A MULTICOMPONENT SCHOOL-BASED INTERVENTION IN DISADVANTAGED SECONDARY SCHOOLS TO REDUCE THE DECLINE IN PHYSICAL ACTIVITY ASSOCIATED WITH ADOLESCENCE: THE PHYSICAL ACTIVITY 4 EVERYONE RANDOMIZED CONTROLLED TRIAL.

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Master Public Health (Distinction)

Submitted for the Degree of Doctor of Philosophy
School of Medicine and Public Health
Faculty of Health Sciences
The University of Newcastle
28 October 2016
STATEMENT OF ORIGINALITY

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I hereby certify that this thesis is submitted in the form of a series of published papers of which I am a joint author. I have included as part of the thesis a written statement from each co-author; endorsed by the Faculty Assistant Dean (Research Training), attesting to my contribution to the joint publications. The University of Newcastle Thesis by Publication Guidelines, are included in Appendix I1.

Signed:

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CONFLICT OF INTEREST STATEMENT

Rachel Sutherland reports no conflict of interest.
LIST OF PUBLICATIONS FROM THESIS CHAPTERS

This thesis is presented as a series of five papers. At the time of submission, all five of these papers were published in peer reviewed journals.

PUBLISHED IN PEER-REVIEWED JOURNALS

Chapter 3


Chapter 4


Chapter 5


Chapter 6


Chapter 7

CO-AUTHOR STATEMENT – CHAPTER 3

I attest that Research Higher Degree candidate Rachel Sutherland contributed to the paper/publication entitled:

**A cluster randomised trial of a school-based intervention to prevent decline in adolescent physical activity levels: study protocol for the 'Physical Activity 4 Everyone' trial.**

By:
- Developing the research question
- Determining the research design
- Development of measures to be used
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'Physical Activity 4 Everyone' school-based intervention to prevent decline in adolescent physical activity levels: 12 month (mid-intervention) report on a cluster randomised trial.

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- Analysis and interpretation of the data
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ADDITIONAL PUBLICATIONS, PRESENTATIONS AND AWARDS ASSOCIATED WITH THE THESIS


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presentation.

2 Sutherland R, Campbell L, Lubans D.R, Morgan P.J, Okely A.D, Nathan N, Wolfenden L,
Gillham K, Wiggers J. Enhancing the implementation and adoption of a multi-component
physical activity intervention in disadvantaged secondary schools. Global Implementation

3 Sutherland R, Campbell L, Lubans D.R, Morgan P.J, Okely A.D, Nathan N, Wolfenden L,
Gillham K, Wiggers J. A Multi-component Intervention In Disadvantaged Secondary Schools
To Reduce The Decline In Adolescent Physical Activity: The PA4E1 Cluster RCT. International
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4 Sutherland R, Hollis J, Williams A, Campbell E, Lubans D, Morgan P, Okely A, Nathan N,
Wolfenden L, Gillham K, and Wiggers J. Moderate-to-vigorous physical activity in secondary
school physical education lessons. International Society of Behavioural Nutrition and
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5 Sutherland R, Campbell L, Lubans D.R, Morgan P.J, Okely A.D, Nathan N, Wolfenden L,
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To Reduce The Decline In Adolescent Physical Activity: The PA4E1 Cluster RCT. 3rd
Presented by Crooks K.

6 NSW Government Healthy Eating Active Living Forum 2016 - NSW Health, Sydney (Invited Presentation) (24 month results -lessons learnt)

7 NSW Health Promotion Forum 2016, Sydney (invited presentation) (Physical Activity 4 Everyone 24 month results)


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GLOSSARY OF COMMON ABBREVIATIONS

BMI  body mass index
BMI-Z body mass index z-score
CATI computer assisted telephone interview
CI Confidence Interval
HPE health and physical education
HPS health promoting schools
ICC intra class correlation
MVPA moderate-vigorous physical activity
NCD non-communicable disease
NHANES National Health and Nutrition Examination Survey
NSW New South Wales
PDHPE Personal Development, Health and Physical Education
PE physical education
PA physical activity
PA4E1 Physical Activity 4 Everyone
RCT randomised controlled trial
sd standard deviation
SOFIT System for Observing Fitness Instruction Time
VPA vigorous physical activity
WHO World Health Organization
WC waist circumference
SCT Social Cognitive Theory
ABSTRACT

BACKGROUND AND AIMS

Physical inactivity has been described as a primary cause of most chronic conditions, as important as both tobacco and obesity as a major modifiable risk factor for chronic diseases. The economic burden of physical inactivity globally is INT $53.8 billion. Despite this, as few as 20% of adolescents globally meet current physical activity recommendations, with socio-economically disadvantaged adolescents less likely to be physically active. Given evidence suggests physical activity levels throughout adolescence track into adulthood, effective interventions targeting socio-economically disadvantaged adolescents are warranted. Comprehensive school-based physical activity interventions have the potential to impact on physical activity levels, yet few such interventions have targeted socio-economically disadvantaged adolescents. As a result, development of cost-effective school-based physical activity interventions targeting socio-economically disadvantaged adolescents is a public health priority.

METHODS

The primary aim of this thesis was to evaluate a 24-month, school-based physical activity intervention in a trial targeting a cohort of Grade 7 students attending schools located in socio-economically disadvantaged communities (*Physical Activity 4 Everyone (PA4E1)*). The *PA4E1* intervention was evaluated using a cluster randomised controlled trial (RCT) involving 1100 adolescents (Grade 7, mean age 12.0 years at baseline) from five intervention and five control schools located in the Hunter, Central Coast and Mid North Coast regions of New South Wales, Australia. The two year multi-component intervention was guided by socio-ecological theory and the Health Promoting Schools Framework, incorporating seven physical activity strategies and six implementation support strategies. The three physical activity strategies implemented across the curriculum were teaching strategies to increase physical activity in physical education lessons, student physical activity plans and enhanced school sport programs; the two school environment strategies were recess/lunchtime activities and school physical activity policy; and two broader school environment strategies were linking schools with community physical activity providers and linking with parents. Six additional strategies supported school implementation of the physical activity intervention strategies.
including an in-school physical activity consultant, leadership and executive support, teacher training, resources, prompts and intervention implementation performance feedback.

The primary outcome was mean duration of moderate-to-vigorous physical activity (MVPA) minutes per day assessed using Actigraph (GT3X) accelerometers at baseline, and 12- and 24-months post randomisation. Additional physical activity outcome measures included: mean minutes per day of vigorous and moderate activity, counts per minute, % wear time spent in MVPA, vigorous and moderate activity, in-school and out-of-school physical activity. Secondary outcome measures were weight, body mass index (BMI), and BMI Z-score. In addition, a cost effectiveness evaluation was undertaken whereby intervention costs and incremental cost effectiveness ratios were calculated for both physical activity and adiposity.

Physical activity and weight status data were analysed using repeated measures linear mixed models with models developed for the baseline to 12-month period, as well as baseline to 24-month period.

RESULTS
Parental consent was provided for 1233 of the 1468 Grade 7 students from participating schools. At baseline, 1150 students wore an accelerometer (mean age 12.0 years, 54% female), with 965 providing at least three days of valid wear data (83% of accelerometer wearers, 78% of those with consent). At 24-month follow-up, 985 students wore an accelerometer (mean age 14.0 years, 57% female), with 441 of these (45%) providing valid wear data.

At both 12- and 24-month follow-up there was a significant group-by-time effect in favour of the intervention group for MVPA. At 12-month mid-intervention follow-up, students in the intervention group participated in 3.85 minutes (95% CI= 0.79, 6.91) more MVPA per day than students in the control group. At 24-month follow up students in the intervention group participated in 7.02 minutes (95% CI= 2.68, 11.36) more MVPA per day (p = ≤0.01) than students in the control group. The mean duration of daily MVPA increased by 4.39 minutes for intervention group students and decreased by 2.63 minutes for control group students. The intervention group students participated in 2.53 minutes more vigorous physical activity (p=0.03, 95% CI= 0.27- 4.79) and 4.5 minutes more moderate physical activity (p≤0.01, 95% CI= 1.98, 7.03) than the control group students at 24-months post randomisation.
ABSTRACT

At 12-month mid intervention, there was a significant group-by-time effect for weight (mean difference=-0.90kg) and BMI (-0.28kg/m²) in favour of the intervention group. At 24-months, there were statistically significant group-by-time effects for weight (mean difference= -0.78 kg, 95% CI= -1.40; -0.16, p=0.03) and BMI (mean difference= -0.28, 95% CI= -0.50,-0.06, p=0.01) in favour of the intervention group. The intervention cost was AUD $329,952 over 24-months. The incremental cost effectiveness ratio per additional minute of MVPA per day was AUD$56 ($35 - $147) and AUD$563 ($282 - $3,942) per 10% reduction in BMI z-score.

CONCLUSION

The PA4E1 trial showed the intervention was effective in not only reducing the decline in physical activity among adolescents attending schools located in socio-economically disadvantaged areas, but in increasing physical activity in comparison to a decrease in the control group. In addition, the intervention had a significant positive effect on adiposity and BMI. The findings suggest that implementation of the intervention by socio-economically disadvantaged secondary schools has the potential to reverse the decline in physical activity in this population group at a relatively small marginal cost. Further understanding of the mechanisms for implementation of the program at scale is required to contribute towards achieving health gains at a population level. The results of the trial suggest an opportunity for the dissemination of the evidenced based program to a larger number of schools. Measuring the sustainability of the intervention, inclusive of effect on both student level outcomes and school practice implementation level outcomes is suggested.
CONTRIBUTION STATEMENT

I was the sole PhD student and project manager of this study and was intricately involved in all aspects of the study conceptualisation, design, development, implementation, and evaluation. I was the contact person for schools, parents and students throughout the study and was responsible for managing all enquiries. A summary of the various contributions I made to the studies reported in this thesis is provided below.

ACQUISITION OF FUNDING

I was involved in the development of the grant application for the Physical Activity 4 Everyone trial. The grant that funded this study was a NSW Ministry of Health, Health Promotion Demonstration Grant 2011: $587,000

PROGRAM DESIGN AND DEVELOPMENT

I took a lead role in program design and development and was responsible for a team of staff involved in the implementation of the PA4E1 trial. With guidance from my supervisors, and a group of study investigators, I led the development of the PA4E1 trial. This required the creation of a range of program components and resources. The trial included: school presentations to staff and school executive, school program manuals, curriculum resources (e.g., student personal physical activity plans, pedometer lesson templates), school physical activity policy templates, amending existing enhanced student physical activity program outline and resources, development of train the trainer manuals for teachers, PA4E1 parent newsletters, and a suite of resources designed to monitor the implementation of the trial.

ETHICS APPROVAL AND CLINICAL TRIAL REGISTRY

I was responsible for correspondence with the Hunter New England Local Health District Human Research Ethics Committee (11/03/16/4.05), University of Newcastle’s Human Research Ethics Committee (H-2011-0210), NSW Department of Education SERAP (2011111) and the Catholic School Office Maitland and Newcastle Diocese Ethics Committee, including drafting applications and addressing feedback from committees. I was also responsible for registering the trial with the Australian New Zealand Clinical Trials Registry (ACTRN12612000382875). This involved developing a study proposal and justification,
CONTRIBUTION STATEMENT

completing all ethics forms, designing the program recruitment material and developing the information statements, consent forms and participant screening procedures.

STUDY MEASURES

In consultation with my supervisors and the investigator team, I selected all of the anthropometric and questionnaire-based assessments for this study. I developed the school environment and Health and Physical Education (PE) teachers’ survey items.

SCHOOL AND STUDENT RECRUITMENT

As the project manager, I was responsible for contacting and recruiting schools to the study. This involved phone calls and face to face meetings. Schools were also requested to sign a Memorandum of Understanding. I was also responsible for presenting the program details at school staff and executive meetings to facilitate consent. I was responsible for the delivery and collection of student consent forms. In addition, I developed scripts and trialled Computer Assisted Telephone Interviewers (CATI) to contact parents to gain parental consent.

DATA COLLECTION, ENTRY, AND MANAGEMENT

I was responsible for planning and coordinating the comprehensive trial assessments for the 1200 students who were eligible and agreed to participate. This involved developing the training protocols and training a team of Research Assistants at three time points to: fit accelerometers and instruct students in their use; undertake anthropometric measures; assist students to complete online surveys and follow-up absent students. I was also responsible for developing data collection timetables and liaising with schools regarding timeframes for data collection. I managed a project officer assisting with aspects of the data management.

Data collection was undertaken over a two year period on three separate occasions. I attended and was involved in all data collection processes. This included responsibility for ensuring all equipment was in working order and charging, initialising and downloading accelerometers. I was also responsible for ensuring all the necessary data was collected and was responsible for managing the data once collected and ensuring all files were backed up.

PROGRAM IMPLEMENTATION
CONTRIBUTION STATEMENT

With support from my supervisors and the investigator team, I oversaw the implementation of the *PA4E1* intervention. I was responsible for managing the in-school physical activity consultant.

DATA CLEANING AND ANALYSIS

In correspondence with my supervisors, the methods of statistical analysis were decided upon and I led data cleaning and analysis process. I was also responsible for interpreting the results and presenting the data in either text, table or figure formats. Data were cleaned and analysed externally.

PRESENTATION OF STUDY RESULTS

During my candidature, the results of the research have been presented at eight international and five national conferences. In 2015, I was awarded a travel grant by the University of Newcastle Priority Research Centre for Health Behaviour for conference registration. I was also one of three students nominated for an international student award for best presentation at the International Society Behavioural Nutrition and Physical Activity conference in Edinburgh in 2015, where I presented the 12-month mid-intervention effects of the *PA4E1* trial on student physical activity levels.
CHAPTER OVERVIEW

This introductory chapter provides a brief overview of the importance of physical activity in preventing morbidity and mortality due to related chronic diseases. It outlines the prevalence of adolescent physical activity in Australia and internationally, followed by an overview of the rationale for school-based interventions to increase adolescents’ physical activity, with a particular focus on socio-economically disadvantaged adolescents. To place this thesis in context, a short overview of the Physical Activity 4 Everyone (PA4E1) trial on which the thesis papers are based, is presented. The chapter concludes by providing the overall thesis aims and the specific research aims for each chapter.
CHAPTER 1: Introduction

BACKGROUND TO THE RESEARCH

Physical inactivity has been described as one of the biggest health problems in the 21st century and is recognised as an important modifiable risk factor for many chronic diseases.\(^1\)\(^-\)\(^2\) Worldwide, physical inactivity is the fourth leading risk factor for global mortality, accounting for 9% of all-cause mortality.\(^3\)\(^-\)\(^4\) Strong evidence indicates that regular participation in adequate physical activity has numerous physiological and psychological health benefits that reduce the risk of non-communicable diseases including hypertension, coronary heart disease, diabetes, stroke, some cancers such as breast and colon cancer, and is also associated with improved mental health.\(^5\) Adequate physical activity is also associated with a reduced risk of overweight and obesity, which is particularly important due to the increasing prevalence of obesity with 63% of Australian adults and 25% of Australian children and adolescents aged 5-18 years of age being either overweight or obese.\(^6\) Globally, the health care costs associated with inadequate physical inactivity are increasing\(^7\)\(^-\)\(^8\), with the costs associated with global physical inactivity estimated at INT$53·8 billion worldwide in 2013.\(^8\) Australian research indicates that an increase in participation in physical activity by ten per cent amongst Australian adults would lead to opportunity cost savings of $258 million per annum.\(^9\)

Due to evidence of the association between physical activity and health status, governments and leading health authorities have recommended minimum levels of physical activity to optimise individual and community well-being. In Australia, physical activity recommendations exist for children, adolescents, and adults.\(^10\) Despite such recommendations, 30% of adults globally are reported to be physically inactive and only 20% of adolescents are reported to participate in adequate levels of daily physical activity.\(^11\) The adolescent period, considered
within this thesis as spanning the ages of 12 to 19 years, and generally corresponding with commencing and completing secondary school\textsuperscript{12}, is well-recognised as a particularly critical period of physical activity decline, with longitudinal studies demonstrating that moderate-to-vigorous physical activity (MVPA) declines by seven percent per year throughout adolescence.\textsuperscript{13} Evidence from systematic reviews indicates that the physical activity habits formed in childhood and adolescence track in to adulthood.\textsuperscript{14} Adolescents from socio-economically disadvantaged backgrounds participate in less physical activity\textsuperscript{15} and have fewer opportunities to maintain an active lifestyle than adolescents from higher socio-economic backgrounds.\textsuperscript{16}

Schools are recognised as an important setting for shaping adolescent health behaviours\textsuperscript{52} and for addressing the less than optimal prevalence of adolescent physical activity.\textsuperscript{17} In Australia, school attendance is compulsory, with 98.5\% of 14 years olds enrolled in secondary school, and 83\% of those enrolled, continue to the final year of school (Grade 12- age 17-18 years).\textsuperscript{18} Schools therefore provide almost universal access to children and adolescents over extended periods of time, creating an opportunity to influence student behaviour.\textsuperscript{17} Schools are further suggested to have the capacity to create environments that promote physical activity via the implementation of policies and programs that teach, motivate and enable students to be physically active.\textsuperscript{19} In addition, school communication links with parents and carers are suggested to be a potential means of reinforcing the positive physical activity messages taught and communicated by schools, extending their impact to the home environment.\textsuperscript{20, 21}

Comprehensive school-based physical activity interventions based on the Health Promoting Schools (HPS) Framework have been endorsed by health and education authorities as a strategy for physical activity promotion.\textsuperscript{22-25} Systematic reviews of studies undertaken across
CHAPTER 1: Introduction

School settings, including elementary and secondary schools combined, indicate that school-based physical activity interventions can increase the proportion of students that are meeting physical activity guidelines\(^\textsuperscript{17}\), the duration of daily physical activity\(^\textsuperscript{17, 26, 27}\), as well as improving fitness and fundamental movement skills\(^\textsuperscript{17, 26, 28, 29}\). However, meta-analyses of studies using objectively measured intervention outcomes indicate that the impact of such interventions appear to be small (Cohen’s $d = 0.08$ to $0.24$).\(^\textsuperscript{30}\) Systematic reviews of school-based physical activity interventions have concluded that to enhance the likelihood of achieving greater effect sizes, interventions should be based on theory, be multicomponent in nature and be implemented for a duration of greater than 12-months.\(^\textsuperscript{17}\) In addition, to ensure confidence in the outcomes of such studies, studies using randomised controlled designs and objective measures of student physical activity have been recommended.\(^\textsuperscript{17, 30}\) Despite such recommendations, systematic reviews have identified that few well designed intervention trials targeting adolescents that meet these criteria have been implemented. For example, only six school-based physical activity trials have targeted socio-economically disadvantaged adolescents, of which only two were greater than 12-months in duration.\(^\textsuperscript{31, 32}\) Of these six interventions, just two had a significant intervention effect on physical activity.\(^\textsuperscript{33, 34}\) As a result of the limited number of effective studies among adolescents, cost effectiveness of school-based physical activity interventions has rarely been reported. As such, the development and rigorous evaluation of interventions to promote physical activity in socio-economically disadvantaged adolescents in the secondary school setting are warranted to reduce the decline in physical activity, to improve weight status and to enhance the health and wellbeing of adolescents.
THE PHYSICAL ACTIVITY 4 EVERYONE (PA4E1) TRIAL

To address the identified evidence gap of rigorously conducted trials of secondary school physical activity interventions, a cluster randomised controlled trial of a multicomponent physical activity intervention in secondary schools located in socio-economically disadvantaged areas, was conducted. The trial assessed the effectiveness of the intervention on adolescent physical activity and adiposity outcomes, and its cost effectiveness. Funding for the trial was provided by the New South Wales Ministry of Health, Health Promotion Demonstration Grants scheme. Ten Australian secondary schools (5 intervention, 5 control) located in socio-economically disadvantaged areas participated in the trial, which involved the implementation of the school-based intervention over 24-months. Outcome assessment occurred at 12-months (mid-point) and 24-months post randomisation. The primary outcome of the study was mean minutes of MVPA per day, whilst the secondary outcomes related to indicators of adiposity and cost effectiveness. This thesis is based on this trial.

THESIS AIMS AND STRUCTURE

This thesis seeks to address identified evidence gaps by developing and determining the effectiveness and cost effectiveness of a multicomponent secondary school-based physical activity intervention for adolescents (known as Physical Activity 4 Everyone (PA4E1) intervention trial). The thesis aims are as follows:

1. To determine the effectiveness of a multicomponent school-based physical activity intervention in reducing the decline in physical activity among students attending secondary schools located in disadvantaged areas at 12-month mid-intervention and at 24-months post randomisation.
CHAPTER 1: Introduction

2. To determine the impact of a multicomponent school-based physical activity intervention on student adiposity outcomes (secondary outcomes) at 12- and 24-months post randomisation.

3. To determine the cost and cost effectiveness of the PA4E1 intervention in terms of physical activity and adiposity outcomes.

This thesis conforms to the University of Newcastle’s rules regarding thesis submission by publication and is composed of eight chapters, five of which are papers that are published. The following chapters review the current literature and address the thesis aims (see Table 1.1). Given this thesis submission is by publication and follows published paper format, a degree of repetition occurs throughout some sections of the data chapters.
TABLE 1.1: Outline of thesis chapters, the associated publications and research aims.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Chapter Title</th>
<th>Research Paper citation</th>
<th>Research Aims</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.</td>
<td>Not applicable</td>
<td>To synthesise the best available evidence on the disease burden, prevalence and opportunity in school-based physical activity interventions targeting socio-economically disadvantaged adolescents.</td>
</tr>
<tr>
<td>3</td>
<td>A cluster randomised trial of a school-based intervention to prevent decline in adolescent physical activity levels: study protocol for the 'Physical Activity for Everyone' trial.</td>
<td>Sutherland R, Campbell E, Lubans DR, Morgan PJ, Okely AD, Nathan N, Wolfenden L, Jones J, Davies L, Gillham K et al: A cluster randomised trial of a school-based intervention to prevent decline in adolescent physical activity levels: study protocol for the 'Physical Activity 4 Everyone' trial. <em>BMC Public Health</em> 2013, 13:57</td>
<td>To design a trial to evaluate the effectiveness of an evidence based, multicomponent school-based physical activity intervention to reduce the decline in physical activity in adolescents attending schools located in socio-economically disadvantaged communities.</td>
</tr>
<tr>
<td>Chapter</td>
<td>Chapter Title</td>
<td>Research Paper citation</td>
<td>Research Aims</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>A summary of findings and future directions for research.</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
REFERENCES


CHAPTER 2

ADOLESCENT PHYSICAL ACTIVITY:
BURDEN OF DISEASE, PREVALENCE,
SCHOOL-BASED PHYSICAL ACTIVITY
INTERVENTIONS.
CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.

CHAPTER OVERVIEW

This chapter provides an overview of the importance of participation in regular physical activity to an individual’s health, to the health of the population, and to adolescents in particular. The chapter begins by outlining the burden of disease attributable to inadequate physical activity, and the role of regular physical activity in protecting against leading non-communicable diseases and promoting optimal physical and psychological health. The chapter then focuses specifically on physical activity recommendations for adolescents and the prevalence of adequate physical activity in this age group. A rationale for school-based interventions to increase adolescent physical activity is then presented. The chapter concludes by providing a review of current trial evidence for the impact of school-based physical activity interventions on adolescent physical activity and adiposity outcomes, with a focus on socio-economically disadvantaged adolescents, and an overview of the cost effectiveness of school-based physical activity interventions. The evidence gaps and thesis aims are then presented. Figure 2.1 provides an overview of the logic of Chapter 2.
CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.

FIGURE 2.1: Schematic diagram of Chapter 2: literature review

- Rationale for physical activity promotion in adolescents
  - Disease burden and premature mortality associated with physical inactivity
  - Association between physical inactivity and chronic diseases
  - Economic consequences of physical inactivity

- Physical activity prevalence and trends throughout adolescence
  - Physical activity recommendations
  - Measuring physical activity
  - Prevalence of recommended levels of physical activity in adolescents
  - Physical activity in socio-economically disadvantaged adolescents

- Understanding adolescents' physical activity behaviours
  - Correlates and mediators of adolescent physical activity
  - Models and theoretical basis for physical activity recommendations

- Review of school-based physical activity interventions targeting adolescents
  - The role of schools in the promotion of physical activity, opportunities for increasing physical activity.
  - Effectiveness of school-based physical activity interventions targeting adolescents and in particular disadvantaged adolescents: on physical activity and adiposity

- Evidence gaps: school-based physical activity interventions targeting adolescents
  - Overview of systematic reviews
  - Overview of new studies published since 2011
  - Overview of the cost effectiveness of school-based physical activity interventions
CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.

RATIONALE FOR PHYSICAL ACTIVITY PROMOTION IN ADOLESCENTS

DISEASE BURDEN AND PREMATURE MORTALITY RELATED TO PHYSICAL INACTIVITY

Physical inactivity has been described as one of the biggest health problems in the 21st century.¹² Strong evidence indicates that regular participation in adequate physical activity has numerous intermediate and long-term health benefits. Lack of sufficient daily physical activity (i.e., physical inactivity) has been described as an ‘underappreciated’ primary cause of most chronic conditions.³ Two Lancet series on physical activity were published in 2012⁴ and updated in 2016⁵ highlighting the strong evidence of the benefits of participation in physical activity for reducing morbidity and mortality across the globe. Within these landmark publications based on data from large-scale cohort studies, meta-analyses of pooled risk ratios, and qualitative reviews, the population attributable fractions (PAF) for all-cause mortality was estimated, together with potential gain in life expectancy if physical inactivity were eliminated.⁴ The PAF estimates the effect of a risk factor on disease incidence in a population.⁴ Lee and colleagues estimated that 9.4% of premature mortality globally is attributable to physical inactivity.⁴ Furthermore, Lee and colleagues estimated that through the elimination of physical inactivity, life expectancy could be increased by 0.68 (range 0.41–0.95) years per person globally.⁴ These gains in life expectancy are across the entire global population, not just for those currently inactive and moving to active. These findings make physical inactivity similar in scale to the established risk factors of smoking and obesity.⁴

Despite the reported risks associated with being physically inactive, only one in three adults are sufficiently physically active, resulting in an estimated 5.3 million deaths globally each year that are attributed to physical inactivity.⁴ Disparity in physical activity according to socio-economic status can contribute to strong patterns of health inequalities in mortality and
morbidity in adults. Evidence suggests a reduction of 25% in global physical inactivity levels would result in 1.3 million deaths being averted each year.\cite{6}

In Australia, consistent with global trends, Lee\cite{4} identified that the PAF of physical inactivity to all-cause mortality in Australia was 10.1%, with a gain of 0.58 years on life expectancy if Australia could eliminate physical inactivity. Physical inactivity is the fourth leading modifiable risk factor contributing to the burden of disease in Australia.\cite{7}

ASSOCIATION BETWEEN PHYSICAL INACTIVITY AND SPECIFIC DISEASES

Evidence outlining the association between physical inactivity and major chronic diseases is outlined in the following section, for adults and for children and adolescents.

*Association between physical inactivity and chronic disease in adults*

The Lancet series on physical activity outlined the protective effect of physical activity on major chronic diseases.\cite{4,5} Globally, the PAF for physical inactivity on a range of leading chronic diseases was reported to be 5.8% of coronary heart disease, 7.2% of Type 2 diabetes, 10.1% of breast cancer, 10.4% of colon cancer and 3.8% of dementia.

Recently, Kyu and colleagues quantified the dose-response relationship between the amount of total physical activity and risk of developing five major chronic diseases: breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke. Utilising the Global Burden of Disease study from 2013, a systematic review and Bayesian dose-response meta-analysis was published in July 2016. Data from 174 studies (149,184,285 total person years of follow-up), was used to quantify the impact increasing levels of physical activity above the recommended level could have on the risk of developing five chronic diseases compared to those insufficiently active.\cite{8} Physical activity was classified as insufficiently active (<600 Metabolic equivalents (MET) minutes per week), low active (600-3999 MET minutes), moderately active (4000-7999 MET minutes) and highly active (≥8000 MET minutes).
Table 2.1 details the reduction in risk of chronic disease associated with differing physical activity intensities compared with people classified as insufficiently active. Higher levels of total physical activity were associated with lower risk of all outcomes, however major gains in disease reduction were also observed at lower levels of activity. As intensity of physical activity increased, the risk of acquiring each of the major chronic diseases significantly reduced, with almost a third of diabetes potentially avoided through being highly active.\(^8\) Compared to those insufficiently active, people with low activity levels could reduce the risk of acquiring chronic disease by 3% (breast cancer) to 16% (Ischemic heart disease and stroke). Moderate activity levels resulted in a 6% (breast cancer) to 25% (diabetes) reduction in chronic disease and highly active people reduced the risk of chronic disease by 14% (breast cancer) to 28% (diabetes).\(^8\)

**TABLE 2.1: Reduction in chronic disease risk by varying physical activity intensities**

<table>
<thead>
<tr>
<th>Physical activity in MET minutes per week</th>
<th>Breast Cancer</th>
<th>Colon Cancer</th>
<th>Diabetes</th>
<th>Ischemic heart disease</th>
<th>Ischemic stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>600-3999 (Low active)</td>
<td>3%</td>
<td>10%</td>
<td>14%</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td>4000-7999 (Moderately active)</td>
<td>6%</td>
<td>17%</td>
<td>25%</td>
<td>23%</td>
<td>19%</td>
</tr>
<tr>
<td>≥8000 (Highly active)</td>
<td>14%</td>
<td>21%</td>
<td>28%</td>
<td>25%</td>
<td>26%</td>
</tr>
</tbody>
</table>

Based on data included in Kyu et al.\(^8\)

Based on this large-scale meta-analysis, the beneficial association between being physical activity and reducing chronic disease risk in adults appears unequivocal. Other review findings support the notion that physical activity is associated with reducing the risk for a variety of chronic diseases, although in contrast to the review by Kyu et al, other reviews conclude that acquiring the recommended level of physical activity of 30 – 60 minutes per day is sufficient to
reduce disease risk, and participation beyond the recommendations may not be accompanied by further risk reductions.

**Association between physical inactivity and health in children and adolescents**

The benefits of physical activity for children and adolescents are extensive. Such benefits include enhanced metabolic profile, mental health and psychological wellbeing, skeletal development as well as reduced risk of overweight and obesity. In 2010, a systematic review by Janssen and colleagues, which included studies published up until January 2008, examined the relationship between physical activity, fitness, and health in school-aged children and youth (aged 5-17 years) and association between a range of health and behaviour outcomes, grouped under six categories: adiposity, cardiovascular health, mental health, academic performance, bone strength and fitness. The review included 86 studies, where evidence was graded for each health outcome using established criteria based on the quantity and quality of studies and strength of effect. In addition, the volume, intensity, and type of physical activity were considered. The review included a mixture of study designs, with similar proportion of experimental and observational study designs, in addition to studies targeting a variety of ages and maturity levels within their samples. Although the experimental studies were graded as higher in quality, sample sizes were often noted to be very small. A summary of the health-related benefits of physical activity on the six health and behavioural indicators for children and adolescents is outlined in Table 2.2.

The review findings demonstrated an effect for physical activity for a range of health and behavioural outcomes. Participating in adequate physical activity was associated with improved cardiovascular health including reduced HDL cholesterol and triglycerides, a range of positive effects on mental health such as reduced anxiety, depression, better self-concept,
improved academic performance, greater bone strength and improved fitness. Based on both observational and experimental studies, a dose response relationship existed indicating that undertaking more physical activity resulted in greater health benefits (data not shown in Table). Undertaking at least moderate intensity exercise was required to achieve substantial health benefits, with vigorous intensity activity providing greater health benefits. Overall, even a modest amount of physical activity is beneficial for higher risk children and adolescents (such as those who are obese).

**TABLE 2.2: Association between physical activity and health and behavioural outcomes amongst children and youth**

<table>
<thead>
<tr>
<th>Health/Behavioural Outcome</th>
<th>Samplea</th>
<th>Effectb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiposity</td>
<td>overweight or obese</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>normal weight</td>
<td>0</td>
</tr>
<tr>
<td><strong>Cardiovascular Health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metabolic syndrome</td>
<td>overweight or obese</td>
<td>+</td>
</tr>
<tr>
<td>Lipids/lipoproteins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>normal weight</td>
<td>0</td>
</tr>
<tr>
<td>LDL-cholesterol</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>HDL-cholesterol</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Triglycerides</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>normotensive</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Hypertensive</td>
<td>+</td>
</tr>
<tr>
<td><strong>Endothelial function</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflammation</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Heart rate variability</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Coagulation</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Mental Health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety symptoms</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Depression symptoms</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Self-concept</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Global self-concept</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Physical self-concept</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sport competence</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Social self-concept</td>
<td>weak +</td>
<td></td>
</tr>
<tr>
<td>Academic self-concept</td>
<td>weak +</td>
<td></td>
</tr>
<tr>
<td><strong>Academic performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grades, standardized tests</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Indicators (eg, memory)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td><strong>Bone strength</strong></td>
<td>prepubertal and pubertal</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>postpubertal</td>
<td>+ weak</td>
</tr>
<tr>
<td><strong>Fitness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerobic fitness</td>
<td>&gt;7 years</td>
<td>+</td>
</tr>
<tr>
<td>Strength and endurance</td>
<td>&gt;6 years</td>
<td>+</td>
</tr>
</tbody>
</table>

a Unless otherwise indicated, all samples are from the general child and youth population, and thus cover a wide range of age and maturity levels (sample heterogeneity)

b + = positive (beneficial) effect, 0 = null effect (insufficient evidence upon which to base a decision or no effect identified)

Modified from I. Janssen.
A further systematic review of experimental and longitudinal studies that included studies with valid and reliable measures of physical activity was conducted in conjunction with reviewing the Australian physical activity guidelines for children and adolescents. This review provided a summary of evidence from studies published from 2008 (last available evidence) up until 2013, providing an update and expansion of the systematic review by Janssen, by reviewing evidence across 12 health outcomes. This review also attempted to determine differences in health outcomes associated with physical activity between children and adolescents. The systematic review involved 127 included studies that aimed to determine the association between physical activity and the biopsychosocial indicators of health and healthy development in children and adolescents aged 5-18 years. Studies were assigned a strength of evidence category based on: Level 1) Randomised controlled trials without important limitations; Level 2) Randomised controlled trials with important limitations and observational studies with overwhelming evidence; Level 3) Other observational studies; and Level 4) inadequate or no data in population of interest anecdotal evidence or clinical experience.

Table 2.3 provides an overview of the health association, strength of the evidence, number of studies conducted on the health condition included within the review, and a summary of the frequency and intensity of the physical activity associated with the health outcome.

For adolescents (aged 13-17 years), Level 1 evidence was found for the association between physical activity and the following health outcomes: cardio-metabolic health, adiposity, skeletal health, mental health and cardiorespiratory fitness. Level 2 evidence was found for conduct behaviour and motor development, whilst insufficient evidence was found for an association between physical activity and muscular health, negative health outcomes and respiratory health. Evidence differed between children and adolescents for the following...
three health outcomes: i) muscular health (level 1 evidence for children compared to level 4 evidence for adolescents), ii) negative outcomes (level 3 for children compared to level 4 for adolescents) and iii) academic/ cognitive development (level 1 for children compared to level 4 for adolescents). These differences were primarily in relation to smaller number of studies conducted within adolescents, highlighting a need for further evidence. The review concluded the associations between physical activity and positive health outcomes were consistent with the review by Janssen. However, this review provided additional evidence of the association between physical activity and adiposity beyond children and adolescents that are overweight or obese to beneficial effects within healthy weight children, concluding that ‘undoubtedly’, physical inactivity has associated health risks. Furthermore, the systematic review identified that based on the strength of the evidence from this review, and prior systematic review evidence, there was no basis to recommend differing physical activity guidelines based on sex, socio-economic status, cultural or indigenous backgrounds. Observational studies also provide evidence of a dose-response relationship between physical activity and health outcomes, resulting in a curvilinear relationship where there is a point where additional activity may increase the risk of injury and not provide additional health benefits.
### TABLE 2.3 Review of the evidence to inform the Australian physical activity guidelines for children and adolescents.

Overview of the health association, strength of the evidence, number of studies and a summary of the frequency and intensity of the physical activity associated with the health outcome.

<table>
<thead>
<tr>
<th>Outcomes</th>
<th># studies</th>
<th>Study Types</th>
<th>Summary of Findings: Children</th>
<th>Summary of Findings: Adolescents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Freq/wk</td>
<td>Intensity</td>
</tr>
<tr>
<td>Cardio-metabolic health</td>
<td>23</td>
<td>RCT (15)</td>
<td>3-5</td>
<td>MVPA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quasi (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adiposity</td>
<td>62</td>
<td>RCT (36)</td>
<td>2-5</td>
<td>MVPA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT (17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long (8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quasi (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quasi (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeletal health</td>
<td>13</td>
<td>RCT (7)</td>
<td>3-5</td>
<td>MVPA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscular health</td>
<td>26</td>
<td>RCT (15)</td>
<td>2-5</td>
<td>MVPA/VPA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT (8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quasi (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental health</td>
<td>18</td>
<td>RCT (12)</td>
<td>3</td>
<td>MVPA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quasi (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative outcomes</td>
<td>4</td>
<td>RCT (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk behaviours</td>
<td>2</td>
<td>CT (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic/cognitive development</td>
<td>9</td>
<td>RCT (8)</td>
<td>5-9</td>
<td>MVPA/VPA</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---</td>
<td>---------</td>
<td>-----</td>
<td>----------</td>
</tr>
<tr>
<td>Conduct behaviour</td>
<td>4</td>
<td>RCT (2) Long (2)</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Motor development</td>
<td>6</td>
<td>RCT (3)</td>
<td>1</td>
<td>MVPA</td>
</tr>
<tr>
<td>Cardiorespiratory fitness</td>
<td>41</td>
<td>RCT (25) Long (2) Quasi (4)</td>
<td>3</td>
<td>MVPA/VPA</td>
</tr>
</tbody>
</table>

Table taken from Okely et al. Systematic review to inform the development of Australian physical activity recommendations for children and adolescents.14

MVPA- moderate-to-vigorous physical activity, VA – vigorous physical activity, RCT – randomised controlled trial, CT – controlled trial
In summary, systematic reviews and meta-analyses of the association between physical activity and physiological and psychological health conditions appear compelling, fulfilling with seven of the nine Bradford Hill Criteria (excluding specificity and analogy) used to determine casual association. Evidence in the form of meta-analysis presented for adults and systematic review evidence in children and adolescents are both consistent in their conclusion regarding the beneficial nature of physical activity and a reduction in the risk of major chronic diseases or the pre-markers for these diseases.

ECONOMIC CONSEQUENCES OF PHYSICAL INACTIVITY

Internationally, the financial cost of physical inactivity occurs at both an individual and societal level. Using data from 142 countries, representing 93.2 per cent of the world’s population, the global cost of physical inactivity has been estimated at \((\text{INT}) 53.8\) billion in direct health care costs in 2013.\(^{16}\) The public sector bears the majority of these costs \((\text{INT}) 31.2\) billion, followed by the private sector \((\text{INT}) 21.9\) billion and remaining \((\text{INT}) 9.7\) billion by households. Productivity losses contribute an additional \((\text{INT}) 13.7\) billion to the financial burden together with 13.4 million disability-adjusted life-years (DALY’s).\(^{16}\) This financial burden is growing exponentially and placing pressure on health care systems globally. Globally, systematic reviews estimating the health care cost associated with physical inactivity indicate costs are increasing, with cost estimated at 1% of the health care budget in Holland and Australia in the 1980s, 2% in Canada and the USA in 1990s to more than 4% of Canada’s health care costs in 2009.\(^{17}\) Although acknowledged as a global concern, the financial burden of physical inactivity is largely met by high income countries (80% of health care costs due to inactivity).\(^{16}\) As a result physical inactivity places undue financial stress on individuals, families, workplaces and communities.\(^{17}\)
Within Australia, the direct health care cost of physical inactivity is estimated at AUD $672 million per year. Based on realistic but conservative estimates of reducing the prevalence of physical inactivity within Australian adults by 10% (from 70% to 60% of adults classified as inactive), the lifetime financial cost saving would be $96 million in the health sector and $162 million in production and leisure.

PHYSICAL ACTIVITY PREVALENCE AND TRENDS THROUGHOUT ADOLESCENCE

PHYSICAL ACTIVITY RECOMMENDATIONS

Governments and health organisations worldwide have developed recommendations as to the amount of physical activity required to achieve a health benefit. Intensity, duration, type and frequency of activity are important factors that influence health outcomes. Research indicates that a ‘threshold’ of physical activity must be reached in order to gain the associated health benefits, with research showing a positive linear association between the duration of activity and health outcomes. Due to the overwhelming evidence indicating a dose response relationship between physical activity and cardiovascular, metabolic, bone and mental health, the World Health Organisation (WHO) has endorsed global recommendations for physical activity and health. These recommendations outline children and youth aged between 5 to 17 years should accumulate a minimum of 60 minutes of moderate to vigorous physical (MVPA) activity each day. This MVPA has been described as health enhancing physical activity. In recognition of the additional health benefits, amounts of MVPA greater than 60 minutes are also encouraged along with the recommendation to incorporate activities that strengthen bone and muscle at least three times per week. Consistent with the international physical activity guidelines issued by WHO, the physical activity recommendations issued by
various western countries all recommend children and youth participate in one hour per day of MVPA, as outlined below in Table 2.4.

The Australian Government has recently updated the Australian physical activity guidelines for children and adolescents aged 5-12 and 13-18 years respectively. Both children and adolescents should accumulate at least 60 minutes of MVPA every day. Furthermore, consistent with the WHO, USA, Canadian and UK physical activity guidelines, Australian guidelines recommend activity should include some aerobic, vigorous and strength training activity. Table 2.4 outlines physical activity recommendations for adolescents from various high income countries including Australia.
TABLE 2.4: Physical activity guidelines for adolescents from various high income countries

<table>
<thead>
<tr>
<th>Organisation or Country</th>
<th>Year</th>
<th>Age range (years)</th>
<th>Guideline</th>
</tr>
</thead>
</table>
| Australia24 | 2014 | 13-17 | At least 60 minutes of MVPA every day.  
• Young people’s physical activity should include a variety of aerobic activities, including some vigorous intensity activity.  
• On at least three days per week, young people should engage in activities that strengthen muscle and bone.  
• To achieve additional health benefits, young people should engage in more activity, up to several hours per day. |
| Canada26 | 2010 | 12-17 | At least 60 minutes of MVPA daily.  
This should include:  
• Vigorous-intensity activities at least three days per week.  
• Activities that strengthen muscle and bone at least three days per week  
More daily physical activity provides greater health benefits. |
| European Union29 | 2008 | School age | School-aged youth should participate in 60 minutes or more of moderate to vigorous physical activity daily, in forms that are developmentally appropriate, enjoyable, and involve a variety of activities. The full dose can be accumulated in bouts of at least 10 minutes. |
| New Zealand30 | 2010 | 5-18 | Throughout each day,  
• do 60 minutes or more of MVPA  
• be active in as many ways as possible, for example, through play, cultural activities, dance, sport, recreation, jobs and going from place to place  
• be active with friends and whānau (extended family), at home, school and in their communities |
| United Kingdom27 | 2010 | 5-18 years | All children and young people should engage in moderate to vigorous intensity physical activity for at least 60 minutes and up to several hours every day.  
• Vigorous intensity activities, including those that strengthen muscle and bone, should be incorporated at least three days a week. |
| United States35 | 2008 | 6-17 | 60 minutes (1 hour) or more of physical activity daily.  
• Aerobic: Most of the 60 or more minutes a day should be either moderate or vigorous-intensity aerobic physical activity, and |

CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.
should include vigorous-intensity physical activity at least three days a week.

- Muscle-strengthening: As part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least three days of the week.
- Bone-strengthening: As part of their 60 or more minutes of daily physical activity, children and adolescents should include bone-strengthening physical activity on at least three days of the week.

<table>
<thead>
<tr>
<th>World Health Organisation(^{22})</th>
<th>2010</th>
<th>5-17</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. At least 60 minutes of MVPA daily.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Amounts of physical activity greater than 60 minutes provide additional health benefits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least three times per week.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MEASURING PHYSICAL ACTIVITY

The accurate measurement of physical activity is important for a number of reasons including detecting positive and negative health outcomes associated with behaviours, estimating population prevalence and trends, identifying correlates and evaluating interventions.³¹ Both subjective and objective measures of physical activity have been used. Subjective measures of physical activity include questionnaires, interviews, activity diaries and direct observation.³² Objective measures of physical activity include pedometers, accelerometers, heart rate monitors and global position system devices. All of these have been used in physical activity monitoring and research. For example, large-scale global studies such as the Health Behaviour in School-aged Children (HBSC) survey have used subjective measures of physical activity, whilst some large scale national monitoring studies such as National Health and Nutrition Examination Survey (NHANES) have commenced measuring population based physical activity prevalence via objective methods.³³ Within intervention research, both subjective and objective measures have been used, and methods vary according to the sample size, available funds and expertise, and the research question being studied. As objective and subjective methods measure varying domains of physical activity, results are unlikely to be comparable and should be selected based on the research question.

The use of subjective measures, whilst able to more easily be used in population wide studies, has limitations including their reliability and validity. For example, self-reported methods consistently overestimate habitual physical activity by up to 2.6 fold compared to objective measures.³⁴ In children and adolescents, subjective methods can be restricted in accuracy due a number of factors including: the reliance on parent proxy in younger age children; limitations in adolescent’s ability to recall their activity retrospectively; variability in opinion or perception
Therefore, objective measures of physical activity have been recommended for measuring physical activity.\textsuperscript{36,37,38} Of the available objective methods, accelerometers provide numerous advantages. Accelerometers provide objective information on the duration and intensity, as well as capturing physical activity in real time.\textsuperscript{38} In addition, they allow activity to be captured for the whole day, as well as the ability to segment physical activity across the day to determine which periods of the day are more or less active.\textsuperscript{37} The method of physical activity measurement should be noted when interpreting data underpinning monitoring epidemiological and intervention research, as variability is inevitable across the data collection methods and different methods may not be comparable.

**PREVALENCE OF RECOMMENDED LEVELS OF PHYSICAL ACTIVITY IN ADOLESCENTS**

*Global physical activity trends throughout adolescence: decline and tracking into adulthood*

Despite the heterogeneity in methods used to assess physical activity levels among children and adolescents, consistent trends have emerged in the literature regarding the prevalence of physical activity. International epidemiological estimates suggest that only 20\% of adolescents across 105 countries meet nationally recommended guidelines for physical activity.\textsuperscript{39,40} Data is derived from self-report using internationally developed measures.\textsuperscript{39} Adolescent physical activity in clearly defined contexts (i.e., active transport, school physical education and organised sport) shows a secular decline over the past 20 to 50 years in several countries.\textsuperscript{41}
International physical activity prevalence data

The prevalence of adolescents meeting recommended physical activity guidelines may differ depending on the method of assessment. In addition, comparing the prevalence rates of adequate physical activity across countries is a challenge due to the variations in operationalising guidelines. Despite these challenges, in 2014, the Global Matrix for Physical Activity in children (3-11 years) and youth (12-19 years) was released, which compared physical activity prevalence and supportive physical activity environments across 15 countries from five continents. In similar style to a school report card, countries were graded across nine indicators including for overall physical activity (% children and adolescents meeting guidelines), using primarily self-reported measures (Table 2.5). While two countries scored a ranking of B, indicating 60-79% of children and adolescents meeting recommended guidelines, the remaining 13 countries achieved lower grades.

Physical activity declines most rapidly throughout adolescence. A systematic review of 26 longitudinal studies reviewing physical activity levels throughout adolescence (defined as children aged 10-19 years) confirmed a decline in physical activity, averaging 7% decline per year. Based on this average, over the period of adolescence, physical activity could decline by as much as 60-70%. Between the ages of 10-17 years, the pattern of decline is generally linear. The decline in physical activity throughout adolescence has also been characterised by a decline in the variety or number of activities undertaken rather than a decline in the time spent in each activity. In terms of general patterns of activity during adolescence, girls have consistently displayed lower levels of MVPA in comparison to boys. Despite finding that girls participated in less MVPA each day, systematic review evidence has demonstrated that there
is no significant gender difference in the rate of decline in physical activity during adolescence.\textsuperscript{44}

Representative data from studies using objective measures are less common, however of the few studies using objective measures of physical activity, physical activity prevalence appears lower than reported within the global physical activity matrix. For example, objectively measured data using accelerometers in a nationally representative sample of adolescents from the United States of America (US), found that only 12% of boys and 3% of girls aged between 12-15 years accumulated 60 minutes or more of MVPA.\textsuperscript{47} Similarly, in the United Kingdom (UK), a study of 5595 young adolescents (11 year olds) using objective measures indicated as few as 2.5% of the sample, and less than one percent of girls, accumulated 60 minutes of moderate to vigorous physical activity per day.\textsuperscript{48} Recent data from across five European countries based on accelerometer measured physical activity from 686 adolescents aged 10-12 years indicates similarly very low levels of physical activity with only 16.8% of boys and 4.8% of girls meeting the physical activity guidelines.\textsuperscript{49} The methods used to operationalise physical activity guidelines (such as on average across days, on all days or on most days) may also explain variability in compliance, as different methods may result in significantly different prevalence estimates of compliance to guidelines and draw on different individuals identified as compliant.\textsuperscript{50}
CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.

**TABLE 2.5: Global Physical Activity Matrix for children and youth: Country Grades for Overall Physical Activity indicators**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Overall physical activity</th>
<th>Sedentary behaviours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mozambique B</td>
<td>Ghana B</td>
<td></td>
</tr>
<tr>
<td>New Zealand B</td>
<td>Kenya B</td>
<td></td>
</tr>
<tr>
<td>Mexico C+</td>
<td>New Zealand C</td>
<td></td>
</tr>
<tr>
<td>Kenya C</td>
<td>Ireland C-</td>
<td></td>
</tr>
<tr>
<td>Nigeria C</td>
<td>Colombia D</td>
<td></td>
</tr>
<tr>
<td>England D+</td>
<td>Finland D</td>
<td></td>
</tr>
<tr>
<td>Colombia D</td>
<td>Mexico D</td>
<td></td>
</tr>
<tr>
<td>Ghana D</td>
<td>United States D</td>
<td></td>
</tr>
<tr>
<td>Finland D</td>
<td><strong>Australia D-</strong></td>
<td></td>
</tr>
<tr>
<td>South Africa D</td>
<td>Canada F</td>
<td></td>
</tr>
<tr>
<td><strong>Australia D-</strong></td>
<td>Nigeria F</td>
<td></td>
</tr>
<tr>
<td>Canada D-</td>
<td>Scotland F</td>
<td></td>
</tr>
<tr>
<td>Ireland D-</td>
<td>South Africa F</td>
<td></td>
</tr>
<tr>
<td>United States D-</td>
<td>England INC</td>
<td></td>
</tr>
<tr>
<td>Scotland F</td>
<td>Mozambique INC</td>
<td></td>
</tr>
</tbody>
</table>

**Footnote**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>We are succeeding with a large majority of children and youth (≥ 80%)</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>We are succeeding with well over half of children and youth (60–79%)</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>We are succeeding with about half of children and youth (40–59%)</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>We are succeeding with less than half but some children and youth (20–39%)</td>
</tr>
<tr>
<td><strong>F</strong></td>
<td>We are succeeding with very few children and youth (&lt; 20%)</td>
</tr>
</tbody>
</table>
Prevalence of physical activity among Australian adolescents

The 2014 Australian Report Card on Physical Activity for Children and Youth (part of the Global Matrix for Physical Activity outlined above in Table 2.5) indicates only 20-39% of children and adolescents aged 5-17 years meet the physical activity guidelines everyday, represented by a grade of D- (see Table 2.5). This places Australia the fifth lowest ranked country and in line with the US, Canada and Ireland. The Australian data was based on prevalence data from four national and one state-based survey, published subsequent to 2008 with one survey focused solely on the physical activity of adolescents 12-17 years, which utilised self-reported measures and concluded only 10-15% of adolescents meet the physical activity guidelines.

There is a paucity of nationally representative data describing objectively measured physical activity of Australian adolescents. The absence of objectively measured physical activity data of Australian children and adolescents was noted as a limitation in Australia’s 2014 Physical Activity report card, whereby all of the data used to inform Australia’s grades were based on self-reported data sources. In the absence of no state or nationally representative studies, two school-based intervention studies published in 2010 and 2011 have described the activity levels of adolescent girls at baseline, concluding 10.4% (n=357) and 1.5% (n=1200) of the sample of adolescent girls aged 13.2 years and 13.6 years respectively, met the physical activity guidelines. As no other accelerometer measured physical activity studies of Australian adolescents have been published, more research utilising objective physical activity data is needed to determine an accurate picture of Australian adolescents’ physical activity habits. Despite considerable variability in the prevalence estimates of physical activity, data consistently demonstrate low levels of physical activity throughout adolescence.
PHYSICAL ACTIVITY IN SOCIO-ECONOMICALLY DISADVANTAGED ADOLESCENTS

Consistent evidence demonstrates that adolescents from lower socio-economic backgrounds are less likely to accumulate sufficient MVPA compared with adolescents from higher socio-economic backgrounds. In a study comparing data from 32 countries participating in the HBSC survey (subjective child self-report measures), all but seven countries showed a significant positive association between higher family socio-economic background (measured via a validated family affluence scale) and higher levels of self-reported MVPA. Of the seven countries that did not show a positive trend, the family socio-economic position did not influence the accumulation of MVPA.

Australian evidence is consistent with global data. In Australia, the NSW School Physical Activity and Nutrition Survey found that students residing in postcodes classified as lower socio-economic, based on Socio-economic Indices for Areas (SEIFA), were significantly less likely to meet the national physical activity guidelines compared to students from middle and higher socio-economic backgrounds, with 57.3%, 67.7% and 71.6% of students respectively reporting undertaking adequate physical activity, based on a self-reported survey. The decline in physical activity throughout adolescence also seems to be higher in those from lower socio-economic backgrounds. Despite variability in estimates, socio-economically disadvantaged adolescents have consistently displayed lower physical activity levels than those in high socio-economic groups. Throughout this thesis, when referring to disadvantage, this reference is made regarding socio-economic disadvantage, unless otherwise specified. Given the high burden of illness associated with inadequate physical activity, addressing adolescent physical activity levels is a public health priority both internationally and in Australia.
UNDERSTANDING ADOLESCENTS’ PHYSICAL ACTIVITY BEHAVIOURS

CORRELATES AND DETERMINANTS OF ADOLESCENT PHYSICAL ACTIVITY

Identifying the correlates and determinants of physical activity behaviour is an important step in developing effective interventions, and useful for targeting and emphasising certain behaviour change strategies in intervention development and implementation. The adoption of an active lifestyle is a complex behavioural process that is influenced by various factors often characterised across multiple domains. Terminology and complexity (e.g. age and gender) across the literature varies, however systematic reviews, and one review of reviews, have identified correlates (identified through cross sectional research) and determinants (identified through longitudinal research) of child and adolescent physical activity behaviour across a range of individual (psychological, behavioural), social (socio-demographic, family-related) and environmental and policy domains. The modifiable correlates and determinants, referred to as ‘factors’, identified in these reviews are summarised in Table 2.6.

TABLE 2.6: Summary of the modifiable factors (correlates and determinants) related to child and adolescent physical activity.

<table>
<thead>
<tr>
<th>Category</th>
<th>Identified correlates and determinants of child and adolescent physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual factors</td>
<td>Motivation (+)</td>
</tr>
<tr>
<td></td>
<td>Body image (+)</td>
</tr>
<tr>
<td></td>
<td>Enjoyment of physical activity (+)</td>
</tr>
<tr>
<td></td>
<td>Physical activity self-efficacy (+)</td>
</tr>
<tr>
<td></td>
<td>Perceived acceptance by peers (+)</td>
</tr>
<tr>
<td></td>
<td>Parental encouragement (+)</td>
</tr>
<tr>
<td></td>
<td>Physical self-perceptions (+)</td>
</tr>
<tr>
<td></td>
<td>Self-concept (+)</td>
</tr>
<tr>
<td></td>
<td>Perceived competence (+) *</td>
</tr>
<tr>
<td></td>
<td>Depression (*)</td>
</tr>
<tr>
<td></td>
<td>Enjoyment (+) *</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy (+)</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Perceived barriers to physical activity (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social factors</strong></td>
</tr>
<tr>
<td>Parental social support (+) *</td>
</tr>
<tr>
<td>Direct parental support (+)</td>
</tr>
<tr>
<td>Parental role modelling (+)</td>
</tr>
<tr>
<td>Involvement and social support provided by siblings (+)</td>
</tr>
<tr>
<td>Perceived support and encouragement from teachers and peers (+) *</td>
</tr>
<tr>
<td>Participating in teams*</td>
</tr>
<tr>
<td><strong>Environment and Policy factors</strong></td>
</tr>
<tr>
<td><em>School setting:</em></td>
</tr>
<tr>
<td>Access to physical activity programs (+)</td>
</tr>
<tr>
<td>Condition of playing grounds/fields (+)</td>
</tr>
<tr>
<td>Access to loose and fixed equipment (+)</td>
</tr>
<tr>
<td>Playground markings (+)</td>
</tr>
<tr>
<td>Size of the playground (+)</td>
</tr>
<tr>
<td>Access to play space (+)</td>
</tr>
<tr>
<td>Provision of organized activities (+)</td>
</tr>
<tr>
<td>Length of school break-time (+)</td>
</tr>
<tr>
<td>School ethos (+) (incl: school policies, physical education specialist, school size, class size)*</td>
</tr>
<tr>
<td>Lesson-specific context *</td>
</tr>
<tr>
<td>Supervision (+)</td>
</tr>
<tr>
<td>Enjoyment in PE*</td>
</tr>
<tr>
<td>Outside of school</td>
</tr>
<tr>
<td>Availability of footpaths (+)</td>
</tr>
<tr>
<td>Availability of public transport (+), a relevant place to walk to (+)</td>
</tr>
<tr>
<td>Low levels of traffic density (+)</td>
</tr>
<tr>
<td>Availability of equipment in parks (+)</td>
</tr>
<tr>
<td>Facilities and infrastructure within schools</td>
</tr>
<tr>
<td>Community sport participation (+)</td>
</tr>
</tbody>
</table>

(+ positive association, (-) negative association, (*) socio-economically disadvantaged factor (i.e., these factors have been shown to be correlates among those from lower SES).

Previous studies have focused predominantly on the individual and socio-cultural correlates and determinants of adolescent physical activity. However, despite being more challenging to measure consistently and limited by quality and methodology, systemic reviews outlining environmental and policy level factors are emerging as important indicators of health and appear to be associated with physical activity decline. A systematic review conducted by Davison and colleagues on the associations between the physical environment and young people’s physical activity concluded that transport-related factors (such as the presence of footpaths, availability of public transport, a relevant place to walk to and low levels of traffic density) and recreation facilities (such as the availability of equipment in parks and the facilities and infrastructure within schools) were positive correlates. Community sport
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participation, school sports and physical education participation, school physical activity policies and safe neighbourhoods have also been identified as important factors relating to adolescent physical activity.\(^{66, 64, 43, 74}\) The importance of such factors is shown by their inclusion in Table 2.6.

A range of factors may explain why adolescents from socio-economically disadvantaged backgrounds are less likely to meet physical activity guidelines.\(^ {75, 76}\) Whitt-glover and colleagues attempted to determine the correlates of physical activity among socio-economically disadvantaged adolescents, reporting the results of three published articles.\(^ {71}\) Collectively, the following individual and social factors were deemed particularly influential for increasing physical activity amongst socio-economically disadvantaged adolescents: encouragement from parents, enjoyment within school physical education, self-efficacy, perceived behaviour control and participating in teams (see Table 2.6 for factors related to socio-economic disadvantage*).\(^ {71}\) Although socio-economic position may shape and constrain the options available to be physically active,\(^ {77}\) limited research exists to explain the environmental and policy level determinants of adolescent physical activity. Students from higher socio-economic backgrounds are twice as likely to access after school activity classes as students from lower socio-economic backgrounds.\(^ {78, 79}\) Furthermore, children and adolescents living in socio-economically disadvantaged areas also have been found to engage in less organised sport than those from higher socio-economic areas.\(^ {76, 80}\) As a result of the disparities in physical activity between higher and lower socio-economically disadvantaged adolescents, and the rapid decline in activity throughout adolescence, interventions aimed at reducing the decline in physical activity, with a particular focus on socio-economically disadvantaged adolescents, have been recommended.\(^ {81, 82, 77}\)
FRAMEWORKS AND THEORETICAL MODELS FOR PHYSICAL ACTIVITY INTERVENTIONS IN ADOLESCENTS

Theories of health behaviour are used to explain behavioural processes and can assist in organising the modifiable factors related to physical activity to identify suitable strategies to achieve behaviour change.\textsuperscript{83} It has been shown that behaviour change interventions guided by theory are more likely to produce effective outcomes than interventions developed without theory.\textsuperscript{20, 84-87} Furthermore, the most successful public health programs have been based on an understanding of the health behaviours and the contexts in which they occur.\textsuperscript{83} Determining the most suitable theory on which to base behaviour change interventions is dependent upon the intervention target, whether it be individuals, groups and/or organisations.\textsuperscript{83} As such, theoretical models of health behaviour can be grouped according to the factors they aim to influence. Theories can target individual level factors (e.g., psychological, self-efficacy), social factors that address the interaction between individuals and their social environment, and/or higher-level influences which consider the environmental, structural and policy contexts of behaviour that are beyond individual control.\textsuperscript{83}

A complex relationship exists between adolescent physical activity participation and numerous school, home and community level factors.\textsuperscript{88} These multi-level factors are also reported to influence adolescent adiposity.\textsuperscript{89, 90} Comprehensive interventions based on theories that account for a broad range of factors may be more influential than those based solely on individual level behaviour change theories.\textsuperscript{91} A socio-ecological model has been advocated as suitable to apply when developing physical activity interventions targeting adolescents given it considers the complexity of health behaviour change and proposes strategies should focus on the individual, social and physical environment factors that impact on physical activity.\textsuperscript{65} Figure
2.2. outlines the socio-ecological correlates of physical activity across the variety of domains that influence physical activity participation. The socio-ecological approach emphasises that interventions should focus not only on personal factors, but also address the multiple-level factors influencing the behaviour in question. These broad multi-level factors are consistent with the determinants and correlates of physical activity described above, reinforcing the mandate for interventions to address multiple domains of influence. Figure 2.2 also highlights important behavioural settings such as schools and home environments, which may influence physical activity levels and provide a means of accessing populations and target groups to influence physical activity behaviours.

**FIGURE 2.2: Socio-ecological model for physical activity**

Note: Extracted from The ecological model for physical activity. From Sallis J.F., Cervero R.B., Ascher W., Henderson K.A., Kraft M.K., & Kerr J. (2006). Figure 1.
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THE ROLE OF SCHOOLS IN THE PROMOTION OF PHYSICAL ACTIVITY

RATIONALE FOR THE PROMOTION OF PHYSICAL ACTIVITY IN SCHOOLS

There is substantial potential for improving the physical activity habits of adolescents through the incorporation of the above correlates and determinants into school policies and programs.\(^{94,95,96}\) In Australia, as recommended by the World Health Organisation (WHO), implementing health promotion strategies in schools is a key strategy in improving health and preventing risks to health.\(^ {97,98}\) With the exception of the home environment, children and adolescents spend more time at school than any other setting.\(^ {99}\) It is estimated that approximately half of students’ waking hours are spent within the school environment.\(^ {100}\) Schools generally have the facilities, infrastructure and teaching resources available to implement programs, as well as established links and systems for communicating with parents and gaining community support. Programs incorporated into usual school practice also have the advantage of reducing stigmatisation, as all students are exposed by way of school attendance.

Studies using objective measures of physical activity have identified that 30 to 47% of a student’s daily activity can be accumulated while at school.\(^ {101,102}\) Irrespective of students’ socio-economic position, schools are well placed to influence the physical activity attitudes and behaviours of adolescents.\(^ {103,96,99}\) In highlighting the role of schools, the WHO has developed a framework to guide a whole of school approach for working within the school setting. The Health Promoting Schools (HPS) Framework strives to improve the health of students, school personnel, families and community members through creating conditions or school environments that are conducive to health. Consistent with Figure 2.2, the HPS
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Framework is social ecological in nature, with the three main domains of influence covering aspects of the behavioural settings and policy environment: school curriculum, school environment, and community partnerships and services.

EFFECTIVENESS OF SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS TARGETING ADOLESCENTS, WITH A PARTICULAR FOCUS ON DISADVANTAGED SCHOOLS

Considering the broad range of determinants of adolescent physical activity, and the role schools play in supporting adolescents to be active, public health efforts have targeted the development of school-based physical activity interventions. The following section provides a review of the available evidence on school-based interventions in terms of physical activity outcomes with a particular focus on adolescents, and adolescents from socio-economically disadvantaged backgrounds. Adiposity outcomes were also reviewed, given the potential for physical activity interventions to also influence adolescent adiposity. Firstly, an overview of systematic reviews of school-based physical activity interventions will be presented. Secondly, the results of adolescent-focused studies published subsequent to the systematic reviews will be presented.

THE EFFECTIVENESS OF SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS ON PHYSICAL ACTIVITY AND ADIPOSITY – EVIDENCE FROM SYSTEMATIC REVIEWS

The broad aim of this section is to summarise the findings of systematic reviews that have appraised the effect of school-based physical activity interventions. More specifically this section will:

- examine systematic review conclusions regarding intervention impact on total daily physical activity levels, particularly for interventions delivered to adolescents, and more specifically to socio-economically disadvantaged adolescents;
• examine review conclusions regarding intervention impact on adiposity outcomes, particularly for interventions delivered to adolescents and socio-economically disadvantaged adolescents;
• examine recommendations for intervention design features shown to enhance intervention effectiveness and to examine other methodological recommendations for future trials.

A search was conducted for systematic reviews published in the past ten years (from 2006 – June 2016) across four data-bases; MEDLINE, EMBASE, CINAHL and PUBMED. The following were included: systematic reviews of trials of physical activity interventions focused on children and/or adolescents where all or the predominance of studies were school-based interventions, and the review drew conclusions regarding intervention impact on total daily physical activity (duration, rate or intensity); and/or systematic reviews that aimed to make methodological recommendations to enhance future physical activity intervention studies. Reviews focused on studies conducted within a single country where the cultural context was not seen to be relevant to designing a school-based physical activity intervention in Australia, were excluded from the summary (e.g., systematic reviews focusing on interventions conducted in South America only). Additionally, reviews focused on a single time segment within the day, such as physical education, recess and lunch breaks, after school, or before school. Reviews that only selected studies with positive findings were not included in the summary unless they aimed to make methodological recommendations regarding characteristics of effective interventions (in which case they were used for this aim). Adolescent-targeted interventions were those that focussed on young people aged 12 to 18 years of age, which corresponds with the commencement and conclusion of secondary school
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Interventions delivered to disadvantaged adolescents were considered to be those where the study sample was specifically identified as socio-economically disadvantaged. This included studies targeting schools located in lower socio-economic areas or students living in low socio-economic communities, but not those isolated to only one ethnic minority group, without specific mention of socio-economic disadvantage.

Based on the above criteria, 11 systematic reviews were selected (Table 2.7) including one Cochrane systematic review by Dobbins et al. Ten examined the effect of interventions on total daily physical activity and targeted children and/ or adolescents (1-10 in Table 2.7). These include a Cochrane review published in 2009 and updated in 2013 (included as one review)(5 in Table 2.7). Five reviews were specific to school-based physical activity interventions, the remaining five included a mixture of school-based interventions and those delivered in other settings such as family and community settings. A broad range of strategies were included within the interventions, most tended to be multicomponent in nature. One review specified the need for studies to include at least two or more components reflective of a Comprehensive School Physical Activity Program (CSPAP). Three reviews specified intervention length within the study selection criteria including studies of four weeks to three months minimum duration. Of the ten reviews, two conducted meta-analyses on a physical activity outcome the results of which provide a summary of the magnitude of effect of an intervention approach and are presented separately. One additional review of successful school-based physical activity interventions targeting adolescents was included when examining recommendations for intervention design features and methodological considerations. The specific aim of this review was to draw
conclusions regarding effective intervention elements in order to inform future research (11 in Table 2.7).

The following sections provide a summary of the systematic review findings relating to impact of interventions on physical activity and adiposity. Reviews using meta-analyses are presented first.

**IMPACT OF SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS ON CHILD AND/OR ADOLESCENT PHYSICAL ACTIVITY**

*Findings from reviews conducting meta-analyses*

Two reviews conducted meta-analyses (1,2 in Table 2.7). Russ et al.\(^{107}\) examined studies published up until August 2014, which examined the effect of CSPAPs conducted within the US only, on student physical activity. Eligible studies included strategies which reflected at least two of the five CSPAP components, with at least one strategy targeting physical activity within the school setting. Fourteen studies were included, of which four targeted adolescents. The majority of studies incorporated a physical education component (12/14), physical activity across the school day (5/12) and a family and community component (14/14). The review was not restricted to randomised controlled trials, and included studies incorporating a variety of physical activity measures. These included self-report instruments and objective monitors such as pedometers or accelerometers. In addition, a variety of different protocols were used to measure intervention effect, even within measurement type (e.g., varying accelerometer data reduction protocols). As a result, the authors assumed that each of the instruments were measuring an aspect of the construct of daily physical activity, and outcomes were pooled together in the analyses. Daily physical activity effects from each of the studies were extracted and transformed into a common metric (i.e., Hedge’s g). Meta-analyses based on 14 trials
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reported the overall effect of the interventions on youth total daily physical activity was minimal, with a pooled effect size of $g = 0.11$ [95% Confidence Interval (95% CI) 0.03-0.19]. The review concluded that school-based interventions have been minimally effective.\textsuperscript{107}

The second meta-analyses, by Metcalf et al\textsuperscript{111} included randomised controlled trials of interventions targeting children and adolescents less than 16 years that used objectively measured physical activity outcomes, had interventions of at least four weeks in duration and published between 1990 and March 2012. The review of 30 studies was not specific to school-based physical activity interventions, however 17 of 30 included studies were conducted within the school setting (four on adolescents), and included studies of varying sizes from 18 to 1138 participants.\textsuperscript{111} Studies used a variety of accelerometer types and models, resulting in variations in the way physical activity was reported. Consequently, outcomes for total daily physical activity and MVPA were represented as the standardised mean difference pooled using a weighted random effects model. The pooled intervention effect across all 30 studies was small to negligible for total physical activity (standardised mean difference 0.12, $p<0.01$, 95% CI [0.04 to 0.20]) and small for MVPA (standardised mean difference 0.16, $p<0.0010$, 95% CI [0.08 to 0.24]). Overall, Metcalf et al\textsuperscript{111} reported a mean increase in daily minutes of MVPA in favour of the intervention group of four minutes per day. A meta-regression was conducted to explore the heterogeneity of intervention effects in relation to participant age, concluding although there was variation between groups, the pooled intervention effect did not differ significantly between studies targeting different age groups. For total daily physical activity, standardised mean differences were 0.07 for age <10 years and 0.16 for ≥10 years, $P=0.19$. Although there were slight differences in intervention effects these were not statistically significant.
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Both meta-analyses were consistent, reporting a small but significant effect of interventions on physical activity. There were no conclusions made in either review regarding impact of interventions on disadvantaged student populations, potentially due to the limited studies targeting this sub group of the population.114, 115

Findings from narrative reviews

Eight of the 11 reviews were narratives, of which six focussed on interventions targeting both children and adolescents, and two focussed on interventions targeting adolescents. Four narrative reviews focussed on school-based physical activity interventions only20, 108-110 whilst the remaining four included interventions conducted in a variety of settings (including school-based interventions plus others conducted in community and home settings).81, 84, 112, 116 The number of studies included within reviews ranged from 10108 to 76.116 All reviews included both objectively measured and self-reported physical activity outcomes. Across the narrative reviews, a range of physical activity outcomes were included. For example, studies included within the Cochrane review reported a primary physical activity outcome that was either expressed as the rate of MVPA (% meeting guidelines), or duration of physical activity (minutes of MVPA per day).20 Other outcome measures for reviews included fitness and cardio-metabolic health.109 Three of the reviews were restricted to include only randomised controlled trials,20, 108, 109 three also included controlled trials81, 84, 112 whilst the remaining two included a variety of study designs where the intervention aimed to promote physical activity including quasi-experimental studies.110, 116

Of the narrative reviews, a Cochrane systematic review published by Dobbins and colleagues20 provided a comprehensive overview of the effect of school-based physical activity
interventions and included only randomised controlled trials, inclusive of studies published up until October 2011. The review by Kriemler et al\textsuperscript{84} provides a review of reviews, plus controlled and randomised controlled trials published subsequent to the four included reviews between 2007 and 2010.

All six of the reviews focusing on interventions targeting both children and adolescents concluded interventions had a positive effect on physical activity. Conclusions across the reviews were consistent in their direction however ranged in their summation of effect from small to moderate effects on physical activity,\textsuperscript{20, 108} to 50\% of the included studies showing an effect on physical activity,\textsuperscript{116} to strong evidence of an effect.\textsuperscript{81}

Four of the narrative reviews targeting both children and adolescents, including the Cochrane review, were able to draw conclusions specific to adolescents.\textsuperscript{20, 81, 84, 116} Within the Cochrane systematic review by Dobbins,\textsuperscript{20} 14 of the 44 included studies targeted adolescents, however only four had a significant intervention effect. The authors concluded that although school-based physical activity interventions appeared successful, the evidence is less convincing for adolescents attending secondary schools. Similarly, four of the 20 new studies within the review by Kriemler,\textsuperscript{84} and 25 of the 76 studies within the Salmon\textsuperscript{116} review targeted adolescents. Both Kriemler\textsuperscript{117} and Salmon\textsuperscript{116} found inconclusive evidence around the effect of the intervention on adolescent physical activity. In contrast, the narrative review by Van Sluijs et al,\textsuperscript{81} of which 24 of the 57 studies targeted adolescents ≥ 12 years old, concluded there was strong evidence that multicomponent school-based interventions, including a family or community component targeting adolescents were effective.
Two narrative reviews focused solely on adolescents,\textsuperscript{108, 112} with one specifically of school-based physical activity interventions.\textsuperscript{108} Of the ten randomised controlled trials included in the Hynynen review\textsuperscript{108} of older adolescents, aged 15-19 years, seven of the ten interventions showed an impact on physical activity; with Cohen’s \( d \) coefficient ranging from 0.13 to 0.66 indicating some effect. Furthermore, nine of the ten included studies were considered high risk of bias. The review identified that studies with interventions with a higher number of behaviour change techniques and delivered by research staff were more likely to be successful.

The second adolescent focused review by De Meester\textsuperscript{112} et al included interventions conducted within Europe in adolescents aged 10-19 years.\textsuperscript{112} Of the 20 included studies (varying research design and intervention duration), 15 were school-based interventions. The review concluded that 13 of the 20 interventions had an effect on physical activity, however the effects observed were generally short-term and isolated to school day physical activity, and did not translate to total daily physical activity. In summary, the narrative reviews draw varying conclusions around the impact of school-based physical activity interventions on adolescent physical activity. Four suggest an effect, but three qualify that effects are less convincing than in children, short term, or small and from poor quality studies. The remaining review suggests multicomponent interventions are effective. Two reviews report evidence is inconclusive.

Of the eight narrative reviews only one made specific reference to reporting outcomes for disadvantaged groups. This review by van Sluijs,\textsuperscript{81} included three (of a total 57) studies targeting physical activity within socio-economically disadvantaged groups. Of the three studies, two targeted adolescents, of which one four week after-school-based study was effective.\textsuperscript{118} This review concluded there was little evidence to draw conclusions regarding
impact of such interventions on socio-economically disadvantaged populations. A further two systematic reviews included a small number of studies targeting disadvantaged groups however separate conclusions relating to this subgroup were not made.\textsuperscript{20, 84}

**IMPACT OF SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS ON CHILD AND/ OR ADOLESCENT ADIPOSY**

*Findings from reviews conducting meta-analyses*

The evidence regarding the impact of school-based physical activity interventions on adiposity is inconclusive. Neither of the two reviews with meta-analyses drew firm conclusions regarding the impact of physical activity interventions on adiposity outcomes.

*Findings from narrative reviews*

Of the eight narrative reviews, two made conclusions regarding intervention impact on adiposity.\textsuperscript{20, 109} Both of these reviews focused on children and/or adolescents and did not draw specific conclusions for adolescents. Of the two narrative reviews of school-based physical activity interventions specific to adolescents, neither reported on the effects on adiposity.

Within the Cochrane review,\textsuperscript{20} 32 of the 44 included studies report on a measure of adiposity of which eight interventions (25\%) had a significant effect. The measure of adiposity reported within the Cochrane systematic review was BMI, where the students in the intervention group demonstrated a smaller increase in BMI from baseline to follow-up compared to those in the control group. On average, the intervention group experienced an increase of 0.1 to 1.0 kg/m\textsuperscript{2} less compared to controls. Of these eight effective studies, only one study targeted adolescents, and the effect on BMI was observed in girls only.\textsuperscript{119} The Cochrane review
concluded school-based interventions generally had little effect on BMI. \(^{20}\) A second review, by Sun et al\(^{109}\) included 18 studies, of which 14 included BMI as an outcome measure and six were classified as high quality. Of these six high quality studies, three reported a statistically significant effect of the intervention on BMI. Similarly, eight of the 18 studies reported intervention outcomes on skin fold thickness, with four of the six high quality studies having a significant intervention effect, concluding strong evidence of an effect on skin fold thickness. Percent body fat was evaluated in seven trials, with two deemed high quality, of which one was effective. Overall, the review concluded that school-based physical activity interventions appeared to have an impact on skinfolds, however impact on BMI, % body fat and waist circumference remained inconclusive. Despite seven of the 18 included studies targeting adolescents, conclusions regarding the effectiveness of the interventions in adolescents were not drawn.\(^{109}\)

**RECOMMENDATIONS FOR THE DESIGN OF SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS**

This section examines the conclusions made within the above mentioned reviews regarding intervention features that enhanced effectiveness. Nine of the ten reviews referred to above formulated such conclusions. Kriemler et al,\(^{84}\) concluded it was not possible to draw conclusions regarding effective intervention elements. An additional review by Murillo et al\(^{82}\) (11 in Table 2.7) aimed to generate intervention guidelines for school-based physical activity interventions targeting adolescents, based on effective trials. Murillo\(^{82}\) reviewed school-based interventions targeting adolescents aged 12 to 19 years that generated a positive effect on physical activity, regardless of study design or measurement type, including studies published up until 2011. The search resulted in 73 included studies.
The most consistent conclusions regarding the design features that appear to enhance the effectiveness of school-based physical activity interventions, based on recommendations made by Murillo and others included:

i) The use of a multicomponent school-based intervention, with strategies beyond the curriculum, including environmental strategies;

ii) Use of theoretical models such as a socio-ecological approach by combining school-based strategies with strategies targeting community and parents;

iii) Assessment of the barriers and facilitators of programs or assessment of implementation issues to design support strategies and

iv) Duration greater than 12 months.

Furthermore, additional design features deemed important in some reviews included: adequate intervention dose and fidelity; improvements to Physical Education curricula; inclusion of computer-tailored interventions during the implementation and monitoring phases and the consideration of higher risk population groups including the implementation of specific strategies that respond to the interests and needs of girls and the need for interventions targeting lower socio-economic groups. While the need for interventions targeting socio-economically disadvantaged groups was noted, reviews did not specifically identify particular design features for such student groups.

OTHER METHODOLOGICAL RECOMMENDATIONS FOR FUTURE TRIALS

Due to uncertainty of the exact design features which may enhance the quality of school-based physical activity interventions, ensuring future trials are of high methodological quality
remains a priority. Of the 11 reviews listed in Table 2.7, eight made recommendations regarding methodological considerations for future school-based physical activity trials.

Collectively, these reviews identified six recommendations:

(i) the inclusion of objective physical activity measures to measure intervention effectiveness across the sample of students.

(ii) incorporation of longer term follow-up (beyond 12 months).

(iii) larger sample sizes powered for an intervention effect which factors in clustering.

(iv) assessment of mid intervention effect.

(v) incorporation of sub group analyses to better understand who benefits or if the intervention results in equal benefit.

(vi) incorporation of and reporting cost effectiveness of interventions.

SUMMARY OF REVIEW CONCLUSIONS

Overall, the evidence presented above from reviews of interventions targeting children and/or adolescents suggests the effect of school-based physical activity interventions on total daily physical activity appears positive but small. The evidence for interventions targeting adolescents is based on a smaller number of trials, in which effectiveness appears equivocal and review conclusions differ. For example, a meta-regression suggests there is no difference in intervention effect between younger and older student groups (4 of 17 school-based studies targeted adolescents), however, another review (narrative) concluded the evidence is less convincing for adolescents. Additionally, whilst one review concluded there is inconclusive evidence regarding the intervention components most effective for adolescents, another review concluded there is strong evidence that multicomponent interventions, including a family or community component were effective with adolescents.
CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.

There has been limited focus placed on interventions targeting socio-economically disadvantaged students. Of the few interventions targeting socio-economically disadvantaged adolescents contained within reviews, results remain inconsistent and study quality is variable. Evidenced generated from systematic reviews regarding the effect of school-based physical activity interventions on adiposity is similarly inconclusive, with limited studies assessing adiposity outcomes with mixed results. Furthermore, within the above reviews of child and/or adolescent school-based physical activity interventions, no review made conclusions regarding intervention effect on adiposity specifically for adolescents.

The conclusions of these reviews do not allow all studies that have examined the impact of school-based physical activity intervention on adolescents to be considered. Beyond the most recent Cochrane systematic review published in 2013,20 which included studies published until late 2011, there is a limited understanding of the effect of school-based physical activity interventions targeting adolescents. A review published in 2015,108 which included studies published until February 2013, summarises the effect of interventions on older adolescents aged 15 to 19 years but does not include studies targeting younger adolescents. There is a gap with regard to the effect of school-based physical activity interventions targeting younger adolescents published since 2011, and those targeting adolescents more broadly published since Feb 2013. To address this gap, an examination of adolescent focussed studies published from November 2011 until June 2016 was undertaken and presented below.
TABLE 2.7: Systematic reviews of school-based physical activity interventions

<table>
<thead>
<tr>
<th>Review</th>
<th>Aim</th>
<th>Search strategy</th>
<th># of studies</th>
<th>Inclusion</th>
<th>Method/synthesis</th>
<th>Conclusion: Physical Activity</th>
<th>Conclusion: Adiposity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Russ (2015)</td>
<td>The effectiveness of interventions incorporating multiple CSPAP components is unclear. A systematic review and meta-analysis were conducted examining the effectiveness of multicomponent interventions on youth total daily PA.</td>
<td>Two electronic databases were searched: Google Scholar and Pubmed. Studies were identified and analysed between August 2013 and January 2014.</td>
<td>14 studies</td>
<td>Published studies that: (1) occurred in the US; (2) targeted K-12 (5-18 years old); (3) were interventions; (4) reflected ≥ 2 CSPAP components, with at least 1 targeting school-based PA during school hours; and (5) reported outcomes as daily PA improvements.</td>
<td>Systematic review and meta-analysis</td>
<td>Intervention impact on physical activity Children and adolescents (4/14 studies targeted adolescents) Meta-analysis on all included trials (x adolescent) Overall, intervention impact was small (0.11, 95% CI 0.03-0.19). There is limited evidence of the effectiveness of multicomponent interventions to increase youth total daily PA Adolescents Not reported Disadvantaged students/adolescents: Not reported</td>
<td>Not reported</td>
</tr>
</tbody>
</table>

CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.
<table>
<thead>
<tr>
<th>Review</th>
<th>Aim</th>
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<th>Conclusion: Adiposity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Metcalf (2012)</td>
<td>To determine whether, and to what extent, physical activity interventions affect the overall activity levels of children. The second aim was to examine the effects of the intervention in relation to potential study level covariates by using meta-regression.</td>
<td>Electronic databases (Embase, Medline, PsycINFO, SPORTDiscus) and reference lists of included studies and of relevant review articles. Articles were published in peer reviewed journals from January 1990 to early March 2012.</td>
<td>30 studies 17/30 were school-based studies 8/30 studies specifically targeted overweight and obese children</td>
<td>Population: Participants had to be aged 16 years or younger. Design: randomised controlled trials or controlled clinical trials (cluster and individual) published in peer reviewed journals. Intervention: incorporated a component designed to increase the physical activity of children/adolescents and was at least four weeks in duration.</td>
<td>Systematic review and meta-analysis</td>
<td>Intervention impact on physical activity Children and adolescents • 17/30 studies were school-based • 4/17 targeted adolescents • Meta-analysis on all included trials • Overall, Strong evidence that PA interventions have a small to negligible effect on total PA and a small effect on MVPA. The pooled intervention effect across all studies was small to negligible for total physical activity (standardised mean difference 0.12, 95% confidence interval 0.04 to 0.20; P&lt;0.01) and small for moderate or vigorous activity (0.16, 0.08 to 0.24; P&lt;0.001). • Trials with exclusively overweight participants were more effective than those including all BMI categories. Adolescents • No significant difference observed between studies targeting younger (&lt;10yrs) and older (&gt;10 yrs) participants)</td>
<td>Intervention impact on adiposity: Intervention effect on adiposity not specifically reported.</td>
</tr>
</tbody>
</table>

CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.
### Narrative reviews evaluating the effectiveness of school-based physical activity intervention targeting adolescents

<table>
<thead>
<tr>
<th>Review</th>
<th>Aim</th>
<th>Search strategy</th>
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<th>Method/synthesis</th>
<th>Conclusion: Physical Activity</th>
<th>Conclusion: Adiposity</th>
</tr>
</thead>
</table>
| 3. Hynynen, 2015 | To evaluate the effectiveness of school-based interventions to increase PA and decrease SB among 15–19-year-old adolescents, To examine whether intervention characteristics (intervention length, delivery mode and intervention provider) and intervention content (i.e. behaviour change techniques) | Systematic search of the following electronic databases of peer reviewed journal articles and online research registers: Medline, Cinahl, Embase, PsycINFO, Cochrane Central | 10 studies | Randomised or cluster randomised controlled trials with outcome measures of PA and/or SB. Only 5/10 were PA only studies, the other 5 included other behaviours such as nutrition or heart health | Narrative | Intervention impact on physical activity Children and adolescents
- (all studies targeted adolescents)
- Overall, seven out of 10 studies reported significant increases in PA
- Effects were generally small and short-term (Cohen’s d ranged from 0.132 to 0.659).

Disadvantaged students/adolescents
- Not reported

Conclusions/recommendations about study methods
- Interventions that increased PA included a higher number of BCTs, specific BCTs (e.g., goal setting, action planning and self- | Intervention impact on adiposity: Not reported |

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**CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.**
<table>
<thead>
<tr>
<th>Review</th>
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<th>Conclusion: Physical Activity</th>
<th>Conclusion: Adiposity</th>
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</thead>
<tbody>
<tr>
<td>BCTs) are related to intervention effectiveness</td>
<td>Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Cochrane Methodology Register. The search spanned from the year of the database’s inception up to and including February 2013.</td>
<td></td>
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<td>monitoring), and were delivered by research staff.  • Intervention length and mode of delivery were unrelated to effectiveness. <strong>Conclusion (methods):</strong>  • Effective intervention incorporated more behaviour change techniques.  • BCT’s unique to effective intervention included: BCTs unique to effective interventions included: information about social and environmental consequences, graded tasks, self-monitoring of behaviour, feedback on behaviour, problem solving, goal setting  • (behaviour), action planning and social support (unspecified).  • Delivery of intervention by research staff more effective  • Intervention length and mode were inconclusive.  • More longer duration studies and long term effectiveness studies are required.</td>
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<tr>
<td>4.De Meester (2009)</td>
<td>To summarize the effectiveness of interventions to promote PA among European teenagers.</td>
<td>Pubmed, Medline, Web of Science, Sport Discus, Cochrane library. Studies published</td>
<td>20 15/20 school-based intervention of which 3/15 included a family and community</td>
<td>From January 1995 to May 2008 All interventions that promote PA among European teenagers. School, family, community, primary care,</td>
<td>Narrative review</td>
<td>Intervention impact on physical activity  <strong>Children and adolescents</strong>  • (All studies targeted adolescents)  • Overall, 13/20 of studies showed positive effects on short-term improvements in PA  • PA improvements mostly during school with no conclusive transfer to LTPA.  • In 3/20 studies with follow-up PA improvements were not sustained.</td>
<td>Intervention impact on adiposity:  • Not reported</td>
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### Review of School-Based Physical Activity Interventions

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<tr>
<th>Review</th>
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<th>Method/synthesis</th>
<th>Conclusion: Physical Activity</th>
<th>Conclusion: Adiposity</th>
</tr>
</thead>
</table>
- Implemented in a school setting and aimed at increasing PA
- Included all school-attending children,
- Implemented for a minimum of 12 weeks.
- Randomised controlled trials
- Reporting on outcomes for | Narrative review | Intervention impact on physical activity
Children and adolescents
- (14/44 studies targeted adolescents)
- Overall, some limited evidence to suggest that school-based
- PA activity interventions have a small to moderate impact on behavioural outcomes related PA.
- Physical activity improvements were shown in: 
  - Time engaged in MVPA (ranging from five to 45 min more)
  - Proportion of children engaged in MVPA during school hours and total daily activity.
  - Spent less time watching TV (ranging from five to 60 min less) | Intervention impact on adiposity:
- 32/44 studies measured BMI
- 8/32 impacted on BMI (0.1–1.0 kg/m², 1 study in adolescents – Haerens 2006—although only in girls)

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**CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.**
### Conclusion: Physical Activity

- VO2max (ranging from 1.6 to 3.7 mL/kg per min).
- Some limited evidence that results are maintained 6 months to 4 yrs post intervention.
- Given the risk of bias, and the small magnitude of effect, results should be interpreted cautiously.

### Conclusion: Adiposity

- Adolescents
  - 4/14 interventions used an objective measure of PA
  - 4 /14 were effective
  - Evidence is less convincing for adolescents attending high schools

### Disadvantaged students/adolescents

- 2/14 adolescent studies targeted disadvantaged students.
- Both used an objective measure of PA (1 accelerometer, 1 pedometer)
- Results not reported separately.

#### Conclusions/recommendations about study methods

- The long term impact of school-based interventions is needed.

### 6. Sun (2013)\(^{109}\)

To evaluate the effectiveness of school-based physical activity interventions

<table>
<thead>
<tr>
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<th>Conclusion: Adiposity</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Central Register of Controlled Trials (CENTRAL). For the updated review, same databases were searched from July 2007 to October 2011.</td>
<td>children and adolescents (aged 6 – 18 years).</td>
<td>Medline, Embase, EBSCOhost CINAHL and</td>
<td>Interventions delivered at school with controls having no</td>
<td>Intervention impact on physical activity Children and adolescents</td>
<td>Intervention impact on adiposity:</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>18 studies</td>
<td></td>
<td>Narrative</td>
<td>(6/18 studies targeted adolescents)</td>
<td>14/18 trials</td>
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<td></td>
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<td></td>
<td></td>
<td>Overall, Large, high dose (duration), high</td>
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CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.
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<th>Conclusion: Physical Activity</th>
<th>Conclusion: Adiposity</th>
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</thead>
<tbody>
<tr>
<td>Kriemler (2011)</td>
<td>To summarise recent reviews that aimed to increase PA or fitness in youth and carry out a systematic review of systematic reviews published after 2006 that</td>
<td>Systematic reviews published after 2006 that</td>
<td>4 systematic reviews plus 20 new interventions</td>
<td>Relevant systematic reviews published from 2007 to 2010 were included.</td>
<td>Narrative review</td>
<td>Intervention impact on physical activity Children and adolescents: • (4/20 new studies targeted adolescents) • Overall, 47–65% of trials were found to be effective.</td>
<td>Intervention impact on adiposity: • Not reported</td>
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</tbody>
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<th>Method/synthesis</th>
<th>Conclusion: Physical Activity</th>
<th>Conclusion: Adiposity</th>
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<tr>
<td>new intervention studies.</td>
<td>summarised the evidence on PA promotion in children and adolescents. Update the reviews by searching original controlled and randomised controlled school-based trials published afterwards. Pubmed, Medline, Embase, Psycinfo, Sportdiscus and Embase</td>
<td>(11 RCT’s, 9 CT’s)</td>
<td>New interventions Inclusion criteria (1) controlled trials (CTs) or randomised controlled trials (RCTs) of interventions that aimed to increase PA or fitness, (2) school-aged children from 6 to 18 years (3) PA or fitness measured as an outcome at baseline and at least one follow-up, (4) a duration of the intervention of at least 3 months, (5) intervention delivered at school, (6) control group not receiving a PA intervention and (7) statistical analyses of the PA/fitness outcome reported.</td>
<td>• All studies showed a positive effect on one aspect of PA with 9/10 studies also documenting a positive effect on overall PA. • 2/3 of new studies showed an increase in fitness. • The majority of studies measured LTPA and/or overall PA, 60% by objective means. • 3 interventions reported a post intervention follow-up, with all showing maintained effects in at least one PA domain.</td>
<td>• Adolescents • In children: multicomponent interventions with family involvement were most effective. • In adolescents: Inconclusive about which components were most effective for adolescents.</td>
<td>• Disadvantaged students/adolescents • 3/20 studies targeted disadvantage (none in adolescents)</td>
<td>Conclusions/recommendations about study methods • Multicomponent school-based intervention most • Consistent, promising strategy, • Inconclusive evidence regarding family involvement, • Focus on healthy populations at increased risk of inactivity</td>
</tr>
<tr>
<td>Review</td>
<td>Aim</td>
<td>Search strategy</td>
<td># of studies</td>
<td>Inclusion</td>
<td>Method/synthesis</td>
<td>Conclusion: Physical Activity</td>
<td>Conclusion: Adiposity</td>
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<tr>
<td>8. Slingerland (2011)(^{110})</td>
<td>Impact of PE intervention on increasing PA</td>
<td>An electronic literature search was conducted (Medline, Academic Search Premier and SportDiscus) and articles’ reference lists were scanned for additional papers. Articles published between 1989–2009</td>
<td>14 studies</td>
<td>Intervention studies using a PE component that directly or indirectly aimed to increase physical activity in primary and secondary school students. Inclusion criteria included 1) was school-based, 2) used modified PE content/frequency/duration as a component, 3) reported physical activity, 4) was published between 1989–2009, and 5) reported in English.</td>
<td>Narrative</td>
<td>Intervention impact on physical activity</td>
<td>Adolescents: Not reported; Disadvantaged students/adolescents: Not reported</td>
</tr>
<tr>
<td>9. Salmon (2007)(^{116})</td>
<td></td>
<td>Medline, Biosis, Cinahl, Embase, Sportdiscus, Psycinfo, PsycARTICLES,</td>
<td>76 studies</td>
<td>From January 1985 to June 2006. All interventions that promote</td>
<td>Narrative</td>
<td>Intervention impact on physical activity</td>
<td>Children and adolescents: Not reported</td>
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</table>

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<th>Conclusion: Physical Activity</th>
<th>Conclusion: Adiposity</th>
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<tr>
<td></td>
<td></td>
<td>Cochrane, Central, ScienceDirect, Web of Knowledge, Social SciSearch, Ovid Databases.</td>
<td></td>
<td>PA (School, family, community, internet-based, primary care). Age 4–19 years</td>
<td>than in other settings. • Most studies did not assess overall PA. • Studies that assessed PA objectively more effective than when PA assessed by questionnaires. • Adolescents • 25/76 interventions targeted adolescents. • 7/25 interventions targeting adolescents used an objective measure of PA. • 4/7 had a significant effect on PA • Among adolescents, interventions in primary care settings and tailored advice/brief counselling appeared to be most effective</td>
<td>Disadvantaged students/adolescents • Not reported</td>
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<td></td>
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<td></td>
<td>Conclusions/recommendations about study methods • Interventions only focusing on curriculum change much less effective than multicomponent interventions. • Involving family appears to enhance the effectiveness of interventions delivered in the school setting. • Most studies did not assess overall PA. • Studies that assessed PA objectively more effective than when PA assessed by questionnaires.</td>
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<tr>
<td>Review</td>
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<td>Conclusion: Physical Activity</td>
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<td>10. van Sluijs (2007)</td>
<td>To review the published literature on the effectiveness of interventions to promote physical activity in children and adolescents.</td>
<td>Medline, Embase, Sportdiscus, Psycinfo, Pubmed, Scopus from the year of their inception up to December 2006</td>
<td>57 studies: 24/57 studies targeted adolescents</td>
<td>To December 2006. All interventions that promote PA. Controlled trial, comparison of intervention to promote physical activity with no intervention control condition. Participants &lt; 18 years. Reported statistical analyses of a physical activity outcome measure. Any setting, any measure of physical activity (segment, whole day, fitness, self-report or objective).</td>
<td>Narrative review</td>
<td>Intervention impact on physical activity. Children and adolescents. 24/57 studies targeted adolescents (of which 18/24 conducted in the USA). Overall, 27/57 studies had a statistically significant effect on PA (47%), about half children (n=14) and adolescent (n=13) studies. Effective interventions achieved increases ranging from an additional 2.6 minutes of physical education related physical activity to 83 minutes per week of overall physical activity. Adolescents. 5/24 intervention were &gt; 6 months. 20/24 were school-based of which 6/20 were multicomponent school-based interventions. Interventions in adolescents found to be more effective than in children. Strong evidence the multicomponent interventions, including a family or community component targeting adolescents were effective. Disadvantaged students/adolescents. 3/57 targeted low SES populations (2/3 in adolescents, of which 1 was effective). Inconclusive evidence of an effect for interventions targeting children from low socio-economic populations.</td>
<td>Intervention impact on adiposity: Not specifically reported.</td>
</tr>
<tr>
<td>Review</td>
<td>Aim</td>
<td>Search strategy</td>
<td># of studies</td>
<td>Inclusion</td>
<td>Method/synthesis</td>
<td>Conclusion: Physical Activity</td>
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<td>11. Murillo (2013)</td>
<td>To identify strategies found in scientific literature, which have been effective in increasing adolescents’ school-based PA and to outline general intervention guidelines that may help translate the research knowledge into the development of future programmes and intervention.</td>
<td>The following databases were searched Medline, Pubmed and Web of Knowledge for literature conducted up to 2011.</td>
<td>73 studies (52 intervention articles and 21 review articles).</td>
<td>Inclusion criteria were as follows: (i) the intervention carried out was school-based; (ii) the intervention generated an increase in PA, regardless of how this was measured; (iii) the study population was between 12 and 18 years; (iv) the characteristics of the intervention were described and (v) the original studies or narrative review.</td>
<td>Narrative review</td>
<td>Conclusion: Physical Activity</td>
<td>Conclusions/recommendations about study methods</td>
</tr>
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<td></td>
<td>The conclusion of strong evidence of effect of multicomponent interventions in adolescents is in keeping with the ecological approach to behaviour change.</td>
</tr>
</tbody>
</table>

**Reviews evaluating strategies that have been effective in increasing adolescents’ school-based physical activity**

- Effective PA strategies to enhance future studies
- 5 guidelines were established:
  - (i) design multicomponent interventions using the socio-ecological as a conceptual model
  - (ii) improve Physical Education curricula
  - (iii) design and implement non-curricular

- **Children and adolescents**

- **Adiposity**

- Not reported
<table>
<thead>
<tr>
<th>Review</th>
<th>Aim</th>
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<td>reviews were written in English or Spanish.</td>
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<td>programmes (iv) include computer-tailored interventions during the implementation and (v) design and implement specific strategies that respond to the interests and needs of girls.</td>
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</table>

CSPAP - Comprehensive school physical activity program, LTPA – leisure time physical activity, PA – physical activity, PE – physical education, CT – controlled trial, RCT – randomised controlled trial, BMI – body mass index, BCTs – behaviour change techniques
THE EFFECTIVENESS OF SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS TARGETING ADOLESCENTS ON PHYSICAL ACTIVITY AND ADIPOSITY – EVIDENCE FROM TRIALS UNDERTAKEN SUBSEQUENT TO PUBLISHED REVIEWS

This section summarises the findings of school-based physical activity trials for total physical activity and adiposity for adolescents in general and those who are socio-economically disadvantaged that were published subsequent to the most recent Cochrane systematic review (from November 2011 onwards to June 2016).

Included were school-based physical activity only interventions with a physical activity outcome as per the previous Cochrane review (see Table 2.7). The search was limited to randomised controlled trials however limited to studies that reported on outcomes for adolescents (defined as those aged ≥ 12 years and ≤ 18 years). Studies with interventions with substantial nutrition content were excluded. Primary outcomes of interest included: total daily MVPA and time engaged in MVPA during the school day. Secondary outcomes related to physical health status measures. Medline, Cinahl and Embase databases were searched. Studies targeting disadvantaged adolescents were defined as per the above summary of systematic reviews. Data related to author, year of publication, participant characteristics and setting, whether the target population was disadvantaged based on the article description, intervention length, physical activity measure and outcome and adiposity measure and outcome was extracted from each study by the candidate.

IMPACT ON PHYSICAL ACTIVITY AMONG ADOLESCENTS

Since November 2011, eight school-based physical activity intervention trials targeting adolescents have been published, including five studies targeting disadvantaged
students. An overview of these studies and their impact on physical activity and adiposity is presented in Table 2.8. Three studies were conducted in Australia and one each in Denmark, Germany, USA, Brazil, and Ecuador. Almost all (n=7) of the interventions were based on a theoretical model, with the most commonly used theories or frameworks being the socio-ecological model and social cognitive theory. Four interventions targeted a single sex, three of which targeted girls only whilst the other targeted boys only. The remaining four interventions targeted both boys and girls. Interventions ranged in length from 12 weeks to two years (four were ≥12 months). Samples ranged from 357 to 1489 students. Four studies used an objective measure of physical activity across the whole sample, including three using accelerometers and one using pedometers. One further study used accelerometers on a subsample whilst the remaining three used a self-report measure of physical activity to evaluate the intervention outcomes.

Whilst all interventions were multicomponent, the focus of most was primarily curriculum or education based. Broader school environment strategies such as school policy, recess physical activity sessions or equipment featured in five interventions, and six incorporated strategies targeting parents. Fewer interventions incorporated links to the community. Only one intervention was predominantly environmental. There were no interventions that clearly incorporated implementation support strategies designed to overcome the known barriers to program implementation as recommended in systematic reviews.

Of the eight studies, three resulted in a significant effect on physical activity, whilst five had no physical activity effect. Of the three effective studies, one measured physical
activity objectively by pedometer across the whole sample, one measured physical activity via accelerometer in a subset of the sample and one used a self-reported measure of physical activity. One of the effective interventions was longer in duration (28-months) and incorporated curriculum, school environment strategies and links to parents, whilst the remaining two were short duration of 12 and 15 weeks respectively and were mainly curriculum focused but included some parent information materials. Overall, findings appear mixed.

Whilst three recently published studies have shown an intervention effect on adolescent physical activity, none have incorporated all of the features recommended within systematic reviews to enhance future studies. Two interventions were of short duration (12 weeks and 15 weeks), primarily education based of which one used a self-reported physical activity measure. The longer duration intervention, whilst it was multi-strategic, planned using theory, and the sample size large, was evaluated primarily via self-report with objective measures only used within a subsample. This intervention however, provides promise that such recommendations will result in an effect on adolescent physical activity.

Four school-based physical activity interventions reported in trials published since 2011 have targeted disadvantaged students. All were based on social cognitive theory, however may have also included other theoretical underpinnings. Intervention duration ranged from 17 months to one year (two interventions were 12 months) and tended to involve smaller sample sizes in comparison to the other newly published studies and ranged from 253 to 1355 students. All were single sex interventions with three targeting only girls and one targeting only boys. Two interventions measured physical activity via accelerometer, and two via self-report.
Of the four interventions targeting disadvantaged adolescents, none had a significant intervention effect on physical activity.

**IMPACT ON ADOLESCENT ADIPOSI TY**

Of the eight studies, five measured the effect of the intervention on adiposity. Of these five studies, three resulted in no significant effect on adiposity, whilst two interventions made a statistically significant impact on adiposity (neither of these also impacted on physical activity).

Three studies targeting socio-economically disadvantaged students measured adiposity outcomes; however none of the interventions showed a significant effect on adiposity. There have been no newly published school-based physical activity studies targeting disadvantaged students that have targeted both boys and girls.

**SUMMARY OF STUDIES PUBLISHED FROM 2011**

In summary, within the past five years, eight studies targeting adolescent physical activity within the school setting have been published, indicating adolescent focused interventions are an emerging area of study. Of these eight studies, four have targeted disadvantaged adolescents, of which all targeted a single sex. However, interventions appear to have continued to have an inconclusive effect on physical activity, consistent with the review evidence presented above. The number of trials assessing physical activity intervention impact on adolescent adiposity remains limited. The additional trials suggest evidence for school-based physical activity intervention effects on both physical activity and adiposity remains particularly limited for disadvantaged adolescents.
### TABLE 2.8: School-based physical activity intervention studies targeting adolescents – new studies.

<table>
<thead>
<tr>
<th>Author and date</th>
<th>Participants, Age, school year, # schools, location, Sex, intervention length</th>
<th>Theory</th>
<th>Health Promoting Schools intervention components: Curriculum, School environment, Community/parents</th>
<th>Intervention details</th>
<th>PA Outcome (Measure)</th>
<th>Adiposity Outcome</th>
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</thead>
<tbody>
<tr>
<td>1. Toftager 2014</td>
<td>1348 adolescents Age: 12.5 years Grade: 5 &amp; 6 14 schools Denmark Sex: 48.4% girls Length: 2 years</td>
<td>SEM</td>
<td>HPS Components</td>
<td>Curriculum/ education</td>
<td>School environment</td>
<td>Community/ parents</td>
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<td></td>
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<td></td>
<td>- 11 components (physical (n=4) and organisational enviro (n=7))</td>
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<td></td>
<td></td>
<td></td>
<td>- Physical – upgrade existing outdoor areas for PA, develop &amp; build playgrounds specially for adolescents, improve safety for active transport, establish after school fitness program</td>
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<td>- Organisational – formulate and implement school PA policy, educate teachers as 'kick starters' who facilitate &amp; motivate PA during recess, establish school play patrol: older students trained to initiate play for minors during recess, mandatory outdoor recess &amp;/or free access to gym, school traffic patrol, educate students in safe cycling, school project/theme week once a yr focus on learning about and doing PA during school lessons</td>
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<td>NS (ob)</td>
<td>Not reported</td>
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<tr>
<td>2. Suchert V 2015</td>
<td>1489 students Age: 13.74 (SD=0.67) 8th grade 29 schools secondary schools Germany Sex: 48% girls Length: 12 weeks</td>
<td>X</td>
<td>HPS Components</td>
<td>Curriculum/ education</td>
<td>School environment</td>
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<td></td>
<td>- Students received pedometers to evaluate daily PA, self-monitoring by study website</td>
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<td>- 2 class competitions for pedometer step counts with cash rewards for largest increase and most creative ideas for increasing step count</td>
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<td></td>
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<td></td>
<td>- 4 education lessons aimed at introducing both competitions, giving &amp; creating ideas at how to integrate PA into life and strategies to be more PA.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Headmaster, teaching staff &amp; parents received elaborated info material.</td>
<td>SIG (SR)</td>
<td>Not reported</td>
<td></td>
</tr>
<tr>
<td>3. Andrade 2015</td>
<td>1440 adolescents Age: 12.3 &amp; 13.3 yrs</td>
<td>SCT, TTM</td>
<td>HPS Components</td>
<td>Curriculum/ education</td>
<td>School environment</td>
<td>Community/ parents</td>
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CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.
<table>
<thead>
<tr>
<th>Author and date</th>
<th>Participants, Age, school year, # schools, location, Sex, intervention length</th>
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<th>Adiposity Outcome</th>
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<tbody>
<tr>
<td>Ecuador</td>
<td>Grade: 8 &amp; 9 20 schools Ecuador Sex: 59.3-66.4% Length: 28 mths</td>
<td>TPB</td>
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<td>+ + +</td>
<td>SIG</td>
<td>NS</td>
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<tr>
<td></td>
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<td></td>
<td>Delivery of educational package at classroom level. Increase awareness regarding importance of PA.</td>
<td>Enviro strategy included workshops with parents covering similar topics to what adolescents learn</td>
<td>(Ob PA by accels in subsample of adolescents selected at random)</td>
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<td></td>
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<td>Organisation of social events Environmental modification: a walking trail drawn on the school playground in 2nd yr of intervention</td>
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<tr>
<td>4. Melnyk 2013</td>
<td>779 adolescents Age: 14-16yrs Grade: freshmen and sophomores 11 Schools USA Sex: 51.5% female,</td>
<td>SCT</td>
<td></td>
<td>+ - +</td>
<td>SIG (Ob-pedometer)</td>
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<td>HPS Components</td>
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<td>COPE – Creating Opportunities for Personal Empowerment Healthy Lifestyles TEEN</td>
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<td>• 15 session education and cognitive behavioural skills building program with PA as a component of each session</td>
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<td>• 15-20 min PA in each session intended to build beliefs that can do PA regularly</td>
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<td>• Pedometers used to reinforce PA</td>
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<td>• Students asked to increase step count by 10% each week and keep diary</td>
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<td>• Teen manual with homework activities for each lesson</td>
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<td>• Parent newsletter describing COPE content x 4 over 15 wks</td>
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<td>Healthy Teens =</td>
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<td>• 15 week attention control program</td>
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<td>5. Dewar 2013</td>
<td>357 adolescent girls Age = 13.2±0.5yrs Grade 8 students 12 secondary schools</td>
<td>SCT</td>
<td></td>
<td>NS (ob)</td>
<td>SIG*</td>
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<td>NEAT, and Lubans 2012</td>
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<td>HPS Components</td>
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<td>Curriculum/ education School environment Community/ parents</td>
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<td></td>
<td>- Enhanced school sport sessions (40x90min), skill development through teacher directed sessions</td>
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<tr>
<td>Author and date</td>
<td>Participants, Age, school year, # schools, location, Sex, intervention length</td>
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<td>6. Casey, 2014</td>
<td>Australia Disadvantaged students: girls, Length: 12 mths</td>
<td>SEM</td>
<td>- Lunchtime PA (30 x 30 min), - Student handbook – building confidence to adopt healthy behaviours, overcome barriers to PA &amp; decrease SED activity, includes 10 weekly home challenges - Interactive seminars (3x30min), - Parent newsletters – - Text messages – 1 per week during second term, twice weekly in third and fourth term, - Pedometers – encouraging goal-setting and daily monitoring of PA behave</td>
<td>Cluster randomised trial by school Int = - PE component – student centred teaching &amp; behavioural skill development, two 6-session units 1 per week during normal PE (57-100 mins), two units = sport unit (tennis or football) &amp; recreational unit (YMCA). - PE classes delivered in collaborative manner by PE teachers with relevant community fitness instructors &amp; tennis &amp; football coaches. - Linked to community component designed to address barriers to PA participation.</td>
<td>NS (SR)</td>
<td>Not measured</td>
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<tr>
<td>7. Smith</td>
<td>361 boys ages: 12-14 yrs, 14 secondary schools, Australia, Sex: males, Disadvantaged students</td>
<td>SDT</td>
<td>Int = Teachers: - Teacher professional development – 2x 6hr workshops, 1 fitness instructor session Parents:</td>
<td></td>
<td>NS (Ob)</td>
<td>NS</td>
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<tr>
<td>Author and date</td>
<td>Participants, Age, school year, # schools, location, Sex, intervention length</td>
<td>Theory</td>
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<td>8. Barco Leme 2016</td>
<td>253 students, Age: 14-18, 10 schools match paired, Sex: Girls, Sao Paulo, Brazil, Length: 6 mths, Those ‘at risk’ of obesity determined by PA and eating questionnaire, Disadvantaged students</td>
<td>SCT</td>
<td>HPS Components</td>
<td>ns: (SR)</td>
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<td>Adapted from NEAT Girls</td>
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<td>10 Nutrition and PA messages to support healthy eating and PA</td>
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<td>(delivered by RAs during school breaks)</td>
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<td>Enhance PE sessions (by PE Teachers)</td>
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<td>School-break PA sessions</td>
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<td>Nutrition and PA handbooks</td>
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<td>Interactive seminars (by Dietitians)</td>
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<td>Nutrition workshops (by Dietitians)</td>
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<td>Weekly nutrition and PA key messages</td>
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<td>Parental newsletters</td>
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<td>Weekly health messages using WhatsApp</td>
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<td>Diet and PA diaries for self-monitoring</td>
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</tbody>
</table>

*The significant finding was only at 24-months and only for body fat (not BMI)

^ Although changes in BMI were not statistically significant, differences favored the intervention group (adjusted mean difference, −0.26 kg/m², se SE = 0.018, p = 0.076). Statistically significant intervention effects were found for waist circumference (−2.28 cm; p ‹ , p = 0.01)

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CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.
OVERVIEW OF THE COST EFFECTIVENESS OF SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS

Based on the small but significant intervention effect observed in meta-analyses and reviews of school-based physical activity interventions overall, reviews have recommended cost effectiveness evaluations be considered within future interventions. However, despite the number of school-based physical activity interventions that have been conducted, few cost effectiveness analyses have been conducted. Consideration of this recommendation remains an imperative, to guide policy makers to make informed allocations of scarce health resources. Economic evaluations of effective programs should be used to guide policy decisions, and such decisions should ideally be based on the outcomes of high quality intervention evidence such as randomised controlled trials. Cost-effectiveness analysis (CEA) aims to evaluate questions around the benefits of interventions relative to their cost in order to inform funding decisions and health care policy. Despite the valuable contribution of CEA, very few studies have evaluated school-based physical activity interventions from a cost effectiveness perspective, with scant few targeting adolescents.

Two recent systematic reviews have been conducted that report the cost effectiveness of physical activity interventions in general. The first systematic review by Wu and colleagues aimed to calculate the cost effectiveness ratios of physical activity interventions. Studies were included if they were included within two large systematic reviews of the effectiveness of physical activity intervention, one review targeting adults, and the other children and adolescents. In addition, a systematic search of seven databases for published trials of physical activity interventions (controlled trial, pre–post trial, or post measure-comparison)
CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.

published between 2000 and 2008 were included. The 91 included studies (of which 48 were RCT’s or controlled trials (CT’s) were categorised into six groups including: (1) community-wide education campaigns, (2) “point-of-decision” prompts to encourage use of stairs as an alternative to elevators or escalators, (3) individually adapted behaviour change programs, (4) school-based physical activity intervention targeting children and adolescents, (5) social support in community context, (6) creation or enhanced access to places for physical activity.

Program costs were considered as the total cost to the public health system to implement the intervention, regardless of sources of funds. Costs incurred for the development of the intervention and for research purposes were excluded in order to capture the cost of replicating proven interventions. The cost of the interventions were derived from one of two methods: 1) costs were available from published cost analyses, or 2) costs were estimated by the researchers and imputed based on resource utilisation including program personnel costs, supplies and materials, equipment, transportation costs and travel expenses of program personnel, training costs, outside consultant cost services, and program overhead costs. This review included 16 school-based interventions, of which four were conducted in secondary schools. The review identified that whilst not the most cost effective, school-based physical activity interventions targeting children and adolescents ranked well with a median of $0.42 per metabolic equivalent hour per person per day, generating an average of 16% of recommended physical activity.

The second review by Laine and colleagues aimed to synthesise the evidence on the cost-effectiveness of population-level interventions to promote physical activity. The review included primary prevention interventions aimed at promoting and maintaining physical activity across the population and included both school-based interventions from the Wu
CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.

review, \(^{136}\) as well as modelled cost-effectiveness studies \(^{132}\) (total of six school-based trials, three in adolescents). The review concluded that school-based physical activity interventions were amongst the most cost effective interventions at a cost of \$.056 per MET hour gained.

Whilst school-based interventions formed a component of the included studies, neither review separated the effects for elementary and secondary school-focused interventions, nor were conclusions regarding disadvantaged population groups made. \(^{132, 136}\) While these reviews have limitations, both reviews conclude that school-based physical activity interventions are cost effective compared to other population based interventions in terms of physical activity outcomes. \(^{132, 136}\) Consistent with the reviews of school-based physical activity intervention explored above, the cost effectiveness of school-based interventions targeting disadvantaged adolescents is currently non-existent. Given this significant gap, future school-based physical activity intervention targeting disadvantaged adolescents should prioritise the conduct of cost effectiveness evaluation, if interventions are able to demonstrate a positive intervention effect.

EVIDENCE GAPS IN SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS TARGETING ADOLESCENTS

OVERALL CONCLUSIONS FROM REVIEW EVIDENCE, EVIDENCE GAINED FROM NEW STUDIES AND EVIDENCE FOR COST EFFECTIVENESS

There are a large number of trials examining the impact of school-based physical activity interventions in young people, however, fewer have focused on adolescents and relatively few on socio-economically disadvantaged adolescents (6 trials). The findings of such studies are inconsistent. Two trials of multicomponent interventions, one an extracurricular sport program \(^{138}\) and the other of an after school intervention \(^{115}\) targeting socio-economically
disadvantaged adolescents within a Cochrane systematic review, resulted in significant intervention effects on physical activity. Since 2011, none of the four studies targeting socio-economically disadvantaged adolescents has had a significant intervention effect on physical activity.\textsuperscript{127} No trials targeting socio-economically disadvantaged adolescents have had a significant effect on physical activity and adiposity. Of the interventions targeting disadvantaged adolescents, few have designed longer duration interventions or used an objective measure of physical activity. Further school-based physical activity interventions targeting socio-economically disadvantaged adolescents are clearly warranted.

Despite the volume of literature focused on school-based physical activity interventions, considerable gaps remain, limiting researchers’ and policy makers’ ability to disseminate effective interventions. Based on the methodological recommendations made within recent systematic reviews, future interventions should:

I. be longer in duration;

II. be multicomponent and incorporate strategies across the social-ecological framework which considers curriculum, school environment and broader links with community and parents (i.e., consistent with a CSPAP approach);

III. consider the barriers and facilitators of strategies and incorporate strategies designed to assist implementation.

IV. recruit sample sizes large enough to detect a statically significant intervention effect, consider clustering and conduct some subgroup analyses;

V. use an objective measure of physical activity, preferably accelerometers, to evaluate the intervention.

VI. incorporate a cost effectiveness evaluation if the intervention is deemed effective.
CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.

THESIS AIMS

As a result of the gaps in the literature identified above, the aims of this thesis are;

1. To determine the effectiveness of a multicomponent school-based physical activity intervention in reducing the decline in physical activity among students attending secondary schools located in socio-economically disadvantaged areas at 12 month mid-intervention and at 24-months.

2. To determine the impact of a multicomponent school-based physical activity intervention on student adiposity outcomes (secondary outcomes) at 12 and 24-months.

3. To determine the intervention cost and cost effectiveness in terms of physical activity and adiposity outcomes.
REFERENCES


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CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.


105. Board of studies taesN. Parents Page. FAQ NSW2016 [cited 2016 18/08/2016]. How old are children in the different stages of schooling?]


CHAPTER 2: Adolescent physical activity: Burden of disease, prevalence, school-based physical activity interventions.


CHAPTER 3

A CLUSTER RANDOMISED TRIAL OF A SCHOOL-BASED INTERVENTION TO PREVENT DECLINE IN ADOLESCENT PHYSICAL ACTIVITY LEVELS: STUDY PROTOCOL FOR THE ‘PHYSICAL ACTIVITY 4 EVERYONE’ TRIAL.

A version of this chapter was published as a paper with BMC Public Health.

ABSTRACT

Background: Adolescence is an established period of physical activity decline. Multicomponent school-based interventions have the potential to slow the decline in adolescents’ physical activity; however, few interventions have been conducted in schools located in socio-economically disadvantaged communities. This study aims to assess the effectiveness of a multicomponent school-based intervention in reducing the decline in physical activity among students attending secondary schools located in socio-economically disadvantaged communities.

Methods: The cluster randomised trial will be conducted with 10 secondary schools located in selected regions of New South Wales (NSW), Australia. The schools will be selected from areas that have a level of socio-economic status that is below the state average. Five schools will be allocated to receive an intervention based on the Health Promoting Schools (HPS) framework, and will be supported by a part-time physical activity consultant placed in intervention schools who will implement a range of intervention adoption strategies. Study measures will be taken at baseline when students are in Grade 7 (12-13 years) and again after 12- and 24-months. The primary outcome, minutes of moderate- to-vigorous- intensity physical activity (MVPA) per day and percentage of time in MVPA, will be objectively assessed using accelerometers (Actigraph GT3x+). Group allocation and intervention delivery will commence after baseline data collection. The trial will continue during school terms through to 24-month follow-up.

Discussion: The trial will provide evidence regarding the effectiveness of a multicomponent school-based intervention that includes an in-school physical activity consultant targeting the physical activity levels of adolescents in socio-economically disadvantaged Australian secondary schools.

Trial Registration: Australian New Zealand Clinical Trials Registry ACTRN12612000382875.
BACKGROUND

Being physically active can prevent numerous chronic diseases including coronary heart disease, obesity, some types of cancers such as colorectal and breast cancers, and improve muscle strength and fitness and aspects of mental health.\(^1,^2\) Despite such benefits, population surveys from the United States of America (USA) and the United Kingdom (UK) have found that only 15.3 percent of 13-18 year olds\(^3\) in the USA and as few as 0-7 percent of 11-15 year olds\(^4\) from the UK are physically active to a sufficient level to improve health. Similarly, the proportion of Australians adolescents aged 13 to 17 years that meet the recommended amount of physical activity is around 15 percent.\(^5\)

The transition into adolescence is a recognised period of physical activity decline. Research suggests that MVPA drops by up to seven percent per year between the ages of nine to 15 years, so that by age 15 the majority of adolescents no longer meet the recommended daily amount of activity.\(^6,^7\) In addition, the physical activity decline associated with adolescence is steeper among youth from socio-economically disadvantaged or low income communities.\(^8,^9\) Reducing this decline is an important health priority as inactivity tends to track into adulthood.\(^10\)

Schools are a key setting for the promotion of physical activity as they have existing curricula, infrastructure, policies and resources to promote physical activity\(^11\) and are also able to reach those from all backgrounds.\(^12\) The effectiveness of multicomponent school-based physical activity interventions, particularly those that include links to families and communities, has consistently been demonstrated in reviews.\(^13-19\) However, recent reviews of school-based
physical activity interventions have identified only three studies focusing on socio-economically disadvantaged groups\textsuperscript{13, 20-22} each targeting children of primary school age (i.e. aged six to 12 years) rather than adolescents.

Schools located in socio-economically disadvantaged communities face a number of challenges in implementing whole of school physical activity programs, including student, teacher and parent disengagement and high staff turnover.\textsuperscript{23-26} In addition, Australian research indicates students from socio-economically disadvantaged backgrounds face barriers in physical activity participation including lack of parental support, cost of school sports, time available for school sport, and choice and variety of physical activities offered at school.\textsuperscript{27,28} A review of the effectiveness of physical activity interventions in socio-economically disadvantaged groups, although not specific to schools, concluded that interventions underpinned by a theoretical framework were more likely to be successful, and suggested the importance of focussing on a range of areas including social and professional supports and increasing the length of the intervention period.\textsuperscript{18} The HPS framework\textsuperscript{29} has an emphasis on intervention across a range of areas including school curriculum, school environment and ethos, and partnerships with community and parents. In order to address the challenges of intervening within socio-economically disadvantaged schools, in addition to the introduction of health strategies, the explicit incorporation of strategies to support intervention adoption within schools has been suggested to be important.\textsuperscript{24,30,31} Such strategies can include teacher professional learning, ongoing teacher support, availability of credible leadership and opinion leaders, provision of resources and prompts, and monitoring and feedback of intervention adoption.\textsuperscript{24,30,31}
CHAPTER 3: A cluster randomised trial of a school-based intervention to prevent decline in adolescent physical activity levels: study protocol

Given the lack of multicomponent intervention studies that target physical activity levels among adolescents from socio-economically disadvantaged groups, the aim of this trial is to determine whether a multicomponent physical activity intervention implemented in socio-economically disadvantaged secondary schools can reduce the decline in physical activity associated with adolescence.

METHODS

STUDY DESIGN

This study will employ a cluster randomised controlled design (Figure 3.1).
CHAPTER 3: A cluster randomised trial of a school-based intervention to prevent decline in adolescent physical activity levels: study protocol

![CONSORT flowchart describing progress of participants through the study](image)

FIGURE 3.1: CONSORT flowchart describing progress of participants through the study
The research will be conducted and reported in accordance with the requirements of the Consolidated Standards of Reporting Trials (CONSORT) Statement.\textsuperscript{32,33} A randomly selected sample of socio-economically disadvantaged secondary schools in the study region will be invited to participate. The schools will be randomly allocated to receive a multicomponent intervention to be implemented during school terms and to commence after baseline data collection, or to a control group. Data will be collected from students at baseline (when students are in their first year of high school, aged 12-13 years), and from the same cohort of students after 12-months (midpoint) and 24-months post baseline data collection. The primary outcome will be minutes per day and percentage of time in MVPA at 24-month follow-up.

\textbf{SETTING}

The study will be conducted in the Hunter, Central Coast and Mid North Coast regions of the state of NSW, Australia. These regions encompass major city and regional areas.\textsuperscript{34} The regions have lower indices of socio-economic status than NSW\textsuperscript{35} and a population of approximately 64,188 children aged between 12 and 15 years (17.6\%).\textsuperscript{35}

\textbf{SAMPLE}

\textbf{SECONDARY SCHOOLS}

Secondary schools in NSW cater for students aged from about 12 (Grade 7) to 18 (Grade 12) years old. Students are required to undertake 300 hours of Health and Physical Education (PE) each year, from Grade 7 to Grade 10.\textsuperscript{36,37} Students also have opportunities to engage in physical activity through school sport (averaging two hours per week).\textsuperscript{38} PE is taught by qualified Health and PE teachers.
Of the secondary schools within the study region, those that meet the following criteria will be eligible to participate in the study: Government and Catholic schools; schools with postcodes ranked in the bottom 50% of NSW postcodes based on the Socio-Economic Indexes For Australia (SEIFA); have between 120-200 Grade 7 students (to meet sample size requirements); and are not participating in other major physical activity or health intervention studies. Ten schools will be recruited.

STUDENTS

All Grade 7 students in participating schools will be eligible to participate in the study measurement. Classes catering for students with severe physical and mental disabilities will be excluded.

RECRUITMENT

SCHOOLS

Prior to recruitment, the study will be promoted to school sector Regional Directors within the NSW Department of Education and Communities (DEC) and the relevant Catholic school Dioceses to gain their support. A random number function in Microsoft Excel will be used to determine the order in which the eligible secondary schools are approached to participate. Invitations to participate will be sent to the 10 randomly selected schools. If a selected school declines, an additional letter will be sent to the next eligible school on the list, until 10 schools accept the invitation to participate.

A letter will be sent to selected schools, detailing the study and inviting participation. Approximately two weeks after the invitation letter is sent to the school, the Principal will be contacted by phone by a member of the research team. A face-to-face meeting will be
requested with both the Principal and the Head PE teacher to outline the requirements of the study and request consent.

**Random allocation of schools**

Eligible schools will be classified into two strata based on geographic location (regional or major city). Research indicates that location may contribute to the varying physical activity levels of adolescents. Four consenting schools will be obtained from the major city strata and six from the regional school strata. Participating schools will be randomly allocated using block randomization (1:1 ratio) to the intervention or control condition using a computerized random number function. Randomization will be undertaken by a statistician not involved in contacting schools or in the study intervention or assessment and will occur after baseline data collection to reduce participation bias from students, teachers and researchers. The school Principal will receive a letter from the study team indicating to which group the school has been allocated. Data collectors will be blinded at baseline and where possible at 12- and 24-months data collection.

**STUDENTS**

All Grade 7 students in the participating schools will be provided an information package that will contain a letter outlining the study and a consent form for parents asking for consent for their child to participate in the study data collection. Parents will be provided with a telephone number where they can leave a message if they do not want to be prompted about consent or do not want their child to participate in the measurement component of the study. Two weeks following distribution of the information package, parents who have not returned a consent form or left a message indicating they do not wish to be contacted, will be telephoned by staff
employed through the education sector and asked if their child can participate in study measurement. A replacement consent form will be sent to parents providing verbal consent.

A number of strategies that have been used successfully in similar research will be adopted in an effort maximise parent and student consent. These include having a designated recruitment co-ordinator, promoting the research prior to requests to participate, disseminating materials to maximise parent engagement, and issuing reminders to parents using a variety of methods including phone calls and letters.41,38,28

INTERVENTION

THEORETICAL FRAMEWORK AND PHYSICAL ACTIVITY CONTENT

Consistent with recommendations from reviews to maximise the effectiveness of school-based physical activity studies, the intervention has been guided by social cognitive42 and social-ecological theories43 and will be implemented using the World Health Organisation’s (WHO) HPS framework. This framework includes strategies that address the school curriculum, school environment and community.29, 44-47

Figure 3.2 shows the seven physical activity intervention strategies that schools will be facilitated to implement, and the strategies that will be used to increase the extent of intervention adoption. A further description of the physical activity intervention strategies within the HPS framework domains is as follows.
FIGURE 3.2: Physical Activity 4 Everyone Intervention model

Formal curriculum

1. Implementation of teaching strategies to maximise student activity levels within PE classes. Schools will aim to meet 50% of PE class time in MVPA for their students, a standard recommended by the US Centres for Disease Control (CDC) and Prevention. PE teachers will receive training and resources to assist in maximising MVPA, including workshop style sessions that will incorporate a facilitated process for reflection on levels of MVPA in lessons and changing teaching practices to enhance levels of activity. In addition to this training, regular pedometer-based lessons and curriculum material will be introduced to assist teachers.

2. Development and monitoring of annual individual student physical activity plans in PE lessons that include: long- and short-term personal goals for improving or maintaining regular physical activity; specific actions and timelines to achieve those goals; fitness
assessments; methods to be used to record actions and assess progress; and rewards for achieving goals.51 PE teachers will be responsible for co-ordinating the development and monitoring of individual physical activity plans. Consistent with the CDC guidelines, students will be encouraged to review their physical activity plans and modify the content regularly.11 Students will also be given small incentives when their personal goals have been met (such as balls, wrist bands, drink bottles).

3. Implementation of enhanced school sport programs for all students. All students will be scheduled to participate in age appropriate 10-week programs during school sport while they are in Years 7, 8 or 9. The school sports programs will be based on Program X and Physical Activity Leaders (PALs), both of which have been shown to be efficacious in adolescents.52,50 These single sex programs include; health-related fitness activities, pedometers for self-monitoring, lunch-time activities, information for parents and interactive seminars.52,50,38 The programs have been designed to meet the needs of low-active students, and are known to be acceptable and appropriate for such students and improve psychological outcomes.53 The program content is relevant to all students, and Year-wide implementation as a sport option will ensure no student is stigmatised.

School ethos and environment

4. Modification of school policies that encourage low-active students to be more physically active.54 The policies within each intervention school will be reviewed with the aim of establishing policies that enhance physical activity, and modifying existing policies that may be inhibiting activity. School policies that promote single sex PE classes, modified PE uniforms for girls, mandatory PE and sport, provision of equipment and staff supervision in breaks have been shown to enhance physical activity.55
5. Implementation of daily physical activity programs for students during school breaks including increasing the availability of facilities and equipment. Intervention schools will be offered equipment and supervised activities in recess and lunch breaks. Supervised activities have been shown to increase the participation of students in recess and lunchtime activities.\textsuperscript{56} Through participation in the enhanced sport programs (ie. Program X and PALs), the intervention aims to train students to lead the recess and lunchtime activities over the course of the intervention.

\textit{Partnerships and services}

6. Implementation of accessible after-school physical activity programs through linkages with community sporting groups and/or organisations from the fitness industry.\textsuperscript{57,54} Links will be established between the school and the broader community to enhance the physical activity opportunities available to students outside of school hours. The types of links established will be based on the criteria used in other physical activity interventions.\textsuperscript{38,58}

7. Parent engagement: Strategies will encourage parents to; increase their adolescent’s physical activity, and be active with their adolescent at home and in the community.\textsuperscript{59,60} Regular information will be sent to parents via existing schools newsletters, school website and program newsletters to support the activities occurring within the school. The materials will inform parents of school-based strategies, promote newly established community links and provide ideas to support physical activity outside of school hours. The newsletters will also aim to provide information on physical activity recommendations and strategies to encourage participation, including parent role modelling.
CHAPTER 3: A cluster randomised trial of a school-based intervention to prevent decline in adolescent physical activity levels: study protocol

INTERVENTION ADOPTION STRATEGIES

The lack of explicit intervention adoption strategies has been highlighted as a limitation of school-based physical activity interventions. To increase the extent of school adoption of the intervention, seven strategies will be used to support implementation of the physical activity components. These strategies are based on literature shown to facilitate the adoption of school-based interventions, change service delivery practices of organisations and build capacity of an organization. These include:

1. **Change agent position (in-school physical activity consultant):** A PE teacher will be located within each school for one day per week over the intervention period to support the planning and implementation of the program under the guidance of the school Principal and the Head PE teacher. This is consistent with previous research showing that location of a physical activity expert within a school can increase the amount of MVPA in PE lessons.

2. **Establishing leadership and support:** A committee will lead and oversee the implementation of the intervention within each school. This role could be taken on by an existing school committee or a new school committee could be established with representatives from the school executive, PE staff, staff from other key learning areas, students, parents and community. The committee, with the guidance of the in-school consultant will develop an intervention implementation plan. Meetings will be suggested to occur quarterly. Schools will also be asked to nominate a school co-ordinator whom the in-school consultant can work closely with for the duration of the project with the aim of handing over to this person when the research trial has been completed. Presentations will be given to all school staff in addition to the PE teachers and parents. These presentations will provide a means of gaining support for the project, providing input into the
implementation and also inform the school community of progress. School Principals and Head PE teachers will be encouraged to provide leadership via raising the program at staff meetings, attending the school committee meetings and approving and implementing supportive policy changes.

3. **Staff training:** Training from credible professionals has been shown to be an effective implementation support strategy. Teachers will be provided with training in the physical activity components relevant to their role in implementation. PE teachers will specifically be trained to deliver PE lessons that increase students MVPA. Training and tips will be regularly provided by the in-school physical activity consultant and further professional development sessions will be held twice a year (four sessions in total over the intervention). The training will be a series of practical learning workshops designed to foster skill development, where schools can jointly share their experiences in implementing the strategies, rather than a didactic lecture style format. Teachers from across the whole school will also be invited and trained to deliver the enhanced school sports programs.

4. **Resources:** Schools will receive an intervention manual including material to implement the PE lesson strategies, enhanced sports and physical activity programs during school breaks, and material on other strategies. Schools will also receive physical activity equipment such as elastic tubing resistance devices, pedometers, active electronic games consoles, skipping and boxing equipment. In addition to the resource kit provided to schools, additional small promotional incentives such as shirts and lanyards will be provided to teachers upon the introduction of curriculum based strategies. Small promotional incentives (balls, wrist bands, water bottles etc.) will also be given to students upon reaching their personal physical activity goals, for participating in recess and lunchtime activity and completing the enhanced school sports programs.
5. **Prompts:** The in-school physical activity consultant will provide prompts such as emails, reminders in meetings and markings on calendars to teaching staff to undertake intervention strategies. The in-school physical activity consultant will also work with schools to identify ways to build prompts into school communication processes and documents such as electronic calendar reminders and agenda items in meetings.

6. **Intervention adoption performance feedback:** Principals and Head PE teachers at each school will be given feedback on progress on each physical activity intervention strategy against agreed standards at the end of each school term (quarterly). The feedback reports will also include suggestions and offer support on how to improve performance.

**CONTROL SCHOOLS**

Control schools will participate in the measurement components of the study only. Control schools will be offered one day of teacher relief funding at each data collection point (baseline, mid-point and follow-up) to reimburse the school for their time in assisting with data collection. Control schools will also be offered the physical activity equipment pack, all developed intervention materials and the results of the study at the end of the intervention period.

**DATA COLLECTION PROCEDURES AND MEASURES**

All data will be collected at three time points: baseline; 12- and 24-months. Students will wear an accelerometer to record physical activity levels, undertake an online survey, and have anthropometric measures taken. The accelerometers and instructions for use will be distributed to students at school within class time, at the same time as students complete the online survey and have anthropometric measures taken.
CHAPTER 3: A cluster randomised trial of a school-based intervention to prevent decline in adolescent physical activity levels: study protocol

OUTCOME MEASURE - PHYSICAL ACTIVITY LEVELS

The primary outcome will be student physical activity defined as mean minutes of MVPA per day. Percentage of time spent in MVPA will also be calculated to adjust for individual accelerometer wear time.

Objectively measured physical activity data will be collected via accelerometers (Actigraph GT3X+ and GT3X model). Accelerometry provides an objective, valid and reliable way of measuring physical activity in young people. Students will be asked by trained research assistants to wear the accelerometers during waking hours for seven consecutive days. The accelerometers will be attached to an elastic belt and worn over the right hip. Raw data will be collected and stored in 15 second epochs. Student data will be analysed if accelerometers are worn for \( \geq 600 \) minutes on \( \geq 3 \) days. The Evenson cut-points will be used to categorize different intensities of physical activity. Students will also be asked to keep activity monitoring logs for the seven-day period when the accelerometers were being worn. To improve compliance, students will be sent a text message each morning reminding them to wear the accelerometer. Student and/or parent mobile phone numbers will be requested via the consent form.

STUDENT CHARACTERISTICS

An online survey, which will take approximately 30 minutes, will be undertaken to assess student socio-demographic characteristics (age, gender, Aboriginal or Torres Strait Islander status and postcode of residence), self-reported physical activity, physical activity mediators.
ANTHROPOMETRIC DATA

Anthropometric data including height and weight will be collected. Research assistants will be trained in measuring height, weight (used to calculate body mass index (BMI)) and waist circumference using the International Society for the Advancement of Kinanthropometry (ISAK) procedures. Weight will be measured in light clothing without shoes using a portable digital scale (Model no. UC-321PC, A&D Company Ltd, Tokyo Japan) to the nearest 0.1 kg. Height will be recorded to the nearest 0.1 cm using a portable stadiometer (Model no. PE087, Mentone Educational Centre, Australia). Waist measurement will be taken as the narrowest point between the inferior rib border and the iliac crest. Using a flexible but inelastic tape measure, the waist measure will be recorded to the nearest 0.1 cm. Two recordings will be taken and then the average will be used. The physical assessments will be conducted in a sensitive manner, with student measurements taken behind a privacy screen. BMI will be calculated as weight/height squared (kg/m²). Weight status will be determined using International Obesity Taskforce definitions.

SCHOOL OUTCOMES/PROCESS MEASURES

Data regarding school policies and practices that enhance student physical activity will be collected at baseline and follow-ups via a school environment survey completed by the Head PE teacher at intervention and control schools. Based on existing surveys, the survey will focus on school policies and practices that enhance student physical activity including questions relating to school equipment and facilities, recess and lunch activities and rewards and punishments related to physical activity. In addition, observational assessments of randomly selected PE classes in both intervention and control schools will be undertaken at each time point to measure physical activity levels, lessons context and teacher interactions.
The observational tool, SOFIT (System for Observing Fitness Instruction Time), has been used in similar studies to assess physical activity levels in PE classes. Trained research assistants will conduct the assessments on the same weeks that student data collection is occurring. Data will be collected by project staff throughout the intervention period to assess the extent of intervention adoption and implementation fidelity in intervention schools.

**SAMPLE SIZE**

Based on an estimate of 50% of Year 7 students consenting and providing usable accelerometer data, each school should yield at least 60 students (based on at least 120 Year 7 students). This will provide at least 300 students per group. Based on an estimated 65% of the cohort providing usable data at follow-up, there will be at least 195 students per group at 24-month follow-up. Previous studies have been used to estimate the standard deviation of mean daily minutes MVPA per group (17.1) and the Intra Class Correlation coefficient (ICC) (0.01). After adjustment for the design effect of 1.38, it is estimated the effective sample size will be at least 141 students per group. With this sample size, with 80% power and an alpha level of 0.05 the study will be able to detect a difference in the mean daily MVPA between experimental and control students of +/- 5.73 minutes at follow-up.

**STATISTICAL ANALYSIS – PRIMARY OUTCOME**

Analyses using cluster-level summaries are more robust than analyses based on individual-level data when there are less than 15 clusters per treatment arm. Therefore the primary outcome for this study will be analysed by calculating the change in the mean number of minutes of MVPA within each school and then comparing the school-level means of the intervention group with the school-level means of the control group using a two sample t-test.
The main analysis will be conducted with all available data using the intention to treat principle and sensitivity analyses conducted under various assumptions about the missing data mechanism. Per protocol analyses will also be performed where appropriate.

**DISCUSSION**

Despite a recent increase in school-based physical activity interventions, few have targeted adolescents living in socio-economically disadvantaged communities. To the research team’s knowledge, this is the first study targeting both boys and girls in socio-economically disadvantaged communities that has used a whole of school approach to physical activity promotion in this cohort and uses an objective physical activity measure. This approach combines strategies shown to be effective in increasing or maintaining physical activity for both boys and girls, and also for enhancing activity for students classified as low-active. The intervention also incorporates strategies known to facilitate intervention adoption, including the use of an in-school physical activity consultant to be placed in intervention schools for the intervention period. This support strategy is designed to overcome a number of barriers reported to inhibit school-based interventions such as providing adequate training and resources, enhancing communication, providing ongoing and regular support to teachers implementing the intervention and gaining leadership and support from the school executive, parents and the community. The study has also been designed with a longer follow-up period.
The study can contribute to the literature by identifying whether the intervention approach can increase physical activity or reduce the decline in physical activity among adolescents living in socio-economically disadvantaged communities.
REFERENCES


Marcus BH, Williams DM, Dubbert PM, Sallis JF, King AC, Yancey AK, et al. Physical activity intervention studies: what we know and what we need to know: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity); Council on Cardiovascular Disease in the Young; and the Interdisciplinary Working Group on Quality of Care and Outcomes Research. *Circulation.* 2006;114(24):2739-52.


Domitrovich CE. Maximizing the Implementation Quality of Evidence-Based Preventive Interventions in Schools: A Conceptual Framework. *Adv in School Mental Hlth Promotion Special Issue: Enhancing Implementation Quality* 2011;1(3).


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56 Connolly P MT. Effects of a games intervention on the physical activity levels of children at recess. Res Q Exerc Sport 2005;60(A60).


CHAPTER 4

‘PHYSICAL ACTIVITY 4 EVERYONE’ SCHOOL-BASED INTERVENTION TO PREVENT DECLINE IN ADOLESCENT PHYSICAL ACTIVITY LEVELS: 12-MONTH (MID-INTERVENTION) REPORT ON A CLUSTER RANDOMISED TRIAL.

A version of this chapter was published as a paper with British Journal of Sports Medicine

ABSTRACT

**Background:** Adolescence is a recognised period of physical activity decline, particularly among adolescents from socio-economically disadvantaged communities. We report the 12-month (mid-point) effects of a two-year multicomponent physical activity intervention implemented in socio-economically disadvantaged secondary schools.

**Methods:** A cluster randomised trial was undertaken in ten secondary schools located in socio-economically disadvantaged areas in New South Wales (NSW), Australia. Students in Grade 7 were recruited, with follow-up in Grade 8. The intervention was guided by socio-ecological theory and included seven physical activity strategies, and six implementation adoption strategies. The primary outcome was mean minutes of moderate-to-vigorous physical activity (MVPA) per day assessed using Actigraph GT3X accelerometers. Outcome data were analysed using repeated measures linear mixed models.

**Results:** At baseline, 1150 (93%) students participated in the data collection (mean age 12.0 years, 48% boys) and 1050 (79%) students participated at 12-month follow-up. By the 12-month follow-up, the six implementation adoption strategies had been used to support schools to deliver four of the seven physical activity elements. There was a significant group-by-time interaction for mean minutes of MVPA per day in favour of the intervention group (adjusted difference between groups at follow-up= 3.85 minutes, 95% CI [0.79 - 6.91], p ≤ 0.01), including significantly more vigorous physical activity (2.45 minutes, p ≤ 0.01), equating to 27 minutes more MVPA per week.

**Discussion:** At 12-month follow-up, the intervention had reduced the decline in physical activity among adolescents from socio-economically disadvantaged schools. The intervention may assist students to meet physical activity guidelines.
BACKGROUND

Participation in adequate physical activity has numerous physical and psychological health benefits.\(^1\) Despite this, the proportion of adolescents who are adequately active is consistently low, with as few as 20% meeting physical activity guidelines of 60 minutes MVPA per day.\(^2\) International data indicate a significant inverse association between physical activity and socio-economic status with adolescents from socio-economically disadvantaged backgrounds experiencing a steeper decline in physical activity.\(^3\)\(^4\) As physical inactivity tends to track into adulthood, reducing this decline is a public health priority.\(^5\)

Schools provide access to almost all adolescents over extended periods of time.\(^6\)\(^7\)\(^8\) Schools have qualified staff such as Health and Physical Education (PE) teachers, resources including sporting equipment and facilities, and a mandate to implement curriculum that promotes physical activity.\(^8\) Based on a number of systematic reviews\(^9\)\(^-\)\(^12\), there is evidence that school-based interventions are effective in increasing the proportion of students that are physically active, the length of time spent being active and student fitness levels.\(^9\)\(^10\)\(^13\)\(^14\) However, such evidence is primarily focused on children of elementary school age (5 - 12 years), with very few studies focusing on adolescents.\(^9\)

Systematic reviews of physical activity interventions for children and adolescents\(^9\)\(^-\)\(^12\), conclude interventions were more likely to be successful if they were multicomponent, longer in duration and based on theory.\(^9\)\(^10\) Such reviews recommended that future trials include the use of an objective measure of physical activity, measurement of total daily physical activity, use clear intervention implementation strategies, focus on socio-economically disadvantaged
CHAPTER 4: Physical Activity 4 Everyone’ school-based intervention to prevent decline in adolescent physical activity levels: 12-month (mid-intervention) report on a cluster randomised trial.

groups, focus on interventions targeting adolescents, have an intervention duration spanning greater than 12 months, and employ longer follow-up.9-11 15

Of the fourteen interventions targeting school-based physical activity in adolescents, only five studies have specifically targeted socio-economically disadvantaged secondary school students. Of these, three have tested single sex interventions, and the studies did not demonstrate a positive intervention effect on physical activity.16-18 The two remaining intervention trials both used an objective measure of physical activity and were able to demonstrate an intervention effect. However, both interventions were of short duration, 17 weeks 19 and 6 months respectively.20

Given the limited number of effective interventions targeting greater physical activity among adolescents from socio-economically disadvantaged backgrounds, the primary aim of this trial was to report on the 12-month, mid-intervention impact of a two-year multicomponent physical activity intervention implemented in socio-economically disadvantaged secondary schools which aimed to reduce the decline in physical activity associated with adolescence. Subgroup analyses for sex, baseline weight status and baseline activity level are also reported.

METHODS

STUDY DESIGN AND SETTING

The Physical Activity 4 Everyone (PA4E1) trial was a multicomponent school-based cluster randomised trial with study assessments conducted at baseline, 12- (mid-intervention) and 24-months. The trial was conducted in three local government areas (Hunter, Central Coast and Mid North Coast) in the state of NSW, Australia. The regions have lower average indices of
socio-economic status (SES) than the state.21 The trial was registered with the Australian New Zealand Clinical Trials Registry (ACTRN1261200038287) and approved by the Hunter New England Area Human Research Ethics Committee (11/03/16/4.0) (Appendix 4.1 - Ethical Approvals) and University of Newcastle Human Research Ethics Committee (H-2011-0210) (Appendix 4.1 - Ethical approvals). A trial protocol has been published elsewhere.22 The trial adheres to the Consolidated Standards of Reporting Trials (CONSORT) guidelines (http://www.consort-statement.org).

SAMPLE AND RECRUITMENT

SECONDARY SCHOOLS

The Socio-Economic Indexes For Areas (SEIFA) of relative socio-economic disadvantage were used to identify eligible secondary schools.21 The SEIFA (scale, 1=lowest to 10=highest) summarizes the characteristics of people and households within an area and is based on postcode. Secondary schools were considered eligible if they met the following criteria: Government and Catholic schools; schools with a SEIFA score of 5 or less (bottom 50% of NSW) [39]; between 120–200 Grade 7 students (to meet sample size requirements); and were not participating in other physical activity intervention studies. Recruitment of schools occurred from October to December 2011. An invitation to participate (Appendix 4.2 – School recruitment) was sent to the first ten randomly selected schools. Thirteen schools were approached to obtain a sample of ten schools.

STUDENTS

All students in Grade 7 (first year of secondary school) at participating schools were invited to take part via an information package sent to their parents (Appendix 4.3 – Parental information letter). Parental consent was obtained via returned consent form (Appendix 4.4 –
Parental consent form). If a consent form was not obtained, parents were contacted via telephone and asked to provide consent (Appendix 4.5 – Computer Assisted Telephone Interview script).

TEACHERS

All PE teachers at intervention schools were invited to complete a pen and paper survey. Consent was obtained via return survey.

RANDOMISATION AND ALLOCATION

Randomisation and allocation of schools to the intervention or control group occurred after baseline data collection. Using block randomisation (1:1 ratio), schools were allocated based on a random number function in Microsoft Excel. Schools were randomly allocated to receive either a multicomponent intervention that was implemented during school terms and commenced after baseline data collection in June 2012, or to a control group.

INTERVENTION AND COMPARISON

The 24-month PA4E1 intervention was designed as a multicomponent school-based program guided by social cognitive and social-ecological theories. The strategies implemented in the intervention addressed the domains of the World Health Organisation’s (WHO) Health Promoting Schools (HPS) framework targeting the curriculum, school environment and community.

The intervention comprised seven physical activity strategies to be implemented in a staged fashion over the intervention period (see Figure 4.1 for strategies and the standards set to be achieved for each). The strategies were: ‘Formal Curriculum’ – 1) teaching strategies to
maximize activity in PE lessons including pedometer based lessons (Appendix 4.6 – Sample teacher training/workshop slides), 2) development of individual student physical activity (PA) plans (Appendix 4.7 – Sample student PA plan), 3) enhanced school sport for all students (to be delivered in Grade 8) (Appendix 4.8 – Sample Program X training manual); ‘School Ethos and Environment’ – 4) school physical activity policies (Appendix 4.9 - Policy template), 5) offering physical activity in school breaks (lunch and recess); and ‘Partnerships and Services’ – 6) linking schools to community physical activity providers, 7) parent engagement (Appendix 4.10 - Sample parent newsletter). By 12-month follow-up, implementation duration within intervention schools ranged from two to three school terms (each term was 10 weeks in duration). Implementation of four of the seven physical activity strategies had commenced (strategies 1, 2, 5, 7 above).

Figure 4.1 summarises the physical activity strategies delivered, the adoption strategies used to facilitate their delivery and the desired standard and dose delivered within the first 12-months of the intervention period. In the first 12-month period, two curriculum based strategies commenced including teaching strategies to maximise activity in PE and the development of individualised student physical activity plans. To facilitate adoption, PE teachers were provided training on strategies to maximise physical activity in PE (Appendix 4.6), prompted by the change agent to teach pedometer based lessons and support students to complete personalized physical activity plans (Appendix 4.7), were given resources (such as templates and instructions for use) to support students in developing personal activity plans (Appendix 4.7), and given feedback on activity levels in PE based on SOFIT observations (Appendix 4.11 – Sample SOFIT feedback). One strategy targeting the school ethos and environment commenced within the first 12-month period. Offering physical activity in school
breaks (lunch and/or recess) commenced in each school twice per week. Schools were provided equipment, including a variety of balls, hoops and ropes in a secure locked box to facilitate the commencement of these activities (Appendix 4.12 – Equipment provided). The final strategy to commence within the first 12-month period focused on parent engagement, whereby hard copy newsletters (Appendix 4.10) and websites were used to provide parents with updates in the program being implemented at school plus articles about ways to support students to be active outside of school. To facilitate the adoption of these physical activity strategies, schools established committees to oversee the changes and were provided with feedback reports outlining the school’s progress towards program adoption at the end of each term (Appendix 4.13 – School feedback and monitoring report). Meetings were held with school executives, PE teachers and the school change agent to communicate the content of each feedback report.
### Physical Activity Strategies

<table>
<thead>
<tr>
<th>Component</th>
<th>Standard for schools to aim for</th>
<th>Intervention dose delivered from baseline to 12 month follow-up to intervention schools (project records)</th>
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</table>
| **Formal Curriculum**                  | - Teaching PE to maximise activity. 2 x pedometer based lessons per teacher each term to monitor student activity levels (4-6 in total). SOFIT™ feedback at each school after baseline and mid-point.  
- 1 x personal student PA plan developed and reviewed each school term (4 in total)  
- Program X (10 week program) delivered to all students  
- Activities offered and equipment available 2 x per week  
- School PA policy modified or developed  
- 1 x hard copy parent newsletter per school term focussed on physical activity (8 in total). Newsletters also placed on school websites.  
- 3 - 5 community links made – students made aware of community PA organisations | - 4-6 pedometer lessons per class  
- 2 - Personal PA plans developed per student  
- Not yet commenced (to run in Grade 8 - planning commenced)  
- 1 - 2x per week at each school (approx. 40 -60/ lunch activity sessions per school)  
- Not yet commenced *  
- 2-3 parent newsletters issued and on website  
- Not yet commenced |
| **School Ethos & Environment**         | - Program X (10 week program) delivered to all students                                                           |                                                                                                        |
| **Recess and Lunchtime activities**    | - Activities offered and equipment available 2 x per week                                                         |                                                                                                        |
| **Supportive school PA policy**        | - School PA policy modified or developed  
- 1 x hard copy parent newsletter per school term focussed on physical activity (8 in total). Newsletters also placed on school websites.  
- 3 - 5 community links made – students made aware of community PA organisations |                                                                                                        |
| **Community Links**                    | - Partnership agreement signed and school committee established. School executive membership represented on committee. |                                                                                                        |
| **Staff Development and Training (PE teachers)** | - Attends school 1 x day/ week to support implementation of the program **  
- 1 x PE teacher professional development training day (for staff at all intervention schools)  
- Physical Activity equipment pack provided to school (including non-traditional PA equipment such as gym sticks, Wii console and active games, boxing equipment and yoga DVD's)  
- Weekly personal email prompts from change agent to teachers, as reminder to conduct pedometer based lessons, support students to develop personal PA plans and to incorporate active teaching principles.  
- Report on strategy implementation delivered 1 x per term to Principal and Head PE teacher. SOFIT results report presented to PE staff and Head PE teacher. | - Agreement signed. Committee formed in all schools. Committee met 1 x per term (maximum 2 - 3 meetings)  
- 20 -30 days per school  
- 1 x 2 hour session (focus on active PE teaching) – at least one staff member from each school attended (range 1-4 per school)  
- Delivered to schools. Storage box provided to support student access to equipment  
- 20-30 prompts per teacher  
- 2-3 reports per school |
| **Linking with parents**               |                                                                                                                     |                                                                                                        |
| **Linking with the community**         |                                                                                                                     |                                                                                                        |

**FIGURE 4.1: Intervention delivery baseline to 12-month follow-up**
CHAPTER 4: Physical Activity 4 Everyone’s school-based intervention to prevent decline in adolescent physical activity levels: 12-month (mid-intervention) report on a cluster randomised trial.

COMPARISON

Schools allocated to the control group participated in the measurement components of the trial only. They were asked to continue with their usual physical activity practices including timetabled PE lessons, school sport, breaks for recess and lunch and any scheduled professional development for teachers.

DATA COLLECTION PROCEDURES AND MEASURES

Data collection was undertaken by trained research assistants, blinded to group allocation (Appendix 4.14 - Data collection protocol). Baseline data were collected from March – June 2012, and 12-month follow-up data (mid-intervention) data collected from the same cohort of students 12-months later in March – June 2013. The average duration between baseline and follow-up measurements for all schools was 12-months.

OUTCOME MEASURES: PHYSICAL ACTIVITY LEVELS

Physical activity was measured using accelerometers (Actigraph GT3X+ and GT3X models). Mean minutes of MVPA per day was the primary outcome. Additional outcome measures included: 1) percentage of time spent in MVPA per day (calculated to adjust for individual wear time), 2) mean minutes per day, and percentage wear time for moderate physical activity, 3) mean minutes per day and percentage of wear time in vigorous physical activity, and 4) accelerometer counts per minute (CPM). Counts were collected in 15 second epochs and counts per minute calculated by dividing the total counts per day by the minutes of wear time. The proportion of students meeting physical activity guidelines of 60 minutes of MVPA per day has also been reported.
Accelerometers and instructions for use were distributed to students within class time (Appendix 4.15 – Accelerometer instructions for students) when students also completed an online survey and had anthropometric measures taken (Appendix 4.16 – Student survey). Students were requested to wear the accelerometer over the right hip during waking hours for seven consecutive days. Student and parent mobile numbers were collected via the consent form and used to text daily reminders to wear the accelerometer. Student data were included in the analysis if the accelerometer was worn for $\geq 600$ minutes on $\geq$ three days. Non-wear time was defined as 30 minutes of consecutive zeros. The Evenson cut-points were used to categorize different intensities of physical activity.

ANTHROPOMETRIC DATA
Student anthropometric data including height, weight (used to calculate body mass index (BMI) and waist circumference was collected in duplicate using the International Society for the Advancement of Kinanthropometry (ISAK) procedures. Weight was measured in light clothing without shoes using a portable digital scale (Model no. UC-321PC, A&D Company Ltd, Tokyo Japan) to the nearest 0.1 kg. Height was recorded to the nearest 0.1 cm using a portable stadiometer (Model no. PE087, Mentone Educational Centre, Australia). Weight status (BMI) was determined using International Obesity Taskforce definitions. Waist measurement was taken at the narrowest point between the inferior rib border and the iliac crest, using a flexible but inelastic tape measure. Waist circumference was recorded to the nearest 0.1cm.

STUDENT CHARACTERISTICS
Students completed an online survey that assessed student socio-demographic characteristics including age, sex, Aboriginal or Torres Strait Islander status and postcode of residence.
(Appendix 4.16). The online survey also included other measures that were not included in the current chapter (e.g. physical activity mediators).

**PROCESS MEASURES**

A process evaluation was conducted to determine if the intervention was delivered (fidelity) and received (reach) as intended. At 12-month follow-up, PE teachers completed a pen and paper survey (Appendix 4.17 – Teacher survey) that assessed intervention fidelity by asking about delivery of three physical activity strategies; implementing pedometer based PE lessons and termly student physical activity plans with their classes, and whether the school offered recess and/or lunch activities. The in-school physical activity consultant also retained records of intervention implementation at each school. These records were used to determine if program strategies were implemented to the desired standard outlined in Figure 4.1. This included records of lessons in which pedometers had been used, personal PA plans developed by students, recess and/or lunch physical activities run at each school, and information in newsletters. Students in the intervention group completed online survey items at 12-month follow-up that aimed to assess the reach of three intervention strategies: pedometer based PE lessons, termly physical activity plans and availability of recess and/or lunch activities. The in-school physical activity consultant also kept records of the adoption strategies implemented by schools including committee meetings held, teacher training attendance, equipment/resources received by schools and prompts sent to teachers.

**SAMPLE SIZE**

Based on an estimate of 120 students per school and 50% of Grade 7 students consenting, it was estimated each school should yield at least 60 students, providing at least 300 students per group. Based on 65% of the cohort providing usable data at 24-months follow-up, it
was estimated that there would be at least 195 students per group at follow-up. Previous studies were used to estimate the standard deviation of mean daily minutes MVPA per group (17.1) and the intra-class correlation coefficient (ICC) (0.01). After adjustment for the design effect of 1.38, the effective sample size was estimated to be at least 141 students per group. With this sample size, 80% power and an alpha level of 0.05, the study was able to detect a difference in the mean daily MVPA between intervention and control students of +/- 5.73 minutes at follow-up.

STATISTICAL ANALYSIS
All analyses were conducted using SAS Version 9.2 (SAS Institute Inc., Cary, NC, USA). Summary statistics were created for the variables of interest (student sex, age, Aboriginality, height, weight, BMI, activity level, SES) and accelerometer wear time. T-tests were used to determine if students who provided data at 12-months follow-up differed to those that only provided baseline data on the following characteristics - sex, baseline age, weight status and physical activity level. Significance levels were set at \( p \leq 0.05 \).

PHYSICAL ACTIVITY CHANGE
Analyses followed intention-to-treat principles. Analysis of the primary outcome (minutes of MVPA/ day), and of the additional physical activity outcome variables (% of wear time spent in MVPA/ day; mean minutes and % wear time in moderate physical activity and vigorous physical activity and accelerometer CPM) were facilitated through a linear mixed model (LMM). The analytic approach based on LMM was used instead of the approach specified in the study protocol paper (comparisons of school-level mean changes in intervention and control groups via t-tests) as the preferred statistical model, as LMM are robust to the biases of missing data. A three level hierarchical model was used to capture the correlations in the
data with random intercepts for repeated measures (level-1) on individuals (level-2) and clustering within schools (level-3). LMM analysis was used to determine whether the change in physical activity between intervention and control groups differed significantly after 12-months, assessed through an interaction term between group (intervention vs control) and time (baseline vs follow-up). The data were analysed assuming data were ‘missing at random’.

Descriptive statistics were used to describe the proportion of students in each group meeting the physical activity guidelines of 60 minutes MVPA per day.

**SUB GROUPS ANALYSES**

Sex, baseline weight status and baseline activity level were the variables chosen *a priori* as they are common moderators of energy balance interventions. Students’ baseline BMI was categorized into two groups: ‘underweight/ healthy weight’ and ‘overweight/ obese’ based on the Cole cut-points. Baseline student activity level was categorized as those who obtained 60 minutes or more of MVPA per day (meeting the guidelines), and those with less than 60 minutes of MVPA each day (not meeting the guidelines). We included moderator interaction terms in the above LMM separately for all potential moderators and presented the results by mediator sub-group if the test for three-way interaction term (group*time*moderator) was significant at the liberal 20% threshold.

**PROCESS MEASURES**

Chi square analyses were used to assess whether student responses to process variables differed by student subgroups of sex, baseline physical activity level and baseline weight status (p = 0.05).
RESULTS

SAMPLE

Ten schools were recruited to the study, which included four Government and one Catholic secondary school in the intervention group and control group. Thirty three PE teachers (100%) in intervention schools completed the pen and paper survey. Parental consent was received from 1233 of the 1468 (84%) Grade 7 students. Figure 4.2 outlines the flow of participants from recruitment to 12-month follow-up.
CHAPTER 4: Physical Activity 4 Everyone’s school-based intervention to prevent decline in adolescent physical activity levels: 12-month (mid-intervention) report on a cluster randomised trial.

Assessed for eligibility
No. of Secondary schools = 22

Excluded:
No. of secondary Schools = 0

Contacted – 13 schools
Consented – 10 schools
Student population (Enrolled) - 1641 (Female 820, Male 816, missing 5)
Unable to contact or ineligible - 173 (Female 69, Male 100, missing 4)
Ineligible after consent - 28 (Female 7, Male 19)
Eligible students – 1468 (Female 751, Male 716, missing 1)

Baseline data collection
Grade 7 Term 1-2, 2012
Secondary schools (N = 10) 100%
Student consent to 1 or more measures - 1246
Refused or absent = 27

<table>
<thead>
<tr>
<th>Measures</th>
<th>Total (%)</th>
<th>Female (%)</th>
<th>Male (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consent</td>
<td>Completion</td>
<td>Valid accel files</td>
</tr>
<tr>
<td>Accelerometry</td>
<td>1233 (84%)</td>
<td>1150 (78%)</td>
<td>965 (66%)</td>
</tr>
</tbody>
</table>

Allocated to intervention
No. Schools = 5
No. Health and Physical Education Staff = 26
No. Students = 837 (Female 432 (52%), Male 405 (48%))

Group allocation
Grade 7 Term 2, 2012

Allocated to control
No. Schools = 5
No. Health and Physical Education Staff = 16
No. Students = 631 (Female 319 (51%), Male 311 (49%), gender missing=1)

Participation in data collection
No. Schools = 5
No. Health and Physical Education Staff = 33
No. Students Participated at mid-point: 591
Participated at MP with 3vld days at BL: 467

12 month follow-up Mid-point data collection
Grade 8 Term 1-2, 2013

Participation in data collection
No. Schools = 5
No. Health and Physical Education Staff = 28
No. Students Participated at MP: 459
Participated at MP with 3vld days at BL: 387

FIGURE 4.2: CONSORT flowchart describing progress of participants from recruitment to 12-month
Baseline characteristics of the 1150 students who wore an accelerometer (93% of those with parental consent) are outlined in Table 4.1.

### TABLE 4.1: PA4E1 sample characteristics at baseline

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number/ Total Participants</td>
<td>645</td>
<td>505</td>
</tr>
<tr>
<td>Boys *</td>
<td>290</td>
<td>239</td>
</tr>
<tr>
<td>Girls *</td>
<td>317</td>
<td>254</td>
</tr>
<tr>
<td>3 valid days</td>
<td>524</td>
<td>435</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>12.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Aboriginal and/ or Torres Strait Islander (%)</td>
<td>5.3</td>
<td>7.8</td>
</tr>
<tr>
<td>Height, (mean cm)</td>
<td>157.1</td>
<td>156.8</td>
</tr>
<tr>
<td>Weight, (mean kg)</td>
<td>49.3</td>
<td>50.0</td>
</tr>
<tr>
<td>Student BMI Category, (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight/ Healthy Weight – all students</td>
<td>77.5%</td>
<td>74.0%</td>
</tr>
<tr>
<td>- Boys</td>
<td>78.3%</td>
<td>74.4%</td>
</tr>
<tr>
<td>- Girls</td>
<td>77.2%</td>
<td>73.7%</td>
</tr>
<tr>
<td>Overweight/ Obese – all students</td>
<td>21.8%</td>
<td>26.0%</td>
</tr>
<tr>
<td>- Boys</td>
<td>21.9%</td>
<td>24.4%</td>
</tr>
<tr>
<td>- Girls</td>
<td>22.9%</td>
<td>26.9%</td>
</tr>
<tr>
<td>Student activity level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active (≥60 min MVPA/ day) – all students</td>
<td>33%</td>
<td>33%</td>
</tr>
<tr>
<td>- Boys</td>
<td>50%</td>
<td>42%</td>
</tr>
<tr>
<td>- Girls</td>
<td>48%</td>
<td>40%</td>
</tr>
<tr>
<td>Low active (&lt; 60 min MVPA/ day) – all students</td>
<td>67%</td>
<td>67%</td>
</tr>
<tr>
<td>- Boys</td>
<td>50%</td>
<td>58%</td>
</tr>
<tr>
<td>- Girls</td>
<td>52%</td>
<td>60%</td>
</tr>
<tr>
<td>Socio-economic status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low SES</td>
<td>57.8%</td>
<td>61%</td>
</tr>
<tr>
<td>Accelerometer wear time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean minutes per day</td>
<td>793.6</td>
<td>804.6</td>
</tr>
</tbody>
</table>

*Note: does not add to total students (n= 645) due to 38 students having gender missing.

At baseline, 78% of those students who wore an accelerometer provided at least three days of valid accelerometer data (965/1150). At 12-month follow-up, 1050 students wore an accelerometer and 61% of these students provided at least three days of valid accelerometer data (643/1050). We found baseline weight and age were predictive of drop out at 12 months,
with higher BMI and younger students more likely to drop out (p = ≤0.001 and p = ≤0.001 respectively). A sensitivity analysis was conducted on the main outcome, adjusting for baseline weight and age, with minimal difference in the result detected, therefore unadjusted results are presented.

**PHYSICAL ACTIVITY OUTCOMES**

Physical activity outcomes from baseline to 12-month follow-up are presented in Table 4.2. At 12-month follow-up, students in the intervention group participated in statistically significantly more minutes per day of MVPA than students in the control group (adjusted difference = 3.85 mins [0.79 - 6.91], p = 0.01).

The intervention group spent significantly more time in vigorous activity each day (adjusted difference = 2.45 min [0.90 - 4.00], p = ≤0.01), but not moderate physical activity. The percentage of time spent in MVPA (0.5% [0.11 - 0.90]) and vigorous activity (0.3%) [0.12 - 0.52]) also differed significantly between groups at 12-month follow-up (p = 0.01 and p = ≤0.01, respectively) in favour of the intervention group. Mean accelerometer counts per minute (CPM) was significantly different between groups at 12-month follow-up in favour of the intervention group (31.02 CPM, [9.05 - 53.00], p = 0.01). The proportion of students meeting the physical activity guidelines were 33% at baseline and 34% at 12-month follow-up in the intervention group and 34% at baseline and 28% at 12-month follow-up in the control group.
# TABLE 4.2: Changes in physical activity from baseline to 12-month follow-up (Minutes MVPA, % wear time in MVPA)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention</th>
<th>Control</th>
<th>Intervention-Control</th>
<th>Adjusted difference between treatment group (95% CI)</th>
<th>Group x time p-val</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BASELINE (n=524)</td>
<td>MIDPOINT (n=352)</td>
<td>P</td>
<td>BASELINE (n=435) MIDPOINT (n=288) P</td>
<td></td>
</tr>
<tr>
<td>Minutes of Physical activity (mean min/ day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total MVPA</td>
<td>53.3</td>
<td>54.2</td>
<td>0.55</td>
<td>53.6</td>
<td>50.8</td>
</tr>
<tr>
<td>Vigorous activity</td>
<td>16.6</td>
<td>18.0</td>
<td>0.07</td>
<td>16.9</td>
<td>16.2</td>
</tr>
<tr>
<td>Moderate activity</td>
<td>36.7</td>
<td>36.2</td>
<td>0.52</td>
<td>36.7</td>
<td>34.6</td>
</tr>
<tr>
<td>Counts per minute</td>
<td>482.2</td>
<td>476.2</td>
<td>0.58</td>
<td>486.1</td>
<td>452.3</td>
</tr>
<tr>
<td>% wear time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage MVPA</td>
<td>6.7</td>
<td>6.9</td>
<td>0.44</td>
<td>6.7</td>
<td>6.4</td>
</tr>
<tr>
<td>Percentage Vigorous</td>
<td>2.1</td>
<td>2.3</td>
<td><strong>0.05</strong></td>
<td>2.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Percentage Moderate</td>
<td>4.6</td>
<td>4.6</td>
<td>0.70</td>
<td>4.6</td>
<td>4.4</td>
</tr>
</tbody>
</table>

*Note: Significant p-values are indicated in bold.*
CHAPTER 4: Physical Activity 4 Everyone’s school-based intervention to prevent decline in adolescent physical activity levels: 12-month (mid-intervention) report on a cluster randomised trial.

CHANGES IN PHYSICAL ACTIVITY FROM BASELINE TO FOLLOW-UP ACROSS SUBGROUPS (SEX, BASELINE WEIGHT STATUS AND BASELINE ACTIVITY LEVEL)

The subgroup interaction term indicated time by intervention effects that differed by subgroup for each variable: sex (p ≤0.01), baseline weight status (p = ≤0.01) and baseline physical activity status (p = ≤0.01), therefore subgroup analyses were progressed for each. The 12-month physical activity analyses by subgroup are reported in Table 4.3. A greater effect was observed in male students in the intervention group compared with the control group on mean minutes of MVPA per day (6.47 minutes (1.24 - 12.95), p = 0.02) and percentage of wear time spent in MVPA (0.9%, p = 0.02). No significant differences between groups for females were observed at 12-month follow-up. There were no detected differences between intervention and control based on weight status or baseline activity level.
TABLE 4.3: Changes in physical activity from baseline to follow-up (12 months) by subgroup (gender, weight status at baseline and activity level at baseline) (Mean minutes of MVPA per day, % wear time in MVPA)

<table>
<thead>
<tr>
<th>Subgroups</th>
<th>Outcome</th>
<th>Intervention</th>
<th>Control</th>
<th>Intervention-Control</th>
<th>Group x time p-val</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BASELINE</td>
<td>MIDPOINT</td>
<td>BASELINE</td>
<td>Adjusted difference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(n=524)</td>
<td>(n=352)</td>
<td>(n=435)</td>
<td>between treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P</td>
<td></td>
<td>MIDPOINT</td>
<td>group (95% CI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(n=288)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>MVPA (min per day)</td>
<td>62.7 (22.54)</td>
<td>66.3 (27.19)</td>
<td>0.17</td>
<td>6.47 (-1.84,14.78)</td>
</tr>
<tr>
<td></td>
<td>% wear time in MVPA</td>
<td>8.0 (2.89)</td>
<td>8.5 (3.72)</td>
<td>0.19</td>
<td>6.61 (-3.13,16.35)</td>
</tr>
<tr>
<td>Females</td>
<td>MVPA (min per day)</td>
<td>46.6 (16.45)</td>
<td>45.7 (15.50)</td>
<td>0.55</td>
<td>-0.94 (-5.62,3.74)</td>
</tr>
<tr>
<td></td>
<td>% wear time in MVPA</td>
<td>5.8 (2.06)</td>
<td>5.8 (1.98)</td>
<td>0.74</td>
<td>-0.06 (-0.55,0.42)</td>
</tr>
<tr>
<td>Weight status at baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight / Healthy Weight</td>
<td>MVPA (min per day)</td>
<td>54.9 (21.83)</td>
<td>54.9 (21.98)</td>
<td>0.98</td>
<td>1.82 (-4.22,7.87)</td>
</tr>
<tr>
<td></td>
<td>% wear time in MVPA</td>
<td>6.9 (2.84)</td>
<td>6.9 (2.89)</td>
<td>0.95</td>
<td>0.28 (-0.39,0.95)</td>
</tr>
<tr>
<td>Overweight/Obese</td>
<td>MVPA (min per day)</td>
<td>49.8 (17.82)</td>
<td>50.3 (21.23)</td>
<td>0.88</td>
<td>1.74 (-5.80,9.29)</td>
</tr>
<tr>
<td></td>
<td>% wear time in MVPA</td>
<td>6.2 (2.07)</td>
<td>6.4 (2.79)</td>
<td>0.63</td>
<td>0.28 (-0.57,1.12)</td>
</tr>
<tr>
<td>Activity level at baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td>MVPA (min per day)</td>
<td>76.9 (16.70)</td>
<td>78.7 (21.06)</td>
<td>0.43</td>
<td>4.54 (-1.22,10.30)</td>
</tr>
<tr>
<td></td>
<td>% wear time in MVPA</td>
<td>9.6 (2.31)</td>
<td>10.1 (2.97)</td>
<td>0.16</td>
<td>0.64 (-0.15,1.44)</td>
</tr>
<tr>
<td>Inactive</td>
<td>MVPA (min per day)</td>
<td>41.9 (10.80)</td>
<td>41.7 (11.50)</td>
<td>0.77</td>
<td>-0.21 (-2.42,1.99)</td>
</tr>
<tr>
<td></td>
<td>% wear time in MVPA</td>
<td>5.4 (1.44)</td>
<td>5.3 (1.54)</td>
<td>0.53</td>
<td>-0.04 (-0.34,0.26)</td>
</tr>
</tbody>
</table>
PROCESS MEASURES

Table 4.4. outlines process evaluation data collected from teachers and students at 12-month follow-up. At 12-month follow-up, 95.5% of teachers reported using pedometers to increase activity levels in PE, 70.3% reported incorporating student personal physical activity plans each term and providing feedback to students on these plans, and 75.0% reported the school offered organized physical activity at recess and/or lunchtimes at least twice per week.

The in-school physical activity consultant records showed that all schools had commenced use of the pedometers in PE classes, with four of the five schools (80%) using them with the desired frequency (Figure 1). Similarly, while all schools had administered student physical activity plans at least once, three (60%) had administered to the desired termly standard (2 or 3 per student). All schools had implemented recess and/or lunch activities at least once per week, and four (80%) had implemented at least twice per week. All schools had provided parents with additional information regarding physical activity via newsletters and the school website with the requested termly frequency.

At 12-month follow-up, 92.7% of students reported being offered pedometer based PE lessons at least twice per term, 51.6% reported completing a personal physical activity plan at least once and 55.8% reported that the school offered organized physical activity at recess and/or lunch. When the results were compared for male and female students, and for students grouped according to baseline weight and physical activity status, the only statistically significant difference was that male students were more likely than female students to report
that the school offered recess and/or lunch physical activities (61.5% vs 50.9% \( p = 0.03 \)) (Table 4.4).

The adoption strategies outlined in Figure 1 were being used consistently with all intervention schools. All schools had formed committees to oversee the implementation of physical activity strategies and had at least two to three- meetings, the school change agent attended each school for one day per week and all schools had at least one staff member attend professional development (range 1-4 staff). The in-school physical activity consultant sent weekly prompts to PE teachers encouraging pedometer based PE lessons and completion of student physical activity plans. A range of equipment to facilitate recess and/or lunch activities and a storage box were delivered to each school, and feedback reports outlining progress against each strategy were delivered and discussed with school executives and the Head PE teacher at the end of each school term.
# TABLE 4.4: Intervention fidelity and reach at 12-months follow-up

<table>
<thead>
<tr>
<th>Process measure category</th>
<th>Formal Curriculum</th>
<th>School Ethos &amp; Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Active PE lessons</td>
<td>Recess and lunchtime activity</td>
</tr>
<tr>
<td></td>
<td>Personal physical activity plans</td>
<td></td>
</tr>
</tbody>
</table>

Fidelity (Teacher report n= 33)

|                          | 95.5%* | 70.3%# | 75.0%∧ |

Reach (Student report n = 600)

- All students
  - 92.7%∞
  - 51.6%>  
  - 55.8%<

- **Student Sex**
  - Female students
    - 93.2%
    - 49.6%
    - 50.9%*
  - Male students
    - 95.0%
    - 54.0%
    - 61.5%*

- **Student activity level**
  - Active students
    - 96.3%
    - 56.8%
    - 59.9%
  - Inactive students
    - 93.6%
    - 47.8%
    - 52.6%

- **Student weight status**
  - Healthy weight students
    - 95.3%
    - 50.3%
    - 55.5%
  - Overweight/ Obese students
    - 94.4%
    - 52.8%
    - 56.2%

*Teacher reports conducting pedometer based lessons
* Teacher reports assisting student complete a personal PA plan each school term
∧ school reports running recess and/or lunch activities
∞ Students recall using pedometers in PE
> Students recall completing personal physical activity plans
< Students recall having organized recess and/or lunchtime physical activities available
DISCUSSION

We report the 12-month mid-intervention findings from a trial of a multicomponent physical activity intervention implemented in socio-economically disadvantaged secondary schools. At 12-month follow-up, students attending intervention schools participated in nearly four minutes more MVPA per day than control group students. To some readers, this may not sound like a clinically meaningful difference. However, it represents 27 minutes more of MVPA over the course of a week.

SMALL, BUT CLINICALLY SIGNIFICANT EFFECT AT ONE YEAR

Research in children and adolescents has identified a dose response relationship between the total volume of MVPA and a reduction in cardio-metabolic risk, any increase in MVPA has public health benefit.47 Students in the intervention group participated in significantly more vigorous activity and spent a greater proportion of time in MVPA and vigorous activity each day. This magnitude of change in physical activity, particularly the increase in vigorous activity, we suggested is clinically meaningful, and may facilitate the prevention of chronic disease, such as type 2 diabetes and obesity.48-50

The results displayed at 12-months extend the results described in a meta-analysis of physical activity interventions in children and adolescents51, however most interventions focus on children, and few on adolescents. As a result, the effect size seems larger than other school-based interventions targeting adolescents. Of the interventions targeting adolescents that have been effective19 52-55, two studies published mid-intervention findings, both of which showed no significant intervention effect.54 56 Other school-based interventions targeting adolescents demonstrated positive post-intervention findings in favour of the intervention
group with effect sizes ranging from 1.9 minutes of MVPA per day after two years of intervention in the TAAG study\textsuperscript{54}, 3.5 minutes MVPA per day for males only in 2-year study by Haerens et al\textsuperscript{56} and 50 accelerometer counts per minute after the 20 month Health in Adolescence study (HEIA)\textsuperscript{56}.

More recently, three interventions\textsuperscript{16-18} have specifically targeted adolescents from lower socio-economic backgrounds, however none have shown a significant intervention effect on MVPA. Given the challenges with conducting intervention research targeting socio-economically disadvantaged adolescents and schools, a positive mid-intervention effect demonstrates potential to intervene with this target group.

**INNOVATIONS IN THIS TRIAL**

The PA4E1 trial differed from previous trials as it focused on students attending schools located in disadvantaged areas, targeted the whole school community whilst incorporating strategies to engage low-active students. In addition, the PA4E1 trial was longer in duration, and included an in-school physical activity consultant within a set of clear adoption strategies. Including explicit implementation strategies, as recommended in systematic reviews\textsuperscript{15,57}, may explain our positive findings.

In particular, the in-school physical activity consultant, someone located within the schools one day per week to support schools in implementing the physical activity strategies (not to deliver them) is novel. Schools often report time and demanding workloads as barriers to implementing intervention strategies.\textsuperscript{58-60} The addition of an in-school physical activity consultant aims to overcome these barriers and maximize intervention reach and
fidelity. The addition of a further three physical activity strategies to the PA4E1 trial in the second phase of intervention, may enhance the likelihood of sustained success. Systematic reviews have concluded that study duration, study size and positive mid-intervention results are associated with a significant intervention effect at follow-up.\textsuperscript{51}

**LIMITATIONS**

As subgroup analyses were exploratory due to limited power, results should be seen as suggestive and interpreted with caution. At 12-month follow-up, the results were only statistically significant for boys – the intervention appeared to be effective for male students, but there was no significant effect was among females. These results are in contrast to a systematic review by Yildirim\textsuperscript{45}, finding girls responded better to interventions than boys. If our mid-point assessment holds true, it would have health implications as female students participate in less MVPA per day, are less likely to achieve the daily physical activity guidelines and reduce their activity throughout adolescence at a faster rate.\textsuperscript{61}

Although program records showed that recess and lunch activities were offered in all intervention schools, girls were less likely to report that their school offered organized recess and lunchtime physical activities compared to boys, and that a substantial proportion of both sexes were not aware of the activities. As physical activity during recess and lunch has been reported to contribute as much as 40% towards daily physical activity recommendations\textsuperscript{62}, the introduction of recess and lunchtime activities that are more evident to students, especially those that appeal to girls, seems an important consideration for future research. However, our mid-intervention results may also indicate girls take longer to respond to interventions than boys.
CHAPTER 4: Physical Activity Everyone’s school-based intervention to prevent decline in adolescent physical activity levels: 12-month (mid-intervention) report on a cluster randomised trial.

STRENGTHS

The strengths of this trial include the group randomised controlled design, use of an objective measure of physical activity, the focus on socio-economically disadvantaged populations and the multicomponent socio-ecological design. However, there are limitations. Obtaining valid accelerometer data in this age group was challenging as has been discussed elsewhere.

Although a high proportion of students who participated in baseline also participated at mid-point (84%), only 61% of the baseline sample provided at least three days of valid data at 12-months. This decrease however, seems consistent with other studies with this target group.

Lubans et al found, although 79% to 85% of the baseline sample was retained after 12-months, only 53.5% of the sample of disadvantaged girls provided three or more days of valid accelerometer data. Similarly, only 64% of students in the Health In Adolescents (HEIA) study in Norway provided useable accelerometer data at 20-months post intervention. Although accelerometers are considered the optimal method for measuring physical activity, compliance to protocols amongst students, particularly disadvantaged students, has been documented as a challenge. The trial did not assess maturation status, which is known to impact on physical activity levels of adolescents.

In summary, the mid-intervention effects of the PA4E1 trial demonstrate the potential to implement a multicomponent school-based intervention in socio-economically disadvantaged secondary schools. We will report 24-month follow-up as that is the primary outcome of the trial.
REFERENCES


CHAPTER 4: Physical Activity 4 Everyone’ school-based intervention to prevent decline in adolescent physical activity levels: 12- month (mid-intervention) report on a cluster randomised trial.


CHAPTER 4: Physical Activity 4 Everyone’ school-based intervention to prevent decline in adolescent physical activity levels: 12- month (mid-intervention) report on a cluster randomised trial.


CHAPTER 5

THE PHYSICAL ACTIVITY 4 EVERYONE CLUSTER RANDOMIZED TRIAL:
2-YEAR OUTCOMES OF A SCHOOL PHYSICAL ACTIVITY INTERVENTION AMONG ADOLESCENTS.

A version of this chapter was published as a paper with the American Journal of Preventive Medicine.

CHAPTER 5: The Physical Activity 4 Everyone cluster randomized trial: 2-year outcomes of a school physical activity intervention among adolescents

ABSTRACT

Background: Few interventions have been successful in reducing the physical activity decline typically observed among adolescents. The aim of this paper is to report the 24-month effectiveness of a multicomponent school-based intervention (Physical Activity 4 Everyone (PA4E)) in reducing the decline in moderate-to-vigorous physical activity (MVPA) among secondary school students in socio-economically disadvantaged areas of New South Wales (NSW), Australia.

Study design: A cluster Randomised Controlled Trial (RCT) was conducted in five intervention and five control schools with follow-up measures taken at 24-months post-randomisation.

Setting/sample: The trial was undertaken within secondary schools located in socio-economically disadvantaged communities in NSW, Australia.

Intervention: A multicomponent school-based intervention based on the Health Promoting Schools (HPS) Framework was implemented. The intervention consisted of seven physical activity promotion strategies that targeted: the curriculum (teaching strategies to increase physical activity in physical education lessons, student physical activity plans, and modification of the school sports program); school environment (recess/lunchtime activities, school physical activity policy); parents and community (parent newsletters and community physical activity promotion). Six additional strategies supported school implementation of the physical activity intervention strategies.

Main outcome measure: Mean minutes per day spent in MVPA, objectively measured by accelerometer.

Results: Participants (n=1,150, 49% male) were a cohort of students aged 12 years (Grade 7) at baseline (March–June 2012) and 14 years (Grade 9) at follow-up (March–July 2014). At 24-month follow-up, there were significant effects in favour of the intervention group for daily minutes of MVPA. The adjusted mean difference in change in daily MVPA between groups was 7.0 minutes (p<0.002, 95% CI [2.7, 11.4]) (analysis conducted December 2014–February 2015). Sensitivity analyses based on multiple imputation were consistent with the main analysis (6.0 minutes, p<0.031, 95% CI [0.6, 11.3]).

Conclusions: The intervention was effective in increasing adolescents’ minutes of MVPA, suggesting that implementation of the intervention by socio-economically disadvantaged schools has the potential to slow the decline in physical activity.

Trial registration: Australian New Zealand Clinical Trials Registry ACTRN12612000382875.
BACKGROUND

Adequate physical activity reduces the risk of a range of non-communicable diseases.\(^1\)\(^,\)\(^2\) Despite this, only 20% of adolescents accumulate the necessary amount to meet the recommended 60 minutes of MVPA per day.\(^2\) Physical activity declines by 7% per year during adolescence,\(^3\) and the decline is higher among those from socio-economically disadvantaged backgrounds.\(^4\) However, few interventions have targeted this high-risk group.\(^5\)\(^,\)\(^6\)

Comprehensive school-based physical activity interventions have been endorsed by health and education authorities as a strategy for promoting physical activity.\(^7\)\(^-\)\(^10\) Systematic reviews of studies in schools indicate that physical activity interventions are effective in increasing the proportion of students meeting physical activity guidelines,\(^11\) increasing physical activity duration,\(^5\)\(^,\)\(^11\)\(^,\)\(^12\) and improving fitness and fundamental movement skills.\(^11\)\(^-\)\(^14\)

In the most recent Cochrane systematic review of school-based physical activity interventions,\(^11\) only 14 of 44 targeted secondary schools. Two of these targeted schools in socio-economically disadvantaged areas,\(^15\)\(^,\)\(^16\) with one showing an intervention effect.\(^15\) A further three trials published since, targeted either socio-economically disadvantaged girls only\(^17\)\(^,\)\(^18\) or socio-economically disadvantaged boys only.\(^19\) However, none resulted in significant intervention effects for physical activity.\(^12\)

Given the limited evidence, a trial was undertaken to determine whether a multicomponent physical activity intervention implemented in secondary schools in socio-economically disadvantaged communities (Physical Activity 4 Everyone (PA4E1)) was effective in reducing
the decline in MVPA among students. As previously reported, mid-intervention results were promising, with significant effects in favour of the intervention group for daily minutes of MVPA (adjusted mean difference in change between groups, 3.9 minutes; \( p < 0.01, 95\% \text{CI [0.79-6.91]} \)).\(^{20}\) This paper reports the 24-month effectiveness of the PA4E1 intervention in reducing the decline in MVPA among secondary school students in socio-economically disadvantaged areas. The secondary aim is to explore the impact of the intervention on five additional MVPA-based measures.

**METHODS**

**STUDY DESIGN AND SETTING**

A cluster RCT was conducted with secondary schools (five intervention, five control) in socio-economically disadvantaged communities. Outcome assessments were conducted with a cohort of students at baseline (Grade 7), 12-months (mid-intervention), and 24-months post-randomisation follow-up (Grade 8). The primary outcome was objectively measured daily minutes of MVPA. Details of the trial methods have been reported.\(^{21}\) The trial was registered with the Australian New Zealand Clinical Trials Registry (ACTRN1261200038287) and approved by the Hunter New England Human Research Ethics Committee (11/03/16/4.0) and the University of Newcastle Human Research Ethics Committee (H-2011-0210). The study adheres to the CONSORT guidelines and extension for cluster trials guidelines (www.consort-statement.org).

**SAMPLE, RECRUITMENT AND RANDOMISATION**

Schools were considered eligible for inclusion if they met the following criteria: were Government or Catholic schools; had a socio-economic status (SES) score of \( \leq 5 \) (lower 50% of
CHAPTER 5: The Physical Activity 4 Everyone cluster randomized trial: 2-year outcomes of a school physical activity intervention among adolescents

NSW) based on postcode; had at least 120 Grade 7 students; and were not participating in other physical activity intervention studies. Recruitment and consent of schools occurred from October to December 2011, via face-to-face meetings with the school Principal. Opt-in parental consent was required. A list of eligible schools was created from which schools were randomly selected until ten consented to participate.

A cohort of all students in their first year of high school (Grade 7) were invited to participate in the study via consent forms sent to parents. Students with severe mental or physical disabilities were excluded. Where signed parental and student consent forms were not received by the required date, parents were contacted via telephone by school-affiliated staff and asked for consent and to provide a signed consent form.

Health and Physical Education (PE) teachers in intervention schools were invited to participate in a survey at 24-month follow-up.

Random allocation of schools (cluster) to the intervention or control group was undertaken following baseline data collection by an independent statistician, using block randomisation (1:1 ratio), based on a random number function.

INTERVENTION

The intervention was guided by social cognitive and social-ecological theories and utilized the World Health Organization’s (WHO) HPS framework. The framework recommends strategies addressing the school curriculum, school environment, and partnerships and services.
The intervention was delivered over seven to eight school terms (average, 24 months) and involved implementation of seven physical activity intervention strategies and six strategies to support implementation of the intervention (Figure 5.1). The physical activity strategies were delivered progressively over the 24-month intervention period, with strategies (3, 4, 7) implemented in the final 12-months and the remaining strategies (1, 2, 5, and 6) implemented throughout the whole intervention period. The six intervention implementation strategies were delivered throughout the intervention period (Figure 5.1).
### FIGURE 5.1: Physical Activity 4 Everyone intervention outline

**Intervention Group**

<table>
<thead>
<tr>
<th>Component</th>
<th>Intervention standard set</th>
<th>Date to be delivered from intervention commencement to 2-year follow-up in NE schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Format curriculum</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Active PE lessons</td>
<td>1. 16-16 pedometer lessons per class</td>
<td></td>
</tr>
<tr>
<td>2. Personal PA plans</td>
<td>2. 8-8 personal PA plans developed per student *</td>
<td></td>
</tr>
<tr>
<td>3. Enhance Sport (Program X)</td>
<td>3. All students attend Program X in Grade 8 *</td>
<td></td>
</tr>
<tr>
<td>School ethos &amp; environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Recess &amp;/or lunchtime activities</td>
<td>4. Offered twice per week at each school</td>
<td></td>
</tr>
<tr>
<td>Support for school PA policy</td>
<td>5. School PA policy developed/updated by completion of intervention period (note: 4/6 schools completed)</td>
<td></td>
</tr>
<tr>
<td>Partnerships and services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Linking with parents</td>
<td>6. 7-11 parent newsletters issued &amp; website</td>
<td></td>
</tr>
<tr>
<td>7. Linking with community PA providers</td>
<td>7. One community activity provider expo run for students per school (1 provider attended) (Grade 8)</td>
<td></td>
</tr>
</tbody>
</table>

#### Intervention Implementation strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>1. Attends school 1 x day/week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a. Partnership agreement signed</td>
<td>1. 70-80 days per school</td>
</tr>
<tr>
<td>2b. School committee established, school executive membership represented on committee</td>
<td>2. Agreement signed. Committee formed in all schools. Committee met 1 x per term (4-7 meetings per school)</td>
</tr>
<tr>
<td>2c. Joint school professional development training</td>
<td>3. 6-2 hour sessions (one in 2012, two in 2013, focus on active PE teaching) – attendance by at least one PE staff member from each school</td>
</tr>
<tr>
<td>3. Teacher training</td>
<td>4. Delivered to schools. Storage box provided to support student access to equipment</td>
</tr>
<tr>
<td>4. Resources</td>
<td>5. 70-100 prompts per teacher</td>
</tr>
<tr>
<td>4a. Physical activity equipment pack (e.g. balls, hoops, ropes)</td>
<td>6. 7-10 reports per school, meetings to discuss</td>
</tr>
<tr>
<td>4b. Recess and lunch equipment</td>
<td>7. 7-4 reports per school, meetings to discuss</td>
</tr>
<tr>
<td>4c. Class pedometer sets</td>
<td>8. Report delivered to Principal and head PE teacher</td>
</tr>
<tr>
<td>4d. Personal Plans (templates and teacher instructions)</td>
<td>9. Feedback/prisoner/interviews during final PE class at each school after baseline and mid-point on activity levels in 30 PE classes based on observational tool/ self-reports for SRH session MYP A</td>
</tr>
<tr>
<td>5. Prompts</td>
<td></td>
</tr>
<tr>
<td>5. Weekly email prompts to teachers from change agent</td>
<td></td>
</tr>
<tr>
<td>6. Performance feedback</td>
<td></td>
</tr>
<tr>
<td>6a. Report delivered to Principal and head PE teacher</td>
<td></td>
</tr>
</tbody>
</table>

**Control Group**

Usual school practices

**Intervention period – August 2012 to March/June 2014 (7-8 school terms depending on when data collection occurred in each school)**
CHAPTER 5: The Physical Activity 4 Everyone cluster randomized trial: 2-year outcomes of a school physical activity intervention among adolescents

PHYSICAL ACTIVITY INTERVENTION STRATEGIES

School curriculum.

1. Teaching strategies to maximize students’ physical activity in Health and PE lessons: PE teachers received training and resources to assist in maximizing MVPA during class time, including the use of pedometer-based lessons (two per term).15, 30, 31

2. Development and monitoring of student physical activity plans within PE lessons: Students developed individual physical activity plans that set goals and actions and recorded progress against timelines, fitness assessments, and provision of rewards.32 Plans were to be reviewed and modified each term.7

3. Enhanced school sport program: All students participated in a 10-week program during school sport in Grade 8. The program, based on the effective Program X,15 included lessons and fitness activities focused on lifelong physical activity skills and knowledge.29, 33

School environment.

1. Development/modification of school policies:34 School policies that aimed to enhance student physical activity were reviewed by the head PE teacher and in-school consultant with input from the school executive.35

2. Physical activity programs during school breaks: Schools were provided with physical activity equipment (e.g., balls, skipping equipment), and encouraged to offer supervised physical activity at recess and lunch on at least two days per week.36

Partnerships and services.

1. Promotion of community physical activity providers (community links):34, 37 Schools were supported to host a physical activity expo that promoted local physical activity providers to students in Grade 8.
2. Parent engagement\textsuperscript{33,38} information was sent to parents each term via newsletters and the school website, promoting physical activity and local providers.

**INTERVENTION IMPLEMENTATION STRATEGIES**

The six intervention implementation strategies were selected based on evidence regarding their ability to facilitate the implementation of school-based interventions, change professional service delivery practices, or build capacity of organizations\textsuperscript{12,39-45}

1. In-school physical activity consultant (change agent): A trained PE teacher was placed within each school for one day per week over the intervention period to support intervention implementation\textsuperscript{37}.

2. Establishing leadership and support: A school committee was established, or responsibility was added to an existing committee, to lead and oversee the intervention.

3. Teacher training: PE teachers were offered three practice-learning workshops focused on delivery of lessons to increase students’ MVPA. All PE teachers and teachers involved in the delivery of the enhanced school sports program were provided training\textsuperscript{15,41,46,47}.

4. Resources: Schools were provided with a manual outlining all physical activity intervention strategies and associated materials, physical activity equipment (e.g., pedometers, resistance devices), and promotional materials for teachers (e.g., shirts, lanyards) and students (e.g., balls, water bottles).

5. Prompts: The in-school physical activity consultant provided prompts to teaching staff to implement the intervention strategies via e-mail, electronic calendar reminders, and in meetings.

6. Intervention implementation performance feedback: Records kept by the in-school physical activity consultant were the basis of quarterly intervention implementation feedback.
reports. The results of observational audits of ten randomly selected PE lessons undertaken using the System for Observing Fitness Instruction Time (SOFIT) were also provided on two occasions.

**CONTROL SCHOOLS**

Control schools participated in the measurement components of the trial only and delivered physical activity teaching and promotion practices according to the PE curriculum and school-based initiatives.

**DATA COLLECTION PROCEDURES**

Data were collected by trained research assistants blind to group allocation. Baseline data were collected in March–June 2012, and follow-up data collected after 12-months and again at 24-month follow-up (March–June 2014).

At baseline and 24-month follow-up, students wore an accelerometer (Actigraph GT3X+ and GT3X models) for seven days during waking hours. Student characteristics were collected at baseline via an online survey.

The in-school physical activity consultant recorded delivery of all strategies. In addition, PE teachers and students in each intervention school completed a survey at 24-month follow-up that included items on intervention delivery and acceptability/perceived usefulness.
MEASURES

Accelerometer data were used to derive the primary physical activity outcome measure, mean student duration (minutes) of MVPA per day.

Secondary outcomes were: minutes of vigorous physical activity per day; minutes of moderate physical activity per day; percentage of accelerometer wear time in MVPA per day, percentage of accelerometer wear time in vigorous physical activity per day; percentage of accelerometer wear time in moderate physical activity per day; and mean daily accelerometer counts.

For all physical activity outcome measures, accelerometer non-wear time was defined as 30 minutes of consecutive zeroes. Counts were collected in 15-second epochs and counts per minute calculated by dividing the total accelerometer counts by the minutes of wear time. The Evenson cut-points were used to categorize the intensity of physical activity (moderate or vigorous physical activity).

The online survey assessed student sociodemographic characteristics; age, sex, Aboriginal or Torres Strait Islander (or both) status, and residential postcode.

Anthropometric data (height and weight) were collected in duplicate by trained research assistants using the International Society for Advanced Kinanthropometry procedures. Students completed the measurements in light clothing without shoes. Weight was measured to the nearest 0.1 kg on a portable digital scale (Model no. UC-321PC, A&D Company Ltd, Tokyo Japan). Height was measured to the nearest 0.1 cm using a portable stadiometer (Model no. PE087, Mentone Educational Centre, Australia). Body Mass Index (BMI) was calculated...
(weight (kg) / height (m)^2) and weight status determined using the International Obesity Taskforce definitions.52, 53

The in-school physical activity consultant records were used to determine the extent to which physical activity intervention and implementation strategies were delivered to the desired standard (Figure 5.1).

The 24-month follow-up PE teacher survey assessed the delivery of the PE curriculum strategies (Strategies 1 and 2 in Figure 5.1). The intervention group student online survey at 24-months assessed the reach of some physical activity intervention strategies (1, 2, and 4 in Figure 5.1).

**SAMPLE SIZE**

It was estimated each school would yield at least 60 students at baseline, providing approximately 300 students per group.54, 55 This assumed at least 120 Grade 7 students per school and that 50% would consent and provide 3 days of valid accelerometer data56 (analyses eligibility inclusion criterion). If 65% of the cohort provided usable data at 24-months, it was estimated that there would be at least 195 students per group.57 Previous studies were used to estimate the standard deviation (SD) of mean daily minutes of MVPA (17.1)58 and the intraclass correlation coefficient (ICC) (0.01).59 After adjustment for a design effect of 1.38, the effective sample size was estimated to be 141 students per group. Based on ten schools, with this sample size, 80% power and an α-level of 0.05, the study was able to detect a difference in the primary trial outcome, mean daily minutes of MVPA, between experimental and control students of +/- 5.73 minutes at 24-month follow-up.
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STATISTICAL ANALYSIS

All analyses were conducted using SAS, version 9.2, from December 2014 to February 2015.

Summary statistics were used to describe all variables of interest. Logistic regressions with generalized estimating equation parameter estimation were used to determine if students who provided accelerometer data at both baseline and 24-months differed from those who provided only baseline accelerometer data in terms of; sex, baseline age, weight status (underweight/healthy weight versus overweight/obese), and physical activity level (meeting physical activity guidelines active) versus not meeting physical activity guidelines (inactive). Significance levels for such analyses were set at $p<0.05$.

Student data were included in the analyses if the accelerometer was worn for at least 600 minutes per day on any three days or more.$^{60-62}$ Analyses followed intention-to-treat principles. Analysis of the primary outcome measure (minutes of MVPA per day), and other physical activity outcomes was undertaken using a linear mixed model (LMM) approach. A three-level hierarchical model was used to capture correlations in the data with random intercepts for repeated measures (Level 1: mean minutes MVPA per day at baseline, mid-point, and follow-up) on individuals (Level 2) and clustering within schools (Level 3: ten clusters, five intervention and five control). An independence structure was assumed for the residual variance–covariance matrix. Fixed effects in the model included treatment group (intervention versus control), time (baseline versus 24-months) and the interaction between treatment group and time. The containment method was used for degrees of freedom estimation. The LMM analyses sought to determine whether there was a difference in mean change from baseline to 24-months between groups in each outcome measure, assessed through an interaction term between groups.
Physical activity outcome data were analysed assuming data were “missing at random.” Sensitivity analyses were undertaken for the primary outcome, initially adjusting for any variables on which students with and without 24-month follow-up accelerometer data were significantly different, secondly, using multiple imputation and thirdly, using complete cases only. Six imputed data sets were created using a two-step multiple imputation process: first missing data were initially filled in to a monotone pattern of missing data using the Markov Chain Monte Carlo method; then, the remaining missing data were filled in using the regression method (where regression equations are used to predict the missing outcome values using baseline values of the outcomes and baseline demographic variables). The five complete data sets were then analysed using LMM as per the primary analyses, and the estimates combined using Rubin’s method.

Descriptive statistics were used to describe the proportion of students in each group meeting the Australian Physical Activity guidelines for children and young people of 60 minutes MVPA per day.

Analyses assessed whether the intervention similarly impacted the primary outcome measure (mean minutes MVPA per day) and two secondary physical activity outcome measures (mean minutes VPA per day and mean minutes MPA per day) for students defined, a priori, in terms of three moderators of energy balance; sex, baseline BMI, and baseline physical activity level. Students were categorized into two groups for baseline BMI ("underweight/healthy weight", "overweight/obese") based on Cole cut-points. Students were categorized into two groups for baseline physical activity (≥60 minutes of MVPA per day (active), <60 minutes of MVPA per
day (low active). The moderator variable interaction terms were included separately in the aforementioned LMM analyses for the relevant duration outcomes and, if the three-way interaction term (group X time X moderator) was significant at $p<0.20$, separate LMM analyses for the moderator subgroups were undertaken for these variables.67

Descriptive statistics were used to summarize in-school consultant record data regarding intervention strategy implementation, and intervention group PE teacher and student survey responses.

RESULTS

SAMPLE

Of 22 eligible schools, 13 were approached, 10 of which consented to participate (77%). Parental consent was obtained for 1,233 of the 1,468 Grade 7 students in the ten schools (84%) (Figure 5.2).
CHAPTER 5: The Physical Activity 4 Everyone cluster randomized trial: 2-year outcomes of a school physical activity intervention among adolescents

Notes:
* Student population excludes: individuals with severe mental or physical disabilities (there were no classes for such students in the participating schools); those on long-term suspension
** the figure 1,233 is for parental consent to accelerometry. A slightly larger sample (1,246) had parental consent for any study measure (including anthropometry, survey)
1 denominator is number of students with parental consent for accelerometry at baseline 1,233
2 male or female breakdown at the respective time point
3 denominator is number of students that participated in data collection at the respective time point

FIGURE 5.2. CONSORT flowchart describing progress of participants through the study to 24-months
At baseline, 1,150 students wore an accelerometer, 84% of whom provided at least three days of valid accelerometer data (965/1,150). The 1,150 students represented 93% of students with parental consent. At 24-months, 985 students wore an accelerometer and provided anthropometric measures and 441 (45%) of these provided at least three days of valid accelerometer data. The 441 students represented 36% of those with parental consent. Baseline characteristics of the 1,150 students who wore an accelerometer are shown in Table 5.1.

**TABLE 5.1: Sample Characteristics at Baseline – Students Wearing an Accelerometer (n=1,150)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number/total participants</td>
<td>645</td>
<td>505</td>
</tr>
<tr>
<td>Boys</td>
<td>312</td>
<td>246</td>
</tr>
<tr>
<td>Girls</td>
<td>333</td>
<td>258</td>
</tr>
<tr>
<td>3 valid days</td>
<td>530</td>
<td>435</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>12.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Aboriginal and/or Torres Strait Islander (%)</td>
<td>5.3%</td>
<td>7.8%</td>
</tr>
<tr>
<td>Height (mean cm)</td>
<td>157.1</td>
<td>156.8</td>
</tr>
<tr>
<td>Weight (mean kg)</td>
<td>49.3</td>
<td>50.0</td>
</tr>
<tr>
<td>Student BMI category (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Underweight/healthy weight</td>
<td>78.3%</td>
<td>73.3%</td>
</tr>
<tr>
<td>- Overweight/obese</td>
<td>21.7%</td>
<td>24.7%</td>
</tr>
<tr>
<td>Student activity level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Active (≥60 minutes MVPA/day)</td>
<td>33%</td>
<td>33%</td>
</tr>
<tr>
<td>- Low active (&lt;60 minutes MVPA/day)</td>
<td>67%</td>
<td>67%</td>
</tr>
<tr>
<td>Accelerometer wear time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean minutes per day</td>
<td>793.6</td>
<td>804.6</td>
</tr>
</tbody>
</table>

*Gender missing, n =1=  
MVPA, moderate-to-vigorous physical activity
Age was the only characteristic associated with whether students provided accelerometer data at baseline only, or at both baseline and 24-months. Students who provided data only at baseline were younger than those providing data at both time points. At 24-months, 35 (100%) intervention PE teachers completed the teacher survey. Students in intervention schools who completed surveys at both baseline and 24-months ($n=409$) were included in analysis of data on reach and acceptability of the physical activity intervention strategies.

**PHYSICAL ACTIVITY OUTCOMES**

The adjusted mean difference in change in daily MVPA between groups was 7.0 minutes ($p<0.002$, 95% CI [2.7, 11.4]) (Table 5.2). The mean duration of daily MVPA increased by 4.4 minutes from baseline for the intervention group and decreased by 2.6 minutes for the control group (Figure 5.3).

**FIGURE 5.3:** Mean minutes of MVPA per day for intervention and control group students at baseline, 12-month (mid-point) and 24-month follow-up.
**TABLE 5.2: Changes in Physical Activity Outcomes from Baseline to 24-Month Follow-up (Mid-point Data Values Also Shown)**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention Baseline Mean (95% CI) (n=524)</th>
<th>Intervention Mid-point * Mean (95% CI) (n=352)</th>
<th>Intervention Follow-up Mean (95% CI) (n=245)</th>
<th>Control Baseline Mean (95% CI) (n=435)</th>
<th>Control Mid-point * Mean (95% CI) (n=288)</th>
<th>Control Follow-up Mean (95% CI) (n=191)</th>
<th>Difference in change from baseline to follow-up between treatment group (95% CI)</th>
<th>Group x time p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear time (minutes/day)</td>
<td>796.1 (781.2 - 811.1)</td>
<td>796.6 (779.7 - 813.4)</td>
<td>832.9 (814.0 - 851.9)</td>
<td>804.4 (788.6 - 820.2)</td>
<td>799.7 (781.8 - 817.6)</td>
<td>800.3 (779.6 - 821.0)</td>
<td>7.9 (2.68 - 11.4)</td>
<td>0.005</td>
</tr>
<tr>
<td>Counts per minute</td>
<td>483.4 (464.3 - 502.4)</td>
<td>485.2 (464.7 - 505.7)</td>
<td>460.2 (438.2 - 482.2)</td>
<td>484.6</td>
<td>455.2 (433.5 - 476.8)</td>
<td>448.5 (424.9 - 472.2)</td>
<td>3.0 (0.3 - 4.8)</td>
<td>0.026</td>
</tr>
<tr>
<td>Mean total daily accelerometer counts</td>
<td>382,999 (364,464 – 401,534)</td>
<td>378,882 (358,957 – 398,807)</td>
<td>378,962 (357,546 – 400,378)</td>
<td>387,946 (368,707-407,185)</td>
<td>360,200 (339,358 – 381,042)</td>
<td>351,081 (328,186 – 373,976)</td>
<td>8,157.9 (5,749)</td>
<td>0.009</td>
</tr>
<tr>
<td>Minutes of physical activity (minutes/day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total MVPA</td>
<td>53.5 (49.6 - 57.3)</td>
<td>54.7 (50.7 - 58.8)</td>
<td>57.9 (53.6 - 62.1)</td>
<td>53.5 (49.5 - 57.4)</td>
<td>51.0 (46.8 - 55.2)</td>
<td>50.8 (46.3 - 55.4)</td>
<td>7.0 (2.68 - 11.4)</td>
<td>0.005</td>
</tr>
<tr>
<td>Vigorous activity</td>
<td>16.5 (14.5 - 18.6)</td>
<td>18.2 (16.0 - 20.3)</td>
<td>19.7 (17.5 - 22.0)</td>
<td>16.7</td>
<td>16.1 (13.9 - 18.3)</td>
<td>17.4 (15.0 - 19.8)</td>
<td>2.5 (0.3 - 4.8)</td>
<td>0.026</td>
</tr>
<tr>
<td>Moderate activity</td>
<td>37.0 (34.7 - 39.2)</td>
<td>36.5 (34.2 - 38.9)</td>
<td>38.1 (35.6 - 40.6)</td>
<td>36.7</td>
<td>34.9 (32.5 - 37.4)</td>
<td>33.4 (30.8 - 36.0)</td>
<td>4.5 (2.0 - 7.0)</td>
<td>0.002</td>
</tr>
<tr>
<td>% Wear time</td>
<td>6.8 (6.3 - 7.2)</td>
<td>7.0 (6.6 - 7.5)</td>
<td>7.0 (6.6 - 7.5)</td>
<td>6.7</td>
<td>6.5 (6.0 - 6.9)</td>
<td>6.5 (6.0 - 7.0)</td>
<td>0.4 (0.0 - 0.9)</td>
<td>0.029</td>
</tr>
<tr>
<td>Percentage MVPA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage vigorous</td>
<td>2.1 (1.9 - 2.3)</td>
<td>2.4 (2.1 - 2.6)</td>
<td>2.4 (2.1 - 2.6)</td>
<td>2.1</td>
<td>2.0 (1.9 - 2.3)</td>
<td>2.2 (1.97 - 2.50)</td>
<td>0.1 (-0.12 - 0.35)</td>
<td>0.009</td>
</tr>
<tr>
<td>Percentage moderate</td>
<td>4.7 (4.4 - 4.9)</td>
<td>4.7 (4.4 - 4.9)</td>
<td>4.7 (4.4 - 4.9)</td>
<td>4.6</td>
<td>4.4 (4.3 - 4.9)</td>
<td>4.3 (4.0 - 4.6)</td>
<td>0.3 (0.0 - 0.6)</td>
<td>0.086</td>
</tr>
</tbody>
</table>

* Mid-intervention effects of the ‘Physical Activity 4 Everyone’ school-based intervention

Note: Boldface indicates statistical significance (p<0.05).

MVPA, moderate-to-vigorous physical activity

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**CHAPTER 5: The Physical Activity 4 Everyone cluster randomized trial: 2-year outcomes of a school physical activity intervention among adolescents**

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The findings of sensitivity analyses of the primary outcome, adjusting for age, were consistent with those of the primary analyses. The mean difference in change in daily MVPA between groups of 6.3 minutes was in favour of the intervention group ($p<0.005$, 95% CI [1.9, 10.7]) (Appendix 5.1 Sensitivity analysis). Similarly, sensitivity analyses results using multiple imputations were consistent with those of the primary analyses. The mean difference in change between groups of 6.2 minutes per day ($p<0.031$, 95% CI [0.6, 11.3]), was in favour of the intervention group. Analyses using complete cases indicated a 6.7 minute difference between groups, in favour of the intervention group ($p = 0.09$, 95% CI [0.62,12.71]) (Appendix 5.1 Sensitivity analysis).

There were significant effects in favour of the intervention group for five of the six secondary physical activity outcomes: minutes per day of VPA; minutes per day of MPA; percentage wear time in MVPA and VPA; and total daily accelerometer counts. There were no significant intervention effects for percentage of wear time in MPA (Table 5.2). The ICC coefficient values for the primary and secondary physical activity variables are reported in Table 5.3.

**TABLE 5.3: Intervention ICC values for the primary and secondary physical activity outcome variables.**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>ICC Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes of Physical Activity (min/day)</td>
<td></td>
</tr>
<tr>
<td>Total MVPA</td>
<td>0.03</td>
</tr>
<tr>
<td>Vigorous activity</td>
<td>0.02</td>
</tr>
<tr>
<td>Moderate activity</td>
<td>0.03</td>
</tr>
<tr>
<td>% wear time</td>
<td></td>
</tr>
<tr>
<td>Percentage MVPA</td>
<td>0.02</td>
</tr>
<tr>
<td>Percentage Vigorous</td>
<td>0.02</td>
</tr>
<tr>
<td>Percentage Moderate</td>
<td>0.02</td>
</tr>
<tr>
<td>Counts per min</td>
<td>0.01</td>
</tr>
</tbody>
</table>
PHYSICAL ACTIVITY OUTCOMES- SUBGROUPS

At the 20% significance threshold, the three-way subgroup interaction terms indicated that time by intervention effects differed only by sex for the primary outcome of daily minutes of MVPA, and the secondary outcome of daily minutes of MPA. A greater effect was observed for male students in the intervention group compared with male students in the control group for minutes of MVPA per day (mean difference in change, 10.4 minutes, \( p < 0.01 \), 95% CI[2.1, 18.8]) and minutes of moderate physical activity (6.2 minutes, \( p < 0.015 \), 95% CI[1.7, 10.7]). A greater effect was also observed for female students in the intervention group compared to female students in the control group for minutes of MVPA per day (mean difference in change, 4.0 minutes, \( p < 0.05 \), 95% CI[0.1, 8.0]) and minutes of moderate physical activity (2.9 minutes, \( p < 0.047 \), 95% CI[0.1, 5.6]) (Table 5.4).
TABLE 5.4: Changes in Physical Activity Outcomes (MVPA and Moderate Activity) from Baseline to 24 Follow-up for Male and Female Students

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention</th>
<th>Control</th>
<th>Intervention-control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Mid-point</td>
<td>Follow-up</td>
</tr>
<tr>
<td></td>
<td>Mean (95% CI)</td>
<td>Mean (95% CI)</td>
<td>Mean (95% CI)</td>
</tr>
<tr>
<td></td>
<td>(males n=218, females n=300)</td>
<td>(males n=138, females n=208)</td>
<td>(males n=102, females n=143)</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minutes of MVPA</td>
<td>46.8 (43.7,49.9)</td>
<td>46.2 (42.9,49.5)</td>
<td>46.6 (43.1,50.2)</td>
</tr>
<tr>
<td>(minutes/day)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate activity</td>
<td>33.7 (31.3,36.0)</td>
<td>32.6 (30.1,35.1)</td>
<td>33.3 (30.7,36.0)</td>
</tr>
<tr>
<td>(minutes/day)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minutes of MVPA</td>
<td>62.7 (56.7,68.6)</td>
<td>67.8 (61.3,74.3)</td>
<td>72.6 (65.7,79.6)</td>
</tr>
<tr>
<td>(minutes/day)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate activity</td>
<td>41.5 (38.3,44.8)</td>
<td>42.7 (39.2,46.3)</td>
<td>44.3 (40.5,48.1)</td>
</tr>
<tr>
<td>(minutes/day)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Mid-intervention effects of the ‘Physical Activity 4 Everyone’ school-based intervention.20
Note: Boldface indicates statistical significance (p<0.05)
At 24-months, program records indicated all five intervention schools implemented six of the seven physical activity strategies (Figure 5.1). The exception was Strategy 5 (school policy), with four of five schools having developed a school policy. All intervention implementation strategies were delivered as planned.

In the 24-month survey of intervention group PE teachers (n=35), 88.9% reported using pedometers to increase activity levels in PE, and 58.8% reported incorporating student personal physical activity plans each term. Acceptability data from the PE teacher survey indicated 40.2% enjoyed teaching pedometer-based lessons, 65.6% reported such lessons helped students to increase their physical activity levels during PE, and 67.6% reported that assisting students to develop personal physical activity plans was a useful strategy.

At 24-months, in the survey of intervention group students (n=409), 90.9% reported using pedometers in PE lessons, 28.9% recalled developing a personal physical activity plan, and 56.9% reported participating in organized physical activity at recess or lunchtimes.

**DISCUSSION**

This study assessed the effectiveness of the PA4E1 intervention, a multicomponent school-based intervention, in reducing the decline in physical activity among secondary school students. After 24-months, the intervention was effective in increasing daily MVPA in the intervention group compared with a decrease in the control group. As a result, students in the intervention group participated in 7 minutes more MVPA at 24-months compared with the control group. This outcome builds on a previously reported 12-month mid-intervention result
of 3.9 minutes more MVPA. The findings suggest that implementation of the intervention by schools in socio-economically disadvantaged areas has the potential to reduce the decline in physical activity during adolescence.

The observed effect size for MVPA was greater than the aggregate effect size of four minutes more MVPA per day reported in a recent meta-analysis of objectively measured school-based physical activity interventions implemented for children and adolescents. No previous intervention studies that have involved socio-economically disadvantaged adolescent participants have reported a statistically significant effect using objectively measured MVPA at 12-months or more follow-up. No comparable trials have reported a significant MVPA effect for both male and female students separately, and for MPA and VPA separately.

The contrasting positive effects observed in this study relative to the findings of past interventions may be attributable to a number of the design elements: an extended intervention duration (average of 24-months); the use of a theory-based intervention; the inclusion of multiple physical activity promotion strategies; and the inclusion of multiple strategies, particularly the in-school physical activity consultant, to support school implementation of the intervention strategies. No previous secondary school-based studies targeting socio-economically disadvantaged adolescents have included all such intervention elements. The extent to which the inclusion of such elements contributed to the contrasting findings is unknown and requires further research.
The finding of a greater intervention effect on duration of MVPA activity at 24-month follow-up, compared with the previously reported 12-month result, strengthens previous suggestions that a dose–response relationship exists between length of intervention and extent of effect on adolescent physical activity. Further research is warranted to determine the incremental benefits of extending the length of intervention further, for example, implementation on a routine basis throughout the first four years of secondary schooling. In addition, further analysis to determine the impact of the intervention on weight status would add to the body of literature regarding the merit of school-based physical activity intervention and obesity prevention.

The intervention had a significant and positive effect on daily MVPA for both male and female students. However, the intervention effect for male students appeared to be approximately 2.5 times that for female students. The MVPA levels of female students in the intervention group remained stable over the 24-month period, whereas they decreased for female students in the control group. By contrast, MVPA consistently increased for male students in the intervention group. As female students are less likely to participate in physical activity than male students, these findings suggest that additional intervention strategies targeting female students may benefit future interventions (e.g., single-sex PE lessons or sport, focus on non-competitive activity).70, 71

**LIMITATIONS**

The study has a number of strengths, including the use of a cluster RCT design, extended intervention duration, objective measurement of physical activity, and the inclusion of a suite of intervention implementation strategies as recommended in past school-based physical
activity reviews. A limitation of the study is the loss of participants at follow-up, with less than half of the students that initially consented providing accelerometer data at 24-months, a finding consistent with previous studies.\cite{14, 17, 72} Accelerometer compliance may be improved by the provision of compensation strategies such as monetary incentives, class points, rewards, and non-monetary incentives for wearing the accelerometer or for correct wear time, particularly for older students.\cite{57, 73} Alternatively, wrist-worn accelerometers may promote compliance.\cite{74} Nonetheless, despite acknowledgement of the dangers of multiple testing including increased risk of Type I errors\cite{75} analysis of outcomes that adjusted for variables associated with loss to follow-up and analysis using multiple imputation for missing data indicated similar findings to the primary analyses, suggesting consistency in direction of the effect. Secondary outcomes for percentage of wear time spent in MVPA and VPA were also consistent with the main trial outcomes over time. MPA shows a positive trend, although statistically not significant, perhaps owing to limited power to detect an effect on this scale. The subgroup analyses indicated no intervention effect by baseline levels of BMI or physical activity despite such variables being shown to be moderators of energy balance.\cite{65} This finding may be attributable to the study not being adequately powered to detect such differences, or to other factors. Future adequately powered studies are required to better understand the impact of such moderators on intervention effectiveness.

**CONCLUSIONS**

The PA4E1 intervention was effective in increasing daily minutes of MVPA in the intervention group compared with a decrease in the control group for all students and for female and male students. Findings suggest that implementation of the intervention by socio-economically 178
disadvantaged schools has the potential to reverse the decline in physical activity in this population group. Further research is warranted to determine the potential to benefit adolescents from a range of schools, regardless of the SES of the school community, and its impact if implemented on a routine basis throughout secondary schooling. Additionally, although review evidence indicates that physical activity benefits achieved from multicomponent school-based interventions are sustainable, few long-term follow-up studies have been published. Further follow-up assessing school practices and student physical activity would determine if implementation has been maintained and the impact sustained beyond the intervention. Assessment of the intervention impact on school day physical activity should also be explored in addition to cost and cost effectiveness.
REFERENCES


CHAPTER 5: The Physical Activity 4 Everyone cluster randomized trial: 2-year outcomes of a school physical activity intervention among adolescents


CHAPTER 5: The Physical Activity 4 Everyone cluster randomized trial: 2-year outcomes of a school physical activity intervention among adolescents


CHAPTER 5: The Physical Activity 4 Everyone cluster randomized trial: 2-year outcomes of a school physical activity intervention among adolescents


CHAPTER 6

EFFECTS OF A SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTION ON ADIPOSY IN ADOLESCENTS FROM ECONOMICALLY DISADVANTAGED COMMUNITIES: SECONDARY OUTCOMES OF THE ‘PHYSICAL ACTIVITY 4 EVERYONE’ RCT.

A version of this chapter was published as a paper with International Journal of Obesity

ABSTRACT

Background: Obesity prevention during adolescence is a health priority. The Physical Activity 4 Everyone (PA4E1) trial tested a multicomponent physical activity intervention in ten secondary schools from socio-economically disadvantaged communities. This paper aimed to report the secondary outcomes of the study; to determine whether the intervention impacted on adiposity outcomes (weight, body mass index (BMI), BMI z-score), and whether any effect was moderated by sex, baseline BMI and baseline physical activity level, at 12- and 24-months.

Subjects/methods: A cluster randomised controlled trial (RCT) was conducted in New South Wales (NSW), Australia. The school-based intervention included seven physical activity strategies targeting: the curriculum (strategies to maximise physical activity in physical education, student physical activity plans, an enhanced school sport program); school environment (physical activity during school breaks, modification of school policy); and parents and the community (parent engagement, links with community physical activity providers). Students’ weight (kg), Body Mass Index (BMI) and BMI z-score, were collected at baseline (Grade 7), 12- and 24-months. Linear Mixed Models were used to assess between-group mean difference from baseline to 12- and 24-months. Exploratory sub-analyses were undertaken according to three moderators of energy balance.

Results: A total of 1150 students (mean age=12 years) provided outcome data at baseline, 1051 (91%) at 12-months and 985 (86%) at 24-months. At 12-months, there were group-by-time effects for weight (mean difference=-0.90kg (95%CI=-1.50;-0.30), p<0.01) and BMI (-0.28kg/m² (-0.50;-0.06), p=0.01) in favour of the intervention group, but not for BMI z-score (-0.05 (-0.11;0.01), p=0.13). These findings were consistent for weight (-0.62kg (-1.21;-0.03), p=0.01) and BMI (-0.28kg/m² (-0.49;-0.06), p=0.01) at 24-months, with group-by-time effects also found for BMI z-score (-0.08 (-0.14;-0.02), p=0.02) favouring the intervention group.

Conclusion: The PA4E1 school-based trial achieved moderate reductions in adiposity among adolescents from socio-economically disadvantaged communities. Multicomponent interventions that increase adolescents’ engagement in moderate-to-vigorous (MVPA) may assist in preventing unhealthy weight gain.
BACKGROUND

Preventing obesity during adolescence is a public health priority. Internationally, among adolescent populations (10-19 years), the prevalence of overweight and obesity is estimated to be between 20-30%, and is increasing. During puberty, adolescents experience changes in body composition and physical fitness, and decreased insulin sensitivity. Changes in eating behaviours, physical activity, sedentary behaviours and psychological wellbeing may also occur during this critical period of growth and development. These behavioural and physiological changes increase the risk of overweight and obesity during adolescence. Global self-reported data from 105 countries estimates that just 20% of adolescents participate in ≥60 minutes of moderate-to-vigorous physical activity (MVPA) each day. Longitudinal studies have also shown a decline in physical activity during adolescence of approximately seven percent of MVPA per year. Research across 32 countries in Europe, Israel and North America indicates a positive association between physical inactivity and socio-economic disadvantage in adolescents.

The school environment is a recommended setting for the promotion of physical activity among adolescents, however, school-based physical activity interventions have resulted in only a small increase in objectively measured MVPA (approximately four minutes/day) of children, and limited reductions in the adiposity of adolescents. A systematic review and meta-analysis of 18 studies (including 18,141 students) that aimed to determine the effect of school-based physical activity interventions (>six months duration) on BMI in children and adolescents found that neither BMI (mean difference= -0.05 kg/m², 95%CI:-0.19;0.10) nor any
other body composition measures improved. The review primarily included elementary-aged students in Grades 3-6, and 15 of the 18 studies included a nutrition co-intervention. The lack of an overall effect on BMI was explained by insufficient intervention dose, either due to the amount of physical activity or low intervention compliance by the students. In a more recent meta-analysis of 43 studies (involving 36,579 children) that aimed to evaluate the impact of nutrition and physical activity school-based interventions on BMI in children and adolescents (<18 years old), studies that assessed physical activity-only interventions reduced BMI by -0.13 kg/m² (-0.22; -0.04). Intervention duration ranged from one month to six years. Neither review reported the physical activity intervention findings separately for adolescents, precluding the drawing of conclusions regarding the effect of physical activity interventions on adiposity in adolescent populations.

To increase the likelihood of an effect, school-based interventions that are multicomponent and socio-ecologically framed are recommended. Systematic reviews of school-based physical activity interventions have also recommended that interventions address educational, curricular, and environmental changes in the school. The ‘Physical Activity 4 Everyone’ (PA4E1) RCT was designed based on these recommendations and aimed to reduce the decline in physical activity typically observed during adolescence. The multicomponent intervention resulted in a significant differential change in the primary outcome (daily minutes MVPA) from baseline to 24-months of seven minutes/day (p<0.01). The secondary aims of PA4E1 reported in this paper, were to determine whether the intervention impacted on adiposity outcomes (weight, BMI and BMI z-score), and whether any effect on such measures was moderated by;
sex (male, female), ii) baseline BMI (underweight/healthy weight; overweight/obese) and iii) baseline physical activity level (active/inactive), at 12- and 24-months.

**METHODS**

**STUDY DESIGN AND SETTING**
A cluster RCT was conducted in secondary schools in socio-economically disadvantaged communities in New South Wales (NSW), Australia. Communities were considered socio-economically disadvantaged if they had a socio-economic status score of five or less (lower 50% of NSW) based on postcode. Outcome assessments were undertaken at baseline, 12-months and 24-months. The trial was approved by the University of Newcastle Human Research Ethics Committee (H-201-0210), the Hunter New England Ethics Committee (11/03/16/4.05) (Appendix 4.1) and the Department of Education and Catholic Schools Diocese. The trial adhered to the Consolidated Standards of Reporting Trials (CONSORT) guidelines and was registered with the Australian New Zealand Clinical Trials Registry (ACTRN 12612000382875). Detailed methods of the PA4E1 trial have been reported elsewhere.

**SAMPLE AND RECRUITMENT**

**SECONDARY SCHOOLS**
Randomly selected secondary schools within the study region were invited to participate between October and December 2011. Schools were eligible to participate in the study if they were: i) Government or Catholic schools, ii) had a socio-economic status score of five or less (lower 50% of NSW) based on postcode, iii) had at least 120 Grade 7 students, and iv) were not participating in any other physical activity or health intervention study. School Principals were provided with a study information package and asked to provide written informed
consent. The consenting schools were randomly allocated to intervention or control groups following the collection of baseline data, using a computer generated block randomisation procedure (1:1 ratio) by an independent statistician.

STUDENTS
A cohort of first year secondary school students (Grade 7, aged 12-13 years) at the consenting schools were invited to participate. Parents were provided with an information package and asked to provide written informed consent for their child. Two weeks following the distribution of the information package, the non-responding parents were telephoned and asked to provide verbal consent.

‘PHYSICAL ACTIVITY FOR EVERYONE’ (PA4E1) INTERVENTION
The design of the PA4E1 intervention was guided by social cognitive theory\textsuperscript{19} and socio-ecological theory\textsuperscript{20}, and based on evidence of effective intervention features including multiple intervention components, delivery for a period of at least 12 months\textsuperscript{13, 14, 21}, and the inclusion of strategies to enhance implementation of intervention components.\textsuperscript{13, 21-24} The intervention strategies have been outlined in detail elsewhere.\textsuperscript{15, 16} Briefly, the intervention components targeted the school curriculum, school environment and broader community and parental support\textsuperscript{7, 21, 25-27} in accordance with the WHO’s Health Promoting Schools framework.\textsuperscript{7} The intervention was delivered over seven to eight school terms (19-24 months), and included the following seven physical activity intervention strategies:

School curriculum
1) \textit{Teaching strategies to maximise student physical activity in health and physical education (PE) lessons}. Health and Physical Education (PE) teachers received two professional learning workshops (conducted at six month intervals) that focused on: i) increasing
CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT.

motivation and MVPA in PE lessons to meet the target of 50% of PE lesson time in MVPA recommended by the US Centers for Disease Control (CDC) and Prevention, ii) an implementation guide for delivering the 10-week enhanced school sport programme (i.e. Program X), and iii) recommended procedures for fitness testing and ‘personal best’ days. A final booster session provided a summary of all concepts and strategies included in the PA4E1 intervention.

2) Development and monitoring of student physical activity plans within PE lessons. The student physical activity plans focused on: i) short and long term physical activity, ii) actions and timelines, iii) fitness assessments, iv) recording actions and goal achievements, and v) rewards for goal attainment (e.g. balls, wrist bands and drink bottles).

3) Implementation of an enhanced school sports program. All students participated in a 10-week enhanced school sport program during school sport. The program was based on Program X, which was originally designed for low-active students.

School environment

4) Development and modification of school policies. School policies were established or modified with the aim of enhancing students’ physical activity. For example; incorporating pedometer-based lessons with PE, offering the enhanced school sport program as a standard school sport option, routinely providing physical activity information to parents.

5) Physical activity programs during school breaks. Schools were provided with physical activity equipment (e.g. balls, skipping equipment) and encouraged to offer supervised physical activity on at least two days/week during recess and lunch breaks.
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**Partnership and services**

6) *Promotion of community physical activity providers (community links).* Schools were supported to host a physical activity expo that promoted local physical activity providers to students in Grade 8. Community physical activity providers were also promoted in school newsletters.

7) *Parent engagement.* Information was regularly sent to the parents via existing school newsletters, the school website and PA4E1 newsletters on physical activity recommendations, school-based physical activity strategies, promotion of community physical activity providers and strategies to support their child’s physical activity.

Four of the seven intervention strategies were implemented during the first 12-months (strategies 1, 2, 5 and 7 above). The remaining strategies were implemented over the next 12-months, with delivery of the initial strategies being maintained. The intervention strategies, particularly those under the curriculum domain, included a range of behaviour change techniques with students such as the provision of information about the behaviour and the consequences, general encouragement, prompting specific goal setting and a review of behavioural goals, prompting self-monitoring, prompting practice, modelling and demonstrating the behaviour, and the provision of feedback on performance. The intervention further employed six strategies to support the implementation of the seven physical activity intervention strategies listed above. The intervention implementation strategies included: i) an in-school physical activity consultant one day/week (change agent position), ii) establishing leadership and support, iii) teacher training, iv) resources, v) teacher prompts, and vi) intervention implementation performance feedback to schools.
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CONTROL SCHOOLS
Schools allocated to the control group participated in the measurement components of the study. Control schools were requested to follow their usual PE and sport programs during the study period and were offered all intervention materials, equipment packs and the findings at the conclusion of the study.

MEASURES
Study outcome assessments were conducted at baseline and on the same cohort of students after 12-months and 24-months post baseline. Data were collected at the schools by trained research assistants using standardised protocols.

STUDENT CHARACTERISTICS
Students completed an online survey to collect data regarding their socio-demographic characteristics including age, sex, Aboriginal and Torres Strait Islander status, language spoken at home and residential postcode. Baseline accelerometer data were collected to derive minutes of MVPA/day. Students wore an accelerometer (Actigraph GT3X+ and GT3X models) for seven days during waking hours. Physical activity data were included in the physical activity analyses if the accelerometer was worn for ≥600 minutes on ≥three days/week. The Evenson cut-points were used to categorize the intensity of physical activity.

OUTCOME MEASURES: INDICATORS OF ADIPOSITY
At each measurement point, trained research assistants used the International Society for Advanced Kinanthropometry (ISAK) procedures to assess height and weight. Participants were required to complete the assessments in light clothing and wearing no shoes. Weight was measured to the nearest 0.1kg on a portable digital scale (Model no. UC-321PC, A&D Company.
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Height was measured to the nearest 0.1cm using a portable stadiometer (Model no. PE087, Mentone Educational Centre, Australia). Two recordings of height (cm) and weight (kg) measures were taken to calculate baseline BMI (weight (kg)/height (m)^2). BMI z-scores were calculated using the WHO 2007 growth reference ranges for 5–19 years of age.\(^{49}\)

**STATISTICAL ANALYSIS**

Data were analysed using SAS Version 9.2 (SAS Institute Inc., Cary, NC, USA). Summary statistics were used to describe student characteristics and accelerometer wear time. Participants were categorized as ‘active’ at baseline if they participated in ≥60 minutes of MVPA/day and ‘inactive’ if they participated in <60 minutes of MVPA/day. Weight status (underweight/healthy weight; overweight/obese) was categorized according to International Obesity Task Force (IOTF) cut-points.\(^{50}\) Participants with a baseline BMI ≥60kg/m^2 and weight ≥150kg were excluded from the analysis. The characteristics of those that provided follow-up data were compared to those that did not, using t-tests for continuous variables and chi-squared tests for categorical variables.

The study was powered on the primary trial outcome (daily minutes of MVPA), based on ten schools providing 120 students/school (assuming 50% of the Grade consented and provided valid accelerometer data).\(^ {51,52}\) If 65% of the cohort provided usable data at 24 months\(^ {53}\), and after adjustment for a design effect of 1.38, the effective sample size was estimated to be 141 students per group. Previous studies were used to estimate the standard deviation of mean daily minutes of MVPA/group (17.1)\(^ {54}\) and Intra Class Correlation coefficient (0.01).\(^ {55}\) With 80% power and an alpha level of 0.05, the study was able to detect a difference in daily mean minutes of MVPA between intervention and control students of +/-5.73 minutes at 24 months.
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Based on this, the detectable difference for weight with a standard deviation of 12.1kg was 4kg.

Analyses followed intention-to-treat principles. Significance levels were set at p<0.05. Linear mixed models (LMM) were used to examine the outcome measures of weight, BMI and BMI z-score. A three level hierarchical model was used to capture correlations in the data with random intercepts for repeat measures (level 1), on individuals (level 2), and clustering within schools (level 3). The LMM analyses aimed to determine if there was a significant difference in mean change from baseline to 12-months and baseline to 24-months between intervention and control groups for each outcome measure, both assessed using an interaction term between treatment group (intervention vs control) and time (baseline vs 12-months, and baseline vs 24-months). Two sensitivity analyses were conducted, first using only those that provided complete adiposity outcomes at all three time points (complete cases), and secondly using multiple imputation to fill-in the missing data. The multiple imputation model used the method of chained regression equations including variables that were prognostic of missing data and additional demographic and outcome data to create five imputed datasets. The results from fitting the LMM were pooled over the five datasets using Rubin’s method.

SUB-ANALYSES

Exploratory sub-analyses (defined a priori) were undertaken to determine whether the intervention impacted on the outcome measures for students according to three moderators of energy balance; i) sex (male; female), ii) baseline BMI (underweight/healthy weight; overweight/obese) and iii) baseline physical activity level (active; inactive). The moderator interaction terms were included in individual LMM analyses for each outcome, and the p-value
CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT.

for the three-way interaction term (group*time*moderator) was used to assess the level of evidence against the null hypothesis of no effect modification. Treatment effects are presented within each subgroup regardless of this p-value.

RESULTS

SAMPLE

Of 22 eligible schools, 13 were approached to participate in the study. Ten schools consented to participate (77%) and parental consent was obtained for 1233 of the 1468 Grade 7 students in the 10 schools (84%). A total of 1150 students provided adiposity outcome data at baseline, 1051 (91%) at mid-point (12-months), and 985 (86%) at 24-months. Demographic characteristics of the sample at baseline, 12- and 24-month are outlined in Table 6.1. At baseline, the mean age of participants was 12 years, 51% were female, 17% were overweight and 5% were obese, and 64% did not meet physical activity recommendation of ≥60 minutes of MVPA/day. Participants who were lost to follow up were more likely to be older in age (p=0.03) and did not speak English as a primary language (p=0.02) compared to those who provided outcome data at all time-points.
**TABLE 6.1: Sample characteristics at baseline, 12- and 24-months for students who provided adiposity outcome measures**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgroup</th>
<th>Baseline</th>
<th></th>
<th>Midpoint (12 months)</th>
<th></th>
<th>Follow-up (24 months)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Control</td>
<td>Intervention</td>
<td>Control</td>
<td>Intervention</td>
<td>Control</td>
<td>Intervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(n=505)</td>
<td>(n=645)</td>
<td>(n=459)</td>
<td>(n=592)</td>
<td>(n=425)</td>
<td>(n=560)</td>
</tr>
<tr>
<td>Sex^1</td>
<td>Male</td>
<td>244 (49%)</td>
<td>299 (48%)</td>
<td>219 (48%)</td>
<td>268 (46%)</td>
<td>219 (52%)</td>
<td>266 (48%)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>254 (51%)</td>
<td>329 (52%)</td>
<td>233 (52%)</td>
<td>311 (54%)</td>
<td>204 (48%)</td>
<td>287 (52%)</td>
</tr>
<tr>
<td>Aboriginal and Torres Strait Islander (ATSI)^2</td>
<td>No</td>
<td>456 (91%)</td>
<td>581 (92%)</td>
<td>415 (91%)</td>
<td>540 (92%)</td>
<td>390 (92%)</td>
<td>520 (93%)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>44 (8.8%)</td>
<td>53 (8.4%)</td>
<td>39 (8.6%)</td>
<td>45 (7.7%)</td>
<td>35 (8.2%)</td>
<td>40 (7.1%)</td>
</tr>
<tr>
<td>Language^3</td>
<td>English</td>
<td>474 (97%)</td>
<td>593 (99%)</td>
<td>425 (97%)</td>
<td>539 (98%)</td>
<td>392 (97%)</td>
<td>506 (98%)</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>15 (3.1%)</td>
<td>8 (1.3%)</td>
<td>11 (2.5%)</td>
<td>9 (1.6%)</td>
<td>11 (2.7%)</td>
<td>8 (1.6%)</td>
</tr>
<tr>
<td>Socio-economic Indexes for Australia (SEIFA)^4</td>
<td>Low</td>
<td>295 (61%)</td>
<td>349 (59%)</td>
<td>260 (60%)</td>
<td>308 (57%)</td>
<td>236 (59%)</td>
<td>285 (56%)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>190 (39%)</td>
<td>246 (41%)</td>
<td>172 (40%)</td>
<td>235 (43%)</td>
<td>163 (41%)</td>
<td>222 (44%)</td>
</tr>
<tr>
<td>Rurality</td>
<td>Metropolitan</td>
<td>236 (47%)</td>
<td>340 (53%)</td>
<td>220 (48%)</td>
<td>324 (55%)</td>
<td>207 (49%)</td>
<td>304 (54%)</td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>269 (53%)</td>
<td>305 (47%)</td>
<td>239 (52%)</td>
<td>268 (45%)</td>
<td>218 (51%)</td>
<td>256 (46%)</td>
</tr>
<tr>
<td>BMI category^5</td>
<td>Underweight</td>
<td>30 (6.3%)</td>
<td>41 (7.3%)</td>
<td>19 (5.8%)</td>
<td>29 (6.9%)</td>
<td>7 (2.0%)</td>
<td>12 (2.5%)</td>
</tr>
<tr>
<td></td>
<td>Normal Weight</td>
<td>321 (67%)</td>
<td>397 (71%)</td>
<td>214 (65%)</td>
<td>291 (69%)</td>
<td>214 (62%)</td>
<td>320 (66%)</td>
</tr>
<tr>
<td></td>
<td>Overweight</td>
<td>100 (21%)</td>
<td>97 (17%)</td>
<td>72 (22%)</td>
<td>75 (18%)</td>
<td>95 (28%)</td>
<td>111 (23%)</td>
</tr>
<tr>
<td></td>
<td>Obese</td>
<td>29 (6.0%)</td>
<td>27 (4.8%)</td>
<td>25 (7.6%)</td>
<td>24 (5.7%)</td>
<td>27 (7.9%)</td>
<td>45 (9.2%)</td>
</tr>
<tr>
<td>MVPA^6</td>
<td>Inactive</td>
<td>324 (67%)</td>
<td>414 (67%)</td>
<td>277 (72%)</td>
<td>340 (68%)</td>
<td>226 (72%)</td>
<td>261 (66%)</td>
</tr>
<tr>
<td></td>
<td>[≤60min/day]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Active</td>
<td>162 (33%)</td>
<td>207 (33%)</td>
<td>108 (28%)</td>
<td>158 (32%)</td>
<td>90 (28%)</td>
<td>137 (34%)</td>
</tr>
<tr>
<td></td>
<td>[≥60min/day]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 6.1: Summary of Baseline and Follow-Up Data for Adiposity Measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgroup</th>
<th>Baseline</th>
<th>Midpoint (12 months)</th>
<th>Follow-up (24 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Control (n=505)</td>
<td>Intervention (n=645)</td>
<td>Control (n=459)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>median</td>
<td>12 (11,13)</td>
<td>12 (11,13)</td>
<td>13 (12,14)</td>
</tr>
<tr>
<td></td>
<td>(min,max)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Height</strong></td>
<td>mean (SD)</td>
<td>156.81 (7.92)</td>
<td>157.13 (7.47)</td>
<td>162.56 (8.20)</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>mean (SD)</td>
<td>50.01 (12.05)</td>
<td>49.43 (11.05)</td>
<td>55.96 (12.60)</td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td>mean (SD)</td>
<td>20.19 (3.81)</td>
<td>19.90 (3.59)</td>
<td>21.04 (3.76)</td>
</tr>
<tr>
<td><strong>BMI Z-score</strong></td>
<td>mean (SD)</td>
<td>0.58 (1.16)</td>
<td>0.54 (1.11)</td>
<td>0.61 (1.13)</td>
</tr>
</tbody>
</table>

**Missing numbers:**
- 1 baseline (control=7, intervention=17), midpoint (control=7, control=13), follow-up (control=2, intervention=7); 2 baseline (control=5, intervention=11), midpoint (control=5, control=7), follow-up (control=0, intervention=0); 3 baseline (control=16, intervention=44), midpoint (control=23, control=44), follow-up (control=22, intervention=46); 4 baseline (control=20, intervention=50), midpoint (control=27, control=49), follow-up (control=26, intervention=53); 5 baseline (control=25, intervention=63), midpoint (control=129, control=173), follow-up (control=82, intervention=72); 6 baseline (control=10, intervention=24), midpoint (control=74, control=94), follow-up (control=109, intervention=129). Participants (n): 7 baseline (control=491, intervention=593), midpoint (control=409, control=516), follow-up (control=407, intervention=534); 8 baseline (control=491, intervention=587), midpoint (control=440, control=562), follow-up (control=410, intervention=547); 9 baseline (control=491, intervention=584), midpoint (control=440, control=562), follow-up (control=409, intervention=547); 10 baseline (control=484, intervention=571), midpoint (control=406, control=502), follow-up (control=343, intervention=488).
At 24-months, all five intervention schools had implemented six of the seven physical activity strategies. The exception was strategy 5 (school policy); four of the five schools had developed a school policy. All intervention implementation strategies were delivered as planned. The majority of intervention group PE teachers (n=35) reported using pedometers to increase activity levels in PE (88.9%), and 58.8% reported including student physical activity plans each term. All schools were represented by at least one PE teacher (range 1–5) at each professional learning workshop. More information on intervention delivery can be found in the 24-month physical activity outcome paper.16

**INDICATORS OF ADIPOSITY**

The results for the 12- and 24-month adiposity outcomes are presented in Table 6.2. At 12-months, there were group-by-time effects for weight (mean difference (95%CI) =-0.90kg (-.50;-0.30), p<0.01) and BMI (-0.28kg/m² (-0.50;-0.06), p=0.01) in favour of the intervention group, but not for BMI z-score (-0.05 (-0.11;0.01), p=0.13). These findings were consistent for weight (-0.62kg (-1.21;-0.03), p=0.01) and BMI (-0.28 kg/m² (-0.49;-0.06), p=0.01) at 24-months, with group-by-time effects also found for BMI z-score (-0.08 (-0.14;-0.02), p=0.02) favouring the intervention group. Intervention effects were significant for all adiposity outcomes at 12- and 24-months based on in both the multiple imputation analyses and complete cases analyses (Appendix 5.1d and Appendix 5.1e Sensitivity analyses from baseline to 24-month follow-up).
TABLE 6.2: Changes in adiposity outcomes from baseline to 12- and 24 month follow-up

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention</th>
<th>Control</th>
<th>Intervention-Control</th>
<th>Group x time p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline (n=645) mean (95%CI)</td>
<td>Baseline (n=505) mean (95%CI)</td>
<td>Baseline – 12m p-value</td>
<td>Baseline – 24m p-value</td>
</tr>
<tr>
<td></td>
<td>12m (n=592) mean (95%CI)</td>
<td>24m (n=560) mean (95%CI)</td>
<td>12m (n=459) mean (95%CI)</td>
<td>24m (n=425) mean (95%CI)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>50.08 (48.83, 51.34)</td>
<td>55.91 (54.65, 57.17)</td>
<td>50.04 (48.69, 51.38)</td>
<td>56.48 (55.13, 57.83)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>20.27 (19.76, 20.78)</td>
<td>21.07 (20.56, 21.59)</td>
<td>20.19 (19.65, 20.72)</td>
<td>21.27 (20.73, 21.81)</td>
</tr>
<tr>
<td>BMI Z-score</td>
<td>0.62 (0.47, 0.77)</td>
<td>0.61 (0.46, 0.75)</td>
<td>0.59 (0.43, 0.74)</td>
<td>0.66 (0.50, 0.81)</td>
</tr>
</tbody>
</table>
CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT.

SUBGROUP ANALYSES

The results of the subgroup analyses are presented in Table 6.3, 6.4 and 6.5

Sex

There was weak evidence of a differential treatment on effect on weight in males compared to females (3-way interaction p=0.22). Among males there was a statistically significant treatment effect at 24-months in favour of the intervention group (-1.26kg (-2.11,-0.41), p=0.01). There were no significant effects on weight, BMI and BMI z-score at either 12- or 24-months for females (Table 6.3).
TABLE 6.3: Changes in adiposity outcomes from baseline to 12- and 24 months follow-up by sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>Outcome</th>
<th>Intervention</th>
<th>Control</th>
<th>Intervention-Control Difference in change between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>12m</td>
<td>24m p-value</td>
<td>Baseline – 12m p-value</td>
</tr>
<tr>
<td>Male</td>
<td>Weight (kg)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
<td></td>
<td>(male=299;</td>
<td>(male=268; female=311)</td>
<td>(male=266; female=287)</td>
<td>(male=244; female=254)</td>
</tr>
<tr>
<td></td>
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<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
<td></td>
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<td>48.87 (47.43,50.31)</td>
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</tr>
<tr>
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<td>57.10 (60.21,63.11)</td>
<td>63.99 (62.40,65.59)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>0.69 (-1.54,0.16)</td>
<td>0.11 (-2.11,-0.41)</td>
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</tr>
<tr>
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<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
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<tr>
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<td>19.87 (19.36,20.38)</td>
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<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
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<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.63 (0.45,0.80)</td>
<td>0.56 (0.38,0.73)</td>
<td>0.58 0.06</td>
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<td></td>
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<td>(0.41,0.75)</td>
<td>(0.45,0.80)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.10 (-0.16,0.02)</td>
<td>0.19 (-0.16,0.02)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>Weight (kg)</td>
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<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>51.53 (49.33,53.73)</td>
<td>56.77 (54.57,58.97)</td>
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</tr>
<tr>
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<td>59.54 (57.22,61.86)</td>
<td>59.54 (57.22,61.86)</td>
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</tr>
<tr>
<td></td>
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<td>0.45 (-1.32,0.20)</td>
<td>0.35 (-1.09,0.48)</td>
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</tr>
<tr>
<td></td>
<td>BMI (kg/m²)</td>
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<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
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<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
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<td>21.64 (20.87,22.41)</td>
<td>22.51 &lt;.01</td>
</tr>
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<td>(21.74,23.28)</td>
<td>(21.74,23.28)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>0.12 (-0.60,0.06)</td>
<td>0.30 (-0.65,0.04)</td>
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</tr>
<tr>
<td></td>
<td>BMI Z-score</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
<td></td>
<td>(male=299;</td>
<td>(male=268; female=311)</td>
<td>(male=266; female=287)</td>
<td>(male=244; female=254)</td>
</tr>
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<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.60 (0.41,0.79)</td>
<td>0.64 (0.45,0.84)</td>
<td>0.78 &lt;.01</td>
</tr>
<tr>
<td></td>
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<td>(0.45,0.84)</td>
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<tr>
<td></td>
<td></td>
<td>0.07 (-0.18,-0.01)</td>
<td>0.43 (-0.12,0.05)</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT.

Weight status at baseline

We found very little evidence of differential treatment effects depending on baseline weight for weight (p=0.50), BMI (p=0.57) or BMI z-score (p=0.64). Nevertheless, we did observe the following:

Among underweight and normal weight participants combined, there were significant effects for weight (-0.71kg (-1.28; -0.14), p=0.04), BMI (-0.33kg/m² (-0.55; -0.10), p=0.01) and BMI z-score (-0.08 (-0.15; -0.01), p=0.01) in favour of the intervention group at 12-month follow-up. Similar findings for weight (-0.71kg (-1.28; -0.14), p=0.04), BMI (-0.33 kg/m² (-0.55; -0.10), p=0.01) and BMI z-score (-0.08 (-0.15; -0.01), p=0.01) in underweight/normal weight participants were found at 24-months in favour of the intervention group.

Among overweight and obese students, no significant effects were found at 12- or 24-months for weight (12-month =-1.29kg (-3.12;0.53), p=0.16; 24-month =-1.16kg (-2.98;0.67), p=0.30), BMI (12-month =-0.39 kg/m² (-1.01;0.22), p=0.21; 24-month =-0.18 kg/m² (-0.80;0.44), p=0.45) and BMI z-score (12-month =-0.07 (-0.21;0.07), p=0.31; 24-month =-0.00 (-0.14;0.14), p=0.54) (Table 6.4).

Physical activity level at baseline

We found no evidence of differential treatment effects depending on activity status at baseline for weight (p=0.94), BMI (p=0.95) or BMI z-score (p=0.31). There was no significant effect on weight, BMI or BMI z-score for either active or inactive students at 12- or 24-months (Table 6.5).
TABLE 6.4: Changes in adiposity outcomes from baseline to 12- and 24- months follow-up by BMI

<table>
<thead>
<tr>
<th>BMI</th>
<th>Outcome</th>
<th>Intervention</th>
<th>Control</th>
<th>Intervention-Control Difference in change between groups</th>
<th>Group x time p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline (BMI&lt;25=438; BMI&gt;25=124) Mean (95%CI)</td>
<td>12m (BMI&lt;25=392; BMI&gt;25=106) Mean (95%CI) 24m (BMI&lt;25=368; BMI&gt;25=105) Mean (95%CI)</td>
<td>p-value (baseline to 24m) (BMI&lt;25=351; BMI&gt;25=129) Mean (95%CI) 24m (BMI&lt;25=316; BMI&gt;25=105) Mean (95%CI)</td>
<td>p-value (baseline to 12m) p-value Baseline – 12m p-value Baseline – 24m p-value</td>
<td>p-value Baseline – 24m p-value</td>
</tr>
<tr>
<td></td>
<td>Weight (kg)</td>
<td>45.33 (44.57,46.08)</td>
<td>51.03 (50.27,51.80) 56.12 (55.35,56.89)</td>
<td>44.65 (43.82,45.49) 50.81 (49.97,51.66) 56.15 (55.30,57.00)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Underweight/healthy weight</td>
<td>BMI (kg/m^2)</td>
<td>18.42 (18.19,18.65)</td>
<td>19.24 (19.00,19.48) 20.01 (19.77,20.25)</td>
<td>18.32 (18.07,18.58) 19.39 (19.13,19.65) 20.24 (19.97,20.50)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>BMI Z-score</td>
<td>0.12 (0.03,0.22)</td>
<td>0.13 (0.03,0.23) 0.23 (0.13,0.33)</td>
<td>0.06 (-0.05,0.16) 0.16 (0.06,0.27) 0.24 (0.13,0.35)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Overweight/obese</td>
<td>Weight (kg)</td>
<td>64.49 (62.20,66.78)</td>
<td>70.62 (68.26,72.97) 76.28 (73.94,78.63)</td>
<td>64.67 (62.40,66.94) 72.09 (69.76,74.42) 77.62 (75.28,79.97)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>BMI (kg/m^2)</td>
<td>25.36 (24.44,26.28)</td>
<td>26.07 (25.13,27.01) 26.89 (25.95,27.83)</td>
<td>25.41 (24.48,26.34) 26.51 (25.57,27.46) 27.12 (26.17,28.07)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>BMI Z-score</td>
<td>2.04 (1.89,2.19)</td>
<td>1.96 (1.81,2.12) 1.97 (1.81,2.12) 0.19</td>
<td>2.07 (1.92,2.22) 2.06 (1.90,2.22) 2.00 (1.84,2.16) 0.34</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT.
### TABLE 6.5: Changes in adiposity outcomes from baseline to 12- and 24 months follow-up by physical activity level

<table>
<thead>
<tr>
<th>Physical Activity Status</th>
<th>Outcome</th>
<th>Intervention</th>
<th>Control</th>
<th>Intervention-Control</th>
<th>Difference in change between groups</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Baseline</td>
<td>12m</td>
<td>24m</td>
<td>p-value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(&lt;60 min=414;</td>
<td>(&lt;60 min=371;</td>
<td>(&lt;60 min=166)&lt;60 min=344;</td>
<td>(&lt;60 min=162)&lt;60 min=324;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;60 min=207)</td>
<td>&gt;60 min=171)</td>
<td>&gt;60 min=168)</td>
<td>&gt;60 min=144)</td>
</tr>
<tr>
<td>&lt;60 min</td>
<td>Weight (kg)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.54 (49.26,51.83)</td>
<td>56.27 (54.98,57.56)</td>
<td>61.15 (59.85,62.44)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20.30 (19.80,20.81)</td>
<td>21.15 (20.64,21.65)</td>
<td>21.93 (21.42,22.44)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.58 (0.44,0.72)</td>
<td>0.59 (0.45,0.74)</td>
<td>0.66 (0.51,0.80)</td>
<td>0.01</td>
</tr>
<tr>
<td>&gt;60 min</td>
<td>Weight (kg)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
<td>Mean (95%CI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48.07 (46.05,50.09)</td>
<td>54.01 (51.98,56.04)</td>
<td>59.77 (57.73,61.80)</td>
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<tr>
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<td>19.64 (18.92,20.36)</td>
<td>20.35 (19.63,21.08)</td>
<td>21.16 (20.44,21.88)</td>
<td>&lt;.01</td>
</tr>
<tr>
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<td>0.55 (0.30,0.79)</td>
<td>0.50 (0.26,0.74)</td>
<td>0.60 (0.36,0.85)</td>
<td>0.03</td>
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CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT.
DISCUSSION

This paper reports the 12- and 24-month effects of the PA4E1 trial on the secondary outcomes of weight, BMI and BMI z-score. The trial had a favourable impact on adiposity outcomes, having a moderate effect on weight and BMI at 12-months, and weight, BMI and BMI z-score at 24-months. A difference in BMI of -0.28kg/m² over 24-months between intervention and control groups is twice the effect found in a meta-analysis of 11 school-based physical activity intervention studies (-0.13 kg/m²) \(^{10}\). However, of the 11 physical activity interventions, only two were conducted in secondary schools, and only one of these during school time.\(^{10}\) In the latter study, the effectiveness of a 12-week school exercise training program was tested in 24 obese adolescent males, and found a significant intervention effect of -0.59 kg/m² (95%CI = -1.4;0.23).\(^{57}\) The small sample in a high risk, single-sex obese subgroup and the short intervention duration makes it difficult to equate to the PA4E1 trial. In an earlier meta-analysis of 18 studies, the intervention effect on BMI was much lower at -0.05 kg/m² (-0.19;0.10).\(^{9}\) However, only two of the 18 studies exclusively investigated the effect of a physical activity intervention in middle or secondary school students.\(^{9}\)

The exploratory subgroup analyses found a significant effect at 24-months, favouring the intervention group on i) weight among male adolescents, and ii) weight, BMI and BMI z-score among underweight/healthy weight adolescents. There were no treatment effects on any of the adiposity measures for the other subgroups examined including females, overweight/obese students, or active/inactive students. Although the moderator analyses indicate that the PA4E1 trial was effective in limiting weight and BMI increases in the
in the underweight/healthy weight subgroup, there was no evidence that the intervention had an adverse effect on underweight students as the proportion of underweight students decreased during the study, from 7.3% at baseline to 2.5% at 24 months. Weight, BMI and BMI z-score increased in both intervention and control underweight/healthy weight students, but increased to a lesser extent among students in the intervention group.

In the PA4E1 trial, 76% of students were not overweight or obese at baseline meaning a lower propensity to reduce adiposity measures. For this reason the authors of the HEALTHY study have suggested that although population-based primary prevention interventions should continue to target all children, the study aim and primary outcomes should be evaluated in the highest risk subgroup (overweight/obese adolescents) instead of the entire cohort. Although there were no significant intervention effects in the PA4E1 overweight/obese subgroup, the adiposity results for the intervention group are trending in the hypothesised direction and the effect was larger than that found in the main analysis and among healthy weight/underweight students. A lack of significant findings in overweight and obese students is likely to be a sample size issue, as the disproportionate number of adolescents in each weight status group may have contributed to the sub-analyses being underpowered.

At 24-months, the mean difference in BMI change between groups was -0.28 kg/m², with the intervention group’s students increasing BMI by 1.59 kg/m² and control by 1.87 kg/m² over two years. This BMI trajectory is higher (intervention=~0.80 kg/m²/year; control=~0.94 kg/m²/year) than that found in a longitudinal study in Britain that aimed to examine the
developmental trajectory of obesity throughout adolescence in relation to sex, ethnicity and socio-economic status in a cohort of 5,836 adolescents. Over five years from Grade 7 to Grade 11, BMI increased by 0.73 kg/m² per year. The rate of BMI increase did not differ by sex, however socio-economically disadvantaged and black female adolescents had higher rates of overweight and obesity. The higher BMI trajectory in participants of the PA4E1 trial may also explain why PA4E1 was effective in limiting the adiposity increases in underweight/healthy weight adolescents, but had a limited, non-significant effect on overweight and obese adolescents.

The majority of school-based physical activity interventions targeting adolescents from socio-economically disadvantaged communities have not reported the effect on adiposity outcomes, and few have found an intervention effect. However, the results of the PA4E1 trial are similar to findings from the ‘Intervention Centred on Adolescent Physical Activity and Sedentary Behaviour’ (ICAPS) study which found intervention effects on BMI z-score. Similar to the PA4E1 trial, ICAPS was a socio-ecologically framed, multicomponent intervention, implemented over a longer four year period. The intervention involved changing attitudes towards physical activity (i.e., educational component), promoting social support from teachers and parents (i.e., regular meetings), and providing environmental and institutional conditions to promote physical activity (e.g. break-time and after-school physical activity, sporting events and cycle to school days). The impact of ICAPS on adiposity (BMI z-score = -0.11; p=0.02) was comparable to PA4E1 (BMI z-score = -0.08; p<0.01), and were maintained two and a half years after the intervention had finished, indicating that the results could be sustained. Similar proportions of overweight and obese adolescents were reported in ICAPS
(23%) and PA4E1 (22%), and neither study found significant adiposity effects on adolescents who were initially overweight or obese. The findings provide evidence for long-term multicomponent interventions that target determinants at all socio-ecological levels (i.e. intrapersonal, interpersonal, organisation, community and policy).

PA4E1 is one of few school-based physical activity interventions to reduce the risk of overweight and obesity in adolescents living in socio-economically disadvantaged areas. A recent systematic review of childhood obesity prevention programs incorporating diet and physical activity strategies, found that the strength of evidence was high for physical activity-only interventions in schools with home involvement, and for combined diet-physical activity interventions delivered with both home and community components. The PA4E1 findings indicate that school-based physical activity-only interventions (with home and community components) show promise, particularly with adolescent populations. The impact of the intervention on adiposity outcomes could also be enhanced by incorporating a dietary school-based component with home and community involvement.

While the adiposity results are unlikely to be clinically significant at an individual level, the reduced adiposity trajectory may produce health benefits at a population level and over an individual’s life-time. A one percent reduction in the prevalence of overweight and obesity in 16-17 year old adolescents today has been projected to reduce the number of obese adults by 52,821 in the future, decrease total lifetime medical costs by $586.3 million dollars, and increase quality-adjusted life years by 47,138 years. The positive effect of PA4E1 on adiposity
may have occurred due to the increase in objectively-measured MVPA of seven more minutes of MVPA per day than the control students at 24-months.\textsuperscript{16} The PA4E1 intervention was a multicomponent and socio-ecologically framed school-based intervention, key elements which have been recommended to increase physical activity and reduce the prevalence of obesity during adolescence.\textsuperscript{11,12} The intervention addressed educational, curricular, and environmental changes in the school, supported by evidence from recent systematic reviews of school-based interventions.\textsuperscript{13,14} A ‘change agent’, who was a trained physical education teacher, visited each of the intervention schools one day per week for the duration of the intervention to support the school and PE teachers in implementing the strategies (the change agent did not deliver any classes). The use of strategies within a sustainable framework of PA4E1 makes it a potentially scalable intervention. The intervention could be disseminated more broadly in secondary schools by education departments, and therefore warrants dissemination evaluation.

The PA4E1 trial had several strengths including the RCT design, the long intervention duration and a large sample size. The trial included a suite of intervention implementation strategies based on theoretical frameworks and evidence from past school-based physical activity reviews. Analyses were repeated using complete cases only and multiple imputation which reported similar results to the main analysis in regards to weight, BMI and BMI z-score, suggesting that the findings are robust. A number of limitations of the trial need to be acknowledged. Although BMI is an acceptable measure of change in adiposity, direct measures, such as dual-energy radiography absorptiometry, give a more accurate measure of adiposity.\textsuperscript{66} While the trial was implemented over a 24-month period, the trial did not assess
whether the adiposity differences were sustained in the longer term once the ‘change agent’ ceased visiting the intervention schools. The students were recruited from moderate-to-large sized, socio-economically disadvantaged schools from one area in Australia, which may reduce the generalisability of the findings. The trial did not collect maturation data from students. The trial is likely to be underpowered for the subgroup analyses so these findings should be interpreted with caution, as the lack of a treatment effect may have been due to type II error (failing to detect an effect that is present). Assessment of the cost and cost effectiveness of the PA4E1 trial will be reported in a separate paper.

There is a need for innovative physical activity interventions to target adolescents most at risk of overweight and obesity. The results from the PA4E1 trial provide evidence for a multicomponent physical activity intervention implemented in secondary schools to have a moderate effect on adiposity outcomes at the population level among adolescents from socio-economically disadvantaged communities. Multicomponent interventions that increase adolescents’ engagement in MVPA may assist in preventing overweight and obesity.
REFERENCES


CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT


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29 Centres for Disease Control and Prevention. School Health Index: A Self-Assessment and Planning Guide. Middle school/ High school version. Atlanta, Georgia: Centre for Disease Control and Prevention, 2005.


CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT


CHAPTER 6: Effects of a 'school-based' physical activity intervention on adiposity in adolescents from economically disadvantaged communities: secondary outcomes of the 'Physical Activity 4 Everyone' RCT


CHAPTER 7

COST EFFECTIVENESS OF A MULTICOMPONENT SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTION TARGETING ADOLESCENTS: THE ‘PHYSICAL ACTIVITY 4 EVERYONE’ CLUSTER RANDOMIZED TRIAL.

A version of this chapter was published as a paper with the International Journal of Behavioral Nutrition and Physical Activity.

ABSTRACT

Background: Few school-based interventions have been successful in reducing physical activity decline and preventing overweight and obesity in adolescent populations. As a result, few cost effectiveness analyses have been reported. The aim of this paper is to report the cost and cost effectiveness of the Physical Activity 4 Everyone (PA4E1) trial which was a multicomponent intervention implemented in secondary schools located in socio-economically disadvantaged communities. Cost effectiveness was assessed using both physical activity and weight status trial outcomes.

Methods

Intervention and Study Design: The PA4E1 cluster randomised controlled trial was implemented in ten Australian secondary schools (five intervention: five control) and consisted of intervention schools receiving seven physical activity promotion strategies and six additional strategies that supported school implementation of the intervention components. Costs associated with physical activity strategies, and intervention implementation strategies within the five intervention schools were estimated and compared to the costs of usual physical activity practices of schools in the control group. The total cost of implementing the intervention was estimated from a societal perspective, based on the number of enrolled students in the target grade at the start of the intervention (Grade 7, n = 837).

Economic Outcomes: The economic analysis outcomes were cost and incremental cost effectiveness ratios for the following: minutes of moderate-to-vigorous physical activity (MVPA) per day gained, metabolic equivalent (MET) hours gained per person/day; Body Mass Index (BMI) unit avoided; and ten percent reduction in BMI z-score.

Results: The intervention cost AUD $329,952 over 24 months, or AUD$394 per student in the intervention group. This resulted in a cost effectiveness ratio of AUD$56 ($35 - $147) per additional minute of MVPA, AUD$1 ($0.6-$2.7) per MET hour gained per person per day, AUD$1408 ($788-$6,570) per BMI unit avoided, and AUD$563 ($282 - $3,942) per 10 percent reduction in BMI z-score.

Conclusion: PA4E1 is a cost effective intervention for increasing the physical activity levels and reducing unhealthy weight gain in adolescence, a period in which physical activity typically declines. Additional modelling could explore the potential economic impact of the intervention on morbidity and mortality.

Trial Registration

Australian New Zealand Clinical Trials Registry ACTRN12612000382875.

BACKGROUND

Regular physical activity has well established positive benefits for both physical and mental health, yet physical activity levels are known to decline throughout adolescence with only 20% of youth currently undertaking sufficient daily physical activity to obtain these health benefits. Physical inactivity is considered to directly contribute to 1.5% -3.0% of global health care costs, including direct and indirect health care costs. The large proportion of low-active adolescents, coupled with the global concern regarding overweight and obesity, make population-based interventions focused on physical activity promotion and obesity prevention in this population sub-group a public health priority. As both physical inactivity and overweight and obesity are more prevalent in adolescents from disadvantaged backgrounds, strategies targeting this population are particularly warranted.

School-based physical activity and lifestyle interventions show promise in addressing both physical inactivity and overweight and obesity. Schools provide almost universal access to children and adolescents, including those from socio-economically disadvantaged backgrounds. In addition, schools have the policies, resources, and teaching staff to adopt programs into usual school practice that are likely to impact on both physical activity and weight status. Despite this, successful interventions targeting adolescents are limited in number, particularly interventions that target adolescents from socio-economically disadvantaged backgrounds. A recent systematic review reported only 14 of 44 included school-based physical activity intervention trials targeted adolescents, of which only four resulted in significant physical activity intervention effects. Just two of the adolescent
trials focused on socio-economically disadvantaged adolescents, with one reporting significant intervention effects on physical activity. Additionally, a recent review of childhood and adolescent obesity prevention interventions reported multicomponent school-based physical activity interventions have resulted in only modest reductions in BMI (-0.13 kg/m², 95% CI -0.22 to -0.04). However, the review reported results for both children and adolescents combined, with the impact specifically on adolescents unknown. Systematic reviews of interventions that aim to prevent obesity have demonstrated smaller effects in adolescent populations in comparison to younger children.

In order for policy makers to allocate scarce health resources, economic evaluations of effective programs, ideally based on outcomes of randomised controlled trials, are needed. Cost-effectiveness analysis (CEA) aims to evaluate questions around the benefits of interventions relative to their cost in order to inform funding decisions and health care policy. CEA is used to determine technical efficiency. That is, the production of health benefit for the least cost. No single threshold exists for determining the acceptability of a cost effectiveness (CE) ratio. Rather, a variety of considerations, including the prosperity of a nation or health system, as well as the incremental value delivered by an intervention, influence funding decisions. Despite the valuable contribution of CEA, very few studies have evaluated school-based physical activity interventions from a cost effectiveness perspective. Even fewer studies have targeted adolescents and none have focussed on disadvantaged adolescents. Two recent systematic reviews of physical activity interventions reporting cost-effectiveness included school-based interventions, but neither separated the effects for elementary and secondary school-focussed interventions. The reported cost effectiveness of interventions included in the first review by Wu and colleagues (16 school-based trials, four
in adolescents) was based on costs obtained either directly from published cost analyses or imputed by the review authors.\textsuperscript{31} The second review by Laine and colleagues included school-based interventions from the Wu review\textsuperscript{31}, as well as modelled cost-effectiveness studies\textsuperscript{27} (total of six school-based trials, three in adolescents). While these reviews have limitations such as few of the studies assessing physical activity using objective measures\textsuperscript{32}, use of imputed cost estimates rather than actual costs and variability in study design (with rigorous well designed RCT’s tending to show smaller physical activity effectiveness and higher cost-effectiveness ratios)\textsuperscript{27, 31}, both reviews conclude that school-based physical activity interventions are cost effective compared to other population-based interventions in terms of physical activity outcomes.\textsuperscript{27, 31}

From an obesity prevention perspective, the Australian ACE Obesity prevention study conducted in 2003 used modelling techniques to review a portfolio of interventions targeting the prevention of childhood obesity.\textsuperscript{33} Five of the thirteen population level interventions were school-based. The review concluded that multi-strategic school-based interventions were cost effective (modelled to cost less than $50,000 AUD per DALY) and estimated at $211-$473 per student\textsuperscript{33}. However the strength of the evidence was often limited, weak or inconclusive with only seven of the 13 interventions included in the study being based on evidence of effect gained from randomised controlled trials.\textsuperscript{33} A further systematic review of eight childhood obesity primary prevention trials (including three school-based trials all targeting elementary aged children) reported school-based interventions were cost effective using a variety of cost effectiveness measures.\textsuperscript{34} The authors concluded that limited comparison between studies could be made due to the heterogeneity of outcome measures across the studies, low quality of included studies and the use of model-based studies to obtain an outcome rather than trial
outcome measures. Given the limitations of existing data there is an increasing demand for additional data on cost and cost effectiveness of school-based intervention for both physical activity and adiposity outcomes.

The Physical Activity 4 Everyone (PA4E1) trial involved a 24-month multicomponent school-based intervention implemented in secondary schools located in disadvantaged communities. The trial aimed to determine the effectiveness of the intervention in reducing the decline in physical activity among adolescents. The trial was one of a very limited number of school-based physical activity interventions that has demonstrated an increase in objectively measured physical activity coupled with a reduction in weight gain, and the first study in adolescents. At both 12- and 24-months, the trial reported improvements in daily moderate-to-vigorous physical activity (MVPA) together with a positive effect for weight and body mass index (BMI) in favour of the intervention group. In addition, a significant intervention effect was also observed for BMI Z-score at 24-months. Due to the limited literature outlining the cost effectiveness of school-based interventions that can impact on both physical activity and weight status in adolescents, the aim of this study was to assess the costs of the PA4E1 intervention, and the cost effectiveness of the intervention considering both physical activity and weight status trial outcomes.

**METHODS**

**INTERVENTION TRIAL DESIGN, SETTING AND SAMPLE**

A cluster randomised trial was conducted involving randomly selected secondary schools (five intervention and five control schools) in socio-economically disadvantaged communities in New South Wales (NSW), Australia. Outcome assessments were conducted with a cohort of
students at baseline (when students were in Grade 7), 12-month (mid-intervention) and 24-
month post-randomisation follow-up. Details of the study methods have been reported
elsewhere\textsuperscript{16}, along with the intervention effects at 12-months\textsuperscript{35} and 24-months.\textsuperscript{39,40}
The trial was registered with the Australian New Zealand Clinical Trials Registry
(\textit{ACTRN1261200038287}) and approved by the Hunter New England Area Human Research
Ethics Committee (11/03/16/4.0) and the University of Newcastle Human Research Ethics
Committee (H-2011-0210). The study adhered to the Consolidated Standards of Reporting
Trials (\textit{CONSORT}) guidelines (http://www.consort-statement.org), and the Consolidated
Health Economic Evaluation Reporting Standards (\textit{CHEERS}) Statement (http://www.equator-
network.org/reporting-guidelines/cheers/).\textsuperscript{41}

\section*{ECONOMIC STUDY AND SETTING}

A trial-based retrospective economic evaluation of a multicomponent school-based physical
activity intervention (PA4E1) versus usual school physical activity practice was conducted from
a societal perspective. The outcomes for the economic analysis were the cost and incremental
cost effectiveness ratios per: minute of MVPA per day gained; metabolic equivalent (MET)
hour gained per person/ day; BMI unit avoided; and ten percent reduction in BMI z-score.

\section*{THE PA4E1 TRIAL}

The intervention, implemented in secondary schools based in socio-economically
disadvantaged communities located in NSW, Australia, was delivered to all students who
commenced Grade 7 in 2012, through incorporating the intervention as part of usual school
business. The intervention was implemented over 7-8 school terms (average 24 months) and
consisted of embedding seven physical activity strategies across the domains of the Health Promoting Schools Framework\textsuperscript{42} into the school community. The seven physical activity strategies included: more active physical education (PE) lessons; development of personal physical activity plans; delivery of a ten week enhanced school sport program (Program X\textsuperscript{43,44}); conducting supervised recess and/or lunch physical activity opportunities; supportive school physical activity policy; and linking with the community and linking with parents (Figure 7.1. Intervention overview – physical activity and intervention implementation strategies \textsuperscript{39}). In addition to the physical activity strategies, six evidenced-based implementation support strategies were delivered\textsuperscript{45-49} including: an in-school physical activity consultant, executive support, teacher training, resources, prompts and monitoring reports (Figure 7.1). Schools allocated to the control group participated in the measurement components of the trial only and delivered physical activity teaching and promotion practices according to the PE curriculum and school-based initiatives. Intervention materials were provided to control schools following the 24-month assessments.
**CHAPTER 7: Cost effectiveness of a multicomponent school-based intervention targeting adolescents: the ‘Physical Activity 4 Everyone’ trial.**

### Baseline measures (Intervention & control group)
- 7 days accelerometry
- Online student survey
- Anthropometry

### Student measures
- 7 days accelerometry
- Online student survey
- Anthropometry

<table>
<thead>
<tr>
<th>Intervention Component</th>
<th>Intervention standard set</th>
<th>Dose to be delivered from intervention commencement to 24 month follow-up in INV schools</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical activity strategies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal curriculum</td>
<td>1. Teachers should maximise student activity in PE. 2 x pedometer based lessons per teacher each term used to build understanding of activity levels.</td>
<td>1. 14-16 pedometer lessons per class</td>
</tr>
<tr>
<td>1. Active PE lessons</td>
<td>2. 1 x personal student PA plan developed and reviewed each school term</td>
<td>2. 7-8 Personal PA plans developed per student</td>
</tr>
<tr>
<td>2. Personal PA plans</td>
<td>3. Program X (10 week program) delivered to all students</td>
<td>3. All students attend Program X in Grade 8</td>
</tr>
<tr>
<td>3. Enhanced Sport (Program X)</td>
<td>4. Activities offered and equipment available at least twice per week</td>
<td>4. Offered twice per week at each school</td>
</tr>
<tr>
<td>School ethos &amp; environment</td>
<td>5. School PA policy modified or developed</td>
<td>5. School PA policy developed/updated by completion of intervention period</td>
</tr>
<tr>
<td>4. Recess and/or Lunchtime activities</td>
<td></td>
<td>6. 7-8 parent newsletters issued &amp; website</td>
</tr>
<tr>
<td>5. Supportive school PA policy</td>
<td></td>
<td>7. 3-5 community activity provider expos run for students per school (at least 3-5 providers) (Grade 8)</td>
</tr>
<tr>
<td><strong>Partnerships and services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Linking with parents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Linking with community PA providers</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intervention implementation strategies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In school PA consultant (change agent)</td>
<td>1. Attends school 1 x day/ week</td>
<td>1. 70-80 days per school</td>
</tr>
<tr>
<td>2a. Partnership agreement signed</td>
<td></td>
<td>2. Agreement signed. Committee formed in all schools. Committee met 1 x per term (6-7 meetings per school)</td>
</tr>
<tr>
<td>2b. School committee established. School executive membership represented on committee</td>
<td></td>
<td>3. 3x2 hour sessions (one in 2012, 2 in 2013) (focus on active PE teaching) – attendance by at least one PE staff member from each school.</td>
</tr>
<tr>
<td>3. Joint school professional development training</td>
<td></td>
<td>4. Delivered to schools. Storage box provided to support student access to equipment</td>
</tr>
<tr>
<td><strong>Intervention period</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 2012 to March/June 2014 (7-8 school terms depending on when data collection occurred in each school)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIGURE 7.1: Intervention overview – physical activity and intervention implementation strategies
MEASUREMENT OF STUDY OUTCOMES

PHYSICAL ACTIVITY:

Accelerometer data were used to derive the physical activity outcome measure, duration (minutes) of MVPA per day. Accelerometer non-wear time was defined as 30 minutes of consecutive zeros. Counts were collected in 15 second epochs and counts per minute calculated by dividing the total accelerometer counts by the minutes of wear time. The Evenson cut-points were used to categorise the intensity of physical activity (moderate or vigorous). Mins per day of MVPA were calculated for students who wore accelerometers for ≥ 600 minutes on ≥ three days. The conversion of minutes of MVPA per day to MET hours gained per person/ day was undertaken to aid the comparison with other cost effectiveness studies of physical activity interventions. A MET represents energy expended divided by resting energy expenditure. Determining MET hours gained accounts for the variety of physical activity measures in use and takes into account a range of parameters including intensity, duration and frequency of physical activity. To determine MET hour gained per person/day, the difference in daily minutes of MVPA between the intervention and the control groups was converted to MET hours gained, following the steps outlined by Wu et al, and replicated in a subsequent systematic review by Laine et al. Using validated measures, moderate physical activity is assigned 3.0 to 6.0 METS, vigorous activity >6.0 METS and MVPA is assigned 4.5 METS. This process of converting minutes of MVPA per day to MET hours gained involves multiplying mean minutes MVPA/ day by MET assigned, divided by 60 minutes.
WEIGHT STATUS:

Anthropometric data were collected in duplicate by trained research assistants using the International Society for Advanced Kinanthropometry (ISAK) procedures to measure student height and weight. Students completed the measurements in light clothing without shoes. Weight was measured to the nearest 0.1kg on a portable digital scale (Model no. UC-321PC, A&D Company Ltd, Tokyo Japan). Height was measured to the nearest 0.1cm using a portable stadiometer (Model no. PE087, Mentone Educational Centre, Australia). Body mass index (BMI) was calculated (weight (kg) / height (m)^2) and weight status determined using the International Obesity Taskforce definitions.

MEASUREMENT OF COSTS

The cost and incremental costs associated with the implementation of the physical activity intervention and intervention implementation strategies were calculated as those costs additional to the costs of usual physical activity practices of schools. The total cost of implementing the intervention was estimated from a societal perspective. Costs incurred for research and development were excluded in order to only capture the costs of replicating the intervention. Resource use categories included personnel costs, materials and printing. Personnel costs included opportunity costs for the delivery of strategies by school staff and community sport and fitness providers. All costs are reported in 2014 Australian dollars. All other resource use categories were valued using market rates. Potential effects on healthcare costs were not included.

DIRECT COSTS OF THE INTERVENTION
Project records relating to intervention delivery, including costs, were kept throughout the trial. For the physical activity strategies (Figure 7.1), personnel costs included opportunity costs for delivery of strategies by school staff and community sport and fitness providers. Personnel costs for the implementation of strategies that occurred outside of PE and sport time were valued using the opportunity cost of forgone time. No opportunity costs were assumed for physical activity strategies 1-3 (Active PE, personal physical activity plans, enhanced sport) as such strategies were implemented by staff within school PE and sport time as part of usual school business. Opportunity costs were included for physical activity strategies four, five and seven (organised recess and/or lunch activities, policy, community links) as strategy four (organised recess and/or lunch activities) involved the provision of additional staffing of playground areas, strategy five (policy) required time for policy development/modification and sign off, and strategy seven (community links) required time for school and community member involvement.

Costs incurred for the intervention implementation strategies (Figure 7.1) included personnel costs, equipment and travel/venue/meal expenses. Personnel costs included in-school consultant salary, payment of consultants to deliver PE teacher training, teacher relief to allow Health and Physical Education (PE) teachers to attend training, and opportunity costs (forgone time) associated with implementation strategy two (school leadership and committee) as staff attended additional committee meetings about intervention implementation. With respect to control schools, it was assumed that no additional costs were incurred in implementing their usual physical education practices. Australian Bureau of Statistics average earnings data (May 2014) were used to impute labour costs for community sport and fitness personnel.57 The

Industrial Relations Commission of NSW 2014 Award data were used to impute labour costs for teaching personnel.58

STATISTICAL ANALYSIS

Cost effectiveness analysis was undertaken from a societal perspective and all analyses were carried out using Microsoft Excel software 2013. The analysis was conducted on an intention to treat basis, with the total program cost being calculated for all enrolled students in the target Grade across the five intervention schools at baseline given these students would have been exposed to the intervention (n=837). Incremental cost effectiveness ratios (ICER) were calculated for each outcome measure and represent the additional expenditure required to deliver each additional unit of benefit. For the physical activity outcome measures, the ICERs calculated were the cost per student per mean minute of MVPA gained and cost per student per MET minute gained. To present the intervention cost per minute of MVPA gain, the total cost per student was divided by the mean difference in change in MVPA minutes between intervention and control groups over 24 months, to provide a cost per student per minute of additional MVPA. The cost per person/day is then divided by the MET hours gained per day, resulting in a cost effectiveness ratio per MET hour gained.27, 31.

For the weight status outcomes, the ICERs were calculated to represent the expenditure per student per BMI unit avoided and cost per student per 0.1 unit (10%) BMI z-score reduction. The total intervention cost per student was divided by mean difference in change in BMI and BMI z-score between groups over 24- months to provide a cost per BMI unit avoided and cost per 0.1 (10%) reduction in BMI z-score.59 The multicomponent intervention was delivered in its entirety to a cohort of students in Grade 7 at the beginning of the trial, followed through to Grade 9. Whilst the evaluation of the trial occurred within the cohort of students and the cost
effectiveness analysis has been conservatively calculated on the basis of the intervention benefiting only the cohort of students measured in the evaluation. Due to the nature of the intervention strategies (teacher training, school environment and broader school community links), it was likely the intervention had an impact on all students attending the school more broadly, not just on those students within the evaluation cohort. Univariate sensitivity analyses were undertaken to test plausible variation in the evaluation components as well as the impact of changing key design features of the trial, including broader exposure and an associated estimate of benefit. Table 7.1 details the sensitivity tests that were modelled and provides justification for the assumptions made based on evaluations and empirical data from the PA4E1 trial: (i and ii) variation in the costs of specific intervention components (iii) variation in the magnitude of effect size using the upper and lower confidence interval limits; (iv) test assuming physical activity strategy four (recess and lunchtime activities) is extended to ten percent of students beyond the target grade, with a reduced effect on daily minutes of MVPA compared to students in the target grade; and (v) test assuming the benefits of physical activity strategy one (active PE), strategy five (physical activity policy) and implementation strategy one (change agent), two (executive support) and three (resources) are extended to all students (100%) outside the target year (in Grades 7-10), with a reduced effect on daily minutes of MVPA compared to students in the target grade. Aggregated costs across schools meant it was not possible to capture the cost profiles of individual student participants, prohibiting uncertainty analysis.
### TABLE 7.1: Sensitivity and scenario description: strategies and benefit

<table>
<thead>
<tr>
<th>Test to be modelled</th>
<th>Detailed assumptions</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Variation in the intervention cost</td>
<td>Higher estimate of the assumed opportunity cost of school staff participation in PA strategy (PAS) 4 &amp; 5 and implementation support strategy (ISS) 1</td>
<td>Plausible variation in the cost</td>
</tr>
<tr>
<td>(ii) Variation in the intervention cost</td>
<td>Lower estimate of the assumed opportunity cost of school staff participation in PAS 4 &amp; 5 and ISS 1</td>
<td>Plausible variation in the cost</td>
</tr>
<tr>
<td>(iii) Varying the magnitude of the effect size</td>
<td>Assumes benefit of the overall intervention varies between the calculated confidence interval of the effect size in daily minutes of MVPA</td>
<td>Plausible variation in the effect size</td>
</tr>
<tr>
<td>(iv) Extending the benefit of physical activity recess and lunchtime activities to students beyond the target year.</td>
<td>Assumes benefit of PAS 4 is extended to 10% of students beyond the target year, with a reduced effect on daily minutes of MVPA compared to students in the target year. Reduced effect estimate was based on the accelerometer data within the recess and lunchtime segment from the efficacy trial (unpublished). The number of additional students that may benefit from whole of school recess and lunchtime activities was conservatively estimated based on 10% of a multiple of 3X the mean number of students in the target year (n= 132).</td>
<td>It was likely these specific components of the intervention would impact students more broadly and not be isolated to those students within the evaluation cohort.</td>
</tr>
<tr>
<td>(v) Extending the benefit of multiple strategies to all students</td>
<td>Assumes benefit of PAS 1, PAS 5 and ISS 1, 2 and 3 are extended to all students (100%) outside the target year (in Grades 7-10), with a reduced effect on daily minutes of MVPA compared to students in the target year. The assumed effect size for the extension cohort was based on the results of the sensitivity analysis conducted within the efficacy trial (undertaken using imputation of missing data).</td>
<td>As above, due to the nature of the intervention strategies (teacher training, school environment and broader school community links) the intervention impact would likely not be isolated to the evaluation cohort. For example, once PE teachers are trained on how to maximise MVPA in PE, these strategies would likely be applied to all classes at no additional cost. The same assumption applies for other strategies such as a school physical activity policy, executive support, change agent, and use of resources. As such the cost of these strategies would not increase, however we have assumed there is potential for more students to benefit from a school implementing such strategies.</td>
</tr>
</tbody>
</table>
Scenario analysis

State wide roll out (current model)
Total cost of the intervention is based on the current implementation support model.
Assumes benefit to 100% of students, with an effect size based on the results of the sensitivity analysis conducted within the efficacy trial (undertaken using imputation of missing data).
The number of students (n=254,923) is based on a calculation from 487 NSW schools with Grades 7-10.

State wide roll out-Alternate (real world) model
The total cost of the intervention is modified to reflect (a) an alternate model of school support - existing in-school teacher to support role out (1/2 day per week (0.5 FTE/ ½ day per week) and (b) a reduction in the equipment cost per school. Whilst the offer of an equipment pack was an attractive selling point for schools to consent to the intervention, evaluation of this specific strategy highlighted that schools within the intervention group were well stocked with equipment. As such, the provision equipment was not deemed an essential component of the trial. Based on this observation, the assumption that reducing the intervention costs by removing the provision of equipment, would not substantively alter the impact of the intervention.
Assumes benefit to 100% of students, with an effect size based on the results of the sensitivity analysis conducted within the efficacy trial (undertaken using imputation of missing data).
The number of students (n=254,923) is based on a calculation from 487 NSW schools with Grades 7-10.
In addition, two scenario analyses, detailed in Table 7.1 were undertaken to explore the potential cost effectiveness of state-wide implementation of the intervention across NSW. There are 487 secondary schools catering for students in Grades 7 - 10 in NSW, with 254,923 students enrolled in these Grades. The first scenario used the current intervention implementation model within the target year across all applicable secondary schools in NSW. That is, those schools with Grades 7-10. Due to the logistical challenges of implementing trials across large groups of schools and based on questions posed to principals of participating schools, the second scenario analysis used a real world solution whereby the implementation of school-based physical activity practices is supported by an existing in-school teacher as an alternative to the school physical activity consultant employed in the efficacy trial. The potential model utilising an existing in-school teacher for providing guidance for schools was assumed for the intervention across Government and Catholic schools catering for students in Grades 7 to 10 across NSW (n = 487 secondary schools, catering for 254,923 students). The dissemination model included the costs of each school receiving relief funding for three periods per week for two years to support the implementation of the intervention within the school. This relief funding would allow an existing teacher within each secondary school to be released from classroom teaching to support the implementation within their school. This existing in-school teacher would be provided with teacher professional learning to enable them to embed the seven PA4E1 strategies within the school, using the same intervention implementation strategies used in PA4E1. Such a model was supported by principals of participating schools, who expressed a willingness to commit school resources for an in-school teacher for a period of 24- months. It was assumed that expansion of the intervention and changes to the support model would result in a reduced effectiveness compared to the
primary trial outcome reported in the efficacy trial\textsuperscript{60}, and a reduced impact as outlined in the sensitivity analysis for students outside the target grade.

RESULTS

SCHOOLS

Five intervention schools (including four government and one catholic school of which three schools were located within the inner city and two were rural schools, with a mean of 129 Grade 7 students) and five control schools (including four government and one catholic school of which three schools were inner city schools and two were rural schools with a mean of 101 Grade 7 students).

TRIAL PARTICIPANTS

The study included 1150 students in Grade 7 (645 intervention, 505 control) at baseline. At 24-month follow-up, 985 students wore an accelerometer with 441 students providing valid physical activity outcome data (three or more days of accelerometer data) and 985 students providing weight status outcome data. Table 7.2 outlines the characteristics of students in the sample.

TABLE 7.2: Student characteristics at baseline – students wearing an accelerometer (n=1150)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number/ Total Participants</td>
<td>645</td>
<td>505</td>
</tr>
<tr>
<td>Boys \textsuperscript{a}</td>
<td>312</td>
<td>246</td>
</tr>
<tr>
<td>Girls \textsuperscript{a}</td>
<td>333</td>
<td>258</td>
</tr>
<tr>
<td>3 valid days</td>
<td>530</td>
<td>435</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>12.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Aboriginal and/ or Torres Strait Islander (%)</td>
<td>5.3%</td>
<td>7.8%</td>
</tr>
<tr>
<td>Height, (mean m)</td>
<td>157.1</td>
<td>156.8</td>
</tr>
<tr>
<td>Weight, (mean kg)</td>
<td>49.3</td>
<td>50.0</td>
</tr>
<tr>
<td>Student BMI Category, (%)</td>
<td>78.3%</td>
<td>73.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Underweight/ Healthy Weight</th>
<th>Overweight/ Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student activity level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active (≥60 min MVPA/ day)</td>
<td>21.7%</td>
<td>24.7%</td>
</tr>
<tr>
<td>Low active (&lt; 60 min MVPA/ day)</td>
<td>33%</td>
<td>33%</td>
</tr>
<tr>
<td>Accelerometer wear time</td>
<td>67%</td>
<td>67%</td>
</tr>
<tr>
<td>Mean minutes per day</td>
<td>793.6</td>
<td>804.6</td>
</tr>
</tbody>
</table>

*Note - One (1) gender missing

TRIAL OUTCOMES

At the 24-month follow-up, the adjusted mean difference in change in daily MVPA between groups was 7.0 minutes (95%CI: 2.7, 11.4, p <0.002). Sensitivity analyses based on multiple imputation were consistent with the main analysis (6.0 minutes, 95%CI: 0.6, 11.3, p < 0.031). The difference in change for BMI and BMI z-score was -0.28 (95%CI= -0.49; -0.06, p=0.01) and - 0.08 (95%CI= -0.14; -0.02, p=0.02) respectively, favouring the intervention group.

INTERVENTION COSTS

A total of 837 students were enrolled in Grade 7 at schools allocated to the intervention group of the study and were therefore included in the economic analysis. Table 7.3 shows the breakdown of the intervention costs against the various physical activity and implementation strategies. The total cost of the intervention was calculated to be $329,952 over 24-months. Unit costs of intervention components are displayed in Table 7.4. On the basis that schools allocated to either intervention or control would likely have the same baseline costs of implementing PE and sport, a zero cost was assumed for usual physical activity practices of schools randomised to the control arm, resulting in an intervention cost of $394 per student.
### TABLE 7.3: Breakdown of costs across physical activity intervention and implementation strategies over two years

<table>
<thead>
<tr>
<th>Physical activity intervention strategies (PAS)</th>
<th>Description &amp; cost components</th>
<th>Total cost (24m)</th>
<th>Total cost (24m) per student</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Active PE lesson a**</td>
<td>Teachers should maximise student activity in PE 2 x pedometer based lessons per teacher each term used to build understanding of activity levels</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>2 Personal physical activity plans a</td>
<td>1 x personal student PA plan developed and reviewed each school term</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>3 Enhanced sports program a</td>
<td>Program X (10 week program) delivered to all students</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>4 Recess and lunchtime activities*</td>
<td>Activities offered and equipment available at least twice per week  Cost includes the opportunity cost of school staff time associated with monitoring and supervision of equipment use</td>
<td>$10,526</td>
<td>$13</td>
</tr>
<tr>
<td>5 Supportive school physical activity policy a**</td>
<td>School PA policy modified or developed Cost includes the opportunity cost of school staff time to modify/ develop PA policy (four schools)</td>
<td>$301</td>
<td>$0.36</td>
</tr>
<tr>
<td>6 Linking with parents</td>
<td>1 x hard copy parent newsletter per term focussed on physical activity. Newsletters also placed on school websites Cost includes printing and materials</td>
<td>$4,933</td>
<td>$6</td>
</tr>
<tr>
<td>7 Linking with the community*</td>
<td>3 - 5 community links made – students made aware of community PA organisations Cost relates to community provider expos and includes showbag materials plus the opportunity cost of the preparation and face-face time of community sports representatives and school staff</td>
<td>$8,285</td>
<td>$10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Implementation support strategies (ISS)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 In school consultant (change agent)</td>
<td>Attends school 1 day per week. Cost is salary for two years</td>
<td>$216,544</td>
<td>$259</td>
</tr>
<tr>
<td>2 School leadership &amp; committee*</td>
<td>Partnership agreement signed, school committee established School executive membership represented on committee Cost includes the opportunity cost of school staff time associated with committee meeting attendance</td>
<td>$1,263</td>
<td>$1.51</td>
</tr>
<tr>
<td>3 Staff development &amp; training</td>
<td>Joint school professional development training Cost includes the opportunity cost of school staff time (teacher relief), external consultant services, travel and meal expenses and venue hire</td>
<td>$28,340</td>
<td>$34</td>
</tr>
<tr>
<td>4 Resources</td>
<td>Physical activity equipment pack (e.g. balls, hoops, ropes), recess and lunch equipment, class pedometer sets (5 per school), personal plans (templates and teacher instructions)</td>
<td>$59,370</td>
<td>$71</td>
</tr>
<tr>
<td>5 Prompts</td>
<td>Weekly email prompts to teachers from change agent Costs include printing and materials</td>
<td>$389</td>
<td>$0.46</td>
</tr>
<tr>
<td>6 Performance feedback *</td>
<td>Report delivered 1 x per term to Principal and head PE teacher</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

**Total cost** | **$329,952** | **$394**

*Costs are accounted for in various implementation strategies*
TABLE 7.4: Physical activity 4 Everyone intervention unit costs

<table>
<thead>
<tr>
<th>Cost variable</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE staff labour time</td>
<td>Rate/hour</td>
<td>$60.15¹</td>
</tr>
<tr>
<td>Volunteer personnel, labour time</td>
<td>Rate per hour</td>
<td>$33.18²</td>
</tr>
<tr>
<td>Printing</td>
<td>Cents per sheet</td>
<td></td>
</tr>
<tr>
<td>Showbag contents</td>
<td>Cost per bag</td>
<td>$0.62³</td>
</tr>
<tr>
<td>Venue hire (including catering)</td>
<td>Cost per session</td>
<td>$482.133³</td>
</tr>
<tr>
<td>Conference fees</td>
<td>Cost per conference</td>
<td>$1805.00³</td>
</tr>
<tr>
<td>Travel expenses</td>
<td>Cost per person</td>
<td>$441.23³</td>
</tr>
<tr>
<td>Equipment packs (including incentives)</td>
<td>Per pack</td>
<td>$11,874.00³</td>
</tr>
</tbody>
</table>

Sources for cost prices:
1 Commission IR: Crown employees (Teachers in schools and related employees) salaries and conditions award 2014.
In., vol. May; 2014.
2 Average weekly total cash earnings May 2014, ABS 6302.1
3 Real cost price

INCREMENTAL COST EFFECTIVENESS RATIOS

Cost per additional minute of MVPA per day gained:

Based on the finding of a difference in change of 7.0 (95% CI 2.68-11.36) minutes per student per day of MVPA for students in the intervention versus control groups³⁹, the intervention cost of $394 per student divided by 7.0 resulted in an incremental cost effectiveness ratio of $56 [95% CI $35 - $147] per additional minute of MVPA per day (Table 7.5).

Cost per met hour gained per person per day:

When mean minutes MVPA per day were converted to MET hours gained, the PA4E1 intervention resulted in 0.5 [95% CI 0.2 – 0.9] MET hours gained per person/ day, and a cost of effectiveness ratio of $1 ($0.6-$2.7 per MET hour gained (Table 7.5).

Cost per BMI unit avoided:
Based on a finding of a difference in change of -0.28 BMI units per student in the intervention group versus the control group\textsuperscript{40}, the intervention cost of $394 per student divided by -0.28 resulted in an incremental cost effectiveness ratio of $1,408 [95% CI $788 - $6,570] per BMI unit avoided (Table 7.5).

\textit{Cost per reduction in BMI z-score:}

Similarly, the intervention cost of $394 per student divided by the difference in BMI z-score of -0.07\textsuperscript{40}, resulted in an incremental cost effectiveness ratio of $5,632 per 1.0 unit BMI z-score reduction or $563 per 10% reduction in BMI z-score [95% CI $282 - $3,942] (Table 7.5).
# TABLE 7.5: Mean costs per participant, mean difference in change and ICERs presented for physical activity (MVPA and MET minutes) and weight status BMI unit avoided and per 0.1 unit (10%) reduction in BMI z-score.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cost per enrolled student in five intervention schools over 24 months</th>
<th>Mean difference in change between Intervention and control groups at 24 month follow-up (95% CI)</th>
<th>ICER (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean minutes MVPA/ Day</td>
<td>$394</td>
<td>7.0 (2.7 – 11.3)</td>
<td>$56 ($35 – $147)†</td>
</tr>
<tr>
<td>MET hours gained per person/ day</td>
<td>$394</td>
<td>0.5 (0.2-0.9)</td>
<td>$749 ($463 - $1,961)*</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td>0.3 (0.1 – 0.5)</td>
<td>$1408 ($788 - $6,570)*</td>
</tr>
<tr>
<td>BMI z-score</td>
<td></td>
<td>0.1 (0.0 – 0.1)</td>
<td>$563 (282 - 3,942)*</td>
</tr>
</tbody>
</table>

# cost per minutes of MVPA gained
>cost per MET hour gained
*cost to avoid a gain in 1 BMI unit
^cost per 0.1 (10%) unit reduction in BMI z-score

Students included all students enrolled in Grade 7 at intervention commencement.


SENSITIVITY ANALYSIS

Figure 7.2 outlines the outcomes from sensitivity testing. Tests (i) and (ii) plausible variation in the cost of the intervention by varying the assumed opportunity cost of school staff participation in PAS 4 & 5 and ISS 2 resulted in ICER’s of $57 ($35, $149) and $54 ($33, $142) respectively. Test (iii) variation in the magnitude of the estimated effect size between the lower and upper confidence interval in minutes of MVPA per day resulted in point estimate ICER’s of $35 and $147 respectively. Tests (iv) and (v) extending the intervention benefit outside the target grade resulted in ICERs of $60 ($37, $150) and $28 ($15, $154) respectively.

SCENARIO ANALYSIS

The costs to disseminate the intervention across secondary schools in NSW using the existing model were $66 ($35-$656) per additional minute of MVPA. The cost of disseminating the intervention across NSW, through a real world model provision of teacher relief funding for half a day per week over 24-months to allow an existing in teacher to lead the implementation of the program at school (estimated to cost $10,100 per school over 24-months) resulted in a cost per minute of MVPA of $27 ($14-$267) (Figure 7.2).

DISCUSSION

This trial assessed the cost and cost effectiveness of a multicomponent school-based intervention (Physical Activity 4 Everyone) that aimed to reduce the decline in physical activity among secondary school students. The cost of the intervention was $329,952 over a 24-month period, resulting in the intervention being delivered at a cost of $394 per student. In terms of physical activity, the ICER was $56 per minute of MVPA gained and $1 per MET hour gained per person. From a weight perspective, the ICER’s were $1,408 per BMI unit avoided and $563
per 10% reduction in BMI z-score. These findings suggest that implementation of the intervention by schools in socio-economically disadvantaged areas has the potential to make a cost-effective contribution to reducing the decline in physical activity during adolescence and the health-related burden associated with physical inactivity and overweight and obesity.

This is one of the few cost effectiveness studies of school-based physical activity interventions targeting adolescents, and to the authors’ knowledge, the first based on an objective measure of physical activity, and the first cost effectiveness study of a school-based physical activity intervention targeting socio-economically disadvantaged adolescents. While, the PA4E1 intervention demonstrated a consistent effect in terms of MET hours gained per person/day compared to a meta-analysis of the cost effectiveness of school-based physical activity interventions (0.50 compared to 0.48 MET hours gained)\textsuperscript{31}, the cost effectiveness profiles of the studies are not as easily compared. The cost-effectiveness result from the PA4E1 trial of $1 per MET hour gained is at the upper end of the spectrum of reported cost-effectiveness ratios of the studies included in the reviews ($0.06-$0.8/MET hr). However, as discussed above, the reported costs and therefore cost-effectiveness of the studies included in the meta-analyses were derived from either published cost analyses or imputed by the review authors and therefore may not accurately reflect the profiles of the interventions. Since the current analysis did not extend to including any potential cost-offsets associated with increased physical activity, the cost-effectiveness of the intervention should still be considered favourable.

From a weight perspective, the intervention costs per child calculated in the PA4E1 trial are similar to a school and community-based childhood obesity intervention (implementing both
nutritional and physical activity strategies) known as Be Active Eat Well, which was also implemented in Australia, targeting children aged 5-12 years. This study reported a cost per child of $344AUD, and resulted in a similar effect on BMI (0.28 BMI Units), but a greater impact on BMI Z-score, potentially due to the younger age of the students targeted by the intervention. Similarly, the APPLES childhood obesity prevention study, conducted in New Zealand targeting children aged 5-12 years, reported higher intervention cost per child of NZD $1,281 (equivalent to $1202.7AUD), and an incremental cost-effectiveness ratio (ICER) of NZD $664-$1708 per kg of weight-gain prevented.

The cost per student in the PA4E1 trial were comparable to other school-based physical activity interventions and multicomponent school-based obesity prevention interventions with a physical education component that have been reported to be cost effective. This is in spite of PA4E1 targeting adolescents, in which systematic reviews show smaller effects in compared to elementary aged children. As a result, the PA4E1 trial seems a cost effective option for improving the physical activity and weight status of adolescents within a higher risk population group. In most cases, the cost effectiveness ratios are conservative in nature due to the intervention effect being limited to the target group only. Sensitivity analyses revealed lower costs per students when the benefits were extended beyond the target group to others students in the school, or if equipment provided was reduced.

Based on conservative estimates of benefit (applied to the target year only), this study demonstrates that PA4E1 is a cost effective intervention for maintaining adolescent physical activity levels and impacting favourably on weight status. The sensitivity analyses provide insight into the impact of the intervention if the health benefits were applied to students
across the school more broadly, with the majority of these analyses demonstrating greater
cost effectiveness and a reduced intervention cost per student. When the assumptions of the
trial are manipulated as demonstrated in the scenario analyses, by reducing the cost of
equipment and extending the benefit of the MVPA outcome (at a reduced level) beyond the
target year, the intervention remains cost effective. The provision of an in-school physical
activity consultant for one day per week was the largest cost relating to the efficacy trial (66%
of the total intervention cost). Whilst the provision of an in-school physical activity consultant
was necessary under efficacy trial conditions in order to evaluate the effect of the combination
of intervention strategies, the feasibility of providing a part-time consultant within schools
across large geographic regions and the cost of such a model of support presents challenges in
upscale the intervention. The dissemination of an effective intervention across the
community requires the use of implementation strategies which better mirror real world
practice. A dissemination model that utilises an existing in-school teacher to embed desired
practices has been shown to successfully impact on student physical activity levels, and our
results indicate such a model is more cost effective at scale.\textsuperscript{45, 62} However, to the authors’
knowledge, the cost effectiveness of these studies has not been reported. Whilst PA4E1
appears to be a cost effective intervention, dissemination is needed if its health benefits are to
be realised. Based on a model to a disseminate an effective intervention under real world
conditions, a scenario analysis indicated the potential of a state-wide roll-out of the PA4E1
program, resulting in a cost per student which was substantially reduced compared to the
costs of the randomised controlled trial. As the intervention is effective, prioritising higher risk
schools such as those located in socio-economically disadvantaged areas may provide a
rationale for prioritisation.
STRENGTHS AND LIMITATIONS

This study has a number of strengths and limitations that should be considered within the broader context of the economic evaluations and disease prevention. The strengths include:

- Firstly, the data informing the analysis is based on results from a randomised controlled trial using objectively measured physical activity using accelerometry.
- Secondly, the costs associated with the intervention were collected prospectively thus improving accuracy by eliminating recall bias.
- Thirdly, this trial reported the ICER from a number of perspectives, both physical activity and weight status. This enables comparison across studies, particularly physical activity studies in which a broad range of outcomes have been used in the past and therefore limit the usefulness of such studies. In our case, the conversion of the physical activity outcome to METS, and cost per MET minute gained enable useful comparison with the limited number of published physical activity cost effectiveness studies.

The trial also has limitations that should be noted. The translation of the intermediate outcomes captured by the trial into final outcomes, such as DALYs, expedient for economic evaluations was beyond the scope of this analysis. This type of modelling has previously been conducted on interventions that aimed to prevent overweight and obesity in children and adolescents, and as a result may provide policy makers with additional useful data to make informed policy decisions. These studies model the broad societal level cost effectiveness, and should potentially be considered for this intervention in the future.

The sensitivity and scenario analysis are both hypothetical. Whilst based on empirical data from the evaluation of the intervention they may overestimate (or underestimate) the impact of changing the intervention component on the intervention costs. The scenario analysis tests
only one set of possible assumptions, and whilst based on empirical data collected via a sensitivity analysis conducted within the efficacy trial and formative research of schools participating in the intervention, the scenario is hypothetical. Additionally, this analysis is constrained by the time horizon of the intervention. Whilst the trial appears to be cost effective and able to obtain health benefits for both physical activity and weight status for a relatively low cost, the sustainability of these behaviours remains unknown. Lai and colleagues\textsuperscript{65} have indicated the physical activity of similar school-based interventions can be sustained, however, the likelihood that the positive change achieved through the PA4E1 trial can be maintained is currently unknown. Future research on the sustainability of PA4E1 is warranted in addition to research evaluating the impact of using an alternative model to support large scale implementation. This would in turn inform the extrapolation of these cost effectiveness results.

**CONCLUSION**

The PA4E1 trial had a statistically significant intervention effect on physical activity and weight gain which can be achieved for a relatively low monetary cost of $394AUD per student over a 24-month period. This investment is promising for public health policy, particularly as the intervention was delivered in school communities located in socio-economically disadvantaged communities where both physical inactivity and overweight and obesity are likely to be more prevalent, therefore likely to result in a greater future burden of disease. Further research is required to determine the impact of the intervention if implemented on a routine basis throughout the period of secondary schooling.
REFERENCES


57 Australian Bureau of Statistics. Average Weekly Earnings, Australia. 2014;May(Cat no. 6302).


A SUMMARY OF FINDINGS AND FUTURE DIRECTIONS FOR RESEARCH.
A SUMMARY OF FINDINGS AND FUTURE DIRECTIONS FOR RESEARCH.

This thesis sought to address identified gaps in evidence regarding the effectiveness and cost effectiveness of school-based physical activity interventions targeting adolescents. The aims of the thesis were to: 1) determine the effectiveness of a multicomponent school-based physical activity intervention, Physical Activity for Everyone (PA4E1), in reducing the decline in physical activity among students attending secondary schools located in disadvantaged areas at 12-month mid-intervention and at 24-month follow-up; 2) determine the impact of a multicomponent school-based physical activity intervention (PA4E1) on adolescent adiposity outcomes at 12- and 24-months (secondary outcomes); 3) to determine the cost and cost effectiveness of the PA4E1 intervention in terms of physical activity and adiposity outcomes.

This chapter provides a summary of the key findings of this thesis and the PA4E1 trial undertaken to address the stated aims. The chapter concludes with the implications of the trial findings for future research.

THESIS FINDINGS

CHAPTER 1: INTRODUCTION

The introductory chapter provided a broad context to the thesis, outlining the background to the research and a brief rationale for the PA4E1 trial. The chapter outlined my contribution to the research trial and highlighted my professional achievements related to research whilst undertaking the thesis. The chapter concluded by outlining the thesis aims and providing an overview of the thesis structure.
CHAPTER 2: ADOLESCENT PHYSICAL ACTIVITY: BURDEN OF DISEASE, PREVALENCE, SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS.

The second chapter presented evidence to demonstrate that inadequate physical activity amongst all ages is responsible for a substantial proportion of the global burden of disease, with recent literature indicating 6% of the overall burden of disease is attributable to physical inactivity. The financial costs of physical inactivity were shown to have increased globally over the past three decades. Whilst inadequate physical activity is of concern for adults, evidence was presented of the impact of physical inactivity on child and adolescent health, including mental health and well-being, obesity, risk of cardiovascular disease, type 2 diabetes and some cancers. Despite these risks of physical inactivity, data were presented that indicated that the prevalence of adolescents meeting internationally recommended physical activity guidelines was low, reported as 20% across 32 countries. Adolescents from socio-economically disadvantaged backgrounds were shown to be less likely to accumulate sufficient moderate-to-vigorous (MVPA) compared to adolescents from higher socio-economic backgrounds. Consistent with global trends, in Australia, only 15% of adolescents aged 12 to 15 years self-reported meeting physical activity guidelines, placing Australia 11th out of 15 countries in an international physical activity surveillance report.

Chapter 2 introduced schools as an opportune setting for interventions to address inadequate physical activity in adolescents in terms of sustained and universal access to students, access to facilities, as well as established links and systems for communicating with parents and gaining community support. In this context, the last decade has seen a large volume of
CHAPTER 8: Thesis findings and future directions for research.

research focused on determining the efficacy of school-based physical activity interventions in maintaining or increasing children’s and adolescents daily physical activity. Despite this, a number of systematic reviews have identified limited school-based physical activity interventions targeting adolescents, particularly targeting adolescents from socio-economically disadvantaged backgrounds.\textsuperscript{11, 12} Two of ten identified systematic reviews specifically aimed to draw conclusions regarding the effectiveness of interventions targeting adolescents\textsuperscript{13, 14}, with one including school-based physical activity studies targeting older adolescents aged 15 to 19 years\textsuperscript{13} and the second including European trials targeting adolescents aged 10 to 19 years.\textsuperscript{14} The former review targeting older adolescents concluded the effect of school-based physical activity interventions for adolescents was generally limited and short-term, with interventions that incorporated a higher number of behaviour change techniques more likely to increase student physical activity.\textsuperscript{13} The second review concluded the intervention effect was generally short term and isolated to school day physical activity, and did not translate to total daily physical activity. Both reviews specific to adolescents recommended more studies evaluating the long-term effectiveness of such intervention effectiveness were needed.\textsuperscript{13} No reviews drew conclusions for socio-economically disadvantaged adolescents, and only two trials had focussed on this group.

Addressing this identified gap, eight recent studies have been published targeting adolescents within the school setting. Four of these eight studies specifically targeted adolescents from socio-economically disadvantaged backgrounds. These four studies, together with the two studies targeting socio-economically disadvantaged students identified within the Cochrane systematic review (2013), gave a total of six school-based physical activity studies specifically targeting socio-economically disadvantaged adolescents. Based on the results of these six
trials,\textsuperscript{15-20} intervention effectiveness appeared to be inconclusive, with just two trials reporting a significant intervention effect on physical activity.\textsuperscript{15, 16}

In addition to intervention effectiveness, reviews were used to identify the recommended design features to enhance the quality and likely effectiveness of interventions, and to strengthen study quality. Implementing longer duration interventions and the incorporation of explicit implementation strategies to maximize the likelihood of an intervention being implemented by schools as planned, were recommended. In addition, the use of an objective measure of physical activity, the inclusion of larger sample sizes to allow for the effect of clustering to be considered, and the incorporation of follow-ups beyond 12-months were recommended.

On the basis of such systematic review findings, the chapter concluded that further rigorous trials regarding the effectiveness of school-based physical activity interventions targeting adolescents from socio-economically disadvantaged backgrounds were required.

\textbf{CHAPTER 3: A CLUSTER RANDOMISED TRIAL OF A SCHOOL-BASED INTERVENTION TO PREVENT DECLINE IN ADOLESCENT PHYSICAL ACTIVITY LEVELS: STUDY PROTOCOL FOR THE ‘PHYSICAL ACTIVITY FOR EVERYONE’ TRIAL.}

To address the gap in the literature identified in Chapter 2, the third thesis chapter outlined the study methods for a multicomponent school-based intervention designed to reduce the decline in physical activity in adolescents attending schools located in socio-economically disadvantaged areas. The cluster randomised controlled trial involved ten secondary schools that were randomly allocated to either a control group or an intervention group. Intervention
schools received a two-year intervention (PA4E1). Schools allocated to the control group received the intervention materials following the completion of the intervention. Randomisation of schools occurred post baseline data collection.

The intervention, developed using social-ecological theory, and based on the Health Promoting Schools (HPS) Framework and systematic review evidence, consisted of two broad components. First, seven strategies addressing the curriculum, school ethos and environment, and links with parents and the community, were delivered by schools to promote student physical activity. Second, an additional six strategies to increase the likelihood of schools implementing such strategies were delivered by the research team. The latter strategies included the provision of a one-day per week ‘change agent’ to support school implementation of the physical activity promotion strategies.

The primary trial outcome measure, mean minutes of student MVPA per day was objectively measured via Actigraph GT3x accelerometer. Student anthropometric data (height and weight) were also objectively measured to determine the impact of the intervention on student adiposity. Outcome data were collected at baseline, and 12- and 24-month post randomisation.

To address thesis aim 1, the impact of the intervention on student physical activity at 12-month post-randomisation was reported in Chapter 4. The trial outcomes on student physical activity 24-months post randomisation were reported in Chapter 5. To address thesis aim 2, the impact of the intervention on the secondary trial outcomes, student adiposity, was reported in Chapter 6. To address thesis aim 3, the intervention cost and cost effectiveness
CHAPTER 8: Thesis findings and future directions for research.

were reported in Chapter 7.

CHAPTER 4: 'PHYSICAL ACTIVITY 4 EVERYONE' SCHOOL-BASED INTERVENTION TO PREVENT DECLINE IN ADOLESCENT PHYSICAL ACTIVITY LEVELS: 12-MONTH (MID-INTERVENTION) FOLLOW-UP.

Chapter 4 described the conduct of the trial of a multicomponent intervention targeting adolescents described in Chapter 3. The trial was conducted in ten secondary schools located in socio-economically disadvantaged areas within the Hunter New England, Central Coast and Lower Mid North Coast regions of New South Wales (NSW), Australia over a two-year period.

In the first 12-months of the intervention, four of seven physical activity promoting strategies were implemented as were all six implementation strategies. In the second 12-months of the intervention all seven physical activity promoting strategies were implemented. To facilitate implementation of these strategies, Health and Physical Education (PE) teachers were trained, prompted by a change agent to modify PE lessons, provided feedback regarding the physical activity levels of students, provided resources and equipment, and supported to establish school committee structures to monitor and support the implementation of the intervention. The change agent did not teach any lessons, but provided the school support to implement the physical activity intervention strategies.

At baseline, 1150 Grade 7 students (93% of those with parental consent, mean age of 12 years) participated in the data collection (645 intervention and 505 control), of whom 965 (84% of those with parental consent) students had at least three days of valid accelerometer data. At 12-month follow-up, 1050 (79% of those with parental consent) students (591 intervention
and 459 control) participated in data collection, of which 643 (61% of those with parental consent) provided at least three days of valid data.

Results indicated a significant intervention effect at 12-months for daily minutes of MVPA and vigorous physical activity (VPA), resulting in 27 minutes more MVPA per week. A greater effect was observed in male students in the intervention group compared with the control group on mean minutes of MVPA per day (6.5 minutes) and percentage of wear time spent in MVPA (0.9%). No significant differences between groups for females were observed at 12-month follow-up. There were no detected differences between intervention and control groups for subgroups based on weight status or activity level at baseline.

CHAPTER 5: THE PHYSICAL ACTIVITY 4 EVERYONE CLUSTER RANDOMIZED TRIAL. 2-YEAR OUTCOMES OF A SCHOOL PHYSICAL ACTIVITY INTERVENTION AMONG ADOLESCENTS

Chapter 5 described the effectiveness of the full implementation of the intervention (Thesis aim 1). At 24-month follow-up, 985 students (560 intervention and 425 control, representing 86% of the baseline sample) wore an accelerometer and provided anthropometric measures and 441 (45%) of these students (250 intervention and 191 control) provided at least three days of valid accelerometer data.

Results indicated a significant intervention effect at 24-months for daily minutes of MVPA, resulting in a 7.0 minute difference in daily MVPA between groups. The mean duration of daily MVPA increased by 4.4 minutes from baseline for the intervention group and decreased by 2.6
minutes for the control group. Furthermore, sensitivity analyses based on multiple imputation and complete cases found effects that were consistent with those of the main analysis.

At 24-month follow-up, exploratory subgroup analysis by sex indicated the intervention was effective for both males and females in the intervention group compared to their counterparts in the control group. A greater effect was observed for male students in the intervention group compared with males in the control group for minutes of MVPA per day (10.4 minutes), and minutes of moderate physical activity (MPA) (6.2 minutes). A greater effect was also observed for females in the intervention group compared to females in the control group for minutes of MVPA per day (4.0 minutes) and minutes of MPA (2.9 minutes). Further subgroup analyses indicated there were no differences in outcomes by baseline weight status or by baseline physical activity levels.

Whilst the intervention was found to result in 49 minutes per week more MVPA being undertaken by students, the sustainability of the physical activity intervention effect on student outcomes is unknown. Further research is required to assess the long-term sustainability of such improvements. Furthermore, in order for the intervention to have a population wide effect, further research is required to explore the strategies required to enable it to be ‘scaled-up’ for delivery to a larger number of schools, and to determine its effectiveness when delivered on that basis.
Chapter 6 reported the impact of the intervention described in Chapters 3, 4 and 5 on measures of adiposity including weight (kg), body mass index (BMI) and BMI z-score. A total of 1150 students provided anthropometric data at baseline, 1051 (91%) at 12-months and 985 (86%) at 24-months.

Results indicated a significant intervention effect at 12-months for weight (-0.90kg) and BMI (-0.28kg/m²). By 24-months results were also significant for weight (-0.62kg), BMI (-0.28kg/m²) and also for BMI z-score (-0.08).

The intervention was effective in achieving a moderate reduction in weight gain. Given these positive findings, coupled with those regarding physical activity described in Chapters 4 and 5, further research is warranted to determine if the positive intervention effect on adolescent adiposity can be sustained over time. Additionally, further research is warranted to determine whether such an effect can be achieved when the intervention is scaled-up for delivery to a larger number of schools.

Chapter 7: Cost Effectiveness of a Multicomponent School-Based Physical Activity Intervention Targeting Adolescents: The ‘Physical Activity 4 Everyone’ Cluster Randomized Trial.

Given the positive effects of the PA4E1 trial outlined in Chapters 4, 5 and 6, evaluation of the cost and cost effectiveness of the intervention was undertaken and reported in Chapter 7 (Thesis aim 3). The study involved a trial-based retrospective economic evaluation conducted...
from a societal perspective. The costs associated with the intervention including, the costs of the seven physical activity strategies, and six intervention implementation strategies delivered to the five intervention schools, were compared to the costs of usual physical activity promotion practices of schools in the control group (assumed to be zero). The economic analysis outcomes were intervention cost and cost per student, based on the number enrolled students in the target grade in the five intervention schools (student n=837). In addition, four incremental cost effectiveness ratios (ICERs) were calculated including: cost per minute of MVPA per day gained; metabolic equivalent (MET) hours gained per person/day; BMI unit avoided; and a 10% reduction in BMI z-score.

The cost of the intervention was calculated to be AUD $329,952 over 24-months, or AUD$197 per student per year of intervention (AUD$394 per student over the two year intervention). Cost effectiveness ratios of: AUD$56 ($35 - $147) per additional minute of MVPA, AUD$1 ($0.6-$2.7) per MET hour gained per person per day, AUD$1408 ($788-$6,570) per BMI unit avoided, and AUD$563 ($282 - $3,942) per 10% reduction in BMI z-score were obtained.

The intervention costs appeared comparable to other multicomponent interventions targeting overweight and obesity in children that have been conducted based on actual intervention cost data rather than modelled on costs imputed by review authors. For example, Be Active Eat Well, a multicomponent obesity prevention intervention implemented in primary schools in Australia, resulted in an intervention cost per child of AUD$344 per student. The APPLES childhood obesity prevention study conducted in primary schools in New Zealand reported a cost per child of NZD $1,281 (equivalent to $1202.7AUD) over the two year intervention ($601.4AUD per year), and an incremental cost effectiveness ratio (ICER) of NZD $664-$1708
CHAPTER 8: Thesis findings and future directions for research.

per kg of weight-gain prevented. There are no actual cost effectiveness evaluations of effective adolescent school-based physical activity interventions, potentially due to the limited intervention effects amongst adolescents. In this context, further research is required to evaluate the cost and cost effectiveness of the PA4E1 program when ‘scaled up’ to a larger number of schools.

SIGNIFICANCE

Strategies to reduce the decline in adolescent physical activity are urgently needed. The PA4E1 trial targeting secondary schools in socio-economically disadvantaged communities, was developed to address this need and was the first to report reversal of the decline in physical activity typically observed among adolescents; reduction in unhealthy weight gain; and to be cost effective for adolescents attending schools located in socio-economically disadvantaged areas.

STRENGTHS

The PA4E1 trial addressed many of the intervention design and methodological limitations identified by previous systematic reviews of school-based physical activity interventions including: 1) use of a multicomponent intervention to facilitate behaviour change; 2) the intervention being theoretically based and incorporating strategies across the domains of the Health Promoting Schools Framework; 3) involving a 24-month intervention period; 4) incorporation of implementation support strategies; 5) use of an objective measure of physical activity; 6) inclusion of a cost effectiveness evaluation. Furthermore, the trial was large enough
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to examine difference in intervention effects MVPA between sub-groups, defined by sex, baseline weight status and activity levels.

The incorporation of implementation support strategies, as recommended in previous systematic reviews of school-based physical activity interventions, are considered to have positively influenced intervention fidelity, with four of the five schools within the PA4E1 trial implementing all of the seven recommended physical activity practices by 24-month follow-up post randomisation, and the remaining school implementing six of the seven strategies. This provides a strong basis to guide ‘scaled-up’ delivery of the intervention. Furthermore, incorporation of a mid-intervention evaluation time-point provided valuable exploratory information regarding the temporal impact of the intervention, represented by an increase in intervention effectiveness over time with implementation of all intervention components.

LIMITATIONS

There are a number of limitations of the PA4E1 trial. Firstly, there were a large number of adolescents not providing three days of valid accelerometer data at 24-month follow-up. This finding appears consistent with literature on objectively measured physical activity in adolescents, particularly disadvantaged adolescents. Attrition and ‘missingness’ of data may result in inadequate power due to a smaller than anticipated analysis sample size and thus true effects of successful interventions may be missed. Statistical methods such as multiple imputation, as was conducted in the PA4E1 trial, or maximum likelihood estimation, which assumes data is missing at random, may help to reduce bias associated from missing data. Recent literature recommends that although adolescents should be requested to wear accelerometers for seven days including a weekend day, three days of eight hours wear time
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per day, rather than three days of ten hour wear time per day (the criteria adopted in the PA4E1 trial), provides a valid and reliable estimate of usual physical activity. Additionally, the use of hip worn accelerometers has been shown to limit the willingness of adolescents to consistently wear accelerometers, with wrist worn monitors displaying higher levels of acceptability amongst adolescents and resulting in better sample retention. These changes may assist with improved data completeness in future studies, and may overcome potential measurement error.

A second limitation was the small number of schools (clusters) included in the study, reducing the generalisability of the study findings. A replication study involving a larger number of schools is warranted. Thirdly, as intervention delivery occurred up until final data collection, effectiveness on student outcomes beyond the intervention period is unknown. Finally, the use of an external physical activity change agent as an implementation support strategy may reduce the feasibility of the intervention being ‘scaled-up’ for implementation across a large number of schools. This strategy was employed to address known barriers to school promotion of student physical activity including lack of time and a crowded curriculum as identified in the literature. A similar model has been used with mixed success in other school-based health promotion initiatives, suggesting further research is warranted. In the cost effectiveness analysis, a scenario analysis was undertaken using an alternative model of implementation support based on the use of an existing in-school teacher being relieved from duties for a portion of a day each week to undertake this role. The scenario analysis resulted in a more cost effective model, potentially more suitable for large-scale dissemination. Further research of the effectiveness of such an approach is warranted.
IMPLICATIONS FOR FUTURE RESEARCH

This trial is one of the few successful school-based interventions targeting physical activity amongst socio-economically disadvantaged adolescents. To understand the longer term benefits of school-based physical activity programs on student health, it is important to understand whether programs that demonstrate positive effects immediately post program continue to have benefits for students in the months or years after the program has been completed.\textsuperscript{31, 32} Similarly, to understand the potential population level benefits of school-based physical activity programs, assessment of the potential for effective programs to be ‘scaled up’ or delivered to a larger number of schools is warranted. The following sections will explore: 1) evidence regarding the likely sustainability of school-based physical activity program effects on student physical activity levels in the months or years after program delivery is complete; and 2) evidence on the effectiveness of scaled-up school-based physical activity interventions, and recommendations on how to approach scaling up an effective school-based physical activity intervention. This evidence will be used to recommend next steps for research on the PA4E1 program.

SUSTAINING STUDENT PHYSICAL ACTIVITY EFFECTS FOLLOWING EFFECTIVE SCHOOL-BASED INTERVENTIONS

As reported in Chapters 4, 5 and 6, the PA4E1 trial achieved an increase in MVPA in adolescents attending intervention schools, compared to a decline in control schools, and a moderate but significantly smaller weight gain among intervention group students. To obtain long term health benefits from such an intervention, it is important that effects are sustained after an intervention is completed. The evaluation of the PA4E1 trial occurred at 24-months post randomisation, immediately following the completion of the intervention period.
Although definitions of sustainability may vary, Dominick and colleagues propose ‘sustainability is the continuation of program activities or benefits beyond initial funding or implementation’. From a school-based physical activity perspective, two reviews have examined the sustainability of effect of school-based interventions on student physical activity levels beyond the intervention period. These are summarised in Table 8.1.
TABLE 8.1: Sustainability of effect of physical activity interventions targeting children and adolescents on student physical activity levels beyond the intervention implementation period.

<table>
<thead>
<tr>
<th>Review/Date range</th>
<th>Review type/ included studies</th>
<th>Aim</th>
<th>Definition of sustainability</th>
<th>Inclusion criteria</th>
<th>PA outcomes assessed/ Method of assessment/ Follow-up duration</th>
<th>Findings (children and adolescents)</th>
</tr>
</thead>
</table>
| Sims et al 2015   | SR and Meta-analysis           | To explore the effect of interventions on maintained whole-day childhood PA, including Furthermore, it was necessary to explore sustained effect sizes following a period of at least six months post-intervention for the same participants measured at baseline. | • Peer review  
• Trial design  
• Non-PA control group  
• PA outcome  
• Non clinical children/adolescents  
• Age 5-18 inclusive  
• Measure of MVPA or TPA via questionnaire or accelerometer  
• F/U data at least 6 month post INV for same participants measures at baseline (ie: trials did NOT need to have shown an effect immediately post intervention to be included in the review)  
• At least 50% F/U measurement rate. | MVPA (n=12) and TPA (n=10).  
8 trials measured both MVPA and TPA  
Assessed via either accelerometers (n=7) or questionnaire (n=7).  
Follow-up range: 6 months to 4 years (median follow-up was 9 months post intervention.  
Overall effect estimates and 95% CI’s were calculated using random effects modelling with inverse variance weighting. | Overall (children and adolescents):  
No statistically significant difference between groups at post intervention follow-up on either MVPA or TPA.  
MVPA: Weak evidence (Non-significant, p = 0.39) for a small effect on MVPA in favour of the intervention group approximating to a mean improvement of 1.47 minutes per day of MVPA compared to controls.  
TPA: There was no statistically significant (p = 0.87) difference in standardised mean difference of TPA.  
Subgroup (age of student)  
Effect size for primary and secondary children was not significant (1.96 v’s 0.86 min MVPA/day)  
Subgroup (school vs community setting)  
Effect size between setting was statistically significant (2.67 v1.03 min MVPA day)  
Overall conclusion  
Physical activity effects are not maintained six months (or more) after INV completion. Potentially ineffective due to insufficiencies |
outcomes, 1 using an objective measure of PA).

| Lai et al\textsuperscript{31} | Narrative review | 1995 to 26 July 2012 | To determine whether PA, fitness, and FMS are sustainable outcomes in typically developing children and adolescents who have participated in school-based interventions measuring one or more of these variables. |
| | 14 studies (13 assessed PA, 3 assessed fitness and 2 assessed FMS) | 3 adolescent studies (all assessed PA) | Sustained impact was defined as a statistically significant difference in the outcomes of interest (PA, fitness, FMS) between the intervention group and the control group at follow-up. |
| | | | • Aged 3-18 years |
| | | | • Interventions aimed to improve and assess PA, fitness, or FMS. |
| | | | • Intervention duration was greater than or equal to 4 weeks. |
| | | | • Studies used a control group. |
| | | | • Studies reported a significant intervention effect between intervention and control groups for the outcomes of interest at post-intervention testing. Follow-up assessment was defined as data collection that occurred at least 6 months after post-intervention testing. |
| | | | • Studies described follow-up intervention and control group PA and/or fitness and/or FMS assessment data. |
| | | | PA assessed via either objective or self-report. |
| | | | PA outcome measures varied, for example: mean minutes MVPA/ day, school day steps, MVPA in PE, min MVPA/ week, % meeting PA guidelines |
| | | | Follow-up: 3 trials had a follow-up of ≤12mths, and 11 trials had a follow-up length >12 mths. |
| | | | Overall (children and adolescents): Of the 13 studies that had PA as an outcome of interest at follow-up, ten found a sustained impact. Degree of physical activity difference reported was 3-14 min per day. |
| | | | One of the three studies that assessed fitness at follow-up reported a sustained impact, both studies that assessed FMS reported a sustained impact. |
| | | | Adolescents – no conclusion due to small number studies (3) |
| | | | It is likely that intervention duration is related to sustained PA impact. |
| | | | Future studies utilize MVPA as their unit of measurement. |
| | | | Future PA interventions should utilize an objective measure of MVPA as their unit of measurement, and more PA, fitness, and FMS studies with long-term follow-ups should be conducted |

SR- systematic review, MVPA- moderate-to-vigorous physical activity, TPA- total physical activity

CHAPTER 8: Thesis findings and future directions for research.
Sims and colleagues examined sustainability of physical activity interventions (including both school and community based trials) for children and/or adolescents. They considered that studies had examined sustainability if they included a follow-up data collection point at least six months post-intervention for the same participants measured at baseline. Studies did not need to have reported a significant program effect immediately post-intervention to be included, and included trials had used both objective and self-report measures of physical activity (See inclusion criteria in Table 8.1). The review and meta-analysis assessed the effect of interventions on whole-day childhood physical activity (MVPA and total daily physical activity (TPA). Of the 14 included studies, seven involved school-based interventions and six targeted adolescents, of which three were conducted in the school setting. The meta-analyses for MVPA and TPA, which included 12 and ten studies respectively, allowed the authors to draw conclusions around whether programs produced significant sustained effects on student physical activity for children and adolescents combined. The meta-analysis was conducted using random effects modelling with inverse variance weighting. Mean difference per day was calculated for MVPA, with standardised mean difference calculated for TPA due to variation in instruments used to measure TPA. Subgroup analyses allowed for conclusions for school-based and community programs separately (seven and seven studies respectively), for children and adolescents separately (eight and six studies), and for boys and girls separately (one study recruited girls only and one study recruited boys only).

Sims and colleagues concluded that there was no significant effect of physical activity programs on students’ physical activity levels at follow-up measured at least six month post-intervention. The meta-analyses showed a small but statistically non-significant mean difference in MVPA existed in favour of the intervention group, equivalent to 1.5 minutes per
day compared to controls, with no differences found on TPA. Although a dose response relationship exists between MVPA and cardio-metabolic risk, this small difference may not be clinically meaningful.\textsuperscript{34}

Subgroup analyses indicated differential effects for interventions conducted in community settings (2.7min/day) compared with those in school settings only (1.7 mins/day) having significantly greater effect on MVPA. Sub-group analyses also indicated males in the intervention groups (2.7mins/day) sustained a greater effect on MVPA compared to males in control groups (-0.4 mins/day). There were no differential effects according to age of child (no significant effects for either children or adolescents).

A second review conducted by Lai and colleagues was specific to the sustainability of physical activity interventions in the school setting, and used a narrative synthesis. Lai and colleagues defined sustainability as a statistically significant intervention effect between intervention and control group at least six months following conclusion of the intervention. Physical activity outcomes varied and included: mean MVPA per day, school day steps, MVPA in PE, min MVPA/week and percentage meeting physical activity guidelines. Fourteen studies that reported a significant effect on physical activity (ten of 13 studies screened), fitness (one of three studies) or fundamental movement skills (two of two studies), immediately post intervention and that included an additional time point at least six months following conclusion of the intervention were included, including three that were conducted in secondary schools.\textsuperscript{31}

Ten of the 13 studies assessing physical activity reported sustainability of the physical activity behaviour change effect between immediately post-intervention to follow-up at least six
months post intervention. The size of the effect ranged from three to ten minutes of physical activity per day. Of the ten studies that showed a sustained physical activity intervention effect, one study assessed physical activity using accelerometers and the nine others assessed physical activity using a self-report measure. The review concluded it was likely that physical activity is a sustainable outcome from interventions in children and adolescents, and there is reasonable evidence that interventions of longer than one year and interventions that utilize a theoretical model or framework contribute to this sustained impact.

The review authors did not draw specific conclusions regarding the sustainability of intervention effects for secondary school-based interventions potentially due to an inadequate number of such studies. Three trials targeting adolescents (none classified as socio-economically disadvantaged) were included in the review, these were different studies to those included within the review by Sims35 and colleagues. The three trials all used a self-reported measure of physical activity and sustainability of intervention effects were measured at six-months36, 15-months37 and 12-years38 respectively. All reported significant differences in physical activity between the intervention and control group at follow-up (assessed as physical activity times per week37, likely exercise per week38 and minutes physical activity per week36).

The main conclusions drawn from these two reviews were somewhat inconsistent. Such inconsistency may be due to differences in the review inclusion criteria. For example, Sims et al35, unlike Lai31, did not require included studies to result in a statistically significant intervention effect on physical activity immediately post intervention. Inclusions criteria around intervention length, minimum age and follow-up rate also differed. The reviews also differed on analytic techniques and the time period covered. While analysis by Sims et al35
suggests caution should be taken in expecting effects on physical activity after program completion, Lai et al\textsuperscript{31} suggest sustained effects are possible. However, both reviews attest to the limited number of studies that have examined the sustainability of physical activity interventions based in secondary schools, and the very small number of trials that have done so using objective measures of physical activity.\textsuperscript{31, 35} Both reviews reinforce the importance of including a follow-up point beyond the completion of intervention delivery of school-based physical activity interventions. Future trials of PA4E1 should therefore include a follow-up data collection at least six months\textsuperscript{31, 35} following the completion of the intervention, in order to evaluate the sustainability of intervention effect on student MVPA.\textsuperscript{32, 39}

SCALING UP EFFECTIVE SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS

Whilst the PA4E1 trial resulted in significant effects on adolescent physical activity (Chapter 4 & 5), adiposity (Chapter 6) and was cost effective at 24-month follow-up (Chapter 7), without effective implementation ‘at scale’ across a larger number of schools the potential for population level benefits of the effective intervention are unlikely to be achieved.\textsuperscript{39, 40} Given this, evaluation of the effectiveness of the intervention when implemented by a larger number of schools is warranted. The following section will address: 1) the rationale and context for scaling-up the PA4E1 trial, 2) evidence of the effectiveness of scaled-up school-based physical activity interventions, 3) theories and frameworks to guide scaling-up of interventions, and 4) recommendations for research regarding scaling up the PA4E1 program.
CHAPTER 8: Thesis findings and future directions for research.

RATIONALE AND CONTEXT FOR SCALING UP PA4E1

Despite the acknowledgement that public health benefit is the principle goal of health research, a significant gap remains between development of health improvement innovations and their successful implementation at scale. Scaling-up has been defined as the "deliberate efforts to increase the impact of successfully tested health innovations so as to benefit more people and to foster policy and programme development on a lasting basis".

 Scaling-up effective health interventions is recognised as an emerging health priority. However, delivering programs at scale may require adaptation of various program components, including implementation support strategies, to cater for the greater number, diversity and differences in the geographic and socio-economic contexts of implementation sites. For example, within the state of New South Wales (NSW) Australia, the state in which the PA4E1 trial was implemented, there are 557 secondary schools of which 276 are located in communities that are socio-economically disadvantaged. Geographically, NSW is also large, spanning 800,642 square kilometres (10.4% of Australia), approximately 3.5 times the size of the United Kingdom (UK). In NSW, curriculum standards for all secondary schools are developed by the Board of Studies, setting standards for the content and key outcomes in school curricula, in addition to outlining minimum standards related to the broader school operating environment. Despite this, secondary schools may vary considerably in the characteristics of their student populations (single sex, coeducational, catering for special needs), purpose (general, academic, performing arts, sporting, agricultural), size (ranging from 16 – 2420 students), geographic location (urban, rural and remote) and their willingness and capacity to implement new innovations.
In this context, scaling-up of effective interventions such as PA4E1 requires consideration of these factors as well as an understanding of the barriers to program implementation in order to develop pragmatic implementation strategies which address real world contextual circumstances, yet retain the fidelity of the original trial.\textsuperscript{47, 48} In the first instance, scaling-up a program shown to be effective could involve working with a larger number of schools with similar characteristics to those included in the initial trial (i.e., socio-economically disadvantaged Government and Catholic secondary schools, with a student population of a similar size). This approach to scaling-up is known as horizontal scaling, or as an intervention replication study.\textsuperscript{49, 50} Approaches to scaling-up also include ‘vertical’ scaling, which involves institutionalization through policy, political, legal, budgetary or other systems change, or can include aspects of both horizontal and vertical scaling-up.\textsuperscript{51} Given the relatively small number of schools involved in the initial PA4E1 trial, evaluation of the effectiveness of the program taking primarily a horizontal approach can determine if similar outcomes are achieved across a greater number of geographically dispersed schools using adapted implementation support methods. Adapting support for a larger number of schools could consider whether aspects of vertical scaling, for example linking the desired school physical activity practice outcomes with school education department physical activity policies, may be beneficial.

**EVIDENCE OF EFFECTIVENESS FOR SCALING UP PHYSICAL ACTIVITY INTERVENTIONS**

A search for systematic reviews relevant to scaling-up of school-based physical activity interventions was undertaken. The Medline, Cinahl and Embase databases were scanned (from January 2000 to September 2016) for reviews whose titles used various terms that have been applied to implementing health or prevention programs in pragmatic or real-world settings, particularly in a large number of sites: ‘scaling-up’, ‘translational research’,
CHAPTER 8: Thesis findings and future directions for research.

‘implementation’ and ‘dissemination’. Such reviews were included if they related to physical activity interventions including those inclusive of children and/or adolescents (not restricted to schools), and/or school-based health programs generally. Reviews that identified barriers or enablers to effective school-based physical activity implementation at-scale were included. Systematic reviews evaluating the effectiveness of implementation at scale were limited. 52 Three reviews of relevance were located. 39, 40, 52 Of the three reviews, one review includes implementation studies of interventions known to be effective 52, a second review includes interventions delivered at-scale including examples of both evidence based interventions reported within peer reviewed literature in addition to localised examples of physical activity interventions being delivered at-scale with little evidence of effect 40, and the third includes studies linking level of implementation with organisational or individual level health outcomes, regardless of scale of intervention. 39 A description of these reviews is outlined in Table 8.2, and discussed in the following paragraphs.
### TABLE 8.2: Description of reviews relevant to scaling up school-based physical activity interventions

<table>
<thead>
<tr>
<th>Author/ Date</th>
<th>Title</th>
<th>Aim</th>
<th>Methods</th>
<th>Main outcomes</th>
<th>Outcomes/ considerations relevant to scaling up school-based interventions</th>
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<tbody>
<tr>
<td>Reis, 2016.</td>
<td>Scaling up physical activity interventions worldwide: stepping up to larger and smarter approaches to get people moving</td>
<td>Review of factors that can help achieve successful scaling up of PA interventions. Four aims: (1) to summarise the available peer-reviewed, scientific evidence on scaling-up physical activity interventions; Scaling-up defined as: <em>when an intervention outgrows the research setting and becomes embedded in a system, thereby ensuring maintenance and sustainability of its health benefits</em>. (2) to integrate the knowledge and experience of senior researchers and key stakeholders on the factors influencing the scalability of physical activity interventions in high income countries and low–middle income countries; (3) to identify case studies of scaled-up physical activity interventions from around the world; and</td>
<td>External Validity Assessment Tool (EVAT) was used to assess programs. Interventions were classified by scalability category, using WHO’s ExpandNet framework for scaling up. 18 peer-reviewed articles (16 interventions) were identified in which physical activity was either the main outcome or a co-benefit of a scaled-up intervention, and for which sufficient detail of the scalability process was reported</td>
<td>Aim 1: Review highlighted limited evidence in this area. Policies to support active living are needed, particularly outside the health-care sector. • 13 of the cases represented evidence-based practice and 3 practice-based evidence cases. • Six cases described interventions targeting children or youth, of which three were whole-of-school programmes (n=3) (n=0 in secondary school setting). Scalability was most commonly defined exclusively as extending the reach of an intervention by replicating it in other localities, cities, or states (horizontal scale-up)(n=6), or as institutionalising the intervention at government level so it could reach all citizens within a given jurisdiction (vertical scale-up) (n=5), or as a combination of horizontal and vertical scale-up (n=4).</td>
<td>Three school-based interventions identified as successfully scaled up. All conducted within primary schools (Scale ranged from 6 communities to 81,000 teachers to over 10,000 schools). Review conclusions related to general physical activity interventions, and no specific conclusions were drawn for school-based physical activity interventions. Conclusions: • The research community should shift the balance of its efforts from designing and testing small-scale interventions to change individual behaviour towards expanding the evidence on strategies for translating, disseminating, implementing, and scaling up effective policy and practice for physical activity promotion worldwide. • The science of scalability will be greatly advanced by research that systematically identifies the key steps and processes needed for</td>
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<tr>
<td>Author/ Date</td>
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<tr>
<td>Rabin, 2010</td>
<td>Dissemination and implementation studies on the primary prevention of cancer (i.e., smoking, healthy diet, physical activity, sun protection) in community settings; (2) assess the quality of the studies; (3) summarize the dissemination- and implementation related characteristics with a special focus on strategies for dissemination and transferability.</td>
<td>Aim 1: Twenty-five unique dissemination and implementation studies were identified. The majority of included studies were conducted in the U.S., in schools (n=11), and with children as the ultimate target population, had the least suitability of study design, had fair or limited execution, and used a theoretic framework, active dissemination and implementation approaches, and multimodal strategies.</td>
<td>A search of dissemination and implementation literature was conducted between 2006 and 2008 in the topic areas of smoking, healthy diet, physical activity, and sun protection. English-language peer-reviewed articles published between 1980 and 2008 that met pre-specified inclusion criteria were classified by suitability of study design (i.e., greatest, transferability).</td>
<td>Few school-based physical activity interventions (n=3, all elementary schools).</td>
<td>Successful scale-up of interventions.</td>
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**CHAPTER 8: Thesis findings and implications for future research.**
## Implementing School-Based Physical Activity Interventions: A Systematic Review

To establish the current state of the evidence related to implementation of school-based PA models to explore:
1) the relationship between implementation and health outcomes, and
2) factors that influence implementation (See Table Searched 7 electronic databases (1995–2014) and included controlled studies of school-based PA programmes for healthy youth (6–18 y) measuring at least one physical health-related outcome. For objective 1, studies 15 studies linked implementation with health outcomes (Aim 1) and 29 studies reported on factors associated with implementation (Aim 2). Few studies linked implementation and health outcomes (n = 15 interventions). Most (11/15) reported a positive relationship between implementation and at least one health outcome. Implementation evaluation supported the scale-up of effective school-based PA interventions.

The review made two calls to action. Future research should:
1) address the link between implementation and health outcome within the school-based PA

### Key Outcomes

- The need for uniform language.
- Need for further studies targeting various populations and settings.
- Valid and reliable measures.
- Triangulation of and more practice-based evidence.
- Standardized reporting criteria.
- Active implementation strategies and multi-strategic interventions.

### Outcomes/Considerations Relevant to Scaling Up School-Based Interventions

- No specific conclusions for school-based physical activity interventions were drawn.

---

**Author/ Date** | **Title** | **Aim** | **Methods** | **Main Outcomes** | **Outcomes/ Considerations relevant to scaling up school-based interventions**
--- | --- | --- | --- | --- | ---
Naylor, 2015 | Implementing school-based physical activity interventions: A systematic review | To establish the current state of the evidence related to implementation of school-based PA models to explore: 1) the relationship between implementation and health outcomes, and 2) factors that influence implementation (See Table Searched 7 electronic databases (1995–2014) and included controlled studies of school-based PA programmes for healthy youth (6–18 y) measuring at least one physical health-related outcome. For objective 1, studies 15 studies linked implementation with health outcomes (Aim 1) and 29 studies reported on factors associated with implementation (Aim 2). Few studies linked implementation and health outcomes (n = 15 interventions). Most (11/15) reported a positive relationship between implementation and at least one health outcome. Implementation evaluation supported the scale-up of effective school-based PA interventions.

The review made two calls to action. Future research should:
1) address the link between implementation and health outcome within the school-based PA

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**CHAPTER 8: Thesis findings and implications for future research.**
Implementation was defined as a “specific set of activities designed to put into practice an activity or programme of known dimensions” linked implementation level to student-level health outcome(s). For objective 2, studies reported factors associated with implementation.

Of these, number of schools in trials (across intervention and control): Less than 10 schools = 9 studies 10 to 20 schools = 3 studies More than 20 schools = 3 studies

Implementation factors were reported in 29 interventions. Of 22 unique categories, time was the most prevalent influencing factor (barrier to implementation) followed by resource availability/quality and supportive school climate. (see Table 8.3)

Outcomes/ considerations relevant to scaling up school-based interventions

<table>
<thead>
<tr>
<th>Author/ Date</th>
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<tbody>
<tr>
<td>8.3)</td>
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<td></td>
<td></td>
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<td>literature 2) improve and standardize definitions and measurement of implementation.</td>
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</tbody>
</table>
The review conducted by Reis and colleagues\textsuperscript{40}, described scaling-up as ‘\textit{when an intervention outgrows the research setting and becomes embedded in a system, thereby ensuring maintenance and sustainability of its health benefits}’.\textsuperscript{40} The review included 16 interventions that were all successful examples (i.e., no longer required researcher input) of either horizontal or vertical scaling, which involve implementation of intervention in a larger number of settings in order to reach more people. Interventions were scaled-up either by extending the reach through replication in other localities, cities, or states (horizontal scale-up)\textsuperscript{16}(n=6), or by institutionalising the intervention at government level in order to reach the population within a given jurisdiction (vertical scale-up) (n=5), or a combination of both (n=4).\textsuperscript{40} Of the 16 included interventions, three were school-based interventions, all of which were delivered in the primary school setting. No examples of a secondary school physical activity intervention being successfully embedded within a system or scaled-up were located. The review did not draw conclusions specific to school-based interventions.

Through a process drawing upon knowledge and experience of senior researchers and key stakeholders, the factors influencing the scalability of the included interventions overall were identified. Sixteen key factors were identified as being necessary to successfully scale (either horizontally or vertically) a physical activity intervention (see Table 8.2). The review concluded that further research is required to focus on the implementation of interventions at scale in order to provide population level benefits, rather than continuing to prioritise the development of further efficacy interventions.

The second review, involved an Agency for Health Care Policy and Research study of the effectiveness of dissemination and implementation interventions.\textsuperscript{52} The included
implementation and dissemination studies targeted smoking, healthy diet, physical activity and sun protection behaviours in the context of the primary prevention of cancer in community settings including schools. Fifty two dissemination and implementation studies were included, of which ten were physical activity interventions. Three of the physical activity interventions were delivered in the school setting (all in primary schools). Of the 25 included studies, only six were evaluated using a randomised design (including one school-based physical activity study). Fifty six The majority of studies were coded as having fair or limited implementation, and twenty one of the 25 of the included studies achieved some evidence of effectiveness (measure of implementation varied and was based on process, individual or setting level, not just individual level outcomes). The review concluded that multi-strategic interventions based on ‘active’ dissemination and implementation strategies (such as training, workshops, interactive websites, technical assistance, financial assistance and electronic media) were most likely to be successful. The review further concluded that additional implementation research is warranted in community settings and that targets underserved populations. Furthermore, identification of the characteristics and practices of settings that facilitate the dissemination and implementation of evidence-based cancer prevention interventions was recommended, as was the use of standardised terminology and reporting of measures.

While the review did not draw conclusions about school-based physical activity interventions, it emphasised the limited evidence around implementation in this field and highlighted the mixed results of such trials. Two of the three primary school-based physical activity studies were cross sectional in design with one targeting the health education curriculum through workshops, ongoing technical assistance and a support agent (n= 6 schools) whilst the other
was a health related physical education program utilising training and ongoing support58 (n=111 schools, 7 states). The effectiveness of both these studies was reported as ‘substantially’ effective, within the review. The third study was a group randomised trial of a multicomponent health promotion intervention (n= 8 schools) focused specifically on a socio-economically disadvantaged group (children from low-income families).56 A range of implementation strategies including teacher training, technical support, financial incentives, provision of resources and coalition building to support the intervention implementation were utilised, resulting in effectiveness of the outcome being classified as ‘some level of effect’ within the review (lower than rating for the previous two studies).56

The third review by Naylor et al39 aimed to describe the implementation of school-based physical activity trials. The review reported on the association between implementation and health outcomes (n=15 studies) in addition to the factors (barriers and facilitators) influencing school-based physical activity implementation (n=29 studies).39 Of the 15 studies examining association between implementation and outcome, three were conducted in secondary schools. Eleven of 15 trials overall, and two of the three trials in secondary schools59, 60 reported an association between implementation and health outcome. Although focused on implementation, not all of the included school-based physical activity trials involved large numbers of schools, with only three targeting more than 20 schools across intervention and control groups (one of these in secondary schools) (see Table 8.2).

The review identified a need for further implementation trials to evaluate student level outcomes in order to determine the effectiveness of interventions at the individual level when implemented at scale, concluding there was limited evidence regarding how to successfully
scale-up school physical activity interventions to achieve both individual and population level health gains.

The review also identified 22 unique school-based factors (aim 2) that were concluded to influence the likelihood of successful school practice change as either a barrier or facilitator. These factors are ranked in order based on number of studies identifying the factor (i.e., higher number indicated factor was identified in more studies) and listed in Table 8.3. Many of the factors identified are consistent with those identified by Rabin et al\textsuperscript{52} including training, technical assistance and funding. Whilst the list of factors identified through the literature is extremely comprehensive, the use of standardised methods to systematically identify which implementation barriers are most important and feasible to address are warranted.\textsuperscript{61} Consensus type processes such as the Delphi method along with more efficient quantitative methods can be used to aid the decision process.\textsuperscript{61}

All reviews attest to the limited evidence on implementation of or scaling-up of school-based physical activity interventions, particularly those of previously successful efficacy or effectiveness trial. As a result, all reviews supported the need for further implementation research. As evidence is currently limited, there is a need for further trials to measure implementation of school practices (school and teacher level) in addition to student level outcomes in order to evaluate the impact of broader implementation on population health. Within such research, there is the need for greater focus on standardized definitions of implementation variables\textsuperscript{52} and improved measurement of implementation within the context of school-based physical activity interventions.\textsuperscript{39}
### TABLE 8.3: Factors (barriers and facilitators) related to implementation of school physical activity interventions

<table>
<thead>
<tr>
<th>Factor</th>
<th>Barrier</th>
<th>Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (e.g., competing instructional requirements, teacher overload)</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>Availability/quality of resources (e.g., activity resources, personnel, facilities)</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Supportive school climate (e.g., shared vision/administrative support)</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Contextual appropriateness (e.g., programme/resource acceptability)</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Training/workshops and technical support from programme staff</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Self-efficacy (e.g., ease of implementation, teacher's skill proficiency)</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Teacher characteristics, engagement and motivation</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Lesson scheduling and programme coordination (e.g., inability to follow students over time, field trips, vacation breaks)</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Parent support and perceptions</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Coordination with other agencies</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Perceived/observed benefits of innovation</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Student characteristics, engagement and motivation</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Weather</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Funding</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Communication</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Adaptability (e.g., flexibility of the programme)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Classroom management/disruptive student behaviour</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Policy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Accountability and feedback</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Characteristics of the schools (e.g., school size, language barriers, student ethnicity, built environment)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Staff turnover/ changing roles</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Physical factors (e.g., appropriate footwear/ clothing)</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

*number relates to number of studies showing an association

Note: Table modified based on Naylor et al

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**CHAPTER 8: Thesis findings and implications for future research.**
THEORIES AND FRAMEWORKS TO GUIDE SCALING UP OF INTERVENTIONS

Theories and frameworks are recommended to guide intervention development, as a means of mapping the key stages and conditions to optimise the intervention success. Utilising evidence generated from 24 publications with a focus on concepts, theories and models for scaling-up of public health interventions, Milat and colleagues conducted a narrative review to identify the contextual factors considered necessary to be addressed to ensure the success of scaling a health intervention. These ten factors were: political will, strong leadership and champions, active engagement of a range of implementers and the target community, tailoring the scaled-up approach to the local context, the use of participatory approaches, establishing monitoring and evaluation systems, costing and economic modelling of intervention approaches, the systematic use of evidence, infrastructure to support implementation, a well-defined scale-up strategy and strong advocacy. Such contextual factors are broadly consistent with the 16 factors identified by Reis.

Building on this evidence, Milat and colleagues have outlined practical steps to scaling an intervention, utilising a four step process, outlined in Table 8.4.
TABLE 8.4: Four step process to scaling up a public health intervention.\textsuperscript{49}

<table>
<thead>
<tr>
<th>Step</th>
<th>Process</th>
<th>Considerations for PA4E1</th>
</tr>
</thead>
</table>
| Step 1 | Assessment of scalability of an intervention including consideration of intervention effectiveness, reach, alignment with strategic context and assessing the feasibility and acceptability of the intervention. | • Review the physical activity and implementation adoption strategies including mode of delivery and ability to be implemented at scale.  
• Conduct key informant interviews with Education departments, school executive and PE teachers, parents and students (key stakeholders) to determine acceptability of modified delivery of physical activity and implementation adoption strategies.  
• Determine alignment with existing education and health policies. |
| Step 2 | Developing of a plan including outlining a vision and rationale, describing the intervention, conducting a stakeholder analysis including identifying the barriers and enablers to interventions, determining key implementation staff, selecting an approach to scaling (such as a vertical or horizontal approach), considering evaluation options and estimating resourcing. | • Develop school level and student level outcomes.  
• Outline number of secondary schools to be included in the sample (sample size calculation).  
• Engage education department, school executive and teachers to identify potential barriers and enablers to modified implementation support strategies.  
• Review potential staff and expertise to support PA4E1 implementation.  
• Based on stakeholder engagement and policy context, consider if PA4E1 should be scaled horizontally (expanded to more schools), or vertically (embedded within educational sector policies and processes), or both.  
• Outline the budget required to scale up PA4E1.  
• Develop an evaluation and cost effectiveness plan. |
| Step 3 | Gaining stakeholder support and mobilising those that are key to successful implementation. | • Develop a governance structure to scale-up PA4E1 including key researchers, implementation staff, education sector representatives and parents. |
| Step 4 | Implementation of the intervention including managing organisation change through training, coaching and mentoring, monitoring performance and achieving sustainability through institutionalising the intervention into routine practice.\textsuperscript{49} | • Implement and monitor program implementation including developing roles, responsibilities and key milestones.  
• Ensure the implementation adoption strategies are planned and implemented.  
• Undertake a process evaluation to enable a thorough evaluation of the scale-up of PA4E1 including a review to determine if the physical activity strategies are embedded within routine practice, and implementation support strategies are feasible and acceptable. |

Note: Step 1 to Step 4 from Milat et al\textsuperscript{49}
CONSIDERATIONS FOR SCALING-UP PA4E1 – RECOMMENDATIONS FOR RESEARCH

To scale-up PA4E1, addressing factors such as those proposed by Reis\textsuperscript{40} and Milat\textsuperscript{49, 63} should be considered to ensure the contextual climate of schools, support scaling-up of the intervention. From an implementation design perspective, the initial PA4E1 efficacy trial incorporated an explicit set of implementation support strategies to assist schools to embed the school physical activity strategies into routine school practice.\textsuperscript{64} The six evidence-based implementation support strategies\textsuperscript{65-69} included: an in-school physical activity consultant, executive support, teacher training, resources, prompts and monitoring and feedback reports.\textsuperscript{70} The implementation support strategies were designed to overcome reported barriers to routine implementation of physical activity practices by schools, including some of the major barriers identified by reviews, including lack of time (addressed through two-year intervention period and external consultant for support), leadership (addressed through school level committees involving school executive), the provision of technical support (addressed through training and external consultant for support) training, equipment and resources.\textsuperscript{39}

The ability of the support strategies to be implemented at scale requires some consideration. For example, training in the efficacy trial was conducted face-to-face. The ability to implement training in this manner to a larger number of schools may not be feasible, particularly across large geographic regions. Delivery of online training has the potential to reach large numbers of schools, in a cost effective manner.\textsuperscript{71} Furthermore, incorporating existing training opportunities supported by the education sector, such as training linked to teacher accreditation systems in preference to developing and delivering tailored training would assist with opportunities for vertical scaling and would overcome further barriers such as contextual
appropriateness and supportive school climate. Likewise, the inclusion of a change agent external to the school in the initial trial, whilst addressing barriers of time and access to practice change resources may be difficult to replicate at scale, without considerable financial resources and logistic difficulties of placing a person in each school one day per week. An alternative implementation support strategy that has been suggested to address this issue could involve the use of existing school staff in this role. The cost saving associated with this alternate model of implementation support was explored as a scenario analysis in Chapter 7 (Scenario 2, Modified state roll-out), indicating a cost $39 per student/minute of MVPA. (i.e., a reduction from $66 to $27 per minutes of MVPA per student).

Given the limitations of the literature evaluating the effectiveness of systematic efforts to scale-up physical activity interventions within secondary schools, conduct of a rigorous randomised trial of scaled-up implementation of PA4E1 would contribute to efforts to move research evidence into practice. Using the steps outlined by Milat et al, considerations for a larger implementation trial of PA4E1 are shown in Table 8.4 (right column). While some considerations apply generally to planning an intervention trial (e.g. resourcing, sample size considerations, assessment of the policy context and development of a plan), the following points drawn from these considerations seem particularly relevant to implementing PA4E1 at scale:

- review and modify the implementation support strategies to address identified barriers to implementation identified through the literature and key informant interviews with school executive, PE teachers and students,
- assess capacity of both the school physical activity practices and implementation support strategies to be horizontally scaled-up (consider reach, policy context,
feasibility of delivering of strategies and acceptability of the physical activity practices in school),

• identify opportunities to link with existing training opportunities offered through the educational sector and teacher accreditation systems to strengthen the likelihood of vertical scaling.

• consider evaluating both the effectiveness of the implementation of the program on school physical activity practices, together with assessing the impact on student physical activity levels. This would entail robust measures of implementation (school physical activity practices) as well as student outcomes (physical activity and adiposity). Trials that assess both practice level and individual level outcomes have been termed hybrid designs and are recommended\textsuperscript{39}, to foster rapid translation gains and aid successful intervention delivery\textsuperscript{39, 73},

• monitor the conduct of efforts to scale-up PA4E1 through a detailed process evaluation of the implementation of the school physical activity practices together with the conduct of the implementation support strategies,

• work in partnership with key sectors such as the education sector and community organisations to identify opportunities for vertical scaling which may result in institutionalisation, following efforts to horizontally scale PA4E1.

CONCLUSION
The evidence presented in this thesis suggests that a significant proportion of adolescents internationally fail to participate in adequate daily physical activity, increasing their risk of developing a number of immediate and long-term illnesses and chronic diseases. This thesis
CHAPTER 8: Thesis findings and future directions for research.

identified that a well-designed multicomponent school-based physical activity program with the inclusion of specific implementation support, the PA4E1 intervention, can significantly increase adolescents’ physical activity; including having a significant intervention effect for both girls and boys. Furthermore, this thesis has demonstrated that increases in adolescent physical activity and adiposity can be achieved in a developmental period where longitudinal research consistently demonstrates a natural decline in adolescent physical activity levels. The cost effectiveness of the PA4E1 intervention appeared to be comparable to other multicomponent school-based interventions targeting childhood obesity conducted within Australia and New Zealand, where the context is consistent with the PA4E1 trial. Thus, the work encompassed in this thesis has contributed to advancing intervention research and practice.

Further understanding of the mechanisms involved in implementation of the program at scale is required to contribute towards achieving health gains at a population level. An implementation trial will strengthen the evidence around translating effective school-based interventions into practice. Measuring the sustainability of intervention outcomes for both student outcomes and school practice implementation level outcomes is suggested.
REFERENCES


CHAPTER 8: Thesis findings and future directions for research.


70. Sutherland R, Campbell E, Lubans DR, Morgan PJ, Okely AD, Nathan N, et al. A cluster randomised trial of a school-based intervention to prevent decline in adolescent


73. Meffert SM, Neylan TC, Chambers DA, Verdeli H. Novel implementation research designs for scaling up global mental health care: overcoming translational challenges to address the world’s leading cause of disability. *Internat J of Mental Hlth Syst.* 2016;10:19.
A MULTICOMPONENT SCHOOL-BASED INTERVENTION IN DISADVANTAGED SECONDARY SCHOOLS TO REDUCE THE DECLINE IN PHYSICAL ACTIVITY ASSOCIATED WITH ADOLESCENCE: THE PHYSICAL ACTIVITY 4 EVERYONE RANDOMIZED CONTROLLED TRIAL.

Rachel Louise Sutherland
B Health Science (Nutrition and Dietetics),
Master Public Health (Distinction)

Submitted for the Degree of Doctor of Philosophy
School of Medicine and Public Health
Faculty of Health Sciences
The University of Newcastle
28 October 2016

BOOK 2- APPENDIX TO THESIS DOCUMENT
APPENDIX FOR INTRODUCTION:

APPENDIX I.1:
UNIVERSITY OF NEWCASTLE THESIS BY PUBLICATIONS GUIDELINES

Office of Graduate Studies
Information Sheet
Thesis by Publication

A thesis may be submitted in the form of a series of published papers and the additional rules specific to this style of thesis are presented below. It is important to note that the general rules for a University of Newcastle thesis are also applicable. Please ensure you also refer to The Rules Governing Research Higher Degrees for the full scope of applicable rules.

Rule 39.1 A thesis by publication will include:
1. a full explanatory overview that links the separate papers and places them in the context of an established body of knowledge;
2. a literature review;
3. if detailed data and descriptions of methods are not otherwise given within the separate papers, they must be included in the body of the thesis or as appendices to the thesis.

Rule 39.2 For a thesis by publication:
1. the separate papers provided under sub-clause 39.1(i) must be published, in press or submitted to scholarly media only, i.e. refereed publications classified by current national standards and refereed conference papers, however at least 50% of these papers must have been published. Papers published up to three years prior to enrolment may be included provided they were published in scholarly media and do not represent more than 50% of the total papers;
2. publications submitted by the candidate for another degree may only be referred to in the thesis literature review;
3. the number of papers submitted should demonstrate that the body of work meets the requirements of the degree as outlined in the relevant schedule;
4. the candidate must be the lead author in at least 50% of the papers written in the time of their formal Research Higher Degree candidature. Any published paper of which the candidate is a joint author may only be included in the thesis provided the work done by the candidate is clearly identified. The candidate must include in the thesis a written statement from each co-author attesting to the candidate’s contribution to a joint publication included as part of the thesis. These statements must be endorsed by the Assistant Dean (Research Training);
5. the Assistant Dean (Research Training) may seek the approval of the Dean of Graduate Studies to include a paper that is outside the scope of these rules.
Considerations

- Each discipline area will have different issues to consider in the decision to submit a thesis in the form of a series of published papers.

- It is essential that you discuss your options carefully with your supervisor(s). The thesis by publication must reflect a sustained and cohesive theme, an integrated whole that adds logically to the body of the available literature. Overall, the material presented for examination needs to equate to that which would otherwise be presented in the traditional thesis format.

- The review process for some journals is significant resulting in lengthy waiting periods for papers to be accepted and this can delay thesis submission/ completion. Time management and selection of journals/publishers is critical. Focusing on publication rather than research may lead to candidates being tempted to publish sections of their work prematurely and missing opportunities to fully capitalize on the significance of the work.

- Consider the thesis from the examiner’s viewpoint - if the publications do not have a clear cohesion and the contribution to knowledge is not clearly demonstrated, then the thesis may attract criticism and be rejected by examiners. The content of the thesis remains a matter of professional judgment for the supervisor(s) and candidate.

- Any published paper of which the candidate is a joint author may only be included in the thesis provided the work done by the candidate is clearly identified. The candidate must include in the thesis a written statement from each co-author attesting to the candidate’s contribution to a joint publication included as part of the thesis. The statement/s need to be signed by the Faculty/Assistant Dean (Research Training). A sample statement is provided below.

- We strongly advise that you arrange for the signatures from co-authors to be collected as soon as the paper is prepared or submitted for publication rather than trying to collect them at the time of thesis submission.

- There is no minimum or maximum requirement on the number of papers. Of equal, or perhaps more importance than quantity, is the quality of the journals. Please refer to your school or faculty for more specific guidance on the number and length of papers that would normally be expected in your discipline.

Alternative option

As discussed above, you need to consider if your publications will form a sufficient body of cohesive work to meet the requirements of thesis by publication. You may like to consider the other option of including publications within a standard thesis format, either in the body or as an appendix as supported in the rule below.

Rule 50.5. A thesis may

1. Include publications arising as a consequence of the research undertaken for a thesis. When the candidate includes a co-authored published paper or co-authored scholarly work, or a substantive component of a co-authored published paper or co-authored scholarly work in the body of the thesis, the candidate must include in the thesis a written statement attesting to their contribution to the joint publication. This statement must be signed by the supervisor. A statement is not required when publications are included as an appendix to the thesis.
Components and Layout

PLEASE NOTE: the layout and ordering of the contents is flexible and should be based on the judgement and experience of candidates and supervisors as well as discipline norms. Please use your own discretion and seek expert advice. The following is a suggested layout only.

1. Title Page

2. Declarations

Originality
I hereby certify that to the best of my knowledge and belief this thesis is my own work and contains no material previously published or written by another person except where due references and acknowledgements are made. It contains no material which has been previously submitted by me for the award of any other degree or diploma in any university or other tertiary institution.

Thesis by Publication
I hereby certify that this thesis is in the form of a series of papers. I have included as part of the thesis a written statement from each co-author, endorsed in writing by the Faculty Assistant Dean (Research Training), attesting to my contribution to any jointly authored papers. (“Refer to clause 39.2 of the Rules Governing Research Higher Degrees for acceptable papers.”)

3. Acknowledgments

4. List of publications included as part of the thesis

4.1 List all of the included published work with the full bibliographic citations in the order they appear in the thesis.

4.2 Provide a statement to indicate that where necessary permission regarding copyright has been obtained from copyright owners. For example, the statement may say ‘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, artwork, unpublished letters), 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).”

5. Table of Contents

6. Abstract

An abstract of approximately 300 words is required to describe the content of the thesis.

7. Overview

A full explanatory overview is required to link the published papers to the research thesis. This may include sections for Literature Review (if not included separately), Research Design and Review/Discussion. Not all of these sections may be necessary. Choose the format that underpins the academic argument so that the contents of the thesis are established as a substantial and significant body of work, but without unnecessary repetition.

8. Literature Review
9. Statement of Contribution of Others

In the thesis, at the front of each paper, include a written statement from each co-author attesting to the candidate's contribution to a joint publication included as part of the thesis. The purpose of this statement is to summarise and clearly identify the nature and extent of the intellectual input by the candidate and any co-authors.

9.1 Sample co-author statement

By signing below I confirm that [Candidate Name] contributed [insert outline of contribution] to the paper/publication entitled [insert reference details].

List:
Full Name of Co-Author(s), Date, Signature of Co-Author(s)

Full Name of Faculty Assistant Dean Research Training, Date, Signature

10. Papers/Chapters

Each paper/chapter should have an introduction to explain how it contributes to the overall body of knowledge. It is not necessary to reformat published papers in the thesis. Where appropriate publications can be included in full or in parts thereof.

11. Appendices

12. Bibliography
APPENDIX FIVE: Additional material for Chapter 5

APPENDIX FOUR
ADDITIONAL MATERIAL FOR CHAPTER 4

APPENDIX 4.1:
ETHICS APPROVAL- HNEAHS 2011

8 April 2011

A/Professor J Wiggers
Population Health
Waltern: NSW 2287

Dear Professor Wiggers,

Re: Physical Activity 4 Every 1 (11/63/164.05)

HNEHREC Reference No: 11/63/164.05
NSW HREC Reference No: HREC/11/HNE/74

Thank you for submitting the above protocol for single ethical review. This project was first considered by the Hunter New England Human Research Ethics Committee at its meeting held on 16 March 2011. This Human Research Ethics Committee is constituted and operates in accordance with the National Health and Medical Research Council’s National Statement on Ethical Conduct in Human Research (2007) (National Statement) and the CMPM/CMT Note for Guidance on Good Clinical Practice. Further, this Committee has been accredited by the NSW Department of Health as a lead HREC under the model for single ethical and scientific review. The Committee’s Terms of Reference are available from the Hunter New England Area Health Service website: http://www.hnee.health.nsw.gov.au/human_research_ethics.

I am pleased to advise that following acceptance under delegated authority of the requested clarifications and revised Information Statements and Surveys by Dr Nicole Gerrard Manager, Research Ethics & Governance, the Hunter New England Human Research Ethics Committee has granted ethical approval of the above project.

The following documentation has been reviewed and approved by the Hunter New England Human Research Ethics Committee:

- For the Information Sheet for Schools (Version 2 dated 18 March 2011);
- For the Principal Consent Form;
- For the Information Sheet for PHEE Staff (Version 2 dated 18 March 2011);
- For the Parent/Carer Information Sheet and Consent Form for Student Participation (Version 2 dated 18 March 2011);
- For the Information Sheet for Students (Version 2 dated 18 March 2011);
- For the School Principal Survey;
- For the Physical Education Teacher Survey;
- For the Student Survey; and
- For the Parent Survey

For the protocol: Physical Activity 4 Every 1

Hunter New England Research Ethics & Governance Unit
Locked Bag No 1
New Lambton, NSW 2305
Telephone (02) 4921 955 Facsimile (02) 4921 816
E-mail: hnehec@hnee.health.nsw.gov.au
Approval from the Hunter New England Human Research Ethics Committee for the above protocol is given for a maximum of 3 years from the date of this letter, after which a renewal application will be required if the protocol has not been completed.

The National Statement on Ethical Conduct in Human Research (2007), which the Committee is obliged to adhere to, include the requirement that the committee monitors the research protocols it has approved. In order for the Committee to fulfill this function, it requires:

- A report of the progress of the above protocol be submitted at 12 monthly intervals. Your review date is April 2012. A proforma for the annual report will be sent two weeks prior to the due date.
- A final report must be submitted at the completion of the above protocol, that is, after data analysis has been completed and a final report compiled. A proforma for the final report will be sent two weeks prior to the due date.
- All variations or amendments to this protocol, including amendments to the Information Sheet and Consent Form, must be forwarded to and approved by the Hunter New England Human Research Ethics Committee prior to their implementation.
- The Principal Investigator will immediately report anything which might warrant review of ethical approval of the project in the specified format, including:
  - any serious or unexpected adverse events
    - Adverse events, however minor, must be recorded as observed by the Investigator or as volunteered by a participant in this protocol. Full details will be documented, whether or not the Investigator or his deputies considers the event to be related to the trial substance or procedure. These do not need to be reported to the Hunter New England Human Research Ethics Committee
    - Serious adverse events that occur during the study or within six months of completion of the trial at your site should be reported to the Manager, Research Ethics & Governance, of the Hunter New England Human Research Ethics Committee as soon as possible and at the latest within 72 hours.
    - Serious adverse events are defined as:
      - Causing death, life threatening or serious disability.
      - Cause or prolong hospitalisation.
      - Overdoses, cancers, congenital abnormalities whether judged to be caused by the investigational agent or new procedure or not.
      - Unforeseen events that might affect continued ethical acceptability of the project.
• If for some reason the above protocol does not commence (for example it does not receive funding), is suspended or discontinued, please inform Dr Nicole Gerrand, as soon as possible.

You are reminded that this letter constitutes ethical approval only. You must not commence this research project at a site until separate authorisation from the Chief Executive or delegate of that site has been obtained.

A copy of this letter must be forwarded to all site investigators for submission to the relevant Research Governance Officer.

Should you have any concerns or questions about your research, please contact Dr Gerrand as per the details at the bottom of the page. The Hunter New England Human Research Ethics Committee wishes you every success in your research.

Please quote 11/03/16/4.05 in all correspondence.

The Hunter New England Human Research Ethics Committee wishes you every success in your research.

Yours faithfully

For:  Associate Professor M Parsons
Chair
Hunter New England Human Research Ethics Committee
ETHICS APPROVAL - UON 2011

HUMAN RESEARCH ETHICS COMMITTEE

Notification of Expedited Approval

To Chief Investigator or Project Supervisor: Associate Professor John Wiggers
Cc Co-investigators / Research Students: Professor Philip Morgan
                                                      Associate Professor David Lubans
                                                      Dr Luke Woffenden
                                                      Dr Libby Campbell

Re Protocol: Physical Activity 4 Every 1
Date: 02-Aug-2011
Reference No: H.2011-0210
Date of Initial Approval: 02-Aug-2011

Thank you for your Initial Application submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.

Your submission was considered under Expedited Review of External Approval review by the Chair/Deputy Chair.

I am pleased to advise that the decision on your submission is External HREC Approval Noted effective 02 Aug 2011.

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal Certificate of Approval will be available upon request. Your approval number is H-2011-0210.

If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants. You may then proceed with the research.
APPENDIX FIVE: Additional material for Chapter 5

Conditions of Approval

This approval has been granted subject to you complying with the requirements for Monitoring of Progress, Reporting of Adverse Events, and Variations to the Approved Protocol as detailed below.

PLEASE NOTE:
In the case where the HREC has "noted" the approval of an External HREC, progress reports and reports of adverse events are to be submitted to the External HREC only. In the case of Variations to the approved protocol, or a Renewal of approval, you will apply to the External HREC for approval in the first instance and then Register that approval with the University's HREC.

- Monitoring of Progress

Other than above, the University is obliged to monitor the progress of research projects involving human participants to ensure that they are conducted according to the protocol as approved by the HREC. A progress report is required on an annual basis. Continuation of your HREC approval for this project is conditional upon receipt, and satisfactory assessment, of annual progress reports. You will be advised when a report is due.

- Reporting of Adverse Events

1. It is the responsibility of the person first named on this Approval Advice to report adverse events.
2. Adverse events, however minor, must be recorded by the investigator as observed by the investigator or as volunteered by a participant in the research. Full details are to be documented, whether or not the investigator, or his/her deputies, consider the event to be related to the research substance or procedure.
3. Serious or unforeseen adverse events that occur during the research or within six (6) months of completion of the research, must be reported by the person first named on the Approval Advice to the (HREC) by way of the Adverse Event Report form within 72 hours of the occurrence of the event or the investigator receiving advice of the event.
4. Serious adverse events are defined as:
   - Causing death, life threatening or serious disability.
   - Causing or prolonging hospitalisation.
   - Overdoses, cancers, congenital abnormalities, tissue damage, whether or not they are judged to be caused by the investigational agent or procedure.
   - Causing psycho-social and/or financial harm. This covers everything from perceived invasion of privacy, breach of confidentiality, or the diminution of social reputation, to the creation of psychological fears and trauma.
   - Any other event which might affect the continued ethical acceptability of the project.
5. Reports of adverse events must include:
   - Participant's study identification number;
   - date of birth;
   - date of entry into the study;
   - treatment arm (if applicable);
   - date of event;
   - details of event;
   - the investigator's opinion as to whether the event is related to the research procedures; and
   - action taken in response to the event.
6. Adverse events which do not fall within the definition of serious or unexpected, including those reported from other sites involved in the research, are to be reported in detail at the time of the annual progress report to the HREC.

- Variations to approved protocol

If you wish to change, or deviate from, the approved protocol, you will need to submit an Application for Variation to Approved Human Research. Variations may include, but are not limited to, changes or additions to investigators, study design, study population, number of participants, methods of recruitment, or participant information/consent documentation. Variations must be approved by the (HREC) before they are implemented except when Registering an approval of a variation from an external HREC which has been designated the lead HREC, in which case you may proceed as soon as you receive an acknowledgement of your Registration.

A10
Linkage of ethics approval to a new Grant

HREC approvals cannot be assigned to a new grant or award (ie those that were not identified on the application for ethics approval) without confirmation of the approval from the Human Research Ethics Officer on behalf of the HREC.

Best wishes for a successful project.

Professor Alison Ferguson
Chair, Human Research Ethics Committee

For communications and enquiries:
Human Research Ethics Administration
Research Services
Research Integrity Unit
HA148, Hunter Building
The University of Newcastle
Callaghan NSW 2308
T +61 2 492 18906
F +61 2 492 17104
Human.ethics@newcastle.edu.au

Linked University of Newcastle administered funding:

<table>
<thead>
<tr>
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<th>Funding project title</th>
<th>First named investigator</th>
<th>Grant Ref</th>
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<td>Hunter New England Population Health/Shared(1)</td>
<td>HNEP Health Promotion Demonstration Grant HA1481</td>
<td>Wiggins John Henry</td>
<td>G1100752</td>
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ETHICS APPROVAL- SERAP 2011

A/Prof John Wiggers
Locked Bag 10
WALLSEND NSW 2287

DOC 11/97350

Dear A/Prof Wiggers

I refer to your application to conduct a research project in New South Wales government schools entitled Physical Activity for Every 1 (PA4E1). I am pleased to inform you that your application has been approved. You may now contact the Principals of the nominated schools to seek their participation. You should include a copy of this letter with the documents you send to schools.

This approval will remain valid until 09/04/2012.

No researchers or research assistants have fulfilled the Working with Children screening requirements to interact with or observe children for the purposes of this research.

I draw your attention to the following requirements for all researchers in New South Wales government schools:

- School Principals have the right to withdraw the school from the study at any time. The approval of the Principal for the specific method of gathering information for the school must also be sought.
- The privacy of the school and the students is to be protected.
- The participation of teachers and students must be voluntary and must be at the school's convenience.
- Any proposal to publish the outcomes of the study should be discussed with the Research Approvals Officer before publication proceeds.

When your study is completed please forward your report marked to Manager, Schooling Research, Department of Education and Training, Locked Bag 53, Darlinghurst, NSW 2010.

Yours sincerely

Dr Max Smith
Senior Manager
Student Engagement and Program Evaluation

June 2011
APPENDIX 4.2:
SCHOOL RECRUITMENT

7 April 2011

Dear XXXXXX,

You are invited to take part in the research program ‘Physical Activity 4 Every 1’ (PA4E1) which is being conducted by Dr John Wiggers from Hunter New England Population Health – Health Reform Transitional Organisation Northern, Hunter New England Population Health has been successful in gaining funding to implement a program to improve the health and wellbeing of young people in the Hunter New England Region by increasing their participation in regular physical activity. The PA4E1 program will run for three years between 2011 and 2013.

Schools have an important role to play in promoting the health of students. We have consulted with the Catholic Schools Diocese and the Department of Education to identify how schools can be involved in the program, and are now offering schools in the region the opportunity to participate in the program.

Why is this research being done?
Physical inactivity greatly increases the risk of cardiovascular disease, cancer and obesity, and is estimated to be responsible for around 1.9 million deaths in Australia each year. As low levels of physical activity in adulthood are associated with low levels during the adolescent years, the promotion of physical activity during this time is suggested to be one approach for reducing this burden of illness.
In Australia, National Physical Activity Guidelines recommend that children and adolescents participate in at least 60 minutes of moderate to vigorous physical activity every day. However, it is also known that Australian adolescents are not meeting these recommendations. In 2007 only 47% of 9-13yr olds met recommended daily step requirements, with this declining to 26% among 14-16yr olds.

Schools are thought to be key settings for the promotion of physical activity as they have existing curricula, infrastructure, policies and resources to promote physical activity.

The primary aim of the PA4E1 study is to determine whether a comprehensive physical activity program implemented in secondary schools over 2 years can increase the physical activity levels of adolescents.

**What will schools be asked to do?**

The seven intervention strategies that will be implemented in schools as part of the PA4E1 program are outlined below:

- Implementation of pedometer-based PE lessons and curriculum material.
- Implementation of annual individual student physical activity plans in PDHPE.
- Modification of school policies to encourage students to be more physically active.
- Implementation of daily, accessible, activity programs for boys and girls during school breaks.
- Implementation of enhanced sports programs for all students based on Program X (for girls) and PALS (for boys), both of which have been shown to be efficacious. Program X and PALS involve a variety of strategies designed to increase physical activity in low active secondary school students and run for 10 week blocks. The programs are known to be acceptable and appropriate for these students.
- Implementation of after-school physical activity programs through linkages with community sporting groups or fitness industry.
- Provision of information to parents with strategies that can improve their children’s activity.

**Who can participate in this research?**

The project will be conducted in 8 Catholic Schools Diocese and Department of Education secondary schools within the Hunter New England and Central and Lower Mid North Coast Areas of NSW.
Schools may participate in the project if they have between 120-200 Year 7 and are not participating in other major physical activity studies. Schools must also be located in an area of low socio-economic status based on Local Government Area.

Schools will be randomly allocated to either a ‘study program’ group or a wait list control group. Schools allocated to the wait list control will not receive the PA4E1 program during the study period, but will participate in the study measures. PA4E1 program materials will be made available to these schools following completion of the study.

Students who are in Year 7 at the selected schools in Year 1 (2011) of the study will be invited to participate. Parents of these students will also be eligible to participate, as are all PDCHE teachers.

**What study measures will students be asked to participate in?**

All students in Year 7 2011 who consent to study measures will be asked to:

- Wear an accelerometer for seven consecutive days (including five school days and two weekend days) from the time they wake up in the morning, until when they go to bed in the evening. This will happen sometime during Term 3, 2011 and students will be asked to wear an accelerometer again in 2012 and 2013. An accelerometer is a small portable device that attaches to the student’s waistband and can be worn out of sight under a shirt or jumper, which measures the amount of physical activity a person does. Using accelerometers is considered a good way to do research where physical activity is of interest.

- Fill in a survey. The survey will ask some questions about the student, their attitudes and beliefs about physical activity and their usual physical activity behaviours. The survey will take place during class in Term 2 of 2011 and will take about 30 minutes to complete on-line. Students will be asked to complete the survey again in 2012 and 2013.

- Allow researchers from the study to measure their height, weight and waist circumference during Term 3, 2011. Students will be asked to allow researchers to measure their height and weight again in 2012 and 2013. Trained data collectors with child protection clearance will conduct these measurements. Measurements will be conducted in a private place and students will be fully clothed.

**What other study measures are involved?**

- The Principal and PDCHE teachers will be asked to complete a survey about PE class practices, policies, curriculum based strategies for increasing physical activity participation, student participation levels, use of facilities and equipment and opinions of the PA4E1 project.
APPENDIX FIVE: Additional material for Chapter 5

The survey will take place during Term 2 of 2011 and will take about 15 minutes to complete. The Principal and teachers will be asked to complete the survey again in 2012 and 2013.

- Parents of students in Year 7 2011 will also be asked to complete an annual survey about the factors that contribute to the physical activity of their child/children annually in Year 1 (2011) through to Year 3 (2013). The survey will be sent home via their child/children and will take approximately 15 minutes to complete.

**What choice do you have?**

Participation in this research is entirely your choice and only schools where principals have given their explicit consent will be included in the study. If you do agree to your school’s participation, you may withdraw from the study at any time without giving a reason. A decision not to participate or discontinuation of involvement in the study will not jeopardise your relationship with Hunter New England Population Health.

Similarly, students in your school will be included in the measurement aspects of the study only after a consent form has been signed by the student and their parents/guardians. Parents or children are free to withdraw from the study measurement at any stage by either the school withdrawing, by parents withdrawing their children or by children not wanting to participate. Withdrawing will not disadvantage anyone. If parents or children withdraw from the study we will be able to delete any information they provided.

**Who will be responsible for delivering and administering the study?**

A team of researchers from Hunter New England Population Health and the University of Newcastle will deliver and administer the study. Schools allocated to receive the study program will receive the equivalent of 0.2 relief for a staff member to act as a school liaison teacher. The liaison teachers will lead the planning, implementation and evaluation of the program within their schools. Schools on the waitlist control group will also receive relief for the time required to complete the study measures.

**What are the risks and benefits of participating?**

The evaluation measures will be carried out by trained research assistants. The school sport, PE and lunchtime sessions will be developed by the research team and delivered by a suitable member of the school’s teaching staff. Based on previous studies, students will have no greater chance of injury by participating in these programs in comparison to other sports and physical activities.
The program will provide students with an opportunity to increase their knowledge and skills and improve attitudes toward physical activity and nutrition. Students will also benefit from participation in a variety of enjoyable exercise activities. Staff involved in running these sessions will also personally benefit through acquired knowledge, skills and fitness. These sessions will also provide opportunities for professional development through the provision of resources and programs to assist with session delivery.

**How will the information collected in the study be used?**

The data collected from this study will be used for journal publications and conference presentations and to inform future practice for the design of valuable, evidence-based school physical activity programs. Reports that will be written about this study will only summarise the information we receive and it will not be possible to identify individuals and their responses in any format where the results may be presented or published.

**How will privacy be protected?**

Any information provided by children, parents, teachers and Principals will be treated as strictly confidential. Only the research team will have access to the completed questionnaires or other study data. Data collected may be used for student research. All research information, questionnaires and consent forms will be stored in a secure location at Hunter New England Population Health and kept in the strictest confidence, as required by law. All information transferred electronically will be done in a file which is password protected. It will not be possible to identify individuals from any publication arising from the research.

**What do you need to do to participate?**

If you are willing for your school to participate in this study, please complete the accompanying Consent Form and return it to the researchers in the reply paid envelope provided. Upon receipt of your consent, we will contact you to organise a time to visit the school and provide students with information about the study. If you would like to organise a different route for the dissemination of the Information Sheet and Consent Form to students, please let us know. All students will be required to return a Consent Form which the student’s parents/guardians have signed before the study starts.
Further information

Following the completion of the study, the school will be sent a report describing the findings of the study. Results will become available to study participants and their parents if requested. Individual results will not be given to students.

If you would like more information regarding this study please contact Ms Rachel Sutherland, Program Manager at Hunter New England Population Health on (02) 4924 6133.

Thank you for considering this invitation.

Yours sincerely

Dr John Wiggers
Director
Health Reform Transitional Organisation Northern
Hunter New England Population Health

The project has been approved by the Hunter New England Human Research Ethics Committee of Hunter New England Local Health Network, reference 11/13/16/4.05

Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher or, if an independent person is preferred, to Dr Nicole O'Hara, Manager, Research Ethics and Governance, Hunter New England Local Health Network, Locked Bag 1, New Lambton NSW 2305, telephone (02) 4921490, email hnehr@hnehealth.health.nsw.gov.au

Researchers on the ‘FAIEI’ project
Associate Professor John Wiggers, Population Health, Health Reform Transitional Organisation Northern
Associate Professor Phil Mogan, University of Newcastle
Dr David Lubens, University of Newcastle
Dr Libby Campbell, Population Health, Health Reform Transitional Organisation Northern
APPENDIX FIVE: Additional material for Chapter 5

Health Reform Transitional Organisation Northern
Hunter New England Population Health
ABN: 65 304 742 467

Locked Bag 10
Wallsend NSW 2287
Phone (02) 4924 6477 Fax (02) 4924 6460
Email PHEnquiries@hnehealth.nsw.gov.au

"PHYSICAL ACTIVITY 4 EVERY 1"
PRINCIPAL CONSENT FORM

I have been given information about the program identified above. I understand that if I consent to my school's involvement in this program, consenting students will participate in the study entitled: Physical Activity 4 Every 1 and my school will be randomly allocated to one of two interventions:

(i) The study program recipient group where schools will receive a three year physical activity program

OR

(ii) The wait-list control group where schools will not receive the physical activity program during the study period. However, program materials will be made available following the study's completion.

I understand that consenting students will also complete the following program evaluation measures: physical activity levels, height, weight, and waist circumference, and physical activity related attitudes and behaviours.

I have had an opportunity to ask the research team questions about the research. I understand that my school's participation in this research is voluntary and that my school and my students are free to withdraw from the study at any time. My refusal to participate or withdrawal of consent will not affect my relationship with Hunter New England Local Health Network.

By signing below I am indicating my consent for my school to participate in this research study conducted by Associate Professor John Wiggers. I am also consenting for the provision of time and space for (1) members of the research team to deliver information to potential student participants at a recruitment presentation, (2) delivery of the study's physical activity program during timeabled school CHOICE sport and weekly lunch periods and members of the research team to collect evaluation measures from student participants three times during the study period.

Name of school:__________________________________________

Principal's name: ________________________________________

Signature: ____________________________ Date: ______________

PLEASE FAX OR EMAIL COMPLETED SHEET BACK ASAP TO RACHEL SUTHERLAND
FAX No. 4924 6200 OR rachel.sutherland@hnehealth.nsw.gov.au

This project has been approved by the Hunter New England Human Research Ethics Committee of Hunter New England Local Health Network, reference 11/33/164/05

Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, Dr Nicole Gerard, Manager, Research Ethics and Governance, Hunter New England Local Health Network, Locked Bag 1, New Lambton NSW 2305, telephone (02) 492 4950, email hnehrco@hnehealth.nsw.gov.au

Researchers on the 'PA4E!' project:
Associate Professor John Wiggers, Health Reform Transitional Organisation Northern, Hunter New England Population Health
Associate Professor Phil Morgan, University of Newcastle
Dr David Lubans, University of Newcastle
Dr Libby Campbell, Health Reform Transitional Organisation Northern, Hunter New England Population Health
APPENDIX 4.3:
PARENT INFORMATION LETTER

Health Reform Transitional Organisation Northern
Hunter New England Population Health
ABN: 36 304 742 457

Locked Bag 10
Wagga Wagga NSW 2650
Phone (02) 4924 6477 Fax (02) 4924 6490
Email PHEnquiries@hnehealth.nsw.gov.au

"PHYSICAL ACTIVITY 4 EVERY 1"
PARENT/CARER INFORMATION SHEET AND CONSENT FORM FOR STUDENT PARTICIPATION
Version 2, dated 18/03/2011

Dear Parent/Carer,

You and your child are invited to take part in the 'Physical Activity 4 Every 1' (PA4E1) program which is being conducted by Hunter New England Population Health. This program aims to improve the health and wellbeing of young people by increasing their participation in regular physical activity.

Why is the research being done?

Physical inactivity greatly increases the risk of heart disease, cancer and obesity. It is thought to result in around 1.9 million deaths in Australia each year. As low levels of physical activity in adulthood are associated with low levels during the adolescent years, the promotion of physical activity is suggested to be one way to reduce these rates of illness. This study will test whether the PA4E1 program is effective in increasing adolescent physical activity levels over three years.

What does the study involve?

Eight schools in the Hunter New England and Central and Lower Mid North Coast Areas of NSW (including your school) will be involved in this study. Four schools will receive a number of whole-of-school strategies designed to increase the physical activity levels of adolescents, while four others will be part of a wait list control group. Schools allocated to the wait list control will not receive the PA4E1 program during the study period, but will still participate in the study measures. PA4E1 program materials will be made available to these schools at the end of the study.
Who can participate?

Your School Principal has given consent for your school to participate in the PA4E1 program. We are asking Year 7 students at your school to participate in the measurement of this study. Parents of Year 7 students are also invited to participate through completion of a survey.

What is required of you and your child/children for the measurement of this study?

Students will be asked to:

- Wear an accelerometer for seven days (including five school days and two weekend days) from the time they wake up, until when they go to bed. An accelerometer is a small portable device that attaches to their waist-band. It can be worn out of sight under a shirt or jumper. Accelerometers measure the amount of physical activity a person does. Using accelerometers is considered a good way to do research where physical activity is of interest. As with all of the information collected in this program, the information collected from the accelerometers is confidential. Student’s names will not be recorded with them. This will happen sometime during Term 3, 2011 and they may be asked to wear an accelerometer again in 2012 and 2013.

- Complete an annual online survey in class which will ask about their attitudes and beliefs about physical activity and their usual physical activity behaviours. The questionnaire will take approximately 30 minutes of class time for your child to complete.

- Allow study researchers to measure their height, weight and waist circumference annually. Only trained data collectors with child protection clearance will conduct these measurements. Measurements will be conducted in a private place and students will be fully clothed.

- Some students, nominated by the school, will be asked to assist with planning for the PA4E1 program. For example students will be key participants in planning committees.

Parents will be asked to:

- Provide consent for their child/children to participate in the measurement components of the PA4E1 project, as described above.

- Complete an annual survey about the factors that contribute to the physical activity of their child/children in Year 1 (2011) through to Year 3 (2013). The survey will be sent home to you via your child/children. The survey will take around 15 minutes to complete. You can return the completed survey to Hunter New England Population Health using the reply paid envelope attached. Alternatively, your child/children can return your completed survey to school and give it to the staff in the office.
When will the information be collected?

Students will wear the accelerometers for seven days during Term 3 of each year of the program (2011, 2012 and 2013). Students’ height, weight and waist circumference will also be measured during Term 3 of each year of the program. The student surveys will take place in Term 3 of each year of the program.

Do you or your child have to participate?

Your child’s participation in the program is entirely yours and your child’s choice. Only those students whose parents give their written consent will wear an accelerometer for seven days, have their height, weight and waist circumference measured and complete the student survey. Where parental consent is given, the final decision to participate is your child’s. If you decide you do not want your child to participate, you and your child will not be disadvantaged in any way. If you decide you do want your child to participate, you or your child can decide to withdraw from the study at any time without giving a reason. If you decide to withdraw your child, or your child decides to withdraw from the study we will be able to delete any information your child has provided. For the parent survey, your participation is also voluntary.

Who will see the information that is collected?

Any information provided through the accelerometers, height, weight and waist circumference measurement and student and parent surveys will be treated as strictly confidential. Student and parent names will not be recorded with the information they provide and their identity will not be revealed to anyone other than the researchers conducting the project. No one including parents, teachers, friends or anyone else will have access to the accelerometer, height, weight and waist circumference or completed survey data. Only the research team from Hunter New England Population Health will have access to the study data. Data collected may be used for student research. The study data will be stored on a secure Hunter New England Local Health Network server and will be kept in the strictest confidence, as required by law. The data will be published in summary form, with no mention of particular individuals. All answers provided are confidential and individual student answers will not be provided to school staff, parents, or friends. The survey will be made available at your child’s school for both you and your child to view prior to the survey period.

How will we ensure the well-being of the children?

Ethical clearance has been given from the Department of Education and Training, the Catholic School’s Office, the University of Newcastle and Hunter New England Local Health Network. We
have made a commitment to protect the safety, privacy and self-esteem of all students. All staff will have appropriate child protection clearance and training. Teachers from the school will be with the children during surveys. If research staff or teachers notice that participation in the study is concerning your child, a teacher will speak with them privately and may decide to withdraw them from the study. If anything about the survey is concerning you or your child, you and your child could speak about it with your school counsellor or doctor.

**Feedback**

A summary report of the results of the annual student survey will be provided to your school for the school newsletter. The report will not identify individuals. Results of the study may be presented at scientific conferences and be published within scientific journals.

**What do you need to do for you and/or your child to participate?**

Please read and be clear on the information provided above, and discuss the study with your child before making a decision. Please ask your child to read the enclosed student information sheet. If you would like your child to participate, both you and your child need to sign the attached consent form. Please, return the completed consent form to your school within 2 weeks. If you would like to participate in the parent survey, there is no need for you to complete a separate consent form. Your completion of the survey will act as your consent to participate. You will be provided with details for how to complete the survey if you wish to, closer to the time.

**Follow up telephone contact**

Should you not return the consent form to your child’s school by the due date, researchers will telephone you to check that you received the information letter and consent form. If you do not want the researchers to telephone you, please contact your child’s school on 1800 XXX XXX (this is a free call number) where a message can be left 24 hours a day. Clearly state your first name and surname, your child’s/children’s first name and surname and the name of your child’s school. Your name and your child’s/children’s name will then be withdrawn from the survey list and you will NOT be contacted by phone. Alternatively, you can tell the interviewer that you do not want your child/children to participate in the survey when they call you.

If you would like more information regarding this study please contact Ms Rachel Sutherland, Program Manager at Hunter New England Population Health on (02) 4924 8133.
Thank you for considering this invitation. The information that you and your child provides will help to develop initiatives to improve the health and wellbeing of all students.

Yours sincerely

Dr John Wiggers  
Director  
Health Reform Transitional Organisation Northern  
Hunter New England Population Health

This project has been approved by the Hunter New England Human Research Ethics Committee of Hunter New England Local Health Network, reference 11/03/16/4.05  

Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher or, if an independent person is preferred, to Dr Nicola Gemmell, Manager Research Ethics and Governance, Hunter New England Local Health Network, Locked Bag 1, New Lambton NSW 2305, telephone (02) 4921 1920, email hnesms@hnehealth.nsw.gov.au

Researchers on the ‘P4E’ project  
Associate Professor John Wiggers, Population Health, Health Reform Transitional Organisation Northern  
Associate Professor Phil Morgan, University of Newcastle  
Dr David Lubans, University of Newcastle  
Dr Libby Campbell, Population Health, Health Reform Transitional Organisation Northern
APPENDIX 4.4: PARENT CONSENT FORM

‘PHYSICAL ACTIVITY 4 EVERY 1’
PARENTAL CONSENT FORM FOR STUDENT PARTICIPATION

Parents and children please read, and parents please sign and return this form to school within 2 weeks if you wish to participate.

I have had this study clearly explained to me. I also acknowledge that my child clearly understands what is required of him/her.

I understand that consenting to participate in this study does not obligate me or my child/children to participate in any future research. I understand that I may withdraw, or withdraw my child/children from the study at any time. I understand that my child/children may choose to withdraw from the study at any time and that the information that my child/children and I provide will be confidential and will be stored safely after the study is completed.

Please tick:

I agree to give consent for my son/daughter to complete an annual questionnaire asking Yes □ No □ about their attitudes and beliefs about physical activity and their usual physical activity habits.

I agree to give consent for my son/daughter to wear an accelerometer to check their Yes □ No □ physical activity levels on 3 separate occasions.

I agree to give consent for my son/daughter to have their height, weight and waist Yes □ No □ circumferenced measured.

Parent/Guardian Name: ____________________________ Date: __________

Parent/Guardian Signature: ____________________________

Son/Daughter Name: ____________________________ from Year: __________

Son/Daughter Signature: ____________________________ Date: __________

PLEASE RETURN THIS CONSENT FORM USING THE ENCLOSED REPLY PAID ENVELOPE OR GIVE TO YOUR CHILD TO RETURN TO HIS/HER SCHOOL.

This project has been approved by the Hunter New England Human Research Ethics Committee of Hunter New England Local Health Network, reference 11/03/16/4.05.

Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to Dr Nicole Gerrand, Manager, Research Ethics and Governance, Hunter New England Local Health Network, Locked Bag 1, New Lambton NSW 2305, telephone (02) 49214960, email thsrec@hnehealth.nsw.gov.au.

Researchers on the ‘PAE1’ project:
Associate Professor John Wiggers, Health Reform Transitional Organisation Northern, Hunter New England Population Health
Associate Professor Phil Morgan, University of Newcastle
Dr David Ljubes, University of Newcastle
APPENDIX 4.5:
CATI CONSENT SCRIPT

TITL 0  TITLE 1  CATI
NOLAB

PA4E1 Parent Consent CATI 2012
*************************** TITLE ITEM
***************************
TIME 0  T_START 1
LABEL
Start Time
This records duration to current point
Starting Time
************************** GET DURATION ITEM
**************************
LINK 1  schonam 1  QINFORM  QFORMAT
LABEL
MODULE  SUBMODUL  16
T_START GT .
SCHOOL NAME
DATACATI.confid  schonam
DATACATI.confid  dcdate
DATACATI.confid  ADDRESS
DATACATI.confid  postcode
DATACATI.confid  suburb
DATACATI.confid  child
DATACATI.confid  child2
DATACATI.confid  cFname1
DATACATI.confid  cLname1
DATACATI.confid  cFname2
DATACATI.confid  cLname2
DATACATI.confid  cFname3
DATACATI.confid  cLname3
DATACATI.confid  pname
DATACATI.confid  stdphone
DATACATI.confid  othphone
Picks up school name
*************************** LINK TO EXTERNAL DATASET ITEM
***************************
INFO 1  INTRO1 2
NOLAB
Intro
SCHONAM GT ''
Hello, my name is ^_INTVR_^ and I am calling on behalf of ^SCHONAM^ in relation to the Physical Activity for Everyone Program.
************************** INFORMATION SCREEN ITEM
**************************
CHCE 1 13  INTRO2 1  _MAKE_
NOLAB
Intro
INTRO1=1
Could I please speak to ^PNAME^?
1  speaking to that person
2  person called to phone
3 person not at home (record on log sheet)
4 person unwell at the moment (record on log sheet)
5 parent has died (record on log sheet)
6 someone in household recently died (record on log sheet)
7 wrong number for parent/carer (record on log sheet)
8 person physically or mentally incapable (record on log sheet)
9 non English speaking and no help available (record on log sheet)
10 person has moved, no forwarding contact details (record on log sheet)
11 child no longer at the school (record on log sheet)
12 other (record on log sheet)
.R Refused

******************* SINGLE CHOICE - CATI VERSION
******************************
INFO 1 WNUM 5
NOLAB
Intro
intro2=7
Sorry to have bothered you. Goodbye.

INTERVIEWER: RECORD as CB on logsheet and try and find the correct number

*** RECORD AS CB ON LOGSHEET ***
****************************** INFORMATION SCREEN ITEM
******************************
CHCE 1 2 TALKA 3 _MAKE_
LABEL

MODULE SUBMODUL
INTRO2=1
Is it ok to speak to you now for a couple of minutes about your "child2"'s participation in the study measures for the Physical Activity for Everyone program?
1 Yes
2 No
ok to talk now

****************************** SINGLE CHOICE - CATI VERSION
******************************
CHCE 1 2 TALKB 4 _MAKE_
LABEL

MODULE SUBMODUL
INTRO2=2
Hello, my name is ^_INTVR_^ and I'm calling from ^SCHONAM^.
Is it ok to speak to you now for about five minutes about your "child2"'s participation in the study measures for the Physical Activity for Everyone program?
1 Yes
2 No
ok to talk now

****************************** SINGLE CHOICE - CATI VERSION
******************************
INFO 1 RECLET 6
NOLAB
Intro
TALKA=1 or TALKB=1
You should have received a parent information letter from us in the last week or so containing information about the Physical Activity for Everyone Program, and letting you know that we may phone you. The letter was given to your child to bring home and was mailed to you in a red NSW Health envelope and included a consent form and a reply paid envelope.

************************ INFORMATION SCREEN ITEM
************************
CHCE 1 4 RECALL 1 _MAKE_
LABEL
Intro
RECALL=1
Do you recall receiving the letter?
1 Yes
2 Yes and I have sent back the consent form
3 No
4 Not sure
Rec a copy of info and consent letters

************************ SINGLE CHOICE - CATI VERSION
************************
INFO 1 LETTR1 6
NOLAB
Intro
RECALL=1
As you may recall, the information letter gives you background to a Program that is running in our school from later this year until the end of 2014. The program is called Physical Activity for Everyone and aims to improve the health and wellbeing of Year 7 to 9 students by increasing their participation in physical activity.

************************ INFORMATION SCREEN ITEM
************************
INFO 1 LETTR2 5
NOLAB
Intro
RECALL in (3,4)
The information letter gives you background to a program that is running in our school from later this year until the end of 2014. The program is called Physical Activity for Everyone and aims to improve the health and wellbeing of Year 7 to 9 students by increasing their participation in physical activity.

************************ INFORMATION SCREEN ITEM
************************
INFO 1 MEASUR1 6
NOLAB
Intro
LETTR1=1 or LETTR2=1
The letter also explained that as part of the program we would like your
child to participate in the 3 study measures, which I will now describe to you. The first measure is wearing an accelerometer to determine the amount of physical activity done each day for a week. It is a small, portable device that is worn on an elastic belt and can be worn out of sight under a shirt or jumper.

INFO 1 MOBILE 4

Intro

MEASUR1=1

We are also asking for your mobile phone number and your child’s so we can send an automated text to remind them to put on the accelerometer each morning and to return it to school after 1 week. The numbers will not be used for any other purpose.

INFO 1 MEASUR2 4

Intro

MOBILE=1

The second measure is an online survey which will ask your child about their attitudes and beliefs about physical activity and their usual physical activity behaviours. It will be completed in class on a computer once a year during the life of the program.

INFO 1 MEASUR3 5

Intro

MEASUR2=1

The third measure is allowing a trained data collector to measure their height, weight and waist circumference once a year during the life of the program. This will be done at school behind a privacy screen in the same room as a teacher is present to supervise other students completing the online survey. Students will remain fully clothed.

CHCE 1 2 NRECORD 6 _MAKE_

MODULE SUBMODUL

RECALL=2

Sorry, but there is no record of the form being received for your child.
We will check again at this end and perhaps you could also check that the form has been sent or handed in. So, seeing as we don't currently have your consent form is it ok to confirm with you now whether you consented to your "child"'s participating in the study measures for the Physical Activity for Everyone program?

1       Yes
2       No

ok to talk now

*********************************************************************** SINGLE CHOICE - CATI VERSION
***********************************************************************
CHCE 1 2       KIDSA 4 _MAKE_
LABEL
MODULE SUBMODUL
MEASUR3=1 or NRECORD=1
Our school records indicate that you are the legal guardian/parent of
"child", "child2", "cFName1" "cLName1", "cFName2" "cLName2", "cFName3"
"cLName3", in Year 7 at "SCHONAM".
Is that correct?
1       Yes
2       No (includes yes but more children)
correct number of children

*********************************************************************** SINGLE CHOICE - CATI VERSION
***********************************************************************
TABL 1 20      KIDB 8
LABEL
MODULE SUBMOD 6
KIDSA=2
Sorry about that. So that I can update our records, would you please
tell me the names of all your children in Year 7?

[NOTE TO INTERVIEWER:]
** Put down ALL the names - even if they were correct in KIDSA
**
** CORRECT SPELLING IS ESSENTIAL. ASK FOR SPELLING OF ALL NAMES.
**
** USE CAPITAL FOR FIRST LETTER OF FIRST & LAST NAMES.
**
** IMPORTANT: Click on the CHILD1 FName SQUARE before moving on
**
numc                    20
CHILD1  FName                               C
CHILD1  LName                               C
CHILD2  FName                               C
CHILD2  LName                               C
CHILD3  FName                               C
CHILD3  LName                               C
All child details

***********************************************************************TABLE ENTRY ITEM - NO BUTTONS
***********************************************************************
Your child's participation in each of the 3 study measures is very important as their opinions and responses will guide future strategies to improve the health and well being of our students.

Your child's measurements and answers will be anonymous and will not be able to be identified by anyone including parents, teachers or friends.

1 - that you and your child's participation in the 3 study measures is voluntary and if you decide not to participate that it will in no way prejudice your child's academic standing or relationship with their school.

2 - that you or your child are free to withdraw your participation at any time.

3 - and finally that all information provided will be treated as strictly confidential, that student names will not be recorded with the information they provide and any data that is published will be in summary form, with no mention of any individual student.

Do you understand everything that we just discussed that was in the information letter?

1  Yes
2  No

Do you understand everything that we just discussed that was in the information letter?
APPENDIX FIVE: Additional material for Chapter 5

UNDERST=2
Do you have any questions about the information letter?

.INTERVIEWER: IF YES, CLICK ON YES AND GO TO NEXT SCREEN AND PUT IN
QUESTION. THE NEXT SCREEN AFTER THAT WILL SAY WHETHER YOU ANSWERED
IT)
1       Yes
2       No

questions around info letter
*********************************************************************** SINGLE CHOICE - CATI VERSION
***********************************************************************
CHCE  1 5 QUEST2a 5 _MAKE_
LABEL
MODULE SUBMODUL
QUEST2a=2
I notice that you have said that you don't understand and that you
don't have any questions. Would you like a member of the program
team to call you or do you have a question now or would you like to be
resent the information letter and have some time to read it
before we call you back?
1       Member of the program team to call
2       Have a question
3       Resend letter
4       Program team to call and resend letter
5       No, respondent does understand

questions around info letter2
*********************************************************************** SINGLE CHOICE - CATI VERSION
***********************************************************************
OPEN  1 200 QUEST2b 1
LABEL
MODULE SUBMODUL
QUEST1=1 or QUEST2a=2
QUESTIONS THAT THEY MAY HAVE
Interviewers comments
*********************************************************************** OPEN ENDED ENTRY ITEM
***********************************************************************
CHCE  1 2 QUEST3 6 _MAKE_
LABEL
MODULE SUBMODUL
QUEST2b ne ''
INTERVIEWER ONLY - DO NOT ASK THE RESPONDENT

Did you answer the respondent's question?
If yes, you will continue with survey
If no, survey will terminate and they will be called back by a
member of
the program team
1       Yes, answered q
2       No, did not answer q

interviewer answered question
*********************************************************************** SINGLE CHOICE - CATI VERSION
***********************************************************************
CHCE  1 2 QUEST4 2 _MAKE_
LABEL
MODULE SUBMODUL
QUEST3=1
Do you understand now or would you like a member of the program team
to call you?
1 Yes, they understand now
2 No, the program team to call
questions around info letter1
************************************************************************** SINGLE CHOICE - CATI VERSION
**************************************************************************

TABL 1 10 ADR1 8
LABEL
MODULE  SUBMOD 4
QUEST2a in (3,4)
A new information letter and consent form will be sent to you in a red NSW
Health envelope.
Your address details are listed on the school system as:

  ^ADDRESS^  ^SUBURB^  ^POSTCODE^  
Is this correct?
** CLICK ON YES BUTTON OR ENTER ADDRESS **
** CHECK SPELLING IS CORRECT. ASK FOR SPELLING OF DIFFICULT WORDS. **

NUMC 30
YES B 1
Street C
Suburb C
Postcode C

Specify address for consent
************************************************************************** TABLE ENTRY ITEM - NO BUTTONS
**************************************************************************

CALC 1 nc 0
NOLAB
MODULE  SUBMOD 23 6
KIDSA in (1,2) and (UNDERST=1 or QUEST2a=5 or QUEST4=1)
length ncfName1 ncfName2 ncfName3 $20.;
length nclName1 nclName2 nclName3 $30.;
if KIDSA=1 then do;
  array cFNam[3] cFName1 cFName2 cFName3;
  array cLNam[3] cLName1 cLName2 cLName3;
  array chF[3] ncfName1 ncfName2 ncfName3;
  array chL[3] nclName1 nclName2 nclName3;
  do i=1 to 3;
    if cFNam[i] gt ' ' then chF[i]=cFNam[i];
    if cLNam[i] gt ' ' then chL[i]=cLNam[i];
  end;
end;
else if KIDSA=2 then do;
  array chF2[3] ncfName1 ncfName2 ncfName3;
  array chL2[3] nclName1 nclName2 nclName3;
  array cchF[3] KIDBc1 KIDBc3 KIDBc5;
  array cchL[3] KIDBc2 KIDBc4 KIDBc6;
  do i=1 to 3;
    if cchF[i] gt ' ' then chF2[i]=cchF[i];
    if cchL[i] gt ' ' then chL2[i]=cchL[i];
  end;
end;
nc=1;
ncFName1         C
ncFName2         C
ncFName3         C
ncLName1         C
ncLName2         C
ncLName3         C

*********************** CALCULATION ITEM
*************************
CHCE 12 ConNow 6

LABEL
MODULE SUBMODUL
nc=1
I will now ask you for your consent for your ^child2^ to participate in the measurement of the Physical Activity For Everyone program for the next 3 years (2012 to 2014). The first round of measurement will be happening at your child's school in the week of ^dcdate^.
Is it ok to ask for consent now?

1   Yes
2   No (incl parent to talk to child 1st)

Consent now?

************************* SINGLE CHOICE - CATI VERSION
*************************
NULL 1 nullCon 0
NOLAB
MODULE SUBMODUL
ConNow=2

**************************NULL ITEM - DOES NOTHING**************************
DO 2 3 lpstart 0
NOLAB
MODULE SUBMODUL
ConNow=1 and (ncFName1 gt ' ' and ncLName1 gt ' ') or (ncFName2 ge ' ' | ncFName3 ge ' ' | ncLName2 ge ' '| ncLName3 ge ' ')

**************************NULL ITEM - DOES NOTHING**************************
INFO 1 2 Consen 2
NOLAB
LOOP
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' ' and ConNow=1
I will now ask for consent for ^ncFName[0]^ ^ncLName[0]^ for each of the 3 study measures.
APPENDIX FIVE: Additional material for Chapter 5

************************** INFORMATION SCREEN ITEM
**************************

CHCE 1 2 ConAC 7 _MAKE_
LABEL
LOOP
Consen[0]=1
The first study measure I am asking your consent for is:
Do you agree to give consent for `ncFName[0]` `ncLName[0]` to wear
an
accelerometer to measure their physical activity level on a number
of
occasions in 2012, 2013 and 2014?

[NOTE TO INTERVIEWER: WRITE RESPONSE ON LOGSHEET]

1 Yes
2 No

*************** SINGLE CHOICE - CATI VERSION

**************************

OPEN 1 200 MOBC 8
LABEL
LOOP
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' ' and
ConAC[0]=1
As explained earlier, an automated text from the program team will
be sent
to you and to `ncFName[0]` `ncLName[0]` as a reminder to put on the
accelerometer each morning and to return it to school after 1 week.
What is `ncFName[0]` `ncLName[0]`'s mobile phone number?

[INTERVIEWER: PLEASE RECORD CHILD’S MOBILE PH NUMBER, IF NOT KNOWN
THEN
WRITE 'PARENT CAN’T REMEMBER' OR 'CHILD DOES NOT HAVE A MOBILE
PHONE'.
THEN PRESS NEXT]

Child's mobile phone number

************************** OPEN ENDED ENTRY ITEM

**************************

CHCE 1 4 MOBP1 5 _MAKE_
LABEL
MODULE SUBMODUL
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' ' and
MOBC[0] gt ' ' 
[INTERVIEWER: ONLY READ OUT IF THIS IS THE FIRST OR ONLY CHILD.
FOR SECOND OR THIRD CHILD SELECT 4 ALREADY ASKED]
We have your contact phone numbers as `stdphone` and `othphone`.
Is this correct?

1 Yes and one is mobile
2 Yes but no mobile number
3 No
4 Already asked

Check parent mobile phone number

************************** SINGLE CHOICE - CATI VERSION

**************************
APPENDIX FIVE: Additional material for Chapter 5

OPEN 1 200 MOBP2 2
LABEL
MODULE
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' ' and
MOBP1[0]=2
That's good. And can you please give us your mobile phone number?
[INTERVIEWER: ENTER MOBILE PHONE NUMBER,
Parent mobile phone number
*** ********** OPEN ENDED ENTRY ITEM
********************
OPEN 1 200 MOBP3 4
LABEL
MODULE
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' ' and
MOBP1[0]=3
Sorry about that. Can you please tell me the correct phone number(s)?
[IF NO MOBILE NUMBER PROVIDED, ASK And what is your mobile phone
number?
[INTERVIEWER: ENTER CORRECTED PHONE NUMBERS,
AND PARENT MOBILE PHONE NUMBER IF NOT ALREADY PROVIDED]
Parent mobile phone number
*** ********** OPEN ENDED ENTRY ITEM
********************
CHCE 3 2 ConOS 8
MAKE
LABEL
LOOP
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' '
and (ConAC[0] in (2, .R) or MOBP1[0]=1 or MOBP1[0]=4 or MOBP2[0] gt ",'',
or MOBP3[0] gt '')
I will now ask you for consent for the second study measure:
Do you agree to give consent for ^ncFName[0]^ ^ncLName[0]^ to
complete
an online survey on the computer at school each year asking about
their
attitudes and beliefs about physical activity and their usual
physical
activity habits?
[NOTE TO INTERVIEWER: WRITE RESPONSE ON LOGSHEET]
1 Yes
2 No
consent measure2
************************ SINGLE CHOICE - CATI VERSION
************************
CHCE 2 2 ConAP 6
MAKE
LABEL
LOOP
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' '
and (ConOS[0] gt .)
I will now ask you for consent for the third study measure:
Do you agree to give consent for ^ncFName[0]^ ^ncLName[0]^ to have
their height, weight and waist circumference measured at school?
[NOTE TO INTERVIEWER: WRITE RESPONSE ON LOGSHEET]

1       Yes
2       No

consent measure3

*************** SINGLE CHOICE - CATI VERSION

***********************
INFO  2         NONCN  8
NOLAB
LOOP
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' ' and ConAP[0] gt .
and (ConAC[0] EQ 2 or ConOS[0] EQ 2 or ConAP[0] EQ 2)
Now I just want to confirm with you that as you have said No to ^ncFName[0]^ participating in one or more study measure/s that they won't be able to participate in that/those study measure/s. If you do change your mind about ^ncFName[0]^'s participation just return the signed consent form if you still have it or contact the school and they will organise to have one sent to you.

[NOTE TO INTERVIEWER: IF NEEDED YOU CAN REFER TO RESPONSES YOU RECORDED ON THE LOGSHEET]

*************** INFORMATION SCREEN ITEM
***********************
NULL  2         nullb   0
NOLAB
MODULE  SUBMODUL
lpstart3 in (1,2,3) and nulla[0]=1 and ncFName[0] gt ' ' and (ConAP[0]=1 or noncn[0] in (. 1)) or (nulla[0]=1 and ncFName[0]=' ')

*************** NULL ITEM - DOES NOTHING ***************
ENDD  1         lpend   0
NOLAB
MODULE  SUBMODUL
nullb3=1

*************** TABLE ENTRY ITEM - NO BUTTONS ***************
CHCE  1 2       NEWFORM 4                      _MAKE_
LABEL
MODULE  SUBMODUL
lpend=1 and RECALL in (1 3 4)
For our records, we would appreciate it if you would please sign and return a consent form as soon as possible.
Would you like us to send out a new one in the post or do you still have the consent form? 
1       Send new consent by post
2       Parent has consent form
Resend consent form

*************** SINGLE CHOICE - CATI VERSION ***************
Thank you very much for going through the answers that you have already posted to us. We will keep an eye out for your form.

A new information letter and consent form will be sent to you in a red NSW Health envelope. Your address details are listed on the school system as:

^ADDRESS^ ^SUBURB^ ^POSTCODE^  
Is this correct?

** CLICK ON YES BUTTON OR ENTER ADDRESS **  
** CHECK SPELLING IS CORRECT. ASK FOR SPELLING TO BE SURE. **

Great, if you and your child would please sign it and then return it to the school or use the reply paid envelope for free postage.

When you have the information letter please read over the letter and if you have any questions feel free to call the number at the bottom of the letter. We ask that you and your ^child2^ please complete and sign the consent form and then return it to the school or use the reply paid envelope for free postage.

We will call you back in a week if you haven't returned the consent form.

Thank you very much for your time today. Goodbye.
When you have the consent form we ask that both you and your child please sign it and then return it to the school or use the reply paid envelope for free postage.

Thank you very much for your time today. Goodbye.

A member of the team from the Physical Activity for Everyone program will be in contact with you shortly. When would be a good time to call?

Thank you for your time. Goodbye.

I'm sorry for your loss, please accept my apology for calling you at such a difficult time. Is it OK if we call you back at a better time?
APPENDIX FIVE: Additional material for Chapter 5

1       Yes
2       No
.R      Refused

Sorry Loss

************************** SINGLE CHOICE - CATI VERSION
**************************
INFO 1      SORLOS2 2
NOLAB
Intro
INTRO2=5

I'm sorry for your loss, please accept my apology for calling you at such a difficult time.

************************** INFORMATION SCREEN ITEM
**************************
CHCE 1 3      SORUNW 2
.MAKE_
NOLAB
Intro
INTRO2=4

I'm sorry to hear they are not feeling well. Would it be OK if I called back at a later time to talk with ^PNAME^?
1       Yes
2       No
.R      Refused

************************** SINGLE CHOICE - CATI VERSION
**************************
INFO 1      CBTIME 9
NOLAB
Intro
INTRO2=3|SORLOS1=1|SORUNW=1|TALKA=2|TALKB=2|nullCon=1
When would be a good time to call back?

Is this the best telephone number to reach you on?

*** INTERVIEWER: Record new number/new time on log sheet ***

Great, I'll call back then. Thank you for your time today. Goodbye.

*** Record as CB on log sheet, THEN PRESS NEXT ***
************************** INFORMATION SCREEN ITEM
**************************
INFO 1      THANKDR 3
NOLAB
MODULE  SUBMODUL
intro2=.R|sorunw in (2,.R)|sorlos1 in (2,.R)
Thank you very much for your time today. Goodbye.

*** RECORD AS DR ON LOGSHEET, THEN PRESS NEXT ***
************************** INFORMATION SCREEN ITEM
**************************
INFO 1      THANKOS 3
NOLAB
MODULE  SUBMODUL
intro2 in (8,9,10,11) or SORLOS2=1
Thank you very much for your time today. Goodbye.
Thank you very much for your time today. Goodbye.

Please type n if you have nothing to put in here.

**APPENDIX FIVE: Additional material for Chapter 5**

*** RECORD AS OS ON LOGSHEET, THEN PRESS NEXT ***
********** INFORMATION SCREEN ITEM
************************** INFO 1 THANKOT 3
NOLAB
MODULE SUBMODUL
other gt ','

*** RECORD AS OT ON LOGSHEET, THEN PRESS NEXT ***
********** INFORMATION SCREEN ITEM
******************************** OPEN 2 200 INTVCOM 7
LABEL
MODULE SUBMODUL
THANKDR=1|THANKOS=1|THANKOT=1|WNUM=1|
THANKNL=1|THANKNF=1|THANKHF=1|THANKTC=1|CBTIME=1
*** END OF SURVEY *** INTERVIEWERS DO NOT READ ***

Note: INTERVIEWER please write your comments here

Interviewers comments
************************** OPEN ENDED ENTRY ITEM
************ TIME 1 T_END 0
LABEL
end time
INTVCOM GT ' ' and (THANKHF=1 or THANKNF=1)
Recording end time
************************** GET DURATION ITEM
************ STAT 1 STAT_CQ 1
NOLAB
end stat
T_END GT .
Completed
CQ
************************** STAT 1 STAT_DR 1
NOLAB
DR stat
T_END EQ . and INTVCOM GT ' ' and THANKDR=1
Refused
DR
************************** STAT 1 STAT_CB 1
NOLAB
CB stat
T_END EQ . and INTVCOM GT ' ' and
(CBTIME=1|THANKNL=1|WNUM=1|THANKTC=1)
Callback
CB

*******************************************************************
********      
STAT  1         STAT_OS  1
NOLAB
OS  stat
T_END EQ . and INTVCOM GT ' ' and (SORLOS2=1 or THANKOS=1)
Incapable or NESB
OS
*******************************************************************
********      
STAT  1         STAT_OT  1
NOLAB
OT  stat
T_END EQ . and INTVCOM GT ' ' and THANKOT=1
other screen - to code
OT
*******************************************************************
********      
INFO  2         TERM    2
NOLAB
END   Term
stat_cq='CQ' or STAT_CB='CB' or STAT_DR='DR'
or STAT_OS='OS' or STAT_OT='OT'
INTERVIEWER TERMINATION INSTRUCTION, PRESS STOP
AND RECORD OUTCOME OF INTERVIEW ON LOG
*******************************************************************
********** INFORMATION SCREEN
APPENDIX 4.6: SAMPLE OF TEACHER TRAINING SLIDES

APPENDIX FIVE: Additional material for Chapter 5
APPENDIX FIVE: Additional material for Chapter 5

Motivation for PE and PA
- Describe the relationship between motivation and physical activity (as similar to A4 material for U3A participants)
- Autonomous motivation for PA (A4 material for U3A participants)
- Autonomous motivation for PA and PA related self-efficacy (A4 material for U3A participants)
- SDT continuum

Promoting autonomous motivation
- Fulfill basic needs
  - Competence: perceptions of effectiveness
  - Relatedness: self-directedness, relevance of task is also important
  - Autonomy: autonomous choice relationships

Self-Determination Theory

Activity: Increasing motivation
- Description: This is a short presentation on how to get students to increase their motivation and adherence to SAJF principles.

Practical session
- Description: This is a short presentation on how to get students to increase their motivation and adherence to SAJF principles.
APPENDIX 4.7:
SAMPLE STUDENT PA PLAN

MY PHYSICAL ACTIVITY PLANNER

Student Name: ___________________________  HPE Class: ___________________________

Term: _____

PERSONAL PHYSICAL ACTIVITY PLANNER

Finding 60 minutes of physical activity every day is one of the best things you can do for your social, mental and physical health. Using a personal physical activity planner can help you get started and stay motivated to achieve your goals. This planner helps you develop a health & fitness plan and a personal best day plan.

HEALTH & FITNESS PLAN

How to use the health & fitness plan

Step 1: List the components of fitness from your PE health and fitness challenge.

<table>
<thead>
<tr>
<th>Component of Fitness</th>
<th>Where I am now</th>
<th>Where I want to be</th>
<th>Things I can do to get there</th>
<th>Where I am at end of Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUPA in PE (pedometer steps)</td>
<td>800 steps</td>
<td>880 steps</td>
<td>Walk or cycle to school 3 times a week</td>
<td>900 steps</td>
</tr>
<tr>
<td>Muscular endurance (1 minute sit-up test)</td>
<td>14 sit ups</td>
<td>18 sit ups</td>
<td>Do sit ups 3 nights a week for 1 minute before bed</td>
<td>18 sit ups</td>
</tr>
<tr>
<td>Cardio-respiratory endurance</td>
<td>Run 1km</td>
<td>Run 2km</td>
<td>Go for a 30 minute run 2 afternoons after school</td>
<td>Run in 2km fun run</td>
</tr>
</tbody>
</table>

Also list any other component of fitness that you want to improve and strategies to help you improve, for example improve cardio-respiratory endurance by running after school to go in a fun run by the end of Term.
## MY PERSONAL BEST DAY (PBD)

<table>
<thead>
<tr>
<th>Component of fitness</th>
<th>PBD #1</th>
<th>PBD #2</th>
<th>PBD #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVPA in PE</td>
<td>My score today</td>
<td>My goal for next PBD</td>
<td></td>
</tr>
<tr>
<td>(pedometer steps in PE)</td>
<td>My score today</td>
<td>My goal for next PBD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My score today</td>
<td>My goal for next PBD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My score today</td>
<td>My goal for next PBD</td>
<td></td>
</tr>
</tbody>
</table>

## HEALTH & FITNESS PLAN

**Step 5:** Check that your strategies are SMART:

- **Specific** (say exactly what you want to do),
- **Measurable** (will you be able to know that you have achieved the goal),
- **Achievable** (is your goal possible to accomplish),
- **Relevant** (will your suggested strategies help you achieve your goal),
- **Time Framed** (what can you achieve by the end of Term)

**Step 6:** At the end of the week check that you have been doing what you planned and if not, try and do better the next week.

**Step 7:** During your PE class monitor and record on your plan how you...
APPENDIX FIVE:  Additional material for Chapter 5

MY HEALTH & FITNESS PLAN

<table>
<thead>
<tr>
<th>Component of Fitness</th>
<th>Where I am now</th>
<th>Where I want to be</th>
<th>Things I can do to get there</th>
<th>Where I am at end of Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVPA in PE</td>
<td>800 steps</td>
<td>1000 steps</td>
<td>Go for a 30 minute run 2 afternoons after school</td>
<td>1100 steps</td>
</tr>
<tr>
<td>(pedometer steps in PE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PERSONAL BEST DAY PLAN

How to use the Personal Best Day plan

Personal Best Day is designed to help you track your health and fitness progress over time. Your PE teacher will tell you when you have a Personal Best Day and what challenge you are going to be doing for example if it is a pedometer lesson for MVPA in PE. At the end of the lesson simply record your score on your card. Based on how well you went you may like to set yourself a goal for the next lesson. You do not need to show anyone your score, nor will you be “marked” on how well you do. It is simply a way of helping you see how well you are going with the health and fitness challenges that you have set. If you are concerned about how you are going, speak to your PE teacher at the end of the lesson.

Example of a Personal Best Day Plan

<table>
<thead>
<tr>
<th>Component of Fitness</th>
<th>PBD #1</th>
<th>PBD #2</th>
<th>PBD #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVPA in PE (pedometer steps)</td>
<td>My score today</td>
<td>400 steps</td>
<td>550 steps</td>
</tr>
<tr>
<td></td>
<td>My goal for next PBD</td>
<td>600 steps</td>
<td>700 steps</td>
</tr>
<tr>
<td>1 minute push up test</td>
<td>My score today</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>My goal for next PBD</td>
<td>14</td>
<td>16</td>
</tr>
</tbody>
</table>
Step 2: Using results from your PE health and fitness challenge write where you are now in terms of how well you performed in the challenge.

<table>
<thead>
<tr>
<th>Component of Fitness</th>
<th>Where I am now</th>
<th>Where I want to be</th>
<th>Things I can do to get there</th>
<th>Where I am at end of Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVPA in PE (pedometer steps)</td>
<td>800 steps</td>
<td>880 steps</td>
<td>Walk or cycle to school 3 times a week</td>
<td>900 steps</td>
</tr>
<tr>
<td>Muscular endurance (1 minute sit-up test)</td>
<td>14 sit ups</td>
<td>18 sit ups</td>
<td>Do sit ups 3 nights a week for 1 minute before bed</td>
<td>18 sit ups</td>
</tr>
<tr>
<td>Cardio-respiratory endurance</td>
<td>Run 1km</td>
<td>Run 2km</td>
<td>Go for a 30 minute run 2 afternoons after school</td>
<td>Ran in 2km local fun run</td>
</tr>
</tbody>
</table>

Step 3: Identify where you want to be with each component of fitness by the end of the Term. For example you may want to improve your result by 10%.

Step 4: Identify some strategies you can use to help you get there, for example:
- 2 afternoons after school go for a run, ride or go bush walking with your family
APPENDIX 4.9:
POLICY TEMPLATE

Physical Activity Policy

Rationale
In recognition of the importance of physical activity for young people aged 12-18 years, XXXX is participating in the Physical Activity for Everyone (PA4E1) program for 3 years, 2012-2014. The PA4E1 program employs seven strategies shown to increase students’ physical activity time and intensity; they are covered under the five goals of this policy.

Physical inactivity significantly increases the risk of cardiovascular disease, cancer and obesity.\(^3\) It is estimated to be responsible for 3.2 million deaths worldwide each year,\(^3\) and 16,00 deaths per year in Australia.\(^4\) Also, physical activity has also been shown to enhance cognitive performance, assist in developing social skills and increase the likelihood of focus on academic subjects in the classroom.\(^4\) Recent surveys suggest that Australian adolescents are not sufficiently active and become progressively less active during their time at secondary school.\(^6\)–\(^8\) Given that low levels of physical activity during adolescence are associated with low levels of physical activity in adulthood,\(^9\)–\(^10\), implementation of appropriate physical activity practices in secondary schools has the potential to deliver both short and long term health and educational benefits.

This policy is complementary to and not in lieu of any NSW Department of Education or Curriculum requirements.

Aim
The purpose of this policy is to ensure that through the school’s participation in the PA4E1 program, secondary school students are supported and encouraged to be physically active in line with current guidelines. Australia’s Physical Activity Guidelines for 12 to 18 Year olds are to achieve at least 60 minutes of moderate-to-vigorous intensity physical activity each day.\(^11\)

Goals and Strategies
Goal 1. Provide adequate opportunities for physical activity
The school will:
- Implement PA4E1 Strategy 4 – provide daily, accessible, evidence based physical activities appropriate for male and female students during recess and lunch (including access to adequate space and equipment)
• Implement PA4E1 Strategy 7 - enable regular, accessible, before and after-school PA programs through linkages with community sporting groups or fitness industry.

• Implement PA4E1 Strategy 6 - provide families with information and strategies that they can use to improve their children’s physical activity and be active with their children at home and in the community, e.g. via school newsletter, website, Facebook, BVC App, P&C meetings and parent events.

Goal 2. Enable appropriate intensity of physical activity
The school will:

• Implement PA4E1 Strategy 1 – fortnightly pedometer-based PE lessons for year 7 and 8 students as well as curriculum material and teaching strategies that aim to increase moderate to vigorous activity to at least 50% of lesson time in PE.

Goal 3. Encourage and support all students (including low-active and high active students) to increase and maintain physical activity levels
The school will:

• Implement PA4E1 Strategy 3 - in Term 1, 2013 and annually after that, review and where necessary modify other school policies to align with practices that research shows encourage low-active students to be more physically active e.g. single sex PE and sports classes, ensuring spaces for physical activity are available during school breaks and outside school hours, ensuring school uniforms are physical activity friendly (e.g. option of shorts and long pants for girls, rather than restricting to skirts)

• Implement PA4E1 Strategy 2 – support students to complete individual physical activity plans in HPE that include: fitness assessments; long and short term personal goals for improving or maintaining regular physical activity; specific actions and timelines to achieve those goals; methods to be used to record actions and assess progress; and rewards for achieving goals.

• Implement PA4E1 Strategy 5 - run an age appropriate 10 week enhanced sports program (Program X) for all students in year 8

Goal 4. Monitor and review the implementation and currency of physical activity policy
The school will:

• Review the physical activity policy and relevant sections of other policies (e.g. school uniform, access to spaces and equipment) against current, evidence based, national recommendations and relevant DEC requirements every 12 months

Goal 5. Allocate resources (professional development time, leadership/committee time, equipment) to support implementation of the above strategies in order to achieve the above goals
The school will:
• Ensure HPE teachers receive adequate training and resources to support physical education classes to be at least 50% moderate to vigorous activity

• Ensure all teachers receive adequate training and resources to deliver the enhanced sports program (Program X)

• Ensure resources are accessible to implement the above strategies, e.g. physical activity equipment and spaces for students during recess and lunch and for community groups for after school physical activity programs, timetabling of 10 weeks sports time for the enhanced sports program (Program X), use of communications and events with families for dissemination of physical activity and PA4E1 information

### Physical Activity Policy Checklist

Use this checklist to review your physical activity policy.

<table>
<thead>
<tr>
<th>Does the policy include:</th>
<th>an overall aim of the school in terms of physical activity?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>specific goals that support the aim of the policy?</td>
</tr>
<tr>
<td></td>
<td>a list of strategies which enable each goal to be met?</td>
</tr>
<tr>
<td>Opportunities for physical activity</td>
<td>statements on how the school will provide and encourage adequate opportunities for physical activity during and outside school hours, respectively?</td>
</tr>
<tr>
<td>Intensity of physical activity</td>
<td>how the school will enable students to attain moderate to vigorous levels of physical activity during at least 50% of PE class time?</td>
</tr>
<tr>
<td>Low-active students</td>
<td>how low-active students will be encouraged and supported to increase and then maintain adequate physical activity levels, in particular run an evidence based, enhanced sports program (Program X)?</td>
</tr>
<tr>
<td>Monitoring and review</td>
<td>information on how and when the school will evaluate their physical activity policies and practices?</td>
</tr>
<tr>
<td>Time frames for review?</td>
<td></td>
</tr>
<tr>
<td>Resource allocation</td>
<td>commitment to adequate training and resources for HPE and other staff to deliver PE lessons with at least 50% MPA and/or the enhanced sports program?</td>
</tr>
<tr>
<td></td>
<td>commitment to staff time to work with the PA4E1 lead the planning, implementation and evaluation of the PA4E1 program within the school?</td>
</tr>
<tr>
<td></td>
<td>commitment to staff and student time to participate in a committee to lead the implementation of the PA4E1 program within the school?</td>
</tr>
<tr>
<td></td>
<td>commitment to ensuring the accessibility of relevant resources to implement the PA4E1 program within the school?</td>
</tr>
</tbody>
</table>
APPENDIX 4.10: SAMPLE PARENT NEWSLETTER

PARENT NEWSLETTER  FEBRUARY, 2013

PA4E1 returns for 2013
Physical Activity for Everyone or PA4E1 is an Australian first program designed to help keep students physically active and healthy. It started last year at your child’s school with all Year 7 students invited to participate in the measurement of the program (survey, accelerometer & height, weight and waist measurements).

PA4E1 then provided some new PE equipment and a support person (Jarrod Wiese, PE teacher) 1 day a week, to help the PE department to:
• offer active games at recess and lunch
• assist each Year 7 student to develop their personal physical activity plan
• develop new ways to make PE times as active as possible

Measuring changes from last year
If you think about it, since this time last year many things have changed for you and your family. Maybe you moved house or started a new job.

Measuring any changes in your child’s physical activity levels, their attitudes and beliefs about physical activity, their usual physical activity habits and their height, weight and waist circumference helps us to see how the PA4E1 program is going. So, if your child had one or more of these things measured last year, we will be look at your school this year to measure them again. Thank you for consenting to these measurements and for your child’s participation last year. Your child will receive a small gift to thank them for their participation.

Just like last time, you and/or your child will receive reminders by sms to wear the accelerometer each day and to return it.

See the attached flyer for when we be visiting your school to collect this data. We look forward to seeing your child again this year.

Physical activity tip
Create a fun kit - keep a box full of ball, bat, kit, frisbee both at home and in the car and you will always be ready for action.

Active boredom fighters
Keep a list of fun activities handy so whenever you hear “I’m bored,” you’ve got a suggestion ready to go. Here are some ideas for your own fun activities list:
• bike rides
• skateboarding
• rock-climbing, abseiling or adventure rope courses
• archery or skimmish
• fun runs and walks
• surfing or body boarding
• kick-boxing or martial arts
• sport in the backyard or local park – lawn bowls, cricket, touch football, Frisbee, handball, shooting hoops (netball or basketball), volleyball or softball – maybe even start a friendly neighbourhood competition
• learning hip-hop or latin dance
• helping around the house – mowing the lawn, or carrying groceries
• starting a business like washing cars or dogs for extra pocket money
• taking the dog or a neighbour’s dog for a walk
• planting and looking after a garden
• dancing to some favourite music

Did you know?
The accelerometer worn in PA4E1 to measure physical activity levels does this by detecting changes in acceleration. In a car, an accelerometer detects when the car slows down quickly and sets off the airbags.
APPENDIX FIVE: Additional material for Chapter 5

PARENT NEWSLETTER FEBRUARY, 2013

Keep an eye out for...
All the new and continuing P4E1 initiatives happening at your child’s school this year.

Ways you can help your child enjoy these activities are listed below.

Personal Physical Activity Planner

Discuss and support SMART goals and strategies for their Personal Physical Activity Plan. SMART stands for:
Specific (say exactly what you want to do),
Measurable (will you be able to know that you have achieved the goal),
Achievable (is your goal humanly possible to accomplish),
Relevant (will your suggested strategies help you achieve your goal),
Time framed (what can you achieve by the end of Term)

Each health and fitness goal is meant to be something that can be achieved over a school term or 10 weeks, so a 10% improvement is more realistic than a 60% improvement.

Strategies are the activities that your child plans to do each week to help them achieve their goals.

For example to reach a goal of 10% increase in the number of steps taken during PE, the strategy could be to go for a 30 minute run 2 afternoons a week after school or to reach a goal of 10% increase in the number of sit ups done in a minute, the strategy could be to do sit ups for 1 minute 3 nights a week before bed.

At the end of each week you could discuss with your child if they have been doing what they planned and if not, what they could do differently to make it easier to do their activities next week.

Program X
This program runs for 1 term in usual sports time and gives students a chance to try out some great new activities, like:
• Circuit Training
• Cross Fit
• Zumba
• Skipping for Fitness
• Boxing for Fitness
• Gymnastics
• Gymnastics Resistance Training
• Gymnastics Pilates
• Fit Ball Training

If your child likes one of these activities you could encourage this interest by hiring a workout DVD from your local library or downloading a workout video from YouTube.

Each week during Program X, there is also a key nutrition or physical activity topic with a challenge related to the topic to do at home. Your participation in these challenges will make them more meaningful and fun for your child. For example, allow the lounge room to become a temporary gym where together you and your child can complete a fitness circuit of exercises such as leg lunges, stomach crunches, and step-ups.

PHYSICAL ACTIVITY FOR EVERYONE
APPENDIX 4.11:
SAMPLE SOFIT FEEDBACK

SOFIT Overview
- SOFIT (systematic observation of fitness instruction) is a tool that assesses PE classes by providing the teachers with a standardized approach. It targets student activity levels, lesson content, and teacher behaviour.
- Participation in moderate to vigorous physical activity (MVPA) during class is highly dependent upon how PE curriculum is delivered and the instructor behaviour.
- In the first year of PE classes were assessed, including any donations, eg casual coaches, assemblies, packing away chairs.
- The main objective we are targeting is for PE classes to reach 50% MVPA. Obviously there are a number of factors that affect this outcome.
- It is our aim to limit these inhibiting factors and use the results to see how we can improve MVPA.

Principles of Active PE Lessons
- Environments that encourage active and efficient learning.
- A variety of activities that are enjoyable and motivating.
- Opportunities for students to be physically active in a safe and supportive environment.

Lesson Context Overview
- Lesson context variables that impact student MVPA.

Comparison MVPA per lesson
- Comparison of MVPA per lesson between different schools.

What does X school do well?
- Identify strengths and areas for improvement.

What can X school improve on?
- Identify areas for improvement and possible solutions.

Educational Research & Evaluation
- The importance of assessing and evaluating educational programs.

MVPA per Lesson
- Graphs showing MVPA per lesson.

MVPA All Schools
- Graphs showing MVPA across all schools.

Lesson Context - Management
- FMVA element management.

Lesson Context Average
- Graphs showing average lesson context variables.

What does X school do well?
- Identify strengths and areas for improvement.

What can X school improve on?
- Identify areas for improvement and possible solutions.

Comparison MVPA per lesson
- Comparison of MVPA per lesson between different schools.

What does X school do well?
- Identify strengths and areas for improvement.

What can X school improve on?
- Identify areas for improvement and possible solutions.

Your school has improved its MVPA average from 28% to 53%.
- We thank you for everything you are doing to make this project a success.
APPENDIX 4.12
EQUIPMENT PROVIDED

As part of the Physical Activity 4 Every1 program, your school will receive over $3000 worth of physical activity equipment including:

- 5 x Group boxing kits - includes 15 pairs of gloves, 15 pairs of focus pads and 5 kit bags
- 15 x Skipping ropes (2.7m long)
- 27 x Gymsticks and team bags (Gymsticks are a fitness tool designed to simplify and combine cardiovascular, muscular endurance and flexibility training)
- 5 x Swiss balls
- 125 x Pedometers including storage containers
- Zumba DVDs
- Set of digital scales
- Nintendo Wii including Wii Sports and Wii Sports Resort games
- Wii Fit
- Dance Dance Revolution Wii game
- Just Dance Wii game
- iPod docking station
APPENDIX 4.13
SAMPLE MONITORING AND FEEDBACK REPORT

Physical Activity for Everyone

IMPLEMENTATION PROGRESS (to be provided at the end of each term)

Progress Report for: XXXX High School
Physical Activity for Everyone Support Manager: XXXX
As at: End of Term 4, 2012

Progress: Completed/ Deliverable met/ on track behind/ Deliverable off track

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Due Date</th>
<th>Progress</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Strategies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA4E1 Support Manager in place</td>
<td>Mid Term 3</td>
<td>Committed in Week 4, Term 3, 2012</td>
<td>The PA4E1 Support Manager has been in place for 15 weeks, as of the end of Week 6, 2012.</td>
</tr>
<tr>
<td>Partnership agreement signed</td>
<td>End Term 3</td>
<td>Signed in Week 10, Term 3, 2012</td>
<td></td>
</tr>
<tr>
<td>PA4E1 Committee formed and functional. The Committee should have a representative from the school executive and a range of teachers outside of the PE department.</td>
<td>End Term 3</td>
<td>1st meeting held in Week 10, Term 3, 2012</td>
<td>The PA4E1 Committee in place and active, with representation from the school executive and PE department, other departments and the community.</td>
</tr>
<tr>
<td>Presentation at whole of staff meeting</td>
<td>Mid Term 3</td>
<td>Held in Week 6, Term 3, 2012</td>
<td></td>
</tr>
<tr>
<td>Presentation to PE staff on PA4E1 and active PE principles</td>
<td>Mid Term 3</td>
<td>Delivered by xxx via face to face meeting in Week 10, Term 3, 2012.</td>
<td>Attended by: XXXX</td>
</tr>
<tr>
<td>Resources manuals provided to school</td>
<td>Mid Term 4</td>
<td>Final resource manual delivered in Week 10, Term 4, 2012.</td>
<td></td>
</tr>
</tbody>
</table>

- Physical activity equipment pack provided to school Early Term 4 Provided to the school in Week 2, Term 4, 2012. Prompts include sticker sheet to be used in day books, email reminders and verbal reminders.
- Prompts in place to remind PE staff to undertake pedometer based lessons and personal best days Early Term 4 |
- SOFIT feedback provided to PE staff (including the development of ‘active PE strategies’ developed by PE department) Early Term 4 Department participated in session focused SOFIT feedback and active PE principles in Week 10, Term 3, 2012. Attended by: XXXX |
- Baseline data report provided to school End Term 4 To be provided by HKE Population Health in Term 1, 2013. The report will be sent to the School Principal and Head PE teacher. The PA4E Team would be happy to organise a meeting to discuss the report is requested.

Physical activity strategies

1. Active PE 50% of class time (practical lessons) should be active (MVPA) by End Term 4 (2012). (Mean % of lesson time that is active (MVPA) across a class is 50%)
   - Pedometer based lessons (termed ‘Personal Best Days’) undertaken once a month in PE class, with students recording step counts on their Personal Physical activity plans Mid Term 3 At baseline (Term 1, 2012) your Year 7 practical PE lessons were identified to be 58% active (measured using the SOFIT observational tool). Pedometers are being used on PE class by most teachers. A reinforcement strategy is in place to ensure participation as part of a reward system. Teachers began using early in Term 4, 2012. Revision of personal plans to occur twice in
### APPENDIX FIVE: Additional material for Chapter 5

**PA4E1**

**Physical Activity for Everyone**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Mid and late Term 4</th>
<th>Term 4, PA4E1 team to develop a method to monitor use of PA plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Year 7, 2012 students have had the opportunity to review the goals outlined in their personal physical activity plans by the end of Term 4, 2012.</td>
<td>End Term 3</td>
<td>A plan for rolling out the Enhanced school sport program (Program X) was provided in Week 10, 2012.</td>
</tr>
<tr>
<td>3. Enhanced School Sport</td>
<td>Mid Term 4</td>
<td>Training of teachers responsible for delivering Program X in 2013 is being provided by the PA4E1 Team in Week 9, Term 4, 2012.</td>
</tr>
<tr>
<td>The school has developed a plan for rolling out the Program X enhanced school sport program by end Term 3, 2012.</td>
<td>End Program</td>
<td>School is on track to deliver Program X to Year 8, 2013 students.</td>
</tr>
<tr>
<td>Relevant teachers have received training on how to deliver Program X to students.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All year 7, 2012 students have been through Program X or PALs at least once by end of Term 1 yr 9 (2012/2013/2014).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recess and lunch activities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least 20% (1 day week) of recess/lunch breaks across a week have at least 1 supervised activity organised and offered/promoted to students by end 2012.</td>
<td>End Term 3</td>
<td>Recessional lunchtime activities commenced in Week 1, Term 4, 2012. Executive support has been gained to have the bottom field open at lunch times.</td>
</tr>
<tr>
<td>At least 50% (2-3 days a week supervised activity) of breaks by end of 2013/14.</td>
<td>End Term 4</td>
<td>Equipment not yet available. Plan should be made to increase activities to 2-3 days per week in 2013.</td>
</tr>
<tr>
<td>50% of days with equipment available for students to access by end of 2012 and throughout 2013/2014.</td>
<td>End Term 4</td>
<td>Meetings organised to involve student leaders in providing equipment strategy in 2013.</td>
</tr>
<tr>
<td><strong>Supportive school policy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policies ideas considered by end Term 4, 2012.</td>
<td>End Term 4</td>
<td>Policy template developed by PA4E1 Team and provided to the school in Week X, Term 4, 2012.</td>
</tr>
<tr>
<td>Plan developed incorporate strategies to support PA by end Term 1, 2013.</td>
<td>End Term 4</td>
<td>Literature provided to the school PA4E1 committee on the link between school policies and student</td>
</tr>
<tr>
<td>School Physical activity policy developed and</td>
<td>End Term 13, 2013</td>
<td></td>
</tr>
<tr>
<td>implemented by end term 2, 2013.</td>
<td></td>
<td>physical activity levels. School physical activity policy to be developed in Term 1, 2013.</td>
</tr>
</tbody>
</table>

**Parent links**

- Newsletters provided 2 times per term by end Term 3, 2012 & maintained throughout 2013/2014
- Parent rep invited to be part of school committee by end Term 3, 2012. Parent rep maintained on the committee through 2012/2013/2014

- Parent links

<table>
<thead>
<tr>
<th>Requirement</th>
<th>End Term 3</th>
<th>End Term 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two parent contacts have been made to date since Term 3, 2012.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>An additional parent newsletter will be distributed to parents in Week 10, Term 4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXX presented PA4E1 program at P&amp;F committee meeting Week 1, Term 4, 2012</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Community links**

- Links made with agencies that offer and promote to students/families after school activities
- Initially proposed
- 3 links by end Term 4, 2012
- 6 activities sustained throughout 2013/2014

- Community links

<table>
<thead>
<tr>
<th>Requirement</th>
<th>End Term 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXX is following up on 3 links discussed at the school PA4E1 committee (Fitness First, Heart Foundation Walking, Active after School) &amp; Synergy dance/pilates studio &amp; 24/7 gym.</td>
<td></td>
</tr>
</tbody>
</table>

**Progress:** Completed/Deliverable met

- On Track/progressing as planned
- Behind/Deliverable off track

---
APPENDIX 4.14
DATA COLLECTION PROTOCOL

Physical Activity 4 Every 1
(PA4E1)

Data Collection Protocol

v4 03.02.12
Background

Rationale
The health and wellbeing benefits of physical activity are well documented. However, recent surveys suggest that Australian adolescents, in particular those who are disadvantaged, are not sufficiently active, and become progressively less active during their time at secondary school. While secondary schools have been suggested to be an appropriate setting for the implementation of interventions to increase the physical activity of adolescents generally, very few studies have assessed the effectiveness of such interventions in disadvantaged schools.

Aim
The primary aim is to determine whether a multi-component physical activity intervention — Physical Activity 4 Every 1 (PA4E1) — implemented in disadvantaged secondary schools over two years, can increase physical activity levels of adolescents.

Design
A cluster randomised controlled trial involving a cohort of students from 10 disadvantaged secondary will be undertaken.

Sample selection
The project will be conducted in secondary schools within the Central Coast, Hunter, New England and Mid North Coast Regions of New South Wales. Schools will be considered eligible if they are classified as being disadvantaged by the SEIFA index of Relative Socio-Economic Advantage/Disadvantage; have between 120-200 Year 7 students (in order to provide adequate sample size); are not participating in other major physical activity intervention studies; and are located within a 3hr drive radius of the research team (Wollongong, Newcastle). The sampling of schools was stratified by education sector (Government and Catholic) and rurality (major cities, regional cities) to ensure a representative sample was obtained.

Measures
The following measures will be conducted at baseline (year 1), mid-point (year 2) and follow up (year 3).

Consenting students will:
• Complete an online survey
• Wear an accelerometer for 7 days
• Have their height, weight and waist circumference measured

Parents, PE teachers and Head PE teachers will complete surveys in pen and paper form.

A member of the project team will observe a number of PE lessons using the tool GOFIT at each of the 3 occasions to assess physical activity practices.

Project outcomes and benefits
The study will be the first Australian study in disadvantaged schools with objectively measured outcome data over an extended follow up period. In addressing identified gaps and limitations of past studies, the study will provide, if successful, evidence of how secondary schools can contribute to an increase in physical activity of adolescents.
Conduct of Data Collection

When will data collection take place?
Baseline data collection will take place during Terms 1, 2 and 3 2012.

It is expected that data collection will take around 2 days per school.

Staffing
A PA4E1 Project Officer (Jannah Jones) within Hunter New England Population Health (HNEPH), Wallenda Campus, will be responsible for co-ordinating arrangements for data collection. The Project Officer will develop a data collection travel itinerary and will forward it to the data collection team as soon as possible.

Jannah will provide the team with the appropriate documents for each school visit including copies of all survey tools, list of consenting students, and all equipment needed.

One team, comprised of 2-6 staff (mixture of male and female) will be responsible for the collection of data from each school. A data collection schedule will be developed and distributed and additional information such as maps and other logistic information will also be prepared by the PA4E1 Project Officer for the site visits.

A separate team of 1-2 staff will be responsible for the collection of SOFIT data.

Training
Staff will be trained in measuring height, weight (used to calculate body mass index, BMI) and waist circumference using the International Society for the Advancement of Kinanthropometry (ISAK) procedures. Staff will also be trained to deliver the online questionnaire and distribute accelerometers to students in a consistent, structured manner. Training in conducting SOFIT will also be provided.

Role of data collectors
After recruitment, all contact with the school in the lead up to data collection will be conducted by the PA4E1 Program Manager (Rachel Sutherland). Rachel and Jannah will be responsible for:

- The team conduct.
- Checking equipment is working order prior to each visit and contacting the PA4E1 Project Officer if there are any problems.
- Ensuring the team has the correct documentation for each visit (as provided by the Project Officer).
- Meeting the liaison teacher at each school and collecting returned envelopes containing consent forms, parent and PE staff surveys.

Each school will be organised slightly differently, however the staff roles will include the following:

- Setting up equipment.
- Checking that consent forms are correctly signed – ONLY students with active consent can participate.
- Checking which children are absent on the day.
- Taking the anthropometric measurements – height, weight and waist measurement.
- Supervising the completion of the online student survey.
- Explaining the use of accelerometers and distributing.
• Distributing the staff survey to PE teachers.
• Distributing the School Environment survey.
• Ensuring unique identifiers on consent materials match the unique identifier on anthropometric data collection forms and accelerometers.
• Packaging and interim storage of data.
• Returning completed questionnaires to the PAIE1 Project Officer.
• Conducting SOFIT.

Role of the school
Participation by schools, staff, students and parents is voluntary. Students may withdraw at any time from the study.

Schools who have agreed to participate in the survey have nominated a Liaison teacher who is the contact person for the survey. Information sheets outlining the survey and the requirements of the school have been sent to the Liaison teacher (Appendix H).

Information sheets and consent forms for parents and students (Appendices J, K) will be mailed to each school 3-4 weeks prior to the field data collection day. The Liaison teacher is in charge of coordinating distribution and collection of information sheets and consent forms to selected classes. It is also the responsibility of the Liaison teacher to organise a venue for data collection.

Data collection venue
Schools have been provided with information about venue requirements for field data collection.

The venue will ideally be a spare computer room, library or hall. This will be at the discretion of the school with the aim to minimise disruption to participating, and surrounding classes.

Requirements include:
• A private place, away from traffic, where the scales and a height measure can be set up. This can be in a partitioned or screen section or in a private corner of a larger room.
• A "registration" table where field officers will greet students and check their records of students consenting.
• A place where students can sit or line up while waiting to have their measurements taken.

Completion of student surveys will take place in a classroom with computers for each student. The environment for undertaking the survey will be at the discretion of the school.

Ethical considerations
Ethics has been obtained from the Hunter New England Human Research Ethics Committee (reference number 11/03/16/4.05) and the NSW Department of Education and Training (reference number 2011111).

Confidentiality
Each and every student must be assured of the confidentiality of their information and that all data is allocated a unique identification number (i.e. de-identified).

The information provided by students will be treated in strict confidence and the responses from each participant will only be accessible to research staff. All child, parent and school information will be de-identified and copies of questionnaires will stored securely and held in confidence at the
HNEPH campus in Wallsend. The results will be published in aggregate form, from which responses from any child or parent will not be identifiable.

Participation in the survey is voluntary for both schools, staff, parents and students. Along with parents and students, schools are free to withdraw from the study at any stage by either the school withdrawing, by parents withdrawing their children or their children not wanting to participate. Withdrawing will not disadvantage anyone and any information provided will be deleted. The only condition for participation is a parental signed consent form.

Care and well-being of students
Awareness of students' reactions and sensitivity to the potential effects of your behaviour and comments is critical to ensure no derogatory comments or gestures are made in response to any measurement and that students are not compared with any others in the group.

If it is noticed that participation in the study is concerning a child or they are showing signs of distress, a teacher will speak with them privately and may decide to withdraw them from the study.

Measurement of students' height and weight is a potentially sensitive issue for students, and may have some impact on the emotional welfare of participants. Measures to avoid and manage potential risk include:
- Height, weight and waist measurements will occur in private behind a portable screen
- All data collected will be confidential
- Students and parents will be informed that they can withdraw consent at any time and will be provided with avenue to make complaints and receive further information
- All project staff will have appropriate child protection clearance and training
- Research staff will be trained to detect signs that participation may be causing a child distress
- Teachers from the school will be present during surveys and anthropometric collection (though not able to see student information)
- Children will be informed that if anything about the study is concerning them they should speak with their teacher, parents or GP
- Prior to each measure being taken children will be informed that they can pull out of the testing at any time
- During collection of the height, weight and waist data, children will be told why the data is being collected
- Children will not be told their height, weight or waist circumference unless they specifically ask for the information. If this is the case, they will be told verbally with the explanation that height and weight vary depending on your age and gender and so it is not appropriate to compare with other children.
Equipment Checklist

Make sure you have the following equipment organised and packed before visiting each school (the PA4E1 Project Office will assist you):

- School details – name, address, arrival time, name of liaison teacher
- Consenting students class list
- Stadiometer
- Weight scales
- Tape measure
- Accelerometers
- Accelerometer bolts
- Accelerometer connection devices
- Laptop
- Clipboards
- Pencils and erasers
- Copies of documentation:
  - Assessment recording sheet (one for each student)
  - Activity monitor information sheet (one for each student)
  - Accelerometer log sheet
  - Consenting students class list – accelerometer tracking
- Copies of survey tools:
  - SOFIT
  - School Environment survey
  - PE staff survey
Order of Procedures

On arrival:
- Arrive 45 minutes before you are due to begin data collection
- Go to the front office of the school and sign in
- Ask to see the liaison teacher
- Gather any additional consent forms and add to the list of consenting students
- Establish where the designated rooms are for data collection
- Set up all equipment
- Check with liaison teacher regarding the process for gathering consenting students (this will differ for each school)

Tasks throughout the day (see specific protocols for more detail):
- Measure student’s height, weight and waist and record
- Online student survey
- Distribute accelerometers, explain how to use, log sheet, incentive on return etc.
- Distribute PE staff surveys
- Distribute School Environment survey
- SOFIT
- Compile all information in electronic form (Consenting students class list with names, ID numbers etc.)
- Confirm mobile phone numbers for both student and parent
- Check with liaison teacher regarding absences

On departure:
- Thank the teachers for accommodating you and for their organisation and preparation for the visit
- Remind the liaison teacher that you will be back in a week to collect accelerometers
- If not yet complete, compile all information gathered from the visit into an electronic copy of the Consentng students class list
- Return all equipment, surveys and documentation to the PA4E1 Project Officer as soon as possible

Visit two:
- Collect accelerometers
- Leave a list of missing accelerometers with the liaison teacher, provide a postage pack and ask for these to be mailed back
Online Student Survey

Prior to starting the student survey, the data collection staff responsible for administering the student survey will need:

- Log onto a school computer in order to access their email account via webmail in order to forward spare usernames for students who don’t receive an email (HNESHealth webmail address https://webmail.hneshlth.nsw.gov.au – then use your normal username and password to log on).
- To ensure a school teacher is present in the testing room at all times.
- With the assistance of the liaison teacher make sure that all computers are turned on and the login page of school email opened.
- Ask the liaison teacher if they have had any parents who have contacted the school and withdrawn consent for their child. If they have please mark on Consent for Student Class List and identify this student as soon as possible to ensure that they don’t complete the survey (see Trouble shooting section for additional instructions)

The liaison teacher will:

- Organise for an IT person to be available during the survey completion and a computer available in each room for the data collection staff member.
- Meet the data collection staff at the office and introduce them to any staff assisting in the organisation of the student survey and the IT contact.
- Provide data collection staff with a run down on: location of amenities, emergency procedures, evacuation procedures.
- Ensure a school teacher is present in the testing room at all times.
- Organise for students to be in the scheduled rooms to complete the survey and supervise their return to class.

Step 1: Identifying consenting students and introduction

- When the classroom teacher arrives, provide them with a copy of the PA4E1 staff information sheet and have a conversation with them to make sure they understand it is their role to manage the classroom and any student behaviour. Let them know that if any students that are present don’t have consent that they will need some work to go on with.

- Where possible ask students to wait outside the room until a teacher arrives and then call the roll, inviting students with consent into the classroom and those that haven’t to wait with the teacher for them to organise. If students are already in the room still call the roll, but ask students whose names haven’t been called to raise their hand and refer to the teacher for them to organise.

- Ask the students that are on the roll to go into the classroom and log onto their computers but those students that do not know their email username or password to wait out the front of the classroom for the IT staff to assist them.

- Once students are seated at a computer please read the following (before asking them to log on):
Good morning/afternoon

My name is XXXX and I am from the Physical Activity 4 Every1 team. Today I am here to help you do an online survey as part of the Physical Activity 4 Every1 project which your school is participating in.

The purpose of these surveys is to find out about you, your attitudes and beliefs about physical activity and your usual physical activity behaviours.

Your survey answers are completely confidential. This means that your parents, friends, teachers or anyone else will not be able to find out any of your answers. Only the members of the research team will have access to your completed survey, however they will not know your name. When completing the survey, please answer for yourselves and don’t talk to anyone about your answers.

You can decide to stop taking part at any time. If anything about the survey is concerning you, please raise your hand and I will come and talk with you. If anything about the survey is concerning you after you have finished, you could speak about it with your parents, teachers, school counsellor or doctor.

Please ensure that you read each question carefully as once you select your answer to the question you can’t go back and change it.

If you have any questions about the survey questions, please raise your hand and I will come to you.

When you have completed the survey, please stay seated and raise your hand.

Does anyone have any questions before we begin?

Step 2: Getting students to log on to their email and the survey

Next, ask students to do each of the following steps – it will be easier if you do this one step at a time and you could also write the instructions on the board:

- **Log into their individual school email accounts** (student email addresses will be listed on the Consenting Student Class List if you need them) – once students have logged on ask them to face the front and looking at you so that you can give them instructions for the survey. Don’t talk over students, just stand in front of the class and wait for them to pay attention to you and when you have their attention remember to say thank you to them. It’s a good idea whilst you are waiting for the ‘naughty’ students to acknowledge those students that are paying attention and looking at the front. Just a simple ‘thanks girls/boys’ etc. works miracles.

- **Ask students to ONLY open the email “Invitation to participate in Physical Activity 4 Every1 Survey”** and anyone who hasn’t received the email to put their hand up and you will check the roll for their name. If their name is not on the roll then ask them to go with the other students that were not on the roll. If their name is on the roll ask them to sit quietly and listen to the instructions and you will send them another email as soon as you get everyone else started.
• Ask students to open their email and notice the username and password in it and tell them that this is what they will need in a moment to log onto the survey.

• Ask students to click on the link provided in the email, read the information provided on the page and then click next.

• You will now be redirected to the survey log on page, please enter your username and password from the email - the easiest way to do this is to copy and paste the information. Ask them to make sure there is no space at the beginning of the username or password as this will stop them from logging on.

• Go through the log on instructions and the instructions for the survey; remind them not to push enter as it will take them to the next page and that they won’t be able to go back and change their answers.

• At this stage it is a good idea to remind students to answer honestly and that no one will know what they have answered. Let students know that if they are on a PC (especially if they are using a laptop) that they can make the survey screen bigger by pushing F11.

• Ask them if they have any questions and if not they can start the survey.

Below is a sample of the email invitation that contains a student’s username and password.

Hello,

The Physical Activity Every1 team is conducting a survey of Year 7 students at your school. The survey will ask some questions about you, your attitudes and beliefs about physical activity and your usual physical activity behaviours.

To participate in the survey please:

1. Click on the link provided below. You will be directed to a welcome/instruction page.
   * Please read the instructions carefully and click on the ‘begin survey’ button
   * Enter your Username and Password (provided below)
   * Begin the survey

2. When you have completed the survey please click the ‘done’ button and close the screen by clicking the ‘X’ in the top right hand corner.

Your login details are:
Username: 23031137605
Password: 6599

To access the survey, please click on the link below and use your login details above.


If you would like more information about the survey, please ask the research staff member for an information letter.
If you would like more information about the survey please contact:
Rachel Sutherland
Program Manager
Hunter New England Population Health
Ph: 49246131 (direct)
Fax: 49246210
Email: PASE1@hnehealth.nsw.gov.au

Thank you for your participation.
From the Physical Activity 4 Every1 team.

- Now that the majority of the class is started, go back to the students who did not receive an email or those students who received an email but the username and password did not work. For these students check to make sure that they are on your Consenting Student Class List before sending a spare email with a new username and password. Please also make sure that you copy Jannah Jones (Jannah.Jones@hnehealth.nsw.gov.au) into any emails that you forward. DON'T FORGET TO RECORD THE NEW USERNAME on the Consenting Student Class List (see trouble shooting section for more specific instructions).
- Please do not forward any emails to students that are not on your Consenting Students Class List unless they have with them a consent form signed by their parent. If a student is convinced that their parent has provided consent please let them know you can't let them access the survey but there will be another opportunity on another day.

Step 3: Support during the survey
- Shortly after students have commenced the survey, they will begin the APARQ questions on physical activity.
- Ask the class for their attention at this time as you explain how to answer the questions.
- Explain the difference between "organised" and "non-organised" activity.
- Organised = sports and games are ones in which you compete, have training or coaching sessions, and which adults may organise. They include activities like playing on a cricket or netball team, gymnastics or dance classes, swimming squads, or classes at a gym or fitness centre.
- Non-organised = physical activities that are not usually supervised by adults and do not usually involve training or competition. It includes things like skateboarding, surfing, riding a bike, walking or cycling to and from school, walking the dog, active chores or jobs you do at home or work, or casually getting together with some friends to play a game or sport after school or during recess/lunchtime.
- Draw the following diagram on the board and give an example of how to complete:
### Organised

<table>
<thead>
<tr>
<th>Sport or Game</th>
<th>Days per week</th>
<th>How long for</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>1</td>
<td>60 mins</td>
</tr>
<tr>
<td>Football</td>
<td>1</td>
<td>120 mins</td>
</tr>
<tr>
<td>Dancing</td>
<td>2</td>
<td>45 mins</td>
</tr>
</tbody>
</table>

### Non-organised

<table>
<thead>
<tr>
<th>Sport or Game</th>
<th>Days per week</th>
<th>How long for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bike riding</td>
<td>1</td>
<td>30 mins</td>
</tr>
<tr>
<td>Surfing</td>
<td>2</td>
<td>60 mins</td>
</tr>
</tbody>
</table>

Whist students are completing the survey please provide the following support as required:

- Clarify terminology/questions for any students that request it
- Encourage the students to answer as honestly as possible
- Encourage the students to ask questions if they have any problems with the questions
- Maintain examination conditions for students to complete the questionnaire
- Alleviate any student concerns regarding the issue of confidentiality
- Look out for and help students who might have learning, comprehension and/or reading difficulties
- Look out for any students who you suspect may be getting distressed by participating in the survey.
- Use the Trouble Shooting section at the end of this procedure should any students have any technical difficulties completing the survey.

**Step 4: Recording the completion status for students**

As students complete the survey and raise their hand, take the Consenting Students Class List with you to approach the student. Locate their name on the list and record in the ‘Survey Completion Status’ column whether they have ‘completed’, ‘partially completed’, or ‘refused’ to complete the survey.

**Step 5: Review**

Once all students have completed the survey please review your Consenting Students Class List and make sure that you have an entry for every student. If students are absent please confirm this with the Liaison teacher and mark on the form.
Please collect the following to take back to Jannah Jones:
- Consenting Students Class List Form
- Error Recording Form (if you have recorded any errors)

5. Student survey trouble shooting

What if a school staff member informs a parent has withdrawn consent?
If you are informed by school staff during a survey visit that a parent has contacted the school and withdrawn consent for a student to participate please do not survey that student even though they are listed on your Consenting Students Class List. These students will have received an email invitation from us, so please identify that student immediately and ask them to delete the survey invitation from their email so that they cannot access the survey. Please witness them deleting the email from both their inbox and Deleted/Trash and record on your Consenting Students Class List.

If the survey is already underway when you are notified, please identify that student immediately and request they stop doing the survey.

If you cannot locate the student, please contact Jannah Jones immediately so that we can block that student from accessing the survey.

What if a student does not recall their email password?
In the event that a student does not know their email password, contact the nominated school IT person. This person will be able to change the student's password and allow them to access their email.

Students who did not receive an email
In the event that a student who has consent to participate did not receive an email:
- Double check that the student's name is on your copy of the Consenting Students Class List.
- Open one of the spare emails sent to you from the PA4E1 Project Officer. The username provided in this email will become the participant ID for this student.
- Forward the email with the new username and password to the students email account, making sure you also copy in Jannah Jones.
- Record the student's new participant ID (the username from the spare email you forwarded the student) on the Consenting Student's Class List in the "New username" field.
- The email address of all students is listed on the Consenting Student's Class List. If a student doesn't receive an email because we have an incorrect email address, please record the correct email address in the "Comments" field on the Consenting Students Class List.

Students are having difficulties logging on
If a student is having trouble logging on to the online student survey, please assist them in accessing the survey. It is highly recommended that students copy and paste or write down (and discard after survey completion) the participant ID and password from the email in order to ensure they are entered correctly. Make sure there isn't any spaces in what they copy and paste as this will stop their log on details from working.
What if students get kicked out of the survey?
Occasionally, students may be cancelled out or kicked out of the survey. If this happens, ask students to go back into their email, open the email with their username and password, and log into the survey again. All the answers they entered previously should still be there. So ask the student to click ‘next’ on each page of the survey until they arrive at the page they were up to.

What if a student receives an error message?
Occasionally, a student may receive an error message and be unable to enter any answers. If this happens, ask the student to close the survey, then log back into the survey using the link and information provided in their email.

How long should the survey take to complete?
Most students should be able to complete the survey between 20 and 30 minutes. If a student runs out of time, instruct them to close the survey by clicking on the “X” button in the top right hand corner of the screen. This will save the answers. For any students in this position please make sure you record on the Consenting Students Class Lists partially completed.

What if a student is unable to complete the survey in the allotted time?
In the event that a student is unable to complete the survey in the allotted time, talk with the liaison teacher to see whether they can complete at another time on the same day. If the student is unable to complete the survey on the same day, they will be able to access the survey via the same email link for up to five days (all emailed links expire on Friday nights). If another time on the same day is not available ensure you have recorded the completion status as ‘partially completed’ and the PAE1 Program Manager will negotiate with the liaison teacher to identify another date that the student can complete the survey. There will be usually be at least 1 ‘mop up’ day scheduled at each school for these students and any other students that were absent on the survey day.

What if a student has made an error on the survey and wishes to correct their response?
If a student believes that they have made an error during the survey he/she is able to amend their response. Students should be encouraged to continue to complete the survey, however, if the student feels that it is important to amend their response as they are able to do so. Please instruct the student to cancel out of the survey by clicking on the cancel button at the bottom of the page. Then instruct the student to return to the survey ‘log on’ page, via the email link, and re-enter their username and password. This will take the student to the first page of the survey where they can click ‘next’ to progress to where they made the error.

What if the student accidently cancels out of the survey?
Efforts have been made to ensure that students who want to complete the survey do not accidentally cancel out. If a student accidently clicks the cancel button he/she will be prompted with a question asking if they are sure they want to cancel the survey. If the student does not want to cancel them simply click ‘no’ and this will take them back into their survey. If the student still manages to accidently cancel out, they can return to the survey ‘log on’ page, via the email link, and re-enter their username and password. This will take the student to the first page of the survey where they can click ‘next’ to progress to where they cancelled.

What if a student is having trouble understanding the content of the survey?
If students are having problems understanding the survey content please provide the student with interpretive assistance only. Please DO NOT:

- Answer the survey questions for students
• View the students’ survey answers
• Guide the students to an answer using leading questions (e.g. “you would eat 5 serves of vegies wouldn’t you?”)

NOTE: Students will be called out of the class by another research assistant one by one to have their height, weight and waist circumference measured WHILE THEY ARE COMPLETING THE SURVEY.
Accelerometers

VISIT ONE:

Checklist:
- Accelerometers and belts
- Consenting students class list (for accelerometer tracking)
- Activity monitor information sheet (one for each student)
- Accelerometer log sheet (one for each student)
- Assessment recording sheet (one for each student)

ACCELEROMETERS SHOULD BE DISTRIBUTED TO CONSENTING STUDENTS WHILE STUDENTS ARE COMPLETING THE ONLINE SURVEY.

Introduction Script – once all students have completed online survey:
Thank you for helping us. Lots of other students in the local area will be doing the same thing as you to help us find ways of keeping active, skilled and healthy. Today we’re going to show you how to put on an accelerometer, how it works and when you should and should not wear it. Accelerometers can tell us when you are active, how long you are active for and whether the activity is light, moderate or vigorous. It will also tell us when you are not wearing the monitor. It is only for 1 week and you wearing it will help us out a lot! Next week, we collect your accelerometers back from you. You will be provided with a reward for bringing it back on time.

Instructions:
1. Distribute the Activity monitor information sheet (Appendix E). Point out Jannah’s phone number on the on this sheet in case they have any problems or questions regarding their accelerometer (02 49249993).

2. Go through the Activity monitor information sheet with the students.

3. Tell students that they should behave normally and not do things just because they are wearing the monitor. Students need to put on the accelerometer as soon as they wake up and take off when they go to sleep at night. Students need to wear the accelerometer for at least 12 hours a day. If the student forgets, they should start wearing it as soon as they remember.

4. Explain to students that they will receive a text message during the week to encourage them to wear their accelerometer and again the day before they need to return their accelerometer to school so researchers can collect them back.

5. Go through the Accelerometer log sheet instructions (see Appendix F) with the students and get them to fill in their name, school, and dates for the next 7 days (starting from tomorrow). Ask students to fill in when they put on their accelerometer on their log sheet (e.g. ON 8am).

6. Have accelerometers set up beforehand in separate bags according to belt size.
7. Students would have already been given an accelerometer during the online survey – make sure all consenting students have one.

8. Ask each student to put on their own accelerometer outside their clothes, and pull it firmly. Explain that once it is fitted correctly they should put it underneath their clothes (i.e. on their skin).

9. Explain that it is very important to wear the accelerometer at all times except for showering, swimming, sleeping and some team sports. Explain that the light on the accelerometer will flash until tomorrow morning – it is normal for it to then stop flashing.

10. Ask students to check the accelerometer is:
   a. firm (does not bounce but shouldn’t be uncomfortably tight)
   b. button facing upwards (pointing towards the sky)
   c. on the right hip (in line with the middle of their right knee)

11. Check each student’s accelerometer to make sure it is on properly using the above criteria. If the belt is the wrong size then the student should be given a different size. Staff should also double-check the belt through the buckle to ensure the belt does not become loose.

12. Once staff have checked that each student’s monitor is on correctly, ask them to take out their monitor log. The field staff write down each student’s mobile number on the Consenting students class list (see Appendix D) and their accelerometer number on the Consenting students class list as well as the student’s accelerometer log. If the student does not have a mobile then ask for their parent/guardian’s number.

13. Ask the student if they have any questions.

14. Finally, ask students some prompt questions regarding their accelerometer such as:
   a. When do we wear it?
   b. When don’t we wear it?
   c. What do we write on the log?

Have you gone through the following with the students:
- Sticker/button facing up
- On the right (preferred) hip in line with the middle of right or left knee
- Firm
- On the skin
- Off – bed and water
- Maintain normal activities
- At least 12 hours a day/for 1 week (including weekends)
- Filling in log
- Prizes
- Text messages
- Check each accelerometer
- Record mobile no. and accelerometer no. carefully on assessment/record sheet
VISIT TWO (one week and one day later):

Checklist
- Accelerometers and belts
- Consenting students class list (for accelerometer tracking)
- Activity monitor information sheet
- Accelerometer log sheet
- Assessment recording sheet
- One registered post pack (posting accelerometers back to HNEPH for students who forgot to bring back in or who were away first time)

Instructions:
1. Students line up and staff collect each student’s accelerometer and log. The date needs to be marked off on the Consenting students class list.

2. Staff need to double-check that the accelerometer number on the log matches the Consenting students class list.

3. Staff will need to put accelerometers on any students who were away on the day of the first visit (see Visit one protocol). Please put an asterisk next to these student’s names on the Consenting students class list.

4. If students forget their accelerometer and log, ask them to bring it in the next day and give to the liaison teacher. A reminder text message will also be sent to the student.

5. Inform liaison teacher of the names of students who forgot their accelerometer or have just been given one to wear. Give the teacher a registered post pack and ask them to post back the accelerometers that students forgot to bring in that day and also those that have been given accelerometers to wear for a week.

Have you:
- Collected accelerometers and logs
- Checked accelerometer no. matches number on Consenting students class list
- Distributed accelerometers to absent students (see visit one protocol)
Measuring Height

Equipment required: Stadiometer

Ensure: The floor is hard and level and that the stadiometer is calibrated

Instructions:
- Shoes and socks off
- Step onto stand with back to column
- Feet together (heels together)
- Ideally heels, buttocks and upper back touch the vertical post
- Stand up straight (tall) hands down by sides
- Look straight ahead
- Breathe in and hold breath
- Bring head board down and crush hair to firmly contacting the persons head and level (horizontal to ground). Students may need to take hair out if up.
- Make sure heels do not lift off floor
- Record height to nearest 0.1 cm
- Get person to step off stand
- Repeat for 2nd assessment
Measuring Weight

Equipment Required: Electronic digital scales

Ensure: Scales have been calibrated, and the floor is hard and level.

Instructions:

- Turn scale on and ensure zeroed 0.00 (if required)
- Shoes off, minimal clothing, all objects out of pockets, belt off, heavy jewellery off (watches, necklaces)
- Record clothing worn on assessment recording sheet (may account for fluctuations)
- Instruct student to step onto middle of scale with feet slightly apart and stand very still with weight evenly balanced on both feet
- Record weight to 0.01 kg
- Step off
- Repeat for 2nd assessment
- If values differ by more than 0.1 kg repeat again
Measuring Waist Circumference

Equipment Required: Tape measure
Ensure: Floor is hard and level

Instructions:
- Ensure minimal clothing – measuring directly against the skin is preferable
- Instruct student stand with feet slightly apart and stand very still with weight evenly balanced on both feet
- Instruct student to breathe out normally
- Measure horizontally halfway between the lowest rib and the top of the hip bone. This is roughly in line with the belly button
- Make sure the tape is snug, without compressing the skin
- Record to the nearest 0.01 cm
- Remove tape measure
- Repeat for 2nd assessment
- If values differ by more than 0.5 cm repeat again

PE Staff Survey

Instructions:
- Distribute one staff survey to each PE teacher
- Explain that the survey is confidential and that we are grateful for their input
- Advise that they can be returned via the postage paid envelope or that the team will be back in one week’s time and can collect the survey then
- At Visit two - collect any returned envelopes containing PE staff surveys
School Environment Survey

Instructions:
- Distribute the survey to the Head PE teacher
- Explain that the survey is confidential and that we are very grateful for their input
- Advise that they can be returned via the postage paid envelope or that the team will be back in one week’s time and can collect the survey themselves
- Ask the Head of PE to complete the survey if required
- At Visit two - collect the School Environment Survey
APPENDIX 4.15
ACCELEROMETER INSTRUCTIONS FOR STUDENTS

**PA4E1 Activity Monitor Information Sheet**

Please do not hesitate to call Jannah on (02) 40246603 if you have any questions or concerns about your monitor.

What does the monitor do?
The monitor records all movement, so that when you watch television, play outside, or eat dinner, it records how much and how often you move your body.

Does the monitor hurt?
No. The monitor is attached to a soft elastic belt and worn under your clothes. You may be aware of the monitor when you first start to wear it, but it will not hurt.

When do you put your monitor ON?
- The monitor is to be put on as soon as you wake up each morning.
- You are to wear the monitor under your clothes over the right hip (not in the middle near their belly button), making sure that it is the correct way up (the button on the top of the monitor should be facing upwards i.e. pointing towards the sky). The monitor should fit firmly so that the elastic belt cannot bounce, but should not be uncomfortably tight.
- Write the time when the monitor is put on (see activity monitor log).
- The monitors are not water-proof, so please remember that the monitor is not to be worn in the shower, bath or when swimming or playing in aquatic areas.

When do you take OFF the monitor?
- The monitor should be taken off when you go to bed, or if there is a chance that the monitor could get wet (e.g. playing near water). Please note on the monitor diary any specific time periods that the monitor is taken off and why (e.g. 3:30-4:30pm on Wednesday – Swimming at the beach).
- The monitor is to be worn for all waking hours for all 7 days. At the end of each day please write the time the monitor is taken OFF (see activity monitor log).

What do I do at the end of the 7 days?
Please keep wearing your monitor until people collect it from you at school the following week.
You will receive a reward if you return the monitor on time.

What if I damage or lose the monitor?
You will NOT have to pay for the monitor if you damage or lose it.

The monitors are expensive, so please take very good care of them. It is quite a sturdy piece of equipment, but will be damaged if thrown or forcefully dropped. You should not lose the monitor because it is securely fitted to a belt, and should not be removed except for during aquatic activities and sleeping.
APPENDIX 4.16
STUDENT SURVEY

Physical Activity 4 Every1 Student Survey

<table>
<thead>
<tr>
<th>Q1</th>
<th>What is your date of birth?</th>
<th>Day</th>
<th>Month</th>
<th>Year</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Q2</th>
<th>What year are you currently in?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Year 7</td>
</tr>
<tr>
<td>2.</td>
<td>Year 8</td>
</tr>
<tr>
<td>3.</td>
<td>Year 9</td>
</tr>
<tr>
<td>4.</td>
<td>Year 10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q3</th>
<th>Are you male or female?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Male</td>
</tr>
<tr>
<td>2.</td>
<td>Female</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q4</th>
<th>What language do you speak most at home?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>English</td>
</tr>
<tr>
<td>2.</td>
<td>Another language (please write it below)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q5</th>
<th>Are you of Aboriginal and/or Torres Strait Islander origin?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Yes, Aboriginal</td>
</tr>
<tr>
<td>2.</td>
<td>Yes, Torres Strait Islander</td>
</tr>
<tr>
<td>3.</td>
<td>Yes, both Aboriginal and Torres Strait Islander</td>
</tr>
<tr>
<td>4.</td>
<td>No</td>
</tr>
</tbody>
</table>

| Q6 | What suburb do you live in? |

| Q7 | What is the postcode where you live? |

The following questions are about ORGANISED physical activities that you do at school, before and after school and on weekends.

- Please think about a normal week and write in the table below:
  - How many times each week you usually do them, and
  - The usual amount of time you spend doing them.

Organised sports and games are ones in which you compete, have training or coaching sessions, and which adults may organise. They include activities like playing on a cricket or netball team, gymnastics or dance classes, swimming squads, or classes at a gym or fitness centre.

If you do not do any organised activities, please write “zero” in the first row of the table.

**Q6** Enter the organised sports or games you participate in during a usual week (not including school holidays). Please include School Sport and PE classes.

<table>
<thead>
<tr>
<th>Sport or game</th>
<th>How many days per week do you do this sport or game?</th>
<th>On average how long do you play this sport or game? (in minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Sport</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix Five: Additional material for Chapter 5

The following questions are about non-organised physical activities that you do at school, before and after school and on weekends.

- Activities that you usually do,
- How many times each week you usually do them, and
- The usual amount of time you spend doing them.

Non-organised physical activities are ones that are not usually supervised by adults and do not usually involve training or competition. It includes things like skateboarding, surfing, riding a bike, walking or cycling to and from school, walking the dog, active chores or jobs you do at home or work, or casually getting together with friends to play a game or sport after school or during recess/lunchtime.

If you do not do any non-organised activities, please write “zero” in the first row of the table.

Q9 Enter the non-organised sport you participate in during a usual week (not including school holidays).

<table>
<thead>
<tr>
<th>Sport or game 1</th>
<th>How many days per week do you do this sport or game?</th>
<th>On average how long do you play this sport or game? (in minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sport or game 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport or game 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Physical Activity Confidence

Instructions:
Select ONE option to indicate how much you agree or disagree with each statement

<table>
<thead>
<tr>
<th>Q10</th>
<th>When I'm physically active (e.g. during PE or school sport) I get embarrassed about my fitness or skill level.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q11</td>
<td>I can still find the time to be physically active even when I've had a busy day.</td>
</tr>
<tr>
<td>Q12</td>
<td>I find it difficult to be physically active when the weather is poor (e.g. too hot, too cold or raining).</td>
</tr>
<tr>
<td>Q13</td>
<td>I find it difficult to be physically active when there is no one to be active with.</td>
</tr>
<tr>
<td>Q14</td>
<td>I do not feel comfortable using local facilities to be physically active (e.g. the gym, beach, skate parks, bike paths).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Disagree slightly</th>
<th>Agree slightly</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
</tbody>
</table>
### APPENDIX FIVE: Additional material for Chapter 5

**In the next THREE MONTHS do you...**

<table>
<thead>
<tr>
<th>Q15</th>
<th>INTEND to be physically active on all or most days of the week?</th>
<th>Not at all true of me</th>
<th>Not very true of me</th>
<th>Somewhat true of me</th>
<th>Very true of me</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

### My Physical Activity Environment

**INSTRUCTIONS:** Select ONE option to indicate how much you agree or disagree with each statement

<table>
<thead>
<tr>
<th>Q16</th>
<th>At home I have access to equipment that helps me to be physically active (e.g. joggers, bikes, balls, skateboards, weights).</th>
<th>SD</th>
<th>D</th>
<th>DS</th>
<th>AS</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>It is difficult to be physically active in my neighborhood because of lots of traffic.</td>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>Q18</td>
<td>I have a place at home where I can be physically active (e.g. gym, backyard, garage).</td>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>Q19</td>
<td>My school has good facilities for physical activity (e.g. gymnasiums, ovals, dance studios, courts).</td>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>Q20</td>
<td>At school there are facilities available during recess/lunch for me to be physically active (e.g. gym, dance studio, courts or oval).</td>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>Q21</td>
<td>At school there are facilities available after school hours for me to be physically active (e.g. gym, dance studio, courts or oval).</td>
<td>SD</td>
<td>D</td>
<td>DS</td>
<td>AS</td>
<td>A</td>
<td>SA</td>
</tr>
</tbody>
</table>

### Physical Activity Support from Your Friends & Family

**INSTRUCTIONS:** Select ONE option for each question.

**FRIEND SUPPORT - In the past THREE MONTHS how often...**

<table>
<thead>
<tr>
<th>Q22</th>
<th>...did your friends participate in physical activities or sports with you during lunch, recess or after school?</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>Q23</td>
<td>...did your friends watch you participate in physical activity or sport (e.g. watch you surf or play netball)?</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>Always</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>Q24</td>
<td>...did your friends participate in physical activities/sports with you?</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>Always</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>Q25</td>
<td>...did you make plans with your friends to be physically active together (e.g. to go skateboarding, walking or kick the football around together)?</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>Always</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
</tbody>
</table>
### FAMILY SUPPORT - In the past THREE MONTHS how often...

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Rare</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>... did members of your family participate in physical activity/sport?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>... did members of your family take you to places where you could be physically active (e.g. to the beach, training, weekend sport, ice-skating rink)?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>... did members of your family watch you participate in physical activity/sport?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>... did your parents buy you equipment that encouraged you to be physically active (e.g. sports clothes, joggers, bike, and iPod for listening to music while being active)?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
</tbody>
</table>

### Strategies for Being Physically Active

#### INSTRUCTIONS: Select ONE option for each question.

In the past THREE MONTHS how often...

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Rare</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>... did you do things to make physical activity more enjoyable (e.g. be physically active with friends or while listening to a fun soundtrack)?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>... did you participate in a variety of physical activities/sports to avoid boredom?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>... did you set yourself physical activity goals (e.g., trying a more difficult mountain bike trail or gradually increasing how far you jog)?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>... did you organise to be physically active with a friend or family member?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>... did you make an effort to look for nearby settings where you could be physically active (e.g. the beach or bush trails)?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>... did you keep track of how much physical activity you did (e.g. by using a timer, pedometer, or by keeping a logbook)?</td>
<td>N</td>
<td>R</td>
<td>S</td>
<td>O</td>
<td>A</td>
</tr>
</tbody>
</table>
APPENDIX FIVE: Additional material for Chapter 5

The Benefits of Physical Activity

The following are statements describing some benefits of REGULAR PHYSICAL ACTIVITY you might experience in the NEXT 3 MONTHS.

Remember, regular physical activity = 60 minutes of at least moderate intensity activity on all or most days of the week. Examples include brisk walking, bike riding, skateboarding, swimming laps, playing football or netball.

THIS IS AN EXAMPLE:

Participation in regular physical activity can help me to manage stress better.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strongly Disagree</strong></td>
<td><strong>Disagree</strong></td>
<td><strong>Partly Disagree</strong></td>
<td><strong>Partly Agree</strong></td>
<td><strong>Agree</strong></td>
<td><strong>Strongly Agree</strong></td>
</tr>
</tbody>
</table>

Q36 Participation in regular physical activity can help to improve my fitness.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strongly Disagree</strong></td>
<td><strong>Disagree</strong></td>
<td><strong>Partly Disagree</strong></td>
<td><strong>Partly Agree</strong></td>
<td><strong>Agree</strong></td>
<td><strong>Strongly Agree</strong></td>
</tr>
</tbody>
</table>

Q37 How important is improving your fitness to you?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Not at all important</strong></td>
<td><strong>Only slightly important</strong></td>
<td><strong>Important</strong></td>
<td><strong>Extremely important</strong></td>
</tr>
</tbody>
</table>

Q38 Participation in regular physical activity can help me to control my weight better.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strongly Disagree</strong></td>
<td><strong>Disagree</strong></td>
<td><strong>Partly Disagree</strong></td>
<td><strong>Partly Agree</strong></td>
<td><strong>Agree</strong></td>
<td><strong>Strongly Agree</strong></td>
</tr>
</tbody>
</table>

Q39 How important is controlling your weight to you?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Not at all important</strong></td>
<td><strong>Only slightly important</strong></td>
<td><strong>Important</strong></td>
<td><strong>Extremely important</strong></td>
</tr>
</tbody>
</table>

Q40 Participation in regular physical activity can help me to feel better physically.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strongly Disagree</strong></td>
<td><strong>Disagree</strong></td>
<td><strong>Partly Disagree</strong></td>
<td><strong>Partly Agree</strong></td>
<td><strong>Agree</strong></td>
<td><strong>Strongly Agree</strong></td>
</tr>
</tbody>
</table>

Q41 How important is feeling better physically to you?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Not at all important</strong></td>
<td><strong>Only slightly important</strong></td>
<td><strong>Important</strong></td>
<td><strong>Extremely important</strong></td>
</tr>
</tbody>
</table>
### APPENDIX FIVE: Additional material for Chapter 5

**Q42** Participation in regular physical activity can help me to manage stress better.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Partly Disagree</th>
<th>Partly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

**Q43** How important is managing stress to you?

<table>
<thead>
<tr>
<th></th>
<th>Not at all important</th>
<th>Only slightly important</th>
<th>Important</th>
<th>Extremely Important</th>
</tr>
</thead>
</table>

**Q44** Participation in regular physical activity with friends can be fun.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Partly Disagree</th>
<th>Partly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

**Q46** How important is physical activity with friends being fun for you?

<table>
<thead>
<tr>
<th></th>
<th>Not at all important</th>
<th>Only slightly important</th>
<th>Important</th>
<th>Extremely Important</th>
</tr>
</thead>
</table>

Think about a normal school week and write down how long you spend doing the following activities before and after school each day (in hours and minutes).

<table>
<thead>
<tr>
<th>Q46 Watching TV?</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q47 Watching videos/DVDs?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q48 Using the computer for fun?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q49 Playing video games other than on the computer?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q50 Using the computer for doing homework?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q51 Doing homework not on the computer?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Think about a normal weekend, and write down how long you spend doing the following activities on the weekend (in hours and minutes).

<table>
<thead>
<tr>
<th>Q52 Watching TV?</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q53 Watching videos/DVDs?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q54 Using the computer for fun?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q55 Playing video games other than on the computer?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q56 Using the computer for doing homework?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q57 Doing homework not on the computer?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For each of the statements below, please select one option.

<table>
<thead>
<tr>
<th>Qn</th>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q68</td>
<td>When I make plans, I follow through with them.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q69</td>
<td>I usually manage one way or another</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q70</td>
<td>I am able to depend on myself more than anyone else.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q71</td>
<td>Keeping interested in things is important to me.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q72</td>
<td>I can be on my own if I have to.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q73</td>
<td>I feel proud that I have accomplished things in life.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q74</td>
<td>I usually take things in stride.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q75</td>
<td>I am confident in myself</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q76</td>
<td>I feel that I can handle many things at a time.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q77</td>
<td>I am determined.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q78</td>
<td>I seldom wonder what the point of it all is.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q79</td>
<td>I take things one day at a time.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q80</td>
<td>I can get through difficult times because I've experienced difficulty before.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q81</td>
<td>I have self-discipline.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q82</td>
<td>I keep interested in things.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q83</td>
<td>I can usually find something to laugh about.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q84</td>
<td>My belief in myself gets me through hard times.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q85</td>
<td>In an emergency, I'm someone people can generally rely on.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q86</td>
<td>I can usually look at a situation in a number of ways.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q87</td>
<td>Sometimes I make myself do things whether I want to or not.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q88</td>
<td>My life has meaning.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q89</td>
<td>I do not dwell on things that I can't do anything about.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q90</td>
<td>When I'm in a difficult situation, I can usually find my way out of it.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q91</td>
<td>I have enough energy to do what I have to do.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q92</td>
<td>It's okay if there are people who don't like me.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Q93</td>
<td>I am resilient.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

Thank you for completing this survey!

This information will allow us to make programs to help students stay active and healthy.
APPENDIX 4.17:  
TEACHER SURVEY

Physical Activity 4 Everyone Physical Education Teacher Survey

<table>
<thead>
<tr>
<th>Question</th>
<th>Poor, needs much improvement</th>
<th>Fair, in need of some improvement</th>
<th>Good, needs little improvement</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q5 How strong is support for PE within your school generally?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q6 How strong is support for sport within your school generally?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q7 How strong is the general school ethos supporting physical activity?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q8 How strong is support for physical activity at your school by school executive?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q9 How strong is support for physical activity at your school by teaching staff?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q10 How strong is support for physical activity at your school by parents?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q11 How strong is support for physical activity at your school by students?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q12 Physical education and physical activity programs are regularly evaluated for participation and engagement of students, use of equipment and meeting physical activity targets as well as skill development.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q13 The school promotes participation in physical activity equally to all students regardless of gender, race or ability.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q14 The school provides a safe and supportive environment for physical activity.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
### APPENDIX FIVE: Additional material for Chapter 5

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q15 School sports teams</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q16 Participation in physical activity within the school (i.e., recess and lunch times)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q17 Academic excellence in Health and Physical Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q18 Other (please describe)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Statements Table

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Unsure</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q19 The school operates a range of physical activity clubs for students at the school.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q20 The school has strategies to actively recruit students to physical activity during recess and lunch times</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q21 Teachers are encouraged to plan and engage students in physical activities while undertaking playground duty</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q22 The school promotes opportunities for students to be active at recess and lunch breaks by providing equipment, facilities (e.g., box of equipment for students to access, tarmac painting)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q23 The school promotes opportunities for students to be active at recess and lunch breaks by providing peer leaders and training (e.g., student led fitness breaks, recess games)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q24 The school promotes opportunities for students to be active at recess and lunch breaks by providing adult (staff or volunteer) assistance to develop and maintain programs.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q25 The school promotes opportunities for students to be active at recess and lunch breaks by providing active clubs and school intramural activities that are available to all students (e.g., sport and non-sport intramurals like lat chi and yoga, running club, hiking club).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q26 The school promotes opportunities for students to be active at recess and lunch breaks by providing School teams that operate on a “no cut” basis to encourage everyone to play.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
## APPENDIX FIVE: Additional material for Chapter 5

### For the following statements, please circle the number to indicate your response

| Q. 27. Administer physical activity, such as laps or push-ups, as a disciplinary measure | A lot | Some | Very little | Not at all | Don’t know |
| Q. 28. We use physical activity as a reward | 1 | 2 | 3 | 4 | 5 |
| Q. 29. We promote physical activity during or as part of special events | 1 | 2 | 3 | 4 | 5 |
| Q. 30. We integrate physical activity into PDH lessons | 1 | 2 | 3 | 4 | 5 |
| Q. 31. All teachers (not only PE teachers) act as role models for physical activity | 1 | 2 | 3 | 4 | 5 |
| Q. 32. All teachers (not only PE teachers) are actively involved in physical activity programs | 1 | 2 | 3 | 4 | 5 |
| Q. 33. We encourage adults in our school community (e.g., staff, parents) to be visibly physically active and act as role models and mentors to students | 1 | 2 | 3 | 4 | 5 |

### For the following statement, please circle the number to indicate your response

| Q. 34. Is sport time used for any other activities (e.g., drama, extra-curriculum extensions activities such as 4U maths, music rehearsal)? | Yes | No |
| Q. 35. If yes, please list the activities | 1 | 2 |
| Q. 36. Does your school offer non-active sports (e.g., movie appreciation, makeup classes)? | Yes, all years | Yes, some years | No |
| Q. 37. If yes, please list the non-active sports | 1 | 2 | 3 |
| Q. 38. Do your students develop personal physical activity plans? | Yes, all years | Yes, some years | No |
### APPENDIX FIVE: Additional material for Chapter 5

If yes,

**Q33. How often do students in each year level develop personal physical activity plans?**

<table>
<thead>
<tr>
<th>Year</th>
<th>Each term</th>
<th>Each semester</th>
<th>Each year</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>c.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>d.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

For each of the following statements, please circle the number that best applies:

**Q40. Assisting students to develop personal physical activity plans is a useful way to increase physical activity**

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

For each of the following statements, please circle the response that best applies:

**Q41. On how many days does your school offer organised physical activity?**

<table>
<thead>
<tr>
<th>Rarely/never</th>
<th>1 day/week</th>
<th>2 days/week</th>
<th>3 days/week</th>
<th>4 days/week</th>
<th>5 days/week</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Before school</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b. Recess</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c. Lunchtimes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d. After school</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

For each of the following statements, please circle the number that best applies:

**Q42. Has the school included information about physical activity in school newsletters?**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

For each of the following statements, please circle the number that best applies:

**Q43. Has the school made links with any community groups to encourage students to be more active?**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
APPENDIX FIVE: Additional material for Chapter 5

### Table 1: Additional Barriers to Enhancing Skill Development, Fitness, and Physical Activity in Adolescents

For the following statement, please circle the number to indicate your response.

Below are some school-based barriers to enhancing skill development, fitness, and physical activity in adolescents. Please indicate how strongly you think each one applies to your school.

<table>
<thead>
<tr>
<th>Question</th>
<th>A lot</th>
<th>Some</th>
<th>Very little</th>
<th>Not at all</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q44. Competing demands on curriculum time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q45. Amount of equipment available</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q46. Expertise of teachers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q47. Amount and standard of facilities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q48. Lack of wet weather facilities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q49. Level of school/home/community interaction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q50. Motivation/attitude of members of staff</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q51. Absence of a quality PE or sport program</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q52. Cultural background of students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 2: Adequacy of Sports/PE Facilities and Equipment

For each of the following statements, please circle the number to indicate your response.

<table>
<thead>
<tr>
<th>Question</th>
<th>Poor, needs much improvement</th>
<th>Fair, needs improvement</th>
<th>Good, needs little improvement</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q53. In your view, how adequate are the sports/PE facilities in your school?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q54. In your view, how adequate is the sports/PE equipment in your school?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
APPENDIX FIVE: Additional material for Chapter 5

In a typical Health and Physical Education class, approximately how long are students engaged in moderate to vigorous physical activity (vs. waiting for their turn, listening to instructions or getting changed)?

<table>
<thead>
<tr>
<th>Q55</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On a typical day, approximately what percentage of students are exempt (i.e. present but not participating) from any given Health and Physical Education class (e.g. due to injury, illness, etc.)?

<table>
<thead>
<tr>
<th>Q56</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
</tbody>
</table>

For each of the following statements, please circle the number to indicate if you strongly agree, agree, are unsure, disagree or strongly disagree.

<table>
<thead>
<tr>
<th>Q57</th>
<th>The school requires every student to develop a Personal Health Plan at the commencement of each school year?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly agree</td>
</tr>
<tr>
<td>-----</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q58</th>
<th>Physical activity is reinforced across the curriculum outside of physical education (e.g. Science, Maths, English).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly agree</td>
</tr>
<tr>
<td>-----</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q59</th>
<th>Teachers have quality resources to provide physical activity (e.g. variety of equipment meeting minimum curriculum standards, equipment in good repair, enough materials for all the class to participate, activities for limited space, outdoor winter games, warm weather outdoor games).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly agree</td>
</tr>
<tr>
<td>-----</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q60</th>
<th>Activity is approximately modified for age and ability/disability.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly agree</td>
</tr>
<tr>
<td>-----</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q61</th>
<th>Girls are encouraged to be as involved as boys in physical activity.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly agree</td>
</tr>
<tr>
<td>-----</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
APPENDIX FIVE: Additional material for Chapter 5

Q To the best of your knowledge, what percentage of students at your school engage in moderate to vigorous physical activity during non-instructional time (e.g., lunch or spare periods) in a typical school day?

*Moderate physical activity causes some increase in breathing and/or heart rate but not enough to prevent comfortable conversation (e.g., brisk walking, skating, bike riding). Vigorous physical activity is aerobic activity which increases breathing and heart rates enough that talking is possible but the ability to carry on a conversation is limited (e.g., running, basketball, aerobic dancing).

| ID: ____ |

| Q62 Before School | ____ % |
| Q63 Recess | ____ % |
| Q64 Lunch | ____ % |

### Role Modeling

For each of the following statements, please circle the number that best applies.

To the best of your knowledge, how well do each of the following statements characterize your school?

<table>
<thead>
<tr>
<th>Q65 Teachers act as role models for physical activity</th>
<th>A lot</th>
<th>Some</th>
<th>Very Little</th>
<th>Not at all</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q66 Staff are actively involved in physical activity programs</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q67 We encourage adults in our school community (e.g., staff, parents) to be visibly physically active and act as role models and mentors to students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
### APPENDIX FIVE: Additional material for Chapter 5

For each of the following statements, please circle the number that best applies.

<table>
<thead>
<tr>
<th>Question</th>
<th>Poor, needs much improvement</th>
<th>Fair, in need of some improvement</th>
<th>Good, in need of little improvement</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q68</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q69</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q70</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q71</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q72</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q73</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Q74</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

**Supportive school structures**

For each of the following statements, please circle the number that best applies.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q75</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Q76</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Q77</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Thank you for taking the time to complete this survey.

Please return via the reply-paid envelope provided or return to the Physical Activity 4 Every1 research team.
### APPENDIX 5.1a: SENSITIVITY ANALYSIS FOR PHYSICAL ACTIVITY OUTCOMES

#### Adjusting for Weight and Age

<table>
<thead>
<tr>
<th>Activity</th>
<th>Age</th>
<th>Weight</th>
<th>Outcome</th>
<th>Covariates</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Table Appendix 5.1a: Changes in physical activity outcomes from baseline to T2 and T4 months following adjustment for weight and age (as covariates).

---

Adjusting for weight and age in the sensitivity analysis for physical activity outcomes.

- Activity levels: 0.01 to 0.05
- Age: 0.01 to 0.05
- Weight: 0.01 to 0.05

Outcome analysis confirms the robustness of the findings across different sensitivity settings.
### APPENDIX 5.1b: SENSITIVITY ANALYSIS FOR PHYSICAL ACTIVITY OUTCOMES USING MULTIPLE IMPUTATION

<table>
<thead>
<tr>
<th>Time</th>
<th>Control</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>7.5±3.5</td>
<td>7.5±3.5</td>
</tr>
<tr>
<td>3 months</td>
<td>5.5±2.4</td>
<td>5.5±2.4</td>
</tr>
<tr>
<td>6 months</td>
<td>3.5±1.3</td>
<td>3.5±1.3</td>
</tr>
</tbody>
</table>

*Note: All values are in mean ± standard deviation.*

**Table 5.1**: Changes in physical activity outcomes from baseline to 3- and 6-month follow-up using multiple imputation to fill-in the missing data.
### Appendix 5.1c: Sensitivity Analysis for Physical Activity Outcomes Using Complete Cases Only

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention-Control</th>
<th>Difference in Change Between Groups</th>
<th>p-Value Group x Time</th>
<th>p-Value Time</th>
<th>p-Value Group</th>
<th>p-Value Change</th>
<th>N</th>
<th>Mean Baseline</th>
<th>Mean Post</th>
<th>95% CI Baseline</th>
<th>95% CI Post</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>44</td>
<td>7.7 ± 2.0</td>
<td>5.2 ± 3.0</td>
<td>4.6 to 8.3</td>
<td>2.7 to 8.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td>7.7 ± 2.0</td>
<td>5.2 ± 3.0</td>
<td>4.6 to 8.3</td>
<td>2.7 to 8.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>7.7 ± 2.0</td>
<td>5.2 ± 3.0</td>
<td>4.6 to 8.3</td>
<td>2.7 to 8.1</td>
</tr>
</tbody>
</table>

Note: All the missing data.

Table Appendix 5.1c: Changes in physical activity outcomes from baseline to 12 and 24 months follow-up (using complete cases).
### APPENDIX 5.1d: SENSITIVITY ANALYSIS FOR ADIPOSITY OUTCOMES USING MULTIPLE IMPUTATION.

<table>
<thead>
<tr>
<th>Group x Time</th>
<th>Baseline</th>
<th>12m</th>
<th>24m</th>
<th>36m</th>
<th>48m</th>
<th>60m</th>
<th>72m</th>
<th>84m</th>
<th>96m</th>
<th>108m</th>
<th>120m</th>
<th>128m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>Mean (BMI)</td>
<td>0.93</td>
<td>0.94</td>
<td>0.95</td>
<td>0.96</td>
<td>0.97</td>
<td>0.98</td>
<td>0.99</td>
<td>1.00</td>
<td>1.01</td>
<td>1.02</td>
<td>1.03</td>
</tr>
<tr>
<td>Control</td>
<td>Mean (BMI)</td>
<td>0.89</td>
<td>0.90</td>
<td>0.91</td>
<td>0.92</td>
<td>0.93</td>
<td>0.94</td>
<td>0.95</td>
<td>0.96</td>
<td>0.97</td>
<td>0.98</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Table 5.1d: Changes in adiposity outcomes from baseline to 24-month follow-up (using multiple imputation to fill-in the missing data)

**Note:** Differences in change between groups.
### APPENDIX 5.1e: SENSITIVITY ANALYSIS FOR ADIPOSY OUTCOMES USING COMPLETE CASES ONLY.

<table>
<thead>
<tr>
<th>Group</th>
<th>Outcome</th>
<th>Difference in Change between Groups</th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>ZIM</td>
<td>p-value</td>
<td>0.17</td>
<td>0.43</td>
</tr>
<tr>
<td>Baseline</td>
<td>ZHM</td>
<td>p-value</td>
<td>0.21</td>
<td>0.43</td>
</tr>
<tr>
<td>Baseline</td>
<td>ZHM</td>
<td>p-value</td>
<td>0.21</td>
<td>0.43</td>
</tr>
<tr>
<td>Baseline</td>
<td>Baseline</td>
<td>p-value</td>
<td>0.21</td>
<td>0.43</td>
</tr>
<tr>
<td>Baseline</td>
<td>Baseline</td>
<td>p-value</td>
<td>0.21</td>
<td>0.43</td>
</tr>
<tr>
<td>Baseline</td>
<td>Baseline</td>
<td>p-value</td>
<td>0.21</td>
<td>0.43</td>
</tr>
<tr>
<td>Baseline</td>
<td>Baseline</td>
<td>p-value</td>
<td>0.21</td>
<td>0.43</td>
</tr>
<tr>
<td>Baseline</td>
<td>Baseline</td>
<td>p-value</td>
<td>0.21</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Table Appendix 5.1e: Changes in adiposity outcomes from baseline to 24-months follow-up (using complete cases)