervene will be important challenges in reducing the public health burden of depression.
8.7. References


Appendices
Appendix A

CDAH General Questionnaire
SECTION A: This section asks you some questions about yourself. You may feel you have already answered these questions in our enrolment questionnaire, however your circumstances may have changed since you completed our enrolment questionnaire.

1. Today's date

2. What sex are you?  ○ Male  ○ Female

3. What is your date of birth?

4. What is your current marital status?
   ○ Single
   ○ Married
   ○ De facto
   ○ Separated/Divorced
   ○ Widowed
   ○ Other

(please specify)

5. What is the highest level of education you have completed? (Select only one answer)
   ○ Primary School
   ○ Year 7, 8 or 9 or equivalent
   ○ Year 10 or equivalent
   ○ Year 11 or equivalent
   ○ Year 12 or equivalent
   ○ Trade/apprenticeship (e.g. hairdresser, chef)
   ○ Certificate/diploma (e.g. child care, technician)
   ○ University Degree
   ○ Higher University Degree (e.g. Grad Dip, Masters, PhD)
   ○ Other

(please specify)
6. What is your main source of income? (Select only one answer)

- Wages or salary
- Own business or share in partnership
- A government pension or cash benefit
- Superannuation
- Investment/Interest
- Other income (please specify)

7. What is your main occupation NOW? (Select only one answer)

- Manager or administrator (e.g., magistrate, farm manager, general manager, director of nursing, school principal)
- Professional (e.g., scientist, doctor, registered nurse, allied health professional, teacher, artist)
- Associate professional (e.g., technician, manager, youth worker, police officer)
- Tradesperson or related worker (e.g., hairdresser, gardener, florist)
- Advanced clerical or service worker (e.g., secretary, personal assistant, flight attendant, law clerk)
- Intermediate clerical, sales or service worker (e.g., typist, word processing/data entry operator, receptionist, child care worker, nursing assistant, hospitality worker)
- Intermediate production or transport worker (e.g., sewing machinist, machine operator, bus driver)
- Elementary clerical, sales or service worker (e.g., filing/mail clerk, parking inspector, sales assistant, telemarketer, housekeeper)
- Labourer or related worker (e.g., cleaner, factory worker, general farm hand, kitchen hand)
- No paid job
8. Which of the following describes your current employment status? You can pick more than one.

- Working full-time
- Working part-time
- Not working (but not retired)
- Home duties
- Full-time student
- Part-time student
- Retired
- Permanently unable to work / Ill
- Other

(please specify)

SECTION B: This section is about your health and your medical history

1. Have you ever been told that you have high blood pressure?

- No --- Skip to Question 2
- Yes

**IF 'YES'**

1a) When were you first told this? [ ] [ ] [ ] (Year)

1b) Was this during pregnancy?

- Yes
- No
- Not applicable

1c) Are you currently taking medication prescribed by a doctor to lower your blood pressure?

- Yes
- No

1d) Has a doctor in the past year recommended you change your way of life, in order to lower your blood pressure?

- Yes
- No
2. Have you ever been told that you have angina?
   ○ No  --> Skip to Question 3
   ○ Yes

   **IF 'YES'**
   2a) When were you first told this?  [ ] [ ] [ ] (Year)

   2b) Are you currently on tablets or other treatment for angina?
   ○ Yes  ○ No

3. Have you ever been told that you have had a heart attack (includes 'coronary', 'coronary occlusion', 'coronary thrombosis', 'myocardial infarction')?
   ○ No  --> Skip to Question 4
   ○ Yes

   **IF 'YES'**
   3a) When were you first told this?  [ ] [ ] [ ] (Year)

4. Have you ever been told that you have had a stroke?
   ○ No  --> Skip to Question 5
   ○ Yes

   **IF 'YES'**
   4a) When were you first told this?  [ ] [ ] [ ] (Year)
5. Have you ever been told that you have high cholesterol?
   - No  --> Skip to Question 6
   - Yes

   **IF 'YES'**
   5a) When were you first told this? (Year)

   5b) Are you currently taking medication prescribed by a doctor to lower your blood cholesterol?
       - Yes  - No

   5c) Has a doctor in the past year recommended that you change your way of life, in order to lower your blood cholesterol?
       - Yes  - No

6. Have you ever been told that you have high triglycerides?
   - No  --> Skip to Question 7
   - Yes

   **IF 'YES'**
   6a) When were you first told this? (Year)

7. Are you currently taking aspirin-containing medication to prevent or treat heart disease or stroke?
   - No
   - Yes
8 Has a doctor or nurse ever told you that you have diabetes?

○ No  --> Skip to Question 9

○ Yes

IF 'YES'
8a) In what year were you first told that you had diabetes? __________ (Year)

8b) Were you told that you had:

○ Type 1 diabetes
( previously known as "insulin-dependant diabetes")

○ Type 2 diabetes
( previously known as "non insulin-dependant diabetes")

○ Don't know which type

8c) What advice and/or treatment have you had for diabetes? (select all that apply)

○ Diet advice

○ Tablets

○ Insulin injections

○ Diet advice and tablets

○ Diet advice and insulin injections
9. Are you currently taking any medication prescribed by a doctor?
   ○ No  --> Skip to Question 9b
   ○ Yes

9a) In the table below please provide the name (or type of medication) and what it was prescribed for. Please continue at the bottom of page 28 if you need more space.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Prescribed for</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

9b) Are you currently using any of the following hormonal medications?
   (If you are female using hormonal contraceptives please do not include them in the "Other" category. We ask about contraception in Section D)
   ○ I do not use any hormone medications
   ○ Hormone replacement therapy
   ○ Testosterone treatment (e.g., Androderm)
   ○ Anabolic steroids
   ○ Other (please specify)  

10. Have you had any illness causing a high temperature during the last two weeks?
   ○ No  --> Skip to SECTION C (Page 8)
   ○ Yes

   IF 'YES'

10a) What was the duration of the fever?  

10b) Was your temperature measured?
   ○ No
   ○ Yes, but temperature not known
   ○ Yes, my temperature was 

10c) How many days ago did the fever stop?
**SECTION C:** The following questions ask for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

1. In general would you say your health is:
   - ○ Excellent  ○ Very Good  ○ Good  ○ Fair  ○ Poor

2. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>YES, limited a lot</th>
<th>YES, limited a little</th>
<th>NO, not limited at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a) Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling or playing golf.</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>2b) Climbing several flights of stairs.</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

3. During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

<table>
<thead>
<tr>
<th>Problem Description</th>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>3a) Accomplished less than you would like</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>3b) Were limited in the kind of work or other activities.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

4. During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)

<table>
<thead>
<tr>
<th>Problem Description</th>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>4a) Accomplished less than you would like</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>4b) Did work or other activities less carefully than usual</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

---

SF-12™ Health Survey © 1992, 2003 by Health Assessment Lab, Medical Outcomes Trust and QualityMetric Incorporated. All rights reserved. SF-12® is a registered trademark of Medical Outcomes Trust. (QOALA SF-12v2 Standard, English (Australia), 7/03)
5. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

<table>
<thead>
<tr>
<th>Not at all</th>
<th>A little bit</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

6. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

<table>
<thead>
<tr>
<th>How much of the time during the past 4 weeks:</th>
<th>All of the time</th>
<th>Much of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>6a) Have you felt calm and peaceful?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>6b) Did you have a lot of energy?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>6c) Have you felt downhearted and depressed?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

7. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives etc.)?

<table>
<thead>
<tr>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
SECTION D: This section is for WOMEN ONLY.
If you are MALE please skip to SECTION E (page 15). The answers to the following questions will help us investigate the influence of hormones on the cardiovascular system.

1. Are you currently using any of the following hormonal contraceptives, even if you are using them for reasons other than contraception?
   - Oral contraceptive pill
   - Minipill (progesterone only pill)
   - Weekly contraceptive patch
   - Progestagen (e.g., Implanon)
   - Progestagen injection (e.g., Depo Provera)
   - Progestin injection (e.g., Noristerat)
   - Progestin releasing intrauterine device (e.g., Mirena, Copper T380A)
   - Progestin releasing implant (e.g., Norplant)
   - Other (please specify)

2. How old were you when you had your first menstrual period?
   - Years
   - Months

3. Have you had a hysterectomy; that is, an operation to remove your uterus?
   - No --> Skip to Question 4
   - Yes

   **IF YES**
   3a) What age were you when you had the hysterectomy?
      - Years

   3b) Were your ovaries removed as well?
      - Yes, both ovaries removed
      - Yes, only one ovary removed
      - No
      - Don't know
      - SKIP TO Question 5
4. The menstrual cycle is the time from the first day of one period to the first day of the next.

Bleeding days Non-bleeding days Bleeding days

The Menstrual cycle

4a) How long is your usual menstrual cycle?
   In other words, how many days are there from the FIRST DAY OF ONE PERIOD to the FIRST DAY OF THE NEXT?

   Days

4b) What is the longest menstrual cycle you have had in the last 12 months? Again count from the FIRST DAY OF ONE PERIOD to the FIRST DAY OF THE NEXT.

   Days

4c) What is the shortest menstrual cycle you have had in the last 12 months? Again count from the FIRST DAY OF ONE PERIOD to the FIRST DAY OF THE NEXT.

   Days

5. Thinking about the most recent time when you were having periods and were NOT using hormonal contraceptives (e.g., the pill) and were not pregnant or breastfeeding:

5a) Would you describe your periods as:
   ○ Very regular
   ○ Fairly regular
   ○ Irregular
   ○ Very irregular

5b) How old were you at this time?
   That is, at the most recent time when you were having periods and were NOT using hormonal contraceptives (e.g., the pill) and were not pregnant or breastfeeding.

   Years

5c) During this time, approximately how many periods did you have in the space of 12 months?
   ○ More than 13
   ○ 11-13
   ○ 6-10
   ○ 1-5
   ○ None
6. Have you ever seen a doctor because of irregular periods?
   ○ No  ---› Skip to Question 7
   ○ Yes

   **IF YES**
   6a) How old were you when you first saw your doctor about irregular periods?

   [ ] Years

   6b) Have you ever taken prescribed hormone medications for irregular periods?

   ○ Yes  ○ No

   6c) Has a doctor ever told you that you have polycystic ovaries or polycystic ovary syndrome?

   ○ Yes  ○ No

7. Have you ever seen a doctor because of concern about the amount of hair on your face?

   ○ No  ---› Skip to Question 8
   ○ Yes

   **IF YES**
   7a) Were you prescribed any treatment for this?

   ○ No

   ○ Yes  [ ]

   (please specify)

8. Has a doctor ever told you that you have acne?

   ○ No  ---› Skip to Question 9
   ○ Yes

   **IF YES**
   8a) Were you prescribed any treatment for this?

   ○ No

   ○ Yes  [ ]

   (please specify)
9. Have you ever tried to become pregnant for 12 months or more without succeeding?
   - Yes  
   - No

10. Have you ever seen a doctor because you were having trouble becoming pregnant?
    - No --> Skip to Question 11
    - Yes

**IF YES**

10a) Did you have any of the following fertility investigations?
    - Test of blood or urine hormone levels
    - Laparoscopy (incision in your stomach to look at your reproductive organs)
    - Your partner's semen analysed

10b) Did a doctor ever tell you that you or your partner had:
    - An ovulatory problem?
    - A tubal problem?
    - Any other female fertility problem?
      - Please specify: 
    - Semen abnormalities?
    - An unexplained fertility problem?

11. Have you ever been pregnant?
    - No --> Skip to SECTION E (Page 15)
    - Yes

12. How many times have you been pregnant?  
    Times:  

13. How many live births have you had? 

13a) When were these babies born?

<table>
<thead>
<tr>
<th>Baby</th>
<th>Month</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>First baby</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Second baby</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Third baby</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Fourth baby</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Fifth baby</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

*If you have had more than 5 live births please continue at the end of this section.*

14. When you were pregnant were you ever tested for diabetes?  
That is, did you have a blood or urine sugar test? This may have involved drinking a very sugary drink.

○ Yes  ○ No

15. Were you ever told that you had gestational diabetes or pregnancy related diabetes?

○ Yes  ○ No
SECTION E: This section is about your family's medical history

The following questions are about your BIOLOGICAL parents and siblings. Because heart disease in women under 50 is uncommon, some questions are only asked about your male relatives. Please do not include adoptive or step-parents or siblings here.

1. Was your biological mother diagnosed with diabetes when she was under the age of 50?
   ○ Yes  ○ No  ○ Don't Know

2. Is your biological mother alive now?  ○ Yes  ○ No  ○ Don't Know
   
   If NO:
   2a) How old was she when she died?   [   ]   Years

   2b) Was the cause of her death diabetes?
      ○ Yes  ○ No  ○ Don't Know

3. Was your biological father diagnosed with diabetes when he was under the age of 50?
   ○ Yes  ○ No  ○ Don't Know

4. Was your biological father diagnosed with heart disease when he was under the age of 50?
   ○ Yes  ○ No  ○ Don't Know

5. Is your biological father alive now?  ○ Yes  ○ No  ○ Don't Know
   
   If NO:
   5a) How old was he when he died?   [   ]   Years

   5b) Was the cause of his death:
         
         Heart disease?  ○ Yes  ○ No  ○ Don't Know
         Diabetes?  ○ Yes  ○ No  ○ Don't Know
6. Do you have any **BIOLOGICAL** brothers?

- ○ Yes
- ○ No --- Skip to question 7
- ○ Don't Know --- Skip to question 7

**IF YES**

6a) Have any of your biological brothers been diagnosed with the following illnesses when under the age of 50?

<table>
<thead>
<tr>
<th>Illness</th>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6b) If 'YES' to either of the above, please complete details below (space has been allowed for you to complete details for up to 3 brothers if necessary):

**HEART DISEASE**

<table>
<thead>
<tr>
<th>Age at diagnosis (if known)</th>
<th>Did this result in his death?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>○ Yes ○ No</td>
</tr>
<tr>
<td>2</td>
<td>○ Yes ○ No</td>
</tr>
<tr>
<td>3</td>
<td>○ Yes ○ No</td>
</tr>
</tbody>
</table>

**DIABETES**

<table>
<thead>
<tr>
<th>Age at diagnosis (if known)</th>
<th>Did this result in his death?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>○ Yes ○ No</td>
</tr>
<tr>
<td>2</td>
<td>○ Yes ○ No</td>
</tr>
<tr>
<td>3</td>
<td>○ Yes ○ No</td>
</tr>
</tbody>
</table>
7. Do you have any **BIOLOGICAL** sisters

- ○ Yes
- ○ No ➔ Skip to SECTION F
- ○ Don’t know ➔ Skip to SECTION F

**IF YES**

7a) Have any of your biological sisters been diagnosed with diabetes when under the age of 50?

- ○ Yes
- ○ No
- ○ Don’t Know

7b) If 'YES', please complete details below (space has been allowed for you to complete details for up to 3 sisters if necessary):

<table>
<thead>
<tr>
<th>Age at diagnosis (if known)</th>
<th>Did this result in her death?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>○ Yes ○ No</td>
</tr>
<tr>
<td>2</td>
<td>○ Yes ○ No</td>
</tr>
<tr>
<td>3</td>
<td>○ Yes ○ No</td>
</tr>
</tbody>
</table>

---

**SECTION F:** This section is about smoking tobacco

1. Over your lifetime, have you smoked at least 100 cigarettes, or a similar amount of tobacco?

- ○ No ➔ SKIP TO SECTION G (Page 20)
- ○ Yes

2. How often do you **now** smoke cigarettes, cigars, pipes or any other tobacco products?

- ○ Daily
- ○ At least once a week (but not daily) ➔ Skip to Question 7
- ○ Less often than weekly ➔ Skip to Question 7
- ○ Not at all ➔ Skip to Question 7
3. When did you start smoking daily?

<table>
<thead>
<tr>
<th>Years of Age</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
</tr>
</tbody>
</table>

4. What do you currently smoke?
(Please indicate types and enter how many you smoke)

| 4a)          |  
|--------------|---
| Manufactured cigarettes |   | Cigarettes per day |
| 4b)          |  
| Hand-rolled cigarettes  |   | Grams per week* |
| 4c)          |  
| Cigars     |   | Cigars per week |
| 4d)          |  
| Pipes full of tobacco |   | Grams per week* |

* A one and three quarter ounce pouch of tobacco equals 50 grams

5. When you smoke manufactured cigarettes, which brand do you usually smoke?

I do not smoke manufactured cigarettes ○

The brand I usually smoke is _____________________________
(Please give as much detail as possible, eg Marlboro Lights)

6. Have there been any periods of time when you gave up daily smoking and then started smoking again?

No ○ --> Skip to SECTION G (Page 20)

Yes ○

IF YES

6a) Were any of these periods greater than 3 months duration?

No ○ --> Skip to SECTION G (Page 20)

Yes ○

IF YES 6b) What is the total amount of time that you stopped smoking for?
(Please add together all the periods of time when you stopped smoking)

<table>
<thead>
<tr>
<th>Years</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Now skip to SECTION G (Page 20)
7. In the past have you ever been a daily smoker?
   No  ○  --> Skip to SECTION G (Page 20)
   Yes ○

8. When did you start smoking daily?  
   Years of Age  OR  

9. When did you finally stop smoking daily?  

10. When you smoked daily, how much did you usually smoke?  
    (Please indicate types and enter the number smoked)

    10a)  ○  Manufactured cigarettes  
          Cigarettes per day  

    10b)  ○  Hand-rolled cigarettes  
          Grams per week*  

    10c)  ○  Cigars  
          Cigars per week  

    10d)  ○  Pipes full of tobacco  
          Grams per week*  

* A one and three quarter ounce pouch of tobacco equals 50 grams

11. When you smoked manufactured cigarettes, which brand did you usually smoke?
    I did not smoke manufactured cigarettes ○
    The brand I usually smoked was  
    (Please give as much detail as possible, eg Marlboro Lights)

12. Prior to the time when you finally stopped daily smoking, were there any periods of time when you gave up daily smoking and then started smoking again?
    No  ○  --> Skip to SECTION G (Page 20)
    Yes ○

    IF YES
    12a) Were any of these periods greater than 3 months duration?
        No  ○  --> Skip to SECTION G (Page 20)
        Yes ○

        IF YES  12b) What is the total amount of time that you stopped smoking for?  
          (Please add together all the periods of time when you stopped smoking)  
          Years  Months
SECTION G: These questions are about your life when you were growing up until the age of 12. They are mostly about your parents or other adults who you lived with and who were responsible for you.

1. This question is about only the people who lived in the same house as you and were like parents to you for most of the time until you turned 12.

   1a) Did you live in the same house as your father or another male who was like a father to you?

   ○ No  --> Skip to question 1c

   ○ Yes

      IF YES

    1b) What is the highest level of education completed by your father (or other male who lived with you and was like a father to you)

      ○ No schooling

      ○ Primary School only

      ○ Year 7, 8 or 9 or equivalent

      ○ Year 10 or equivalent

      ○ Year 11 or equivalent

      ○ Year 12 or equivalent

      ○ Trade/apprenticeship (e.g. hairdresser, chef)

      ○ Certificate/diploma (e.g. child care, technician)

      ○ University Degree

      ○ Higher University Degree (e.g. Grad Dip, Masters, PHD)

      ○ Other (please specify)  

1c) Did you live in the same house as your mother or another female who lived with you and was like a mother to you?

○ No --> Skip to question 2

○ Yes

**IF YES**

1d) What is the **highest** level of education completed by your mother (or other female who lived with you and was like a mother to you)

○ No schooling

○ Primary School only

○ Year 7, 8 or 9 or equivalent

○ Year 10 or equivalent

○ Year 11 or equivalent

○ Year 12 or equivalent

○ Trade/apprenticeship (e.g. hairdresser, chef)

○ Certificate/diploma (e.g. child care, technician)

○ University Degree

○ Higher University Degree (e.g. Grad Dip, Masters, PHD)

○ Other (please specify)
2. What was the MAIN occupation of your father (or other male who lived with you and was like a father to you), and your mother (or other female who lived with you and was like a mother to you) until you turned 12? Please only select one answer for your father and one answer for your mother.

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Father</th>
<th>Mother</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager or administrator (e.g. magistrate, farm manager, general manager, director of nursing, school principal)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Professional (e.g. scientist, doctor, registered nurse, allied health professional, teacher, artist)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Associate professional (e.g. technician, manager, youth worker, police officer)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Tradesperson or related worker (e.g. hairdresser, gardener, florist)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Advanced clerical or service worker (e.g. secretary, personal assistant, flight attendant, law clerk)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Intermediate clerical, sales or service worker (e.g. typist, word processing/data entry operator, receptionist, child care worker, nursing assistant, hospitality worker)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Intermediate production or transport worker (e.g. sewing machinist, machine operator, bus driver)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Elementary clerical, sales or service worker (e.g. filing/mail clerk, parking inspector, sales assistant, telemarketer, housekeeper)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Labourer or related worker (e.g. cleaner, factory worker, general farm hand, kitchenhand)</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>No paid job</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

3. Thinking about until you were 12, how many rooms were there in the home where you lived the longest?

Please include buildings on the property that were regularly used for living, such as bungalows. If your house had open plan areas, consider each area as a separate room (i.e. an open plan kitchen, dining and living area would count as three rooms). Do not include separate toilets.

| Rooms in house |
4. Thinking about most of the years until you were 12, did your parents or the people who brought you up own the house you mostly lived in, or did they rent it?
   ○ They owned or were paying off the house
   ○ They rented the house
   ○ Unsure

5. Thinking about the years until you were 12, how many times did you move house?
   If you did not move house, please write "0"
   
   □□□□ Times

6. All together, how many brothers and sisters did you have in your family until you were 12? Include adopted, step and half brothers and sisters. Please also include any brothers or sisters that may have died, but not those who died before you were born.

   I did not have any brothers or sisters ○
   □ Older brothers
   □ Older sisters
   □ Younger brothers
   □ Younger sisters
   □ Twin brother to you
   □ Twin sister to you

7. About how much did you weigh when you were born?

   ○ 3 pounds or less (less than 1360g)
   ○ More than 3 pounds and up to 5 pounds (1361-2270 grams)
   ○ More than 5 pounds and up to 8 pounds (2271-3630 grams)
   ○ More than 8 pounds (more than 3630 grams)
   ○ Don’t know
**SECTION H:** The following statements have been used by many people to describe how much support they get from other people.

We would like to know whether you share any of these feelings and how strongly you feel about them, by filling in the circle according to whether you strongly agree, agree, disagree or strongly disagree with each one. If you are undecided, select the column with this heading.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. People do not come and visit me as often as I would like.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2. I find it easy to make friends.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3. I often need help from other people but can’t get it.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>4. I’m afraid of being left alone.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5. I seem to have a lot of friends.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>6. I don’t have anyone that I can confide in.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7. The person who means most to me takes an interest in my affairs.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>8. There is someone who needs me as much as I need them.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>9. I don’t have a very close friend.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>10. The person who means most to me does spend time with me.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>11. I have no-one to lean on in times of trouble.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>12. I have someone to share good news with.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>13. There is someone who can always cheer me up.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>14. I often feel very lonely.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>15. I feel there is something missing from my life.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
### SECTION I

This section contains 60 statements. Read each statement carefully. For each statement fill in the circle with the response that best represents your opinion. Make sure your answer is in the correct box.

- **Fill in Strongly Disagree** if you strongly disagree or the statement is definitely false.
- **Fill in Disagree** if you disagree or the statement is mostly false.
- **Fill in Neutral** if you are neutral about the statement, you cannot decide, or the statement is about equally true and false.
- **Fill in Agree** if you agree or the statement is mostly true.
- **Fill in Strongly Agree** if you strongly agree or the statement is definitely true.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am not a worrier.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>2. I like to have a lot of people around me.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>3. I do not like to waste my time.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>4. I try to be courteous to everyone I meet.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>5. I keep my belongings clean and neat.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>6. I often feel inferior to others.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>7. I laugh easily.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>8. Once I find the right way to do something, I stick to it.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>9. I often get into arguments with my family and co-workers.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>10. I am pretty good about pacing myself so as to get things done on time.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>11. When I am under a great deal of stress, sometimes I feel like I am going to pieces.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>12. I do not consider myself especially &quot;light-hearted&quot;.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>13. I am intrigued by the patterns I find in art and nature.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>14. Some people think I am selfish and egotistical.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>15. I am not a very methodical person.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>16. I rarely feel lonely or blue.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Reproduced by special permission of the Publisher, Psychological Assessment Resources, Inc., 1204 North Florida Avenue, Lutz, Florida 33549, from NEO Five Factor Inventory, by Paul Costa and Robert McCrae, Copyright 1978, 1985, 1989 by PAR, Inc. Further reproduction is prohibited without permission of PAR, Inc.
<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. I really enjoy talking to people.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>18. I believe letting students hear controversial speakers can only confuse and mislead them.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>19. I would rather cooperate with others than compete with them.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>20. I try to perform all the tasks assigned to me conscientiously.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>21. I often feel tense and jittery.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>22. I like to be where the action is.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>23. Poetry has little or no effect on me.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>24. I tend to be cynical and sceptical of others' intentions.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>25. I have a clear set of goals and work toward them in an orderly fashion.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>26. Sometimes I feel completely worthless.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>27. I usually prefer to do things alone.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>28. I often try new and foreign foods.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>29. I believe that most people will take advantage of you if you let them.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>30. I waste a lot of time before settling down to work.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>31. I rarely feel fearful or anxious.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>32. I often feel as if I am bursting with energy.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Undecided</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>----------</td>
<td>-----------</td>
<td>-------</td>
<td>----------------</td>
</tr>
<tr>
<td>33.</td>
<td>I seldom notice the moods or feelings that different environments produce.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>34.</td>
<td>Most people I know like me.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>35.</td>
<td>I work hard to accomplish my goals.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>36.</td>
<td>I often get angry at the way people treat me.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>37.</td>
<td>I am a cheerful, high-spirited person.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>38.</td>
<td>I believe we should look to our religious authorities for decisions on moral issues.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>39.</td>
<td>Some people think of me as cold and calculating.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>40.</td>
<td>When I make a commitment, I can always be counted on to follow through.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>41.</td>
<td>Too often, when things go wrong, I get discouraged and feel like giving up.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>42.</td>
<td>I am not a cheerful optimist.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>43.</td>
<td>Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>44.</td>
<td>I am hard-headed and tough-minded in my attitudes.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>45.</td>
<td>Sometimes I am not as dependable or reliable as I should be.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>46.</td>
<td>I am seldom sad or depressed.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>47.</td>
<td>My life is fast-paced.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>48.</td>
<td>I have little interest in speculating on the nature of the universe or the human condition.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>49.</td>
<td>I generally try to be thoughtful and considerate.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Reproduced by special permission of the Publisher, Psychological Assessment Resources, Inc., 16204 North Florida Avenue, Lutz, Florida 33549, from NEO Five Factor Inventory, by Paul Costa and Robert McCrae, Copyright 1978, 1985, 1989 by PAR, Inc. Further reproduction is prohibited without permission of PAR Inc.
<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>50. I am a productive person who always gets the job done.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>51. I often feel helpless and want someone else to solve my problems.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>52. I am a very active person.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>53. I have a lot of intellectual curiosity.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>54. If I do not like people, I let them know it.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>55. I never seem to be able to get organised.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>56. At times I have been so ashamed I just wanted to hide.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>57. I would rather go my own way than be a leader of others.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>58. I often enjoy playing with theories or abstract ideas.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>59. If necessary, I am willing to manipulate people to get what I want.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>60. I strive for excellence in everything I do.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Appendix B

ASHFS Questionnaire
**AUSTRALIAN HEALTH & FITNESS SURVEY**

**1985 QUESTIONNAIRE**

On the following pages you will find a number of questions about yourself, the exercise you do and your health. We would like you to answer them all. Please note that there are no right or wrong answers and that the answers you give are strictly private.

How to fill in your questionnaire:

1. **I will read the questions with you and then you can answer each one yourself.**
2. **For most questions you will tick the box for the answer you want to give.**
   
   **For example:**
   
   Do you watch television?
   Yes ☑
   No ☐

3. **For other questions you will need to write the answer in the space provided. Please print clearly.**
4. **If you have any problems just ask me and I will help you with the answer.**

Remember this is not a test, there are no right or wrong answers. What we want to know is what you do, how you think and how you feel.

---

**Table: Sport Participation**

<table>
<thead>
<tr>
<th>Name of Sport</th>
<th>Summer</th>
<th>Winter</th>
<th>Club</th>
<th>School</th>
<th>Other</th>
<th>Dane</th>
<th>Days</th>
<th>Hours 1</th>
<th>Hours 2</th>
<th>Hours 3</th>
<th>Hours 4</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. DOLFF</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>e.g. SWIMING</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

---

**Exercise in the last week:**

**Activity (please list)**

- Travel to school (bicycle)
- Travel to school (walking)
- School Physical Education
- School sport (please print)
- Other activities (please print)

**How often (how many times you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

**How long (in minutes each time you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**How often (how many times you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

**How long (in minutes each time you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

---

**Total (total number of minutes you went this week):**

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
3. Is your answer to the last question typical of your exercise pattern in the last month?
   - I am usually more active .................................................
   - The same as usual .....................................................
   - I am usually less active ...............................................  

4. In most weeks do you get exercise or activity three or four times which makes you feel and push and lift at least 30 minutes each time?
   - Yes ................................................................................
   - No ................................................................................

5. What do you usually do at recess? (Usually means 2 or more days a week)
   - Sit and talk to friends ...................................................
   - Walk around the school ...............................................  
   - Run around playing sports/games .................................
   - Read/study for the next classes ....................................
   - Not much ........................................................................
   - Other (Please print) .......................................................

6. What do you usually do at lunch time? (Usually means 2 or more days a week)
   - Sit and talk to friends ...................................................
   - Walk around the school ...............................................  
   - Run or walk home for lunch ........................................
   - Trade for school sports teams ....................................
   - Play sports/games on the yard or in the school grounds ...
   - Study or do homework ...............................................  
   - Other (Please print) .......................................................

7. Do you enjoy School Physical Education Classes?
   - Very much ........................................................................
   - Quite a bit ........................................................................
   - Sometimes .......................................................................  
   - Not much ........................................................................
   - Not at all ...........................................................................
   - We don't have School Physical Education .................
   - I don't do Physical Education ......................................

8. Do you enjoy School Sports?
   - Very much ........................................................................
   - Quite a bit ........................................................................
   - Sometimes .......................................................................  
   - Not much ........................................................................
   - Not at all ...........................................................................
   - We don't have School Sport .........................................
   - I don't do Sport ...............................................................

9. Do you enjoy Physical Activity (exercise or sport that you do by choice)
   - Yes ................................................................................  
   - Why/Why not? ................................................................
   - No ................................................................................

10. How do you think you are compared to others of your age?
    - Better than most .........................................................
    - About average ...........................................................
    - Not as good as most ....................................................

11. Is your health usual?
    - Very good ......................................................................
    - Good ..............................................................................
    - Average .........................................................................
    - Poor ..............................................................................
    - Very poor .....................................................................

12. Do you enjoy school?
    - Yes, all the time ...........................................................
    - Yes, most of the time ...................................................
    - Sometimes Yes, sometimes No ...................................
    - Not very often ................................................................
    - Never ............................................................................

13. How good are you at school work compared to others of your age?
    - Better than most .........................................................
    - About the average .....................................................
    - Not as good as most ....................................................

14. What time did you go to bed and turn off the lights last night? (For example 02:35)
    - [Time] Hours [Minutes]

15. What time did you wake up this morning? (For example 06:15)
    - [Time] Hours [Minutes]

16. Here is a list that describes some of the ways people feel at different times. During the past few weeks, how often have you felt (Tick one box for each line)

   - On top of the world?
   - Very lonely or remote from other people?
   - Particularly excited or interested in something?
   - Depressed or unhappy?
   - Please about having accomplished something?
   - Scared?
   - Proud because someone complimented you something you had done?
   - So restless you couldn't sit still in a chair?
   - Things were going your way?
   - Upset because someone criticized you?
17. Have you ever smoked even part of a cigarette?
   No ....................................................
   Yes, but a few puffs ................................
   Yes, I have smoked less than 10 cigarettes in my life ........................................
   Yes, I have smoked more than 10 cigarettes in my life ........................................

18. How many cigarettes have you smoked in the last 7 days?  

19. How long have you been smoking regularly? (Regularly means 1 or more times a week.)
   I don't smoke .....................................
   Just started .....................................
   1 month up to 6 months ........................
   7 months up to 1 year ..........................
   1 year up to 2 years ............................
   2 years up to 4 years ...........................
   More than 4 years ..............................

20. How many people smoke at home? (If you smoke – do not include yourself)
   Number of persons ................................

21. Do you think you will be smoking this time next year?
   Yes .............................................
   No .............................................
   Don't know .....................................

22. Please say what you think about the following statements about smoking.

   (a) It makes you catch cold easily ..........................
   Agree  Disagree  Don't know
   (b) It slows your circulation and makes your fingers cold ....
   (c) It keeps you thin ....................................
   (d) It makes you unable to play sports well ..............
   (e) It makes your breathing difficult ........................
   (f) It can cause lung cancer ..............................
   (g) It makes you nervous ................................
   (h) It can cause heart disease ............................
   (i) It gives you bad breath ..............................
   (j) It keeps you slim ....................................
   (k) It is a social habit (habit-forming) ..................

23. How often do you usually drink alcohol?
   I don't drink alcohol ................................
   Less than once a week ............................
   On 1 or 2 days a week ............................
   On 3 or 4 days a week ............................
   On 5 or 6 days a week ............................
   Every day ........................................

24. Do you usually eat something before starting school? (Usually means 4 or more times a week)
   Yes .............................................
   No .............................................

25. In your opinion how important is it to you to—

   (a) See a dentist once a year ..........................
   (b) Have a school's checkup ........................
   (c) Know about your body and how it works ...
   (d) Have a good night's sleep .....................
   (e) Eat a good diet ..................................
   (f) Be a non-smoker ................................
   (g) Have a good body image ........................
   (h) Exercise regularly .............................
   (i) Not be fat .....................................
   (j) Have friends ....................................
   (k) Not be stressed and worried .................
   (l) Not drink alcohol or only drink a little .....  
   (m) Know about ill health and how to stay fit ...

26. How well can you do the following?

   (a) Play a musical instrument ........................
   (b) Ride a horse ...................................
   (c) Play tennis ....................................
   (d) Swim 100 meters non-stop .....................
   (e) Play a round of golf ..........................
   (f) Ride a bicycle or skateboard ...................
   (g) Ice or roller skate ............................
   (h) Play basketball or football ....................
   (i) Play video games ................................
   (j) Play billiards or pool .........................
   (k) Ride on a skateboard .........................

   Never tried  Can't do  Can do about average  Can do very well

27. In what subsection do you live? (State if you live on a farm.)

28. When were you born? (eg 06/05/1970)

29. What sex are you?
- Male
- Female

30. In what country were you born? (If you don’t know the country put the city or town.)

31. In which Australian State or Territory were you born?
- Born outside Australia
- A.C.T.
- New South Wales
- Victoria
- Queensland
- South Australia
- Western Australia
- Tasmania
- Northern Territory
- Don’t know

32. How many years have you lived in Australia?

In the next question, when we ask about your brothers and sisters please include step-brothers and step-sisters.

33. How many older brothers do you have at home?

34. How many older sisters do you have at home?

35. How many younger brothers do you have at home?

36. How many younger sisters do you have at home?

The next two questions are about where your natural parents (not your step-parents) were born. If you don’t know the country, give the city or town, if you don’t know write “don’t know.”

37. In what country was your father born?

38. In what country was your mother born?

39. Do you speak a language other than English, at home?
- No, English only
- Yes, we speak

The rest of the questions ask about your home and parents. By father we also mean stepfather or male guardian. For mother we also want you to include stepmother or female guardian.

37. During the school week, where do you live?

40. Does your father or other smoke at home?
- No
- Yes, both smoke
- Yes, mother
- Yes, father

41. Does your father exercise regularly (2 or more times a week)?

42. Does your father exercise regularly (2 or more times a week)?
- Yes
- No
- Don’t know

43. What activity does he do?

44. Does your mother exercise regularly (2 or more times a week)?
- Yes
- No
- Don’t know

45. What activity does she do?
Appendix C

CDAH Physical Activity Questionnaire
SECTION A: CURRENT ACTIVITIES

The following questions will ask you about the time you spent being physically active in the last 7 days. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Please answer each question even if you do not consider yourself to be an active person.

Think about all the vigorous and moderate activities that you have done in the last 7 days.

- Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal.

- Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal

PART 1: WORK RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home.

Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. We ask about these in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

   No ☐ --- SKIP TO PART 2, TRANSPORTATION

   Yes ☐

The next questions are about all the physical activity you did in the last 7 days as part of your paid or unpaid work. This does not include travelling to and from work.

2. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, heavy construction, or climbing up stairs as part of your work?

   Think about only those physical activities that you did for at least 10 minutes at a time.

   ☐ days per week

   ☐ No vigorous job-related physical activity --- SKIP TO Question 4

3. How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?

   ☐ hours ☐ minutes Per day
4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads as part of your work? Please DO NOT include walking.

☐ days per week

○ No moderate job-related physical activity --> SKIP TO Question 6

5. How much time did you usually spend on one of those days doing moderate physical activities as part of your work?

☐ hours ☐ minutes Per day

6. During the last 7 days, on how many days did you walk for at least 10 minutes at a time as part of your work? Please do not count any walking you did to travel to, or from work.

☐ days per week

○ No job-related walking --> Skip to PART 2: TRANSPORTATION

7. How much time did you usually spend on one of those days walking as part of your work?

☐ hours ☐ minutes Per day

PART 2: TRANSPORTATION PHYSICAL ACTIVITY
These questions are about how you travelled from place to place, including to places like work, stores, movies, and so on.

8. During the last 7 days, on how many days did you travel in a motor vehicle like a train, bus, car, or tram?

☐ days per week

○ No motor transport --> SKIP TO Question 10
9. How much time did you usually spend in a motor vehicle on one of those days.

[ ] hours [ ] minutes Per day

Now think only about the cycling and walking you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the last 7 days, on how many days did you cycle for at least 10 minutes at a time to go from place to place?

[ ] days per week

○ No cycling from place to place  --> SKIP TO Question 12

11. How much time did you usually spend on one of those days cycling from place to place?

[ ] hours [ ] minutes Per day

12. During the last 7 days, on how many days did you walk for at least 10 minutes at a time to go from place to place?

[ ] days per week

○ No walking from place to place  --> SKIP TO PART 3: HOUSEWORK, MAINTENANCE AND CARING FOR FAMILY

13. How much time did you usually spend on one of those days walking from place to place?

[ ] hours [ ] minutes Per day
PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY
This section is about some of the physical activities you might have done in the last 7 days in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

YARD WORK:
14. Think about only those physical activities that you did for at least 10 minutes at a time.
   During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, chopping wood, shovelling snow, or digging in the garden or yard?
   
   □ days per week
   ○ No vigorous yard activity —— SKIP TO Question 16

15. How much time did you usually spend on one of those days doing vigorous physical activities in the garden or yard?
   
   □ hours □ minutes Per day

16. Again, think about only those physical activities that you did for at least 10 minutes at a time.
   During the last 7 days, on how many days did you do moderate activities like carrying light loads, sweeping, washing windows, and raking in the garden or yard?
   
   □ days per week
   ○ No moderate yard activity —— SKIP TO Question 18

17. How much time did you usually spend on one of those days doing moderate physical activities in the garden or yard?
   
   □ hours □ minutes Per day

HOUSEWORK:
18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, washing windows, scrubbing floors and sweeping inside your home?
   
   □ days per week
   ○ No moderate activity at home —— SKIP TO PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

19. How much time did you usually spend on one of those days doing moderate physical activities inside your home?
   
   □ hours □ minutes Per day
PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY
This section is about all the physical activities that you did in the last 7 days solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the last 7 days, on how many days did you walk for **at least 10 minutes** at a time in your leisure time?

   [ ] days per week

   ○ No leisure walking → SKIP TO Question 22

21. How much time did you usually spend on one of those days walking in your leisure time?

   [ ] hours [ ] minutes  **Per day**

22. Think about only those physical activities that you did for **at least 10 minutes** at a time. During the last 7 days, on how many days did you do **vigorous** physical activities like: aerobics, running, fast bicycling, or fast swimming in your leisure time?

   [ ] days per week

   ○ No vigorous activity in leisure time → SKIP TO Question 24

23. How much time did you usually spend on one of those days doing vigorous physical activities in your leisure time?

   [ ] hours [ ] minutes  **Per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** physical activities like: bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time?

   [ ] days per week

   ○ No moderate activity in leisure time → SKIP TO PART 5: TIME SPENT SITTING

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?

   [ ] hours [ ] minutes  **Per day**
PART 5: TIME SPENT SITTING
These last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television.
Do not include any time spent sitting in a motor vehicle that you have already told us about.

26. During the last 7 days, how much time did you usually spend sitting on a weekday?
   ____________ hours ____________ minutes Per day

27. During the last 7 days, how much time did you usually spend sitting on a weekend day?
   ____________ hours ____________ minutes Per day

We are also interested in finding out about your television viewing and computer use habits

28. Please estimate the total time during the last week that you spent watching television, videos or DVD’s when it was the main activity that you were doing.
   For example, you should not include time when the television was switched on and you were preparing a meal or ironing.

   Total time Monday to Friday
   ____________ hours ____________ minutes

   Total time Saturday and Sunday
   ____________ hours ____________ minutes

29. Please estimate how often in a usual week you would have each of the following while watching television

<table>
<thead>
<tr>
<th></th>
<th>Always (every day)</th>
<th>Usually (5–6 times/week)</th>
<th>Sometimes (3–4 times/week)</th>
<th>Rarely (1–2 times/week)</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Meal</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>A Snack</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>A soft drink</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>An alcoholic drink</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

I do not watch television ○

30. Please estimate the total time during the last week that you spent using a computer during the week and on weekends (this might be a personal computer at home or work, Playstation, X-box, Gameboy, etc).

   Total time Monday to Friday
   ____________ hours ____________ minutes

   Total time Saturday and Sunday
   ____________ hours ____________ minutes
### PART 6: STRENGTH TRAINING
We are interested in any strength/weight training that you may be involved in.

31. Are you currently involved in a muscle-strengthening program?
   - No ○ → SKIP TO Question 35
   - Yes ○

   **If YES, please specify the type(s) of muscle strengthening program you are involved in. (Select all that apply.)**
   - Free weights ○
   - Weight training machines ○
   - Other (please specify) [ ]

32. How many days per week do you usually do these activities? [ ] days
33. What is the average duration of your workout? [ ] hours [ ] minutes
34. How long have you been involved in this routine? [ ] years [ ] months

35. Have you ever held a job for 12 months or more that regularly (more than once a week) involved vigorous activities (hard physical effort that made you breathe much harder than normal)?
   - No ○ → SKIP to SECTION B: PAST PHYSICAL ACTIVITIES
   - Yes ○

   **If ‘YES’, please complete the table below by indicating:**
   - the type of job you held
   - the year you started this job
   - how long you held the job for, in years and months
   - the average number of days per week you did vigorous activity in that job
   - the average amount of time you spent doing vigorous activity each day, in hours

   (If you have held more than four jobs that involved vigorous activity, please list the four that you held the longest)

<table>
<thead>
<tr>
<th>Occupation/Job type</th>
<th>Year started</th>
<th>Length of time in job</th>
<th>Days per week</th>
<th>Hours per day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix D

CDAH Historical Leisure Activity Questionnaire
SECTION B: PAST PHYSICAL ACTIVITIES

Please use the tables on the following pages to indicate how many years, months per year and hours per week you participated in each of the leisure activities in each of the given age periods.

Include all activities that you may have participated in regularly (on at least 10 occasions) with friends, an organised team, group, club or for your school, but NOT those done during physical education classes. If you participated in an activity that is not listed, please specify this activity in the "other" category.

EXAMPLE BELOW: From the age of 25-29 you walked for 30 minutes five days a week for 10 months of the year.
You played a one-hour basketball match twice a week for 8 months of the year when you were 15-16 years old.
You also surfed for an hour once a week for three months of the year when you were 20.

<table>
<thead>
<tr>
<th>Activity</th>
<th>15-19 years</th>
<th>20-24 years</th>
<th>25-29 years</th>
<th>30 or more years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>15-19 years</td>
<td>20-24 years</td>
<td>25-29 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Years</td>
<td>Months /year</td>
<td>Hours /week</td>
</tr>
<tr>
<td>Walking</td>
<td></td>
<td>5</td>
<td>10</td>
<td>2½</td>
</tr>
<tr>
<td>Basketball</td>
<td>2</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Surfing</td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

If you have NOT participated in ANY activities please fill in the circle below

○ I have not participated in any activities
<table>
<thead>
<tr>
<th>Activity</th>
<th>15-19 years</th>
<th></th>
<th></th>
<th>20-24 years</th>
<th></th>
<th></th>
<th>25-29 years</th>
<th></th>
<th></th>
<th>30 or more years</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Years</td>
<td>Months</td>
<td>Hours</td>
<td>Years</td>
<td>Months</td>
<td>Hours</td>
<td>Years</td>
<td>Months</td>
<td>Hours</td>
<td>Years</td>
<td>Months</td>
</tr>
<tr>
<td>1 Aerobics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Athletics or track and field</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Australian rules football</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Basketball</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Bushwalking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Cricket</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Cycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Dance including ballet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Fishing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Horseriding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Golf</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Snow or ice sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Martial arts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 Netball</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Newcombe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Roller sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>15-19 years</td>
<td></td>
<td></td>
<td>20-24 years</td>
<td></td>
<td></td>
<td>25-29 years</td>
<td></td>
<td></td>
<td>30 or more years</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------</td>
<td>----------</td>
<td>----------</td>
<td>-------------</td>
<td>----------</td>
<td>----------</td>
<td>-------------</td>
<td>----------</td>
<td>----------</td>
<td>------------------</td>
<td>----------</td>
</tr>
<tr>
<td>17 Rugby</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 Running or jogging</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 Soccer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Softball or baseball or tball</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 Squash or racketball</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 Surf sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 Swimming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 Tennis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 Touch football</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 Volleyball</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 Walking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 Weight training</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix E

Associations between physical inactivity by each physical activity domain and DSM-IV major depression symptoms for women, additionally adjusted for overweight/obesity.
<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Leisure physical activity</th>
<th></th>
<th>Work physical activity</th>
<th></th>
<th>Pedometer steps/day</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>PR*</td>
<td>95% CI</td>
<td>n</td>
<td>PR*</td>
<td>95% CI</td>
</tr>
<tr>
<td>Depressed mood</td>
<td>106</td>
<td>0.90</td>
<td>0.79, 1.04</td>
<td>106</td>
<td>0.99</td>
<td>0.87, 1.11</td>
</tr>
<tr>
<td>Loss of interest</td>
<td>104</td>
<td>1.12</td>
<td>0.98, 1.28</td>
<td>104</td>
<td>1.03</td>
<td>0.90, 1.17</td>
</tr>
<tr>
<td>Weight/appetite changes</td>
<td>94</td>
<td>1.11</td>
<td>0.92, 1.34</td>
<td>94</td>
<td>0.98</td>
<td>0.83, 1.20</td>
</tr>
<tr>
<td>Loss of appetite</td>
<td>56</td>
<td>1.36</td>
<td>0.92, 1.98</td>
<td>56</td>
<td>1.11</td>
<td>0.76, 1.63</td>
</tr>
<tr>
<td>Increase in appetite</td>
<td>50</td>
<td>0.82</td>
<td>0.51, 1.30</td>
<td>50</td>
<td>0.82</td>
<td>0.53, 1.29</td>
</tr>
<tr>
<td>Weight loss</td>
<td>38</td>
<td>0.93</td>
<td>0.52, 1.66</td>
<td>38</td>
<td>1.05</td>
<td>0.63, 1.75</td>
</tr>
<tr>
<td>Weight gain</td>
<td>36</td>
<td>0.72</td>
<td>0.40, 1.29</td>
<td>36</td>
<td>1.00</td>
<td>0.58, 1.75</td>
</tr>
<tr>
<td>Sleep disturbance</td>
<td>103</td>
<td>1.04</td>
<td>0.92, 1.17</td>
<td>103</td>
<td>1.04</td>
<td>0.91, 1.19</td>
</tr>
<tr>
<td>Insomnia</td>
<td>94</td>
<td>1.05</td>
<td>0.86, 1.28</td>
<td>94</td>
<td>1.10</td>
<td>0.90, 1.34</td>
</tr>
<tr>
<td>Hypersomnia</td>
<td>45</td>
<td>1.11</td>
<td>0.70, 1.77</td>
<td>45</td>
<td>1.01</td>
<td>0.61, 1.66</td>
</tr>
<tr>
<td>Psychomotor difficulties</td>
<td>34</td>
<td>0.96</td>
<td>0.56, 1.66</td>
<td>34</td>
<td>1.39</td>
<td>0.84, 2.29</td>
</tr>
<tr>
<td>Psychomotor retardation</td>
<td>43</td>
<td>0.86</td>
<td>0.55, 1.32</td>
<td>43</td>
<td>1.19</td>
<td>0.73, 1.93</td>
</tr>
<tr>
<td>Objective psychomotor retardation</td>
<td>24</td>
<td>1.09</td>
<td>0.58, 2.07</td>
<td>24</td>
<td>1.29</td>
<td>0.65, 2.59</td>
</tr>
<tr>
<td>Psychomotor agitation</td>
<td>27</td>
<td>0.58</td>
<td>0.26, 1.31</td>
<td>27</td>
<td>0.71</td>
<td>0.36, 1.42</td>
</tr>
<tr>
<td>Objective psychomotor agitation</td>
<td>20</td>
<td>0.42</td>
<td>0.15, 1.14</td>
<td>20</td>
<td>0.79</td>
<td>0.37, 1.67</td>
</tr>
<tr>
<td>Fatigability</td>
<td>103</td>
<td>0.97</td>
<td>0.83, 1.14</td>
<td>103</td>
<td>0.90</td>
<td>0.78, 1.03</td>
</tr>
<tr>
<td>Worthlessness/guilt</td>
<td>56</td>
<td>0.81</td>
<td>0.53, 1.26</td>
<td>56</td>
<td>1.96</td>
<td>1.34, 2.87</td>
</tr>
<tr>
<td>Feelings of worthlessness</td>
<td>76</td>
<td>0.95</td>
<td>0.71, 1.27</td>
<td>76</td>
<td>1.11</td>
<td>0.86, 1.44</td>
</tr>
<tr>
<td>Excessive/irrational guilt</td>
<td>79</td>
<td>1.30</td>
<td>1.01, 1.67</td>
<td>79</td>
<td>1.25</td>
<td>0.97, 1.60</td>
</tr>
<tr>
<td>Concentration difficulties/Indecision</td>
<td>116</td>
<td>1.04</td>
<td>0.98, 1.10</td>
<td>116</td>
<td>0.97</td>
<td>0.91, 1.01</td>
</tr>
<tr>
<td>Vacillating thoughts</td>
<td>88</td>
<td>0.82</td>
<td>0.64, 1.04</td>
<td>88</td>
<td>1.17</td>
<td>0.95, 1.43</td>
</tr>
<tr>
<td>Indecisiveness</td>
<td>94</td>
<td>1.07</td>
<td>0.89, 1.28</td>
<td>94</td>
<td>1.08</td>
<td>0.90, 1.29</td>
</tr>
<tr>
<td>Death/Suicidal thoughts</td>
<td>55</td>
<td>1.03</td>
<td>0.74, 1.44</td>
<td>55</td>
<td>0.87</td>
<td>0.63, 1.21</td>
</tr>
<tr>
<td>Thoughts of death</td>
<td>58</td>
<td>0.78</td>
<td>0.56, 1.10</td>
<td>58</td>
<td>0.89</td>
<td>0.64, 1.23</td>
</tr>
<tr>
<td>Suicidal ideation</td>
<td>35</td>
<td>1.25</td>
<td>0.74, 2.13</td>
<td>35</td>
<td>0.73</td>
<td>0.44, 1.23</td>
</tr>
<tr>
<td>Suicide plan</td>
<td>19</td>
<td>2.45</td>
<td>1.23, 4.86</td>
<td>19</td>
<td>0.72</td>
<td>0.35, 1.52</td>
</tr>
</tbody>
</table>

*Prevalence ratios adjusted for educational attainment, age, physical health, depression severity, other symptoms and overweight/obesity. Physically active is the reference group. *p<0.05; **p<0.01; ***p<0.001