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
STATEMENT OF ORIGINALITY

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university of other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968. I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying subject to the provisions of the Copyright Act 1968.
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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.
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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- Development of measures to be used
- Developing, delivering and overseeing intervention delivery
- Overseeing data collection
- Analysis and interpretation of the data
- Leading the writing of the manuscript

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- Development of measures to be used
- Developing, delivering and overseeing intervention delivery
- Overseeing data collection
- Analysis and interpretation of the data
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Effects of a school-based physical activity intervention on adiposity in adolescents from economically disadvantaged communities: The ‘Physical Activity 4 Everyone’ RCT.

By:
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- Development of measures to be used
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- Overseeing data collection
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- Assisting in development of measures to be used
- Overseeing data collection
- Assisting in analysis and interpretation of the data
- Leading the writing of the manuscript

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ADDITIONAL PUBLICATIONS, PRESENTATIONS AND AWARDS ASSOCIATED WITH THE THESIS


In addition to the published papers listed above, an additional six co-authored papers are currently under review.

CONFERENCE ABSTRACTS RELATED TO THIS THESIS: PUBLISHED IN PEER-REVIEWED JOURNALS

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ADDITIONAL PUBLICATIONS, PRESENTATIONS AND AWARDS ASSOCIATED WITH THE THESIS


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)


ADDITIONAL PUBLICATIONS, PRESENTATIONS AND AWARDS ASSOCIATED WITH THE THESIS


ADDITIONAL PUBLICATIONS, PRESENTATIONS AND AWARDS ASSOCIATED WITH THE THESIS


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### GLOSSARY OF COMMON ABBREVIATIONS

<table>
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<tr>
<td>BMI</td>
<td>body mass index</td>
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<tr>
<td>BMI-Z</td>
<td>body mass index z-score</td>
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<tr>
<td>CATI</td>
<td>computer assisted telephone interview</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Interval</td>
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<tr>
<td>HPE</td>
<td>health and physical education</td>
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<td>HPS</td>
<td>health promoting schools</td>
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<tr>
<td>ICC</td>
<td>intra class correlation</td>
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<tr>
<td>MVPA</td>
<td>moderate-vigorous physical activity</td>
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<td>NCD</td>
<td>non-communicable disease</td>
</tr>
<tr>
<td>NHANES</td>
<td>National Health and Nutrition Examination Survey</td>
</tr>
<tr>
<td>NSW</td>
<td>New South Wales</td>
</tr>
<tr>
<td>PDHPE</td>
<td>Personal Development, Health and Physical Education</td>
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<tr>
<td>PE</td>
<td>physical education</td>
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<tr>
<td>PA</td>
<td>physical activity</td>
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<tr>
<td>PA4E1</td>
<td>Physical Activity 4 Everyone</td>
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<tr>
<td>RCT</td>
<td>randomised controlled trial</td>
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<tr>
<td>sd</td>
<td>standard deviation</td>
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<tr>
<td>SOFIT</td>
<td>System for Observing Fitness Instruction Time</td>
</tr>
<tr>
<td>VPA</td>
<td>vigorous physical activity</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WC</td>
<td>waist circumference</td>
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<td>Social Cognitive Theory</td>
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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 multicomponent 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 (20111111) 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.