Reducing Recreational Screen-time in Adolescents:
The ‘Switch-off 4 Healthy Minds’ Randomised Controlled Trial

Mark James Babic

B Teaching / B Health and Physical Education

This thesis is submitted in fulfilment of the requirements for the award of the degree of:
Doctorate of Philosophy (Education)

Faculty of Education and Arts

University of Newcastle

January 2017
Statement of Originality

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968.

Signed: _______________________

Name: Mark James Babic

Date: 
Thesis by Publication

I hereby certify that this thesis is in the form of a series of published papers of which I am a joint author. I have included as part of my thesis a written statement from each co-author, endorsed by the Faculty Assistant Dean (Research Training), attesting to my contribution to the joint publications.

Signed: __________________________

Name: Mark James Babic

Date:
Copyright Permission

I warrant that I have obtained, where necessary, permission from the copyright owners to use any third party copyright material reproduced in the thesis (e.g., questionnaires and figures) or to use any of my own published work (e.g., journal articles) in which the copyright is held by another party (e.g., publisher, co-author).

Signed: ______________________

Name: Mark James Babic

Date:
Conflict of Interest

My research higher degree was supported and funded by a scholarship from Wests Leagues Club. The ‘Switch-off 4 Healthy Minds’ study was supported by a Hunter Children’s Research Foundation grant for $25,000. Sponsors had no involvement in the research process, including the drafting of this thesis or manuscripts contained within. This trial has been registered with the Australian and New Zealand Clinical Trials Registry ACTRN12614000163606.
Supervisors

Primary supervisor
Professor David R. Lubans
Priority Research Centre in Physical Activity and Nutrition
School of Education
Faculty of Education & Arts
University of Newcastle, Australia

Co-supervisors
Professor Philip J. Morgan
Priority Research Centre in Physical Activity and Nutrition
School of Education
Faculty of Education & Arts
University of Newcastle, Australia

Professor Ronald C. Plotnikoff
Priority Research Centre in Physical Activity and Nutrition
School of Education
Faculty of Education & Arts
University of Newcastle, Australia
Acknowledgements

The submission of this thesis is attributed to several influential people of which I am grateful to.

To David Lubans, Phillip Morgan and Ron Plotnikoff, I thank you for your ongoing efforts and dedication. Your knowledge was invaluable and I thank you all for your time, friendships, work ethics and mentorship. I want to especially thank David for his optimism and enthusiasm throughout the difficult times.

To my colleagues in the Priority Research Centre for Physical Activity and Nutrition, thank you for making my time in the research group enjoyable. I wish to thank Ryan Hulteen, Jordan Smith, Lee Ashton, Mitch Duncan, Elroy Aguiar, Kristen Cohen, Nick Riley, Narelle Eather, Wayne Durand, all the Sarah’s and Lisa Spencer for our friendships. Such appreciation obviously extends to Emma Pollock and Tara Finn who assisted in running numerous interventions alongside me.

To the school staff, parents, principals, and students of my intervention, your participation and commitment was treasured.

To the Hunter Medical Research Institute and Wests Leagues Club, I wish to thank you for your continued research and support of students and the University of Newcastle.

Finally to my wife, there are no words to describe my gratitude.
Publications arising from this Thesis

This thesis includes four manuscripts, all of which have or are being published in peer-reviewed journals. At the time of submission, three were published and one was submitted to a journal for consideration.

Manuscripts in peer-reviewed journals: Published


Manuscripts in peer-reviewed journals: Under review


Presentations arising from this thesis

I have presented results from this thesis at international and local conferences

Presentations:


**Additional publications from my PhD candidature**

During my PhD candidature, I have co-authored the following papers that are not included in my thesis:

**Manuscripts in peer-reviewed journals: Published**


**Manuscripts in peer-reviewed journals: Under review**

# Table of Contents

Statement of Originality ................................................................................................... ii  
Thesis by Publication ....................................................................................................... iii  
Copyright Permission ...................................................................................................... iv  
Conflict of Interest ........................................................................................................... v  
Supervisors ....................................................................................................................... vi  
Acknowledgements ......................................................................................................... vii  
Publications arising from this Thesis ........................................................................... viii  
Table of Contents ............................................................................................................. xi  
List of Tables ................................................................................................................. xvii  
List of Figures ................................................................................................................. xviii  
List of Abbreviations ..................................................................................................... xix  
Operational Definitions ................................................................................................. xxi  
Thesis Abstract .............................................................................................................. xxii  
Statement of Contribution .......................................................................................... xxvi  
Introduction ..................................................................................................................... 1  

## Chapter 1 Literature Review .................................................................................. 4  
Part 1 Rationale for Increasing Physical Activity and Reducing Screen-time in Adolescence....................................................................................................................... 6  
1.1 Definitions of physical activity, sedentary behaviour and screen-time ............... 6  
1.1.1 Inter-relationships between physical activity and sedentary behaviour .......... 7  
1.1.2 Measurements of physical activity and sedentary behaviour ......................... 7  
1.1.3 The key period of adolescence ..................................................................... 8  
1.2 Guidelines, prevalence and trends ...................................................................... 8  
1.2.1 International and national and guidelines of physical activity and screen-time 8  
1.2.2 Prevalence and trends of physical activity in adolescents ......................... 11  
1.2.3 Screen-time prevalence and trends among adolescents ......................... 11  
1.3 Health consequences of inactivity and excessive sedentary behaviour ............. 12  
1.3.1 Physical activity and physical health ......................................................... 12  
1.3.2 Physical activity and mental health ......................................................... 12  
1.3.3 Excessive screen-time and physical health .............................................. 13  
1.3.4 Mental health outcomes of excessive screen-time .................................. 13  
1.4 Mechanisms responsible for the effects of physical activity and screen-time on mental health ................................................................. 14  
1.5 Summary ............................................................................................................. 15  
Part 2 Understanding Physical Activity and Sedentary Behaviour ...................... 16  
1.6 Correlates and determinants of physical activity ............................................. 16
1.6.1 Individual correlates of physical activity ........................................................... 16
1.6.2 Social correlates of physical activity ................................................................. 16
1.6.3 Environmental correlates of physical activity ................................................... 17
1.6.4 Issues examining correlates of physical activity ............................................... 17
1.7 Correlates and determinants of screen-time ............................................................ 18
1.7.1 Individual correlates of screen-time ................................................................. 18
1.7.2 Social correlates of screen-time ......................................................................... 19
1.7.3 Environmental correlates of screen-time ........................................................... 19
1.7.4 Issues examining correlates of screen-time ....................................................... 19
1.8 Mediators of physical activity and screen-time behaviour change ....................... 20
1.8.1 Mediators of physical activity in adolescents .................................................... 21
1.8.2 Mediators of screen-time in adolescents ........................................................... 22
1.9 Theories of health behaviour change .................................................................. 22
1.9.1 Current evidence .............................................................................................. 22
1.9.2 Self-Determination Theory .............................................................................. 22
1.10 Summary of Part 2 .............................................................................................. 24
Part 3 Review of Interventions to Increase Physical Activity and Reduce Screen-time
  in Adolescents ......................................................................................................... 25
1.11 Physical activity interventions for adolescents ...................................................... 25
1.12 Interventions to increase physical activity and reduce screen-time ..................... 26
1.13 Screen-time interventions for adolescents ........................................................... 28
1.14 Implementation and scaling up of interventions ............................................... 29
1.15 Summary of Part 3 .............................................................................................. 30
1.16 Thesis aims and hypothesis .............................................................................. 31
Chapter 2 Physical Activity and Physical Self-concept in Youth: Systematic Review
  and Meta-analysis .................................................................................................. 32
2.1 Preface .................................................................................................................. 32
2.2 Abstract ............................................................................................................... 32
2.3 Background ......................................................................................................... 33
2.4 Methods .............................................................................................................. 35
  2.4.1 Eligibility criteria ........................................................................................... 35
  2.4.2 Search strategy .............................................................................................. 36
  2.4.3 Screening ....................................................................................................... 37
  2.4.4 Data extraction ............................................................................................. 37
  2.4.5 Analytic strategies ....................................................................................... 37
  2.4.6 Synthesis of studies not included in the meta-analysis ................................... 39
  2.4.7 Criteria for risk of bias assessment ............................................................... 39
2.4.8 Description of the synthesis of studies not included in the meta-analysis ....41
2.5 Results.................................................................................................................................................41
2.5.1 Study/sample characteristics.................................................................................................42
2.5.2 Overall effect size, heterogeneity and significance of moderators.........................43
   2.5.2.1 General physical self-concept ...........................................................................43
   2.5.2.2 Perceived competence ...................................................................................43
   2.5.2.3 Perceived fitness .............................................................................................44
   2.5.2.4 Perceived appearance .......................................................................................44
   2.5.2.5 Synthesis of findings not included in the meta-analysis ................................45
2.6 Risk of bias assessment..............................................................................................................59
2.7 Testing for publication bias....................................................................................................62
2.8 Discussion........................................................................................................................................63
   2.8.1 Overview of findings.................................................................................................63
   2.8.2 Summary of risk of bias from included studies.....................................................64
   2.8.3 Major findings and potential contributors .............................................................65
   2.8.4 Practical implications .............................................................................................67
   2.8.5 Strengths and limitations of the review ..................................................................67
2.9 Conclusion.........................................................................................................................................68

Chapter 3 Rationale and Study Protocol for ‘Switch-off 4 Healthy Minds’ (S4HM):
A Cluster Randomised Controlled Trial to Reduce Recreational Screen-time in Adolescents ....69
3.1 Preface................................................................................................................................................69
3.2 Abstract.............................................................................................................................................69
3.3 Background ......................................................................................................................................70
3.4 Methods............................................................................................................................................71
   3.4.1 Study design ...............................................................................................................71
   3.4.2 Sample size calculation ..............................................................................................74
   3.4.3 Setting and screening of participants ........................................................................74
   3.4.4 Blinding and randomisation ......................................................................................74
   3.4.5 Intervention ..................................................................................................................75
   3.4.6 Control group ...............................................................................................................76
3.5 Outcomes..........................................................................................................................................78
   3.5.1 Primary outcome..........................................................................................................78
   3.5.2 Secondary outcomes ....................................................................................................78
      3.5.2.1 Psychological distress ....................................................................................78
      3.5.2.2 Pathological video game use .........................................................................79
      3.5.2.3 Aggression ........................................................................................................79
Part 3 Longitudinal Associations between Screen-time and Mental Health

Outcomes ................................................................................................................ 131

6.6 Overview of findings .............................................................................................. 131

6.6.1 Strengths and limitations ................................................................................. 131

6.6.2 Recommendations ........................................................................................... 132

6.6.2.1 For schools and parents ............................................................................. 132

6.6.2.2 For future research .................................................................................... 132

6.7 Conclusion .............................................................................................................. 133

Appendices ...................................................................................................................... 134

Appendix 1: PRISMA checklist ................................................................................... 135

Appendix 2: Human Research Ethics Approval .......................................................... 140

Appendix 3: Principal Information Sheet ..................................................................... 145

Appendix 4: Student and Parent Information Statement .............................................. 152

Appendix 5: Principal Consent Form .......................................................................... 158

Appendix 6: Parent and Student Consent Form ........................................................... 160

Appendix 7: Eligibility Screening Questionnaire ......................................................... 164

Appendix 8: Recording Sheet ...................................................................................... 166

Appendix 9: Accelerometer Information Sheet and Activity Log ............................... 167

Appendix 10: Questionnaires ....................................................................................... 171

Appendix 11: Protocol ................................................................................................. 189

Appendix 12: Student End of Study Evaluation Questionnaire ................................... 204

Appendix 12: Parent End of Program Evaluation Questionnaire ............................... 208

Appendix 13: Newsletters ............................................................................................ 210

Appendix 14: Behavioural Contract ............................................................................. 216

Appendix 15: Interactive Presentation ......................................................................... 217

References ....................................................................................................................... 235
List of Tables

Table 1: International physical activity guidelines for young people .................. 10
Table 2: International screen-time guidelines for young people ......................... 10
Table 3: Correlates of physical activity in young people ..................................... 18
Table 4: Correlates of screen-time in young people .......................................... 20
Table 5: Summary of articles included in the systematic review ....................... 46
Table 6: Qualitative summary of studies examining the association between physical activity and physical self-concept ......................................................... 59
Table 7: Risk of bias results .............................................................................. 60
Table 8: Intervention components, behaviour change techniques and targeted constructs in the S4HM intervention ......................................................... 77
Table 9: Baseline characteristics of the S4HM study sample ............................... 102
Table 10: Changes in primary and secondary outcomes in the S4HM intervention ... 103
Table 11: Mediation analyses for the single mediator models adjusted for sex and SES 104
Table 12: Characteristics of the study sample .................................................... 111
Table 13: Levels of screen-time and mental health across time points in the total sample and by sex ................................................................. 112
Table 14: Associations of screen-time (T2) and mental health (T2) for the total sample over the first year of secondary school ........................................... 114
Table A3.1: Intervention components and evaluation strategies ......................... 146
List of Figures

Figure 1: Schematic diagram of literature review ................................................................. 5
Figure 2: Statistical mediation model ................................................................................... 21
Figure 3: Self-determination Theory (SDT) ...................................................................... 23
Figure 4: Organismic Integration Theory (OIT) ................................................................. 23
Figure 5: Results of literature search ................................................................................... 42
Figure 6: Study design and flow .......................................................................................... 73
Figure 7: Study design and flow with follow-up data ......................................................... 101
Figure 8: Mean screen-time usage across time points in the total sample and by sex ...... 115
Figure 9: Mean mental health scores across time points in the total sample and by sex 116
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOR</td>
<td>Adjusted Odds Ratio</td>
</tr>
<tr>
<td>AS!BC</td>
<td>Action Schools! British Columbia intervention</td>
</tr>
<tr>
<td>ASAQ</td>
<td>Adolescent Sedentary Activity Questionnaire</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>BMI z score</td>
<td>Body Mass Index z-score</td>
</tr>
<tr>
<td>CPCLA</td>
<td>Children's Participation in Cultural and Leisure Activities survey</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Intervals</td>
</tr>
<tr>
<td>CONSORT</td>
<td>Consolidated Standard of Reporting Trials</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular Disease</td>
</tr>
<tr>
<td>DOiT</td>
<td>Dutch Obesity Intervention in Teenagers</td>
</tr>
<tr>
<td>HEIA</td>
<td>HEalth In Adolescents study</td>
</tr>
<tr>
<td>HRQoL</td>
<td>Health Related Quality of Life</td>
</tr>
<tr>
<td>ICC</td>
<td>Intra-class Correlation Coefficient</td>
</tr>
<tr>
<td>K10</td>
<td>Kessler Psychological Distress Scale</td>
</tr>
<tr>
<td>Kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>MET</td>
<td>Metabolic Equivalent</td>
</tr>
<tr>
<td>MLSQ</td>
<td>Motivation to Limit Screen-time Questionnaire</td>
</tr>
<tr>
<td>MVPA</td>
<td>Moderate-to-Vigorous Physical Activity</td>
</tr>
<tr>
<td>N</td>
<td>Number</td>
</tr>
<tr>
<td>NaSSDA</td>
<td>National Secondary Students’ Diet and Activity survey</td>
</tr>
<tr>
<td>NCD</td>
<td>Non-Communicable Diseases</td>
</tr>
<tr>
<td>NSW</td>
<td>New South Wales</td>
</tr>
<tr>
<td>OIT</td>
<td>Organismic Integration Theory</td>
</tr>
<tr>
<td>P</td>
<td>Probability (statistical significance level)</td>
</tr>
<tr>
<td>PA</td>
<td>Physical Activity</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
</tr>
<tr>
<td>PRISMA</td>
<td>Preferred Reporting Items for Systematic Reviews and Meta-Analyses</td>
</tr>
<tr>
<td>PSDQ</td>
<td>Physical Self-Description Questionnaire</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomised Controlled Trial</td>
</tr>
<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>SDQ</td>
<td>Strength and Difficulties Questionnaire</td>
</tr>
<tr>
<td>SDT</td>
<td>Self-Determination Theory</td>
</tr>
<tr>
<td>SEIFA</td>
<td>Socio-Economic Indexes for Areas</td>
</tr>
<tr>
<td>S4HM</td>
<td>Switch-off 4 Healthy Minds</td>
</tr>
<tr>
<td>SES</td>
<td>Socio-Economic Status</td>
</tr>
<tr>
<td>SMD</td>
<td>Standardised Mean Differences</td>
</tr>
<tr>
<td>SMS</td>
<td>Short-Message Service</td>
</tr>
</tbody>
</table>
WHO World Health Organization

*Note.* This list represents abbreviations used in the main text of this thesis. Additional abbreviations in tables are defined in the bottom row.
## Operational Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary behaviour</td>
<td>Sedentary behaviour was defined as activities characterised by an energy expenditure $\leq 1.5$ metabolic equivalents</td>
</tr>
<tr>
<td>Screen-time</td>
<td>Screen-time was defined as the time spent using screen based devices.</td>
</tr>
<tr>
<td>Recreational screen-time</td>
<td>Recreational screen-time was defined as screen use for entertainment purposes e.g. computer use for games/fun.</td>
</tr>
<tr>
<td>Non-recreational screen-time</td>
<td>Non-recreational screen-time was defined as screen use for educational purposes e.g. computer use for homework.</td>
</tr>
<tr>
<td>Physical activity</td>
<td>Physical activity was defined as any bodily movement produced by skeletal muscles requiring energy expenditure.</td>
</tr>
<tr>
<td>Mental health</td>
<td>Mental health is a sense of well-being, confidence and self-esteem whereas mental ill-being is a health problem that may negatively affect how a person thinks, behaves and interacts with other people.</td>
</tr>
<tr>
<td>Self-concept</td>
<td>The term self-concept is a general term used to refer to how someone thinks about or perceives themselves.</td>
</tr>
<tr>
<td>Adolescence</td>
<td>Adolescence was defined as youth aged between 13 and 18 (which corresponds with secondary school).</td>
</tr>
</tbody>
</table>
Thesis Abstract

Background

Secular decreases in physical activity and increases in recreational screen-time among young people are cause for concern. Both physical inactivity and excessive recreational screen-time are independently associated with poor physical, social and psychological health in adolescence. As adolescence marks a key period for establishing health behaviours, there is a need to identify effective and scalable interventions to address both physical inactivity and excessive recreational screen-time. Although an abundance of interventions have been conducted to increase young people’s physical activity, fewer studies have examined the impact of interventions designed to reduce recreational screen-time, especially in adolescent populations. Of those studies that have examined screen-time reduction in young people, few interventions have been designed to be ‘scalable’ or adopted a theoretical framework to assist in the identification of behaviour change mechanisms.

Thesis objectives

Presented as a series of studies, this thesis by publication aims to address current gaps in the literature. The principal focus of this thesis is the development and evaluation of the ‘Switch-off 4 Healthy Minds’ (S4HM) intervention, which was evaluated using a cluster randomised controlled trial (RCT) in a sample of Australian adolescents. Further, this thesis presents a series of related studies investigating secondary aims, which are briefly described below. Given the chronology of the research included within this thesis, and the importance of providing context to the primary aim, the Secondary aims will be presented first and are listed in order below.

Secondary aim 1: Review the evidence of associations between physical activity, screen-time and mental health outcomes in adolescents

The aim of this chapter was to examine associations between health behaviours (i.e., physical activity and recreational screen-time) and indicators of mental health among adolescents. The original objective was to conduct a novel systematic review of studies that had examined the association between recreational screen-time and self-concept. However, as too few studies were identified in the preliminary search, an alternate systematic review focused on physical activity and physical self-concept (general and
sub-domains) was conducted. Included studies were identified through a structured search of six electronic databases with no date restrictions. In total, 111 studies were qualitatively and 64 were quantitatively synthesised. Potential moderators examined included; sex, age and study design. Perceived competence was most strongly associated with physical activity \( r = 0.30, 95\% \text{ CI} = 0.24 \text{ to } 0.35, p < 0.001 \), followed by perceived fitness \( r = 0.26, 95\% \text{ CI} = 0.20 \text{ to } 0.32, p < 0.001 \), general physical self-concept \( r = 0.25, 95\% \text{ CI} = 0.16 \text{ to } 0.34, p < 0.001 \) and perceived physical appearance \( r = 0.12, 95\% \text{ CI} = 0.08 \text{ to } 0.16, p < 0.001 \). Sex was a significant moderator for general physical self-concept and age for perceived appearance as well as perceived competence. No significant moderators were found for perceived fitness. Overall, significant associations of a medium effect size were present between general physical self-concept, perceived competence, perceived fitness and physical activity in young people.

Secondary aim 2: To provide a rationale and present the study protocol for the ‘Switch-off 4 Healthy Minds’ (S4HM) intervention: A cluster randomised controlled trial to reduce recreational screen-time in adolescents

The aim of chapter 3 was to describe the methods used in the S4HM intervention and to provide justification for the examination of each outcome. The primary outcome of the S4HM intervention was recreational screen-time. Secondary outcomes consisted of mental health indicators including; physical self-concept, psychological well-being, psychological difficulties and psychological distress. Objectively measured physical activity (accelerometry), body mass index (BMI) and hypothesised mediators of behaviour change (autonomous motivation, controlled motivation, and amotivation) were explored. The 6-month multi-component intervention was designed to encourage adolescents to manage their recreational screen-time using a range of evidence-based strategies. Grounded in Self-determination Theory (SDT), the S4HM intervention included the following components: an interactive seminar for students, eHealth messaging, behavioural contract and parental newsletters. This chapter highlighted the lack of screen-time interventions among adolescents and projected future research was needed to determine if reducing screen-time aids the prevention and treatment of physical inactivity and mental health in youth.
Secondary aim 3: To examine longitudinal associations between changes in screen-time and mental health outcomes in adolescents

The aim of this chapter was to explore longitudinal associations between changes in recreational screen-time (both total and device specific) and mental health outcomes (mental well-being and ill-being) in a sample of Australian adolescents. A subsequent aim was to examine the association between non-recreational screen-time (computer use for homework) and mental health. Recreational screen-time (television, DVD, computer, tablet and mobile phone use), non-recreational screen-time and mental health indicators (physical self-concept, psychological well-being and psychological difficulties) were reported on two occasions (Time 1 and Time 2) over the first year of secondary school. After adjusting for relevant covariates (Time 1 measurements, group allocation, school clustering, sex, socio-economic status, Time 1 body mass index (BMI) and Time 1 physical activity), multi-level linear mixed models were conducted. Changes in total recreational screen-time ($\beta = -.09$, $p = .048$) and tablet/phone use ($\beta = -.18$, $p < .001$) were negatively associated with physical self-concept. Changes in total recreational screen-time ($\beta = -.20$, $p = .001$) and computer use ($\beta = -.23$, $p = .003$) were negatively associated with psychological well-being. A positive association was found with television/DVD use and psychological difficulties ($\beta = .16$, $p = .015$). No associations were found between indicators of mental health and screen use for homework purposes. Findings suggest different devices have distinct associations with mental health outcomes. While this study did not provide causal evidence for the detrimental effect of screen-time on mental health, findings suggest reducing screen-time may improve mental health in young people.

Primary aim 1: To evaluate the effects of the S4HM intervention by examining outcomes and potential mediators in a cluster RCT

The aim of this chapter was to evaluate the impact of the S4HM intervention in adolescents. The primary outcome was recreational screen-time and secondary outcomes included mental health indicators, physical activity, and BMI. Eligible participants reported exceeding recreational screen-time recommendations (i.e., $> 2$ hours/day). In total, 322 adolescents (mean age = 14.4 ± 0.6 years) from eight secondary schools in New South Wales, Australia were recruited. The S4HM intervention was a cluster RCT with study measures at baseline and 6-months (post-intervention). Outcome analyses were conducted using linear mixed models. Meditation analyses were conducted to determine
if changes in motivation mediated the intervention effect using a product-of-coefficient test. At post intervention, significant reductions in screen-time occurred in both groups, with a greater reduction observed in the intervention group (-50 min/day versus -29 minutes, \( p < .05 \) for both). However, the adjusted difference in change between groups was not statistically significant (mean = -21.3 min/day, \( p = 0.255 \)). There were no significant intervention effects for mental health outcomes, physical activity or BMI. It was found that the intervention effect was partially mediated by increases in autonomous motivation to limit screen-time but not controlled motivation.
Statement of Contribution

I was involved in all stages of the S4HM study including; conceptualisation, ethical approval, recruitment, intervention development, implementation and evaluation. More specifically, I completed the following tasks:

**Ethics approval**

In collaboration with my supervisors and the project manager, I assisted in drafting, revising and submitting ethics applications through the Human Research Ethics Committees of the University of Newcastle, Newcastle-Maitland Catholic Schools Office and the Diocese of Broken Bay.

**Recruitment**

I met with school principals, teachers and students to discuss the S4HM study and provided each with an overview of the intervention whilst conducting eligibility screening questionnaires. I was responsible for distributing and collecting principal, student and parent information and consent letters.

**Designing resources**

Cooperating with my primary supervisor, I was responsible for developing the S4HM intervention resources, including: an interactive seminar for students, eHealth messages, a behavioural contract and six parental newsletters.

**Assessments**

Partnering with the project manager, I was involved in the organisation of data collection. I assumed responsibility for leading the baseline and post-program assessments with the assistants of two research assistants. Training days were held for the research assistants in preparation for data collection.

**Data management**

Entry, cleaning and de-identifying all data and the development of a database for analysis was my responsibility. Statistical analysis of primary and secondary outcomes was a collaborative effort with my primary supervisor.
Introduction

While this thesis is focused primarily on recreational screen-time, it also addresses three important and inter-related themes: physical activity, general screen-time and mental health. This thesis begins with a literature review, followed by a series of interrelated research papers, three of which have been published. The fourth paper is currently under review in a peer-reviewed journal. The final chapter discusses theoretical and practical recommendations as a result of the research. A more detailed overview of each chapter, with citation details of published and in-press articles, is provided below.

Chapter 1: Literature Review

This chapter provides a rationale for the thesis, presenting an overview of the current literature regarding patterns of health behaviours and their associations with health outcomes among adolescents. Chapter 1 is divided into three main sections, of which the first provides a rationale for increasing physical activity and reducing screen-time in adolescence. The second section involves an examination of health consequences of inactivity and sedentary behaviour, through an analysis of correlates, determinants, mediators and theories of health behaviour change. The final section reviews sedentary behaviour interventions designed to increase physical activity and reduce screen-time in young people. By reviewing previous literature, including behavioural theories and interventions; this chapter highlights the significant public health challenges of physical inactivity, screen-time and mental health.

Chapter 2: Physical Activity and Physical Self-concept in Youth: Systematic Review and Meta-analysis

Previous studies have found negative associations between recreational screen-time and indicators of mental health (e.g., depression, anxiety and self-esteem). An initial review was proposed to examine the relationship between self-concept and recreational screen-time in adolescents. However, preliminary searches demonstrated that there were not sufficient studies focusing on this relationship to justify a systematic review and meta-analysis on this topic. No previous review examining the relationship between physical activity and physical self-concept could be found; therefore it was determined that a review focusing on this topic would provide an important contribution to the field.

Chapter 3: Rationale and Study Protocol for ‘Switch-off 4 Healthy Minds’ (S4HM): A Cluster Randomised Controlled Trial to Reduce Recreational Screen-time in Adolescents

This chapter provides a rationale for reducing recreational screen-time in adolescents and describes the methods used in the S4HM intervention. Details of the study design, recruitment, power calculation, randomisation procedures and outcome measures are provided.


Chapter 4: Intervention to Reduce Recreational Screen-time in Adolescents: Outcomes and Mediators from the ‘Switch-off 4 Healthy Minds’ (S4HM) Cluster Randomised Controlled Trial

Chapter 4 presents the results of a study examining the outcomes and mediating effects of a screen-time reduction intervention in adolescents. First, outcomes among adolescents participating in the S4HM intervention are detailed. Second, hypothesised mediation models are analysed to determine whether improvements in motivation (autonomous, controlled, amotivation) mediated effects of the intervention.

Chapter 5: Longitudinal Associations between Screen-time and Mental Health in Australian Adolescents

This chapter describes the findings from a longitudinal study examining associations between changes in screen-time and mental health outcomes among adolescents during their first year of secondary school. A number of proposed mechanisms are provided.


Chapter 6: Thesis Discussion and Conclusion

This chapter provides theoretical and practical recommendations based on experiences in conducting S4HM and appraising current literature. The conclusion aims to summarise the findings of the work conducted for this thesis and provides suggestions for future work.