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

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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

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## 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.

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# 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.

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# 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**

**Babic, M. J.,** Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., White, R. L., & Lubans, D. R. (2014). Physical activity and physical self-concept in youth: Systematic review and meta-analysis. *Sports Medicine, 44*(11), 1589-1601.

**Babic, M. J.,** Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., Eather, N., Skinner, G., Baker, A. L., Pollock, E., & Lubans, D. R. (2015). Rationale and study protocol for 'Switch-off 4 Healthy Minds' (S4HM): A cluster randomised controlled trial to reduce recreational screen-time in adolescents. *Contemporary Clinical Trials, 40*(1), 150-158.

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**Presentations arising from this thesis**

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

**Presentations:**

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**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**

Smith, J., Morgan, P., Plotnikoff, R., Dally, K., Salmon, J., Okely, A., Finn, T., **Babic, M.,** Skinner, G., Lubans, D. (2014). Rationale and study protocol for the 'Active Teen Leaders Avoiding Screen-time' (ATLAS) group randomised controlled trial: An obesity prevention intervention for adolescent boys from schools in low-income communities. *Contemporary Clinical Trials*, *37*(1), 106-119.

Thorne, H. T., Smith, J. J., Morgan, P. J., **Babic, M. J.,** & Lubans, D. R. (2014). Video game genre preference, physical activity and screen-time in adolescent boys from low-income communities. *Journal of Adolescence*, *37*(8), 1345-1352.

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Nathan, N., Cohen, K., Sutherland, R., Wolfenden, L., Beauchamp, M., Hulteen, R., **Babic, M. J.,** Lubans, D. R. (2016). Feasibility and efficacy of the 'Great Leaders Active StudentS' (GLASS) program on children's physical activity and fundamental movement skill competency. *Journal of Science and Medicine in Sport* (Under review).

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# List of Abbreviations

| | |
|---|---|
| AOR | Adjusted Odds Ratio |
| AS!BC | Action Schools! British Columbia intervention |
| ASAQ | Adolescent Sedentary Activity Questionnaire |
| BMI | Body Mass Index |
| BMI z score | Body Mass Index z-score |
| CPCLA | Children's Participation in Cultural and Leisure Activities survey |
| CI | Confidence Intervals |
| CONSORT | Consolidated Standard of Reporting Trials |
| CVD | Cardiovascular Disease |
| DOiT | Dutch Obesity Intervention in Teenagers |
| HEIA | HEalth In Adolescents study |
| HRQoL | Health Related Quality of Life |
| ICC | Intra-class Correlation Coefficient |
| K10 | Kessler Psychological Distress Scale |
| Kg | Kilogram |
| MET | Metabolic Equivalent |
| MLSQ | Motivation to Limit Screen-time Questionnaire |
| MVPA | Moderate-to-Vigorous Physical Activity |
| N | Number |
| NaSSDA | National Secondary Students' Diet and Activity survey |
| NCD | Non-Communicable Diseases |
| NSW | New South Wales |
| OIT | Organismic Integration Theory |
| *P* | Probability (statistical significance level) |
| PA | Physical Activity |
| PC | Personal Computer |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| PSDQ | Physical Self-Description Questionnaire |
| RCT | Randomised Controlled Trial |
| SD | Standard Deviation |
| SDQ | Strength and Difficulties Questionnaire |
| SDT | Self-Determination Theory |
| SEIFA | Socio-Economic Indexes for Areas |
| S4HM | Switch-off 4 Healthy Minds |
| SES | Socio-Economic Status |
| SMD | Standardised Mean Differences |
| SMS | Short-Message Service |

| | |
|---|---|
| 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

| | |
|---|---|
| Sedentary behaviour | Sedentary behaviour was defined as activities characterised by an energy expenditure ≤ 1.5 metabolic equivalents |
| Screen-time | Screen-time was defined as the time spent using screen based devices. |
| Recreational screen-time | Recreational screen-time was defined as screen use for entertainment purposes e.g. computer use for games/fun. |
| Non-recreational screen-time | Non-recreational screen-time was defined as screen use for educational purposes e.g. computer use for homework. |
| Physical activity | Physical activity was defined as any bodily movement produced by skeletal muscles requiring energy expenditure. |
| Mental health | 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. |
| Self-concept | The term self-concept is a general term used to refer to how someone thinks about or perceives themselves. |
| Adolescence | Adolescence was defined as youth aged between 13 and 18 (which corresponds with secondary school). |

# 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% CI = 0.24 to 0.35, $p < 0.001$), followed by perceived fitness ($r$ = 0.26, 95% CI = 0.20 to 0.32, $p < 0.001$), general physical self-concept ($r$ = 0.25, 95% CI = 0.16 to 0.34, $p < 0.001$) and perceived physical appearance ($r$ = 0.12, 95% CI = 0.08 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.

**Citation: Babic, MJ,** Morgan, PJ, Plotnikoff, RC, Lonsdale, C, White, RL, Lubans, DR. Physical activity and physical self-concept in youth: systematic review and meta-analysis. *Sports Medicine*, 2014; 44(11): 1589–601.

**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.

**Citation: Babic, MJ,** Morgan, PJ, Plotnikoff, RC, Lonsdale, C, Eather, N, Skinner, G, Baker, AL, Pollock, E, Lubans, DR. Rationale and study protocol for 'Switch-off 4 Healthy Minds' (S4HM): a cluster randomised controlled trial to reduce recreational screen-time in adolescents. *Contemporary Clinical Trials*, 2015; 40: 150–158.

**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.

**Citation: Babic, MJ,** Morgan, PJ, Lonsdale, C, Plotnikoff, RC, Eather, N, Skinner, G, Baker, AL, Pollock, E, Lubans, DR. Intervention to reduce recreational screen-time in adolescents: outcomes and mediators from the 'Switch-Off 4 Healthy Minds' (S4HM) cluster randomised controlled trial. *Preventive Medicine*, 2016: 91(1): 50–57.

**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.

**Citation: Babic, MJ,** Smith, JJ, Morgan, PJ, Plotnikoff, RC, Lonsdale, C, Lubans, DR. (2016). Longitudinal associations between changes in screen-time and mental health outcomes in a sample of Australian adolescents. *Mental Health and Physical Activity* (Under review).

**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.