THE ‘M.A.D.E (MOTHERS AND DAUGHTERS EXERCISING) 4 LIFE’ PILOT RANDOMISED CONTROL TRIAL: A THEORY-BASED, PHYSICAL ACTIVITY INTERVENTION TARGETING MOTHERS AND THEIR DAUGHTERS

ALYCE THERESE BARNES (nee COOK)
Bachelor of Teaching (Secondary)/Bachelor of Health and Physical Education (Hons) University of Newcastle, Australia

PhD Thesis
Presented in fulfilment of the requirements for the award of

DOCTOR OF PHILOSOPHY

THE UNIVERSITY OF NEWCASTLE, AUSTRALIA
AUGUST 2014
Statement of Originality

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

Alyce Therese Barnes (nee Cook) …………………………..    Date: 29/08/2014

Supervisors

Primary Supervisor: Professor Philip J Morgan¹.³
Supervisor: Professor Clare E Collins².³
Supervisor: Professor Ronald C Plotnikoff ¹.³

¹School of Education, University of Newcastle, Faculty of Education and Arts
²School of Health Sciences, University of Newcastle, Faculty of Health and Medicine
³Priority Research Centre for Physical Activity and Nutrition, University of Newcastle, Australia
Statement of Contribution of Others

Co-author statement

I, Professor Philip Morgan, attest that Research Higher Degree candidate Alyce Barnes (nee Cook) contributed substantially in terms of study concept and design, data collection and analysis, and preparation of the following manuscripts.

Professor Philip J. Morgan  ……………………………… Date: 29/08/2014

I, Professor Ronald Plotnikoff, attest that Research Higher Degree candidate Alyce Barnes (nee Cook) contributed substantially in terms of study concept and design, data collection and analysis, and preparation of the following manuscripts.

Professor Ronald C. Plotnikoff  ……………………………… Date: 29/08/2014

I, Professor Clare Collins, attest that Research Higher Degree candidate Alyce Barnes (nee Cook) contributed substantially in terms of study concept and design, data collection and analysis, and preparation of the following manuscripts.

Professor Clare E. Collins  ……………………………… Date: 29/08/2014
Acknowledgement of Authorship

I hereby certify that the work embodied in this thesis contains a published paper/s/scholarly work of which I am a joint author. I have included as part of the thesis a written statement, endorsed by my supervisor, attesting to my contribution to the joint publication/s/scholarly work.

Alyce Therese Barnes (nee Cook) .................................. Date: 29/08/2014
Disclosure of editing services

Professional editor, Ms Amy Lovat (Bachelor of Arts (Hons)), provided copyediting and proofreading services, according to the guidelines laid out in the university-endorsed national ‘Guidelines for editing research theses’.
Acknowledgements

I would like to acknowledge the important people who have been involved in, and have significantly contributed to, the completion of this thesis.

First, I would like to thank my supervisors Professor Philip Morgan, Professor Ronald Plotnikoff and Professor Clare Collins for guiding me through the incredible PhD journey. You have all shared your highly regarded expertise, extraordinary knowledge base and astute advice over the past four years and, in turn, this has thoroughly enriched my educational experience as a PhD student. Each of you model significant qualities I hope to adopt in shaping myself as an early career researcher.

In particular, I would like to thank Philip for his guidance four years ago when embarking on a life-changing opportunity. Your positive attitude and continued belief in my ability to achieve my goals is something I am eternally grateful for. I have great admiration for your teaching, mentoring and parenting philosophies and these have an immense influence on my goals in life. Thank you for inspiring and encouraging me to be an empowered woman (GIRL POWER!).

To Erin, you were the perfect fit for the MADE4Life co-facilitator. Your passion for teaching PDHPE, bright attitude and knowledge was truly remarkable. I am so grateful for your friendship and support.

To the incredible staff in the PRC, in particular Sarah Costigan and Kristen Saunders for your endless support and special friendships. To Ken Cliff, thank
you for guiding me through your area of expertise. To the volunteers Joanne Graham, Kayla Lawson, Siobhan Handley, Jessie Dunn, Brianne McCabe, Katie Sylvester, Angela Humphrey and Amanda Williams who assisted in the assessment sessions and MADE4Life sessions. Thank you for your enthusiasm, professionalism and reliability; all were key to the MADE4Life program’s success.

To the mothers and daughters who participated in the MADE4Life program. Without you, the research would not be possible. Your commitment and enthusiasm for the study will always be treasured.

To my PhD bestie, Myles. You make coming to University an absolute delight. I have learnt so much from you and count you as one of my very best friends. Your patience, optimism, and confident yet humble personality is respected by all. Thank you for making my PhD years so meaningful.

To my mum and dad. I believe I have the qualities and characteristics of two incredibly inspiring people, both who have contributed to achieving my goals. I wouldn’t be here today without your endless support, encouragement and love. I am so grateful for all of the opportunities you have given me in life. Thank you for always encouraging me to think big and aim high in all aspects of my life.

Finally, to my extremely special husband Matt, my number one fan. Your colossal encouragement and ability to motivate me and maintain focus of achieving my PhD goal has been tremendous. Thank you for your patience,
learned advice and belief in me. I am extremely grateful for you being by my side in life. I love you to infinity, and beyond.

This thesis was supported by an Australian Postgraduate Award (APA) scholarship.
# Table of Contents

Statement of Originality ..................................................................................... ii
Statement of Contribution of Others ................................................................... iii
Acknowledgement of Authorship ....................................................................... iv
Disclosure of editing services .......................................................................... v
Acknowledgements .......................................................................................... vi
Table of Contents ............................................................................................. ix
List of Tables ..................................................................................................... xiii
List of Figures ................................................................................................... xv
List of Appendices ............................................................................................ xvi
Abstract .......................................................................................................... xviii
List of peer reviewed journal articles from this PhD ......................................... xxii
List of published conference abstracts in refereed journals from this PhD .... xxiii
List of published conference abstracts in peer reviewed conference proceedings from this PhD ................................................................. xxv
Additional papers during PhD Candidature .................................................... xxvi
List of Abbreviations ....................................................................................... xxviii
Preface and Contribution Statement ............................................................... xxx

## Chapter 1: Introduction

1.1 Background .............................................................................................. 1

1.1.1 Benefits of Physical Activity ............................................................. 2

1.1.2 Consequences of Physical Inactivity ................................................. 2

1.1.3 Physical Activity Recommendations For Children ...................... 3

1.1.4 Physical Activity Measurement ....................................................... 4

1.1.5 Physical Activity Levels of Children .............................................. 4

1.2 Potential Influences on Physical Activity ............................................. 6

1.2.1 Social Cognitive Theory .................................................................. 7

1.3 Parental Influences on Children’s Physical Activity ........................... 10

1.3.1 Parental Influences on Girls’ Physical Activity .............................. 11

1.3.2 Maternal Influences on Girls’ Physical Activity ......................... 12

1.4 Physical Activity Interventions for Children ...................................... 14

1.4.1 Parent Involvement in Interventions ............................................ 15
Chapter 3: Methods ................................................................. 81

3.1 Study Design ........................................................................... 82
  3.1.1 Study Design: Aim Two .................................................... 82
  3.1.2 Study Design: Aim Three .................................................. 82

3.2 Participants .............................................................................. 83
  3.2.1 Recruitment ...................................................................... 83
  3.2.2 Eligibility Criteria ............................................................... 85
  3.2.3 Ethical Approval ................................................................. 86
  3.2.4 Assessment Sessions .......................................................... 86
  3.2.5 Randomisation ................................................................. 86

3.3 Intervention ............................................................................. 87
  3.3.1 The M.A.D.E 4 Life Program .............................................. 87
  3.3.2 Wait-list control group ......................................................... 96

3.4 Processes ................................................................................. 97
  3.4.1 Data Collection ................................................................... 97

3.5 Measurement of Study Outcomes ............................................. 99
  3.5.1 Objectively measured Physical Activity .............................. 99
  3.5.2 Mothers’ questionnaire ....................................................... 102
  3.5.3 Physical Measures ............................................................. 109
  3.5.4 Demographics ................................................................. 113
  3.5.5 Data Entry ................................................................... 114

3.6 Statistical Analysis .................................................................. 114
  3.6.1 Maternal Correlates Of Daughters’ Physical Activity .......... 115
  3.6.2 Feasibility and Preliminary Efficacy .................................... 116

3.7 Chapter Summary .................................................................... 118

Chapter 4: Results ....................................................................... 119

4.1 Descriptives and Baseline Characteristics ................................ 120
  4.1.1 Baseline Characteristics of Daughters and Mothers ............ 120

4.2 Maternal correlates of daughters physical activity .................. 125
  4.2.1 Hypothesis Two: Correlates .............................................. 125
List of Tables

Table 2.1: Risk of Bias Checklist ............................................................. 36
Table 2.2: Intervention characteristics of mother-daughter PA, fitness and/or diet interventions ........................................................ 41
Table 2.3: Summary of risk of bias assessment of included studies ...... 51
Table 2.4: Results from mother-daughter PA, Fitness and/or Diet Interventions ................................................................. 57
Table 3.1: Intervention content and alignment with SCT .................... 90
Table 4.1: Descriptive statistics of mothers’ and daughters’ demographic, anthropometric, physical activity variables, behaviour characteristics ................................................................. 122
Table 4.2: Bivariate correlations between potential maternal correlates of PA behaviour ................................................................. 126
Table 4.3: Linear regression analyses results of physical activity, % time spent in sedentary behaviour, screen time and BMI z-score in daughters (Daughters n=40; Mothers n=40) ....................... 128
Table 4.4: Baseline characteristics of Daughters randomised to the MADE4Life intervention and control groups .................... 132
Table 4.5: Baseline characteristics of Mothers randomised to the MADE4Life intervention and control group .................... 133
Table 4.6: Mothers’ process evaluation from the M.A.D.E 4 Life program ............................................................................................ 136
Table 4.7: Mothers’ Process Evaluation for the MADE4Life program Part One ..................................................................................... 137
Table 4.8: Mothers’ Process Evaluation for the MADE4Life program Part Two ..................................................................................... 138
Table 4.9: Mothers’ Process Evaluation for the MADE4Life program Part Three ................................................................................... 141
Table 4.10: Short qualitative answers representing mothers from the MADE4Life intervention group ...................................................... 145
Table 4.11: Short qualitative answers representing mothers from the Wait-list control group .............................................................. 147
Table 4.12: Changes in outcome variables for daughters by treatment group from baseline to immediate post-intervention and 3-month post-intervention and differences in outcomes among the treatment groups at immediate post-intervention and 3-month post-intervention follow up (ITT analysis) (n= 48) .................. 157

Table 4.13: Changes in outcome variables for mothers by treatment group from baseline to immediate post-intervention and 3-month post-intervention and differences in outcomes among the treatment groups at immediate post-intervention and 3-month post-intervention follow up (ITT analysis) (n= 40) ................................. 159

Table 4.14: Overall summary of the study results ........................................... 166
List of Figures

Figure 1.1: Social Cognitive Theory: proposed pathways of behaviour change mediators (Bandura, 2004) ........................................ 9

Figure 2.1: Flow of study selection through the phases of the review .... 35

Figure 3.1 Study design for the MADE4Life RCT ........................................ 83

Figure 3.2: MADE4Life resources ................................................................. 88

Figure 3.3: Daughters’ MADE4Life resources ........................................... 93

Figure 4.1 Participant flow through the trial and analysed for the primary outcome (Daughters’ %MVPA). .................................................. 130

Figure 4.2: Daughters’ mean % time in MVPA in both groups (n=48).  
MADE4Life group x time (P=0.99) .................................................... 162

Figure 4.3: Daughters’ mean % time in VPA in both groups (n=48).  
MADE4Life group x time (P=0.67) .................................................... 162

Figure 4.4: Mothers’ mean % time in MVPA in both groups (n=40).  
MADE4Life group x time (P=0.06) .................................................... 163

Figure 4.5: Mothers’ mean % time in VPA in both groups (n=40).  
MADE4Life group x time (P=0.04) .................................................... 164
List of Appendices


Appendix 3: Secondary Publication ‘The ‘Healthy Dads, Healthy Kids’ community randomised controlled trial: A community-based healthy lifestyle program for fathers and their children’. Preventive medicine ................................................. 298

Appendix 4: Secondary Publication ‘Efficacy of a workplace-based weight loss program for overweight male shift workers: The Workplace POWER (Preventing Obesity Without Eating like a Rabbit) randomized controlled trial’. Preventive Medicine ................................................................... 309

Appendix 5: Secondary Publication ‘The impact of a workplace-based weight loss program on work-related outcomes in overweight male shift workers’. Journal of Occupational and Environmental Medicine ........................................ 319

Appendix 6: MADE4Life Recruitment Flyer ................................................ 326

Appendix 7: MADE4Life School Newsletter Entry ............................... 328

Appendix 8: University of Newcastle Media Release ............................ 330

Appendix 9: Media Coverage .................................................................. 332

Appendix 10: Participant Telephone Screen ......................................... 335

Appendix 11: Sports Medicine Australia Pre Exercise Screening Questionnaire ................................................................. 338

Appendix 12: University of Newcastle Human Research Ethics Committee (HREC) approval ................................................................. 341

Appendix 13: Participant Information Statement and Consent Forms 345

Appendix 14: Participant Randomisation Outcome Letter ................. 351
Appendix 15: Daughters’ Booklet/Weekly Worksheets ......................... 354
Appendix 16: Daughters’ Pink Slip Tasks ....................................... 367
Appendix 17: MADE4Life Sticker Chart........................................... 371
Appendix 18: Daughters’ Card ......................................................... 373
Appendix 19: MADE4Life Certificate .............................................. 376
Appendix 20: Mothers’ Manual ....................................................... 378
Appendix 21: Mothers’ SMART Goal Setting Sheets ......................... 380
Appendix 22: Mothers’ Pedometer Chart ....................................... 382
Appendix 23: MADE4Life Pathways and Possibilities Resource ....... 385
Appendix 24: Table A1: Education content, physical activities, pink slip
  tasks and alignment with SCT .................................................. 406
Appendix 25: MADE4Life Assessment Measurement Sheets ............. 412
Appendix 26: MADE4Life Assessment Protocol ............................. 415
Appendix 27: MADE4Life Mother’s Questionnaire Booklet ............... 429
Appendix 28: MADE4Life Activity Information Sheet & Monitor Log .... 445
Appendix 29: MADE4Life Teacher Information Sheet ....................... 449
Appendix 30: MADE4Life Process Evaluation Questionnaire ............. 452
Appendix 31: Table A2: MADE4Life Extended Open Ended Questions 461
Appendix 32: MADE4Life Amazing Race Resource ........................... 467
Abstract

There is a marked gender difference in physical activity levels, with girls less active than boys at every age. Given the established low physical activity levels of girls, there is a need to develop and evaluate innovative strategies to increase girls’ physical activity levels. It is widely recognised that parents play a key role in the promotion and provision of physical activity opportunities, and mothers might be particularly influential for their daughters. This thesis had three major aims relating to understanding and improving the physical activity levels of mothers and daughters.

Aim One

The first aim of this thesis was to systematically review the literature surrounding the effectiveness of mother-daughter lifestyle interventions to improve physical activity, fitness and/or diet. A systematic search across eight databases was conducted. All 12 studies (11 unique interventions) met the eligibility criteria. There were five Randomised Controlled Trials, one pseudo-randomised controlled trial, one non-randomised controlled trial and five pre-post trials. Half of the studies were conducted in the past five years, and the majority were conducted within the U.S. Overall, study quality was poor, with a high risk of bias apparent in the majority of studies. Significant intervention effects in fitness (n=6) were reported in both mothers and daughters. Although dietary behaviours were only assessed in three studies, intervention findings were generally positive. Statistically significant improvements in physical activity were reported for two out of five studies, although measures of physical activity were less commonly reported overall. Characteristics associated with increases in
mother-daughter fitness were face-to-face, structured physical activity and fitness programs that ran for at least two to three times per week for a minimum of 60 minutes per session. Future high-quality trials in this area are needed to determine the impact of gender-specific interventions that target mothers and daughters in community settings.

Aim Two

The second aim of this thesis was to establish potential associations between maternal measures and girls’ physical activity measures. A cross-sectional design was used to assess 40 girls (mean±SD age 8.8±1.6 years; mean BMI [body mass index] z-score=0.7±1.2) and their mothers (39.1±4.8 years; mean BMI=27.6±5.5). Maternal correlates of daughters’ accelerometer-assessed physical activity (moderate-to-vigorous physical activity % MVPA; counts per minute, CPM; sedentary behaviour; % SED), screen time and BMI z-score (objectively measured) included demographic, anthropometric, maternal behaviours, activity-related parenting practices and physical activity cognitions. Correlates were examined using regression models.

A number of maternal behaviours, social-cognitive and parenting correlates were found to be significantly associated with daughters’ physical activity. A significant relationship was found between daughters’ % MVPA and mothers’ beliefs about the benefits of girls physical activity and explained a weak proportion of variance ($R^2=0.14$). Furthermore, the relationships between daughters’ CPM, mothers’ logistic support ($P=0.03$), mothers’ CPM ($P=0.02$) and outcome expectations ($P=0.01$) were all significant and this model explained a moderate proportion of the variance ($R^2=0.24$). Daughters’ % SED and their
mothers’ logistic support ($P=0.02$) was inversely related, and explained a small proportion of the variance ($R^2=0.11$).

Experimental studies targeting mothers as the primary agents of change to increase physical activity and reduce sedentary behaviour among girls may be warranted. Specific maternal targets included their beliefs about the benefits of physical activity for girls, logistic support regarding girls physical activity involvement, and outcome expectations of physical activity.

**Aim Three**

The final aim of this thesis was to establish both the feasibility and preliminary efficacy of a physical activity program designed specifically to target mothers and their daughters (*MADE4Life* intervention). A randomised controlled trial (RCT) of 48 primary school-aged girls and their 40 mothers was conducted. Families were randomised to (i) the ‘Mothers And Daughters Exercising for Life’ (*MADE4Life*) (n=21 mothers, n=25 daughters) group, or (ii) a wait-list control (n=19 mothers, n=23 daughters) group. The eight-week program involved eight sessions, 25-minute separate mothers’ and daughters’ education sessions and 60 minutes of physical activity together. Assessments were at baseline, post-intervention (10 weeks) and three-month post-intervention (20 weeks). The primary outcome measure was daughters’ MVPA (seven days of accelerometry). Secondary outcomes included mother and daughter accelerometer-assessed light/moderate/vigorous physical activity, BMI, waist circumference, body composition, blood pressure, resting heart rate, sedentary behaviours and mothers’ self-reported physical activity, parenting measures and cognitions. Intention-to-treat analysis was conducted utilising linear mixed models.
Recruitment and retention goals (>80%) were exceeded. Attendance rates, program acceptability and satisfaction were high (m=4.8/5). There was no significant group-by-time effect for daughters’ % MVPA (-0.08; 95%CI -1.49, 1.33, \( d=-0.03 \)) or other secondary outcomes for girls (post-intervention range \( d=0.01\)–\(-0.46\)). Significant intervention effects were found for mothers’ % VPA (\( P=0.04, d=0.25 \)) and role modelling (\( P=0.02, d=0.66 \)). \textit{MADE4Life} was highly feasible and acceptable for mothers and daughters. Future fully-powered trials targeting physical activity in mothers and daughters are warranted.

The study targeted the topic of intergenerational female physical activity. Findings from this thesis make an important contribution to the paucity of studies targeting mothers and daughters. However, the primary hypothesis was not supported. Further research is needed that involves larger samples of mothers and daughters in a family-based, gender-specific program in a community setting.

Numerous recommendations were made from the findings in this thesis to assist future program development aiming to improve PA levels of females, in particular mothers and daughters, with regards to intervention design, intervention content and methodological considerations. Of great importance and concern is the growing evidence base for females being less active compared to males and the negative health consequences of physical inactivity. Further exploration of the impact of gender-tailored PA interventions is needed, along with sustained research attention. \textit{MADE4Life} is one step in developing this evidence base.
List of peer reviewed journal articles from this PhD

**Barnes, A.T.** Plotnikoff, R.C., Collins, C.E., Young, M.D., & Morgan, P.J. (submitted to *Sports Medicine*). The effectiveness of physical activity, fitness, and/or dietary interventions targeting mothers and their daughters: A systematic review (Chapter 2).


List of published conference abstracts in refereed journals from this PhD


List of published conference abstracts in peer reviewed conference proceedings from this PhD


Additional papers during PhD Candidature

During my PhD candidature, I was involved in two major randomised controlled trials (RCT), as a part-time (one day a week) Research Assistant for The ‘Healthy Dads, Healthy Kids’ community RCT and as Project Manager (two days a week) for The ‘Workplace POWER’ (Preventing Obesity Without Eating like a Rabbit) RCT prior and during the first year of my PhD.

The following journal articles are included in Appendix 3, Appendix 4 and Appendix 5 as additional papers. My contribution to each of these papers has been outlined below.


My contribution to the above paper involved: working as a research assistant; recruiting families, i.e. conducting school presentations, recruiting families; managing assessment sessions across the various community programs at baseline three-, six-, nine-, and 12-month follow-up; data management; and, contributing to the drafting and review of the manuscript.

Without Eating like a Rabbit) randomised controlled trial. *Preventive Medicine, 52*(5), 317-325. doi: 10.1016/j.ypmed.2011.01.031


My contribution to the above two papers involved: working as the project manager; assisting with ethics documentation; managing assessment sessions off-site; data entry and management; and drafting of manuscripts.
### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Term</th>
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<tbody>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>Body Mass Index Z-score</td>
</tr>
<tr>
<td>BPM</td>
<td>Beats per minute</td>
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<tr>
<td>CI</td>
<td>Confidence Intervals</td>
</tr>
<tr>
<td>CONSORT</td>
<td>Consolidated standards of reporting trials</td>
</tr>
<tr>
<td>CPM</td>
<td>Counts per minute</td>
</tr>
<tr>
<td>d</td>
<td>Cohen’s $d$ effect size</td>
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<tr>
<td>FFM</td>
<td>Fat free mass</td>
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<tr>
<td>GEMS</td>
<td>Girls enrichment multi-site studies</td>
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<tr>
<td>ITT</td>
<td>Intention-to-treat</td>
</tr>
<tr>
<td>Kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>m</td>
<td>Mean</td>
</tr>
<tr>
<td>M</td>
<td>Metre</td>
</tr>
<tr>
<td>MADE4Life</td>
<td>Mothers and Daughters Exercising for Life</td>
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<tr>
<td>METs</td>
<td>Metabolic equivalent</td>
</tr>
<tr>
<td>Min</td>
<td>Minutes</td>
</tr>
<tr>
<td>MI</td>
<td>Millimetre</td>
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<tr>
<td>mmHg</td>
<td>Millimetres of mercury</td>
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<td>N</td>
<td>Number</td>
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<tr>
<td>NSW</td>
<td>New South Wales</td>
</tr>
<tr>
<td>% LPA</td>
<td>Percent time spent in light physical activity</td>
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<tr>
<td>% MPA</td>
<td>Percent time spent in moderate physical activity</td>
</tr>
<tr>
<td>% MVPA</td>
<td>Percent time spent in moderate to vigorous physical activity</td>
</tr>
<tr>
<td>% SED</td>
<td>Percent time spent in sedentary behaviour</td>
</tr>
<tr>
<td>% VPA</td>
<td>Percent time spent in vigorous physical activity</td>
</tr>
<tr>
<td>$P$</td>
<td>Probability (statistical significance level)</td>
</tr>
<tr>
<td>PA</td>
<td>Physical Activity</td>
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<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>PRC</td>
<td>Priority Research Centre for Physical Activity and Nutrition</td>
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<tr>
<td>RCTs</td>
<td>Randomised Controlled Trial</td>
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<td>RHR</td>
<td>Resting Heart Rate</td>
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<tr>
<td>SCT</td>
<td>Social Cognitive Theory</td>
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<tr>
<td>Sd</td>
<td>standard deviation</td>
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<td>SEIFA</td>
<td>Socio-economic indices for areas</td>
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<tr>
<td>SES</td>
<td>Socio-economic status</td>
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<tr>
<td>SPANS</td>
<td>Schools physical activity and nutrition survey</td>
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<tr>
<td>SSR</td>
<td>Small-screen recreation</td>
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<td>TV</td>
<td>Television</td>
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<td>Umb</td>
<td>Umbilicus</td>
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<td>WC</td>
<td>Waist circumference</td>
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<tr>
<td>WC z-score</td>
<td>Waist circumference Z-score</td>
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<td>WHO</td>
<td>World Health Organization</td>
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## List of Definitions

<table>
<thead>
<tr>
<th>Term</th>
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<tr>
<td>Physical activity</td>
<td>The WHO defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure (World Health Organization, 2010). Physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths globally (World Health Organization, 2010). VPA has been defined as expending more than 7 Metabolic Equivalents (METs), or a minimum of 7.5 kilocal/min, or working at a minimum of 70% of maximum heart rate, or 70% of VO2max (e.g., running, sprinting, jumping, skipping) (Janssen &amp; Leblanc, 2010). MPA has been defined as expending 3–4 METs, or approximately 5–7.5 kilo cals per min, or exercising at 60–70% of maximum heart rate, or at 60% of VO2max (e.g., swimming, cycling, brisk walking) (Janssen &amp; Leblanc, 2010).</td>
</tr>
<tr>
<td>Physical inactivity</td>
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<tr>
<td>Vigorous physical activity</td>
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<tr>
<td>Moderate physical activity</td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td>In this thesis the term child refers to a young person aged between 5-12 years</td>
</tr>
<tr>
<td>Mother/Mum</td>
<td>In this thesis the term mother or ‘mum’ refers to a female parent (Macquarie Dictionary, 2013).</td>
</tr>
<tr>
<td>Daughter</td>
<td>In this thesis the term daughter refers to a female child in relation to her mother (Macquarie Dictionary, 2013).</td>
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Preface and Contribution Statement

Below is an outline of what I, Alyce Therese Barnes (nee Cook), have contributed to the design, development, implementation and evaluation of the program and overall study/thesis. In summary, I led all aspects of the study including program design, development, delivery, assessment and analysis. Further detail is now provided.

Program development and recruitment

I was responsible for the design and the development of the MADE4Life program. I was responsible for the development of program sessions and presentations (weekly educational content for mothers’ and daughters’ PowerPoint presentations, weekly physical activity session content) resource and material development (additional program resources, i.e. daughters’ weekly worksheets, pathways and possibilities to physical activity in the local community document, detailed weekly home tasks, SMART Goal and pedometer recording worksheets, and providing resources such as pedometers, skipping ropes etc). I was also responsible for recruiting the sample of mothers and daughters (i.e. organising school presentations, school gate discussions with parents, school newsletter entries and local media presentations).

Ethics and safety approval

I was responsible for the drafting and submission of the ethics to the University of Newcastle Human Research Ethics Committee, completing safety procedures and registering the pilot RCT with the Australian New Zealand Clinical Trial Registry (ANZCTR12611000622909). Tasks involved developing a
research proposal, submitting all ethical forms, developing participant information statements and consent forms, developing questionnaires, and ensuring all research volunteers and staff had completed their child protection checks and working with children safety check.

**Measurement of study outcomes, data collection and data entry**

Through collaboration with my three supervisors, the methods and measures were determined. I was responsible for seeking 12 student volunteers, organising training and assessment sessions and coordinating and conducting all assessment sessions. The research assistants were responsible for recording participants’ measurements; however, I was responsible for entering and double checking all data.

**Intervention delivery for both intervention and wait-list control groups**

I was in charge of organising, delivering and leading the eight-week MADE4Life program for the intervention group and the wait-list control. For the separate information sessions, a qualified PDHPE teacher led the 25-minute daughter sessions based on my lesson planning and task development.

**Analysis of data**

Through collaboration with my supervisors and a senior statistician, the statistical analysis plan was developed and I completed all analyses using SPSS, MeterPlus and Microsoft Excel, interpreting results and presenting results in text, table and figure output.
Acquiring of funding

I was responsible for applying for MADE4Life funding as lead chief investigator. I was successful in gaining a grant from the Priority Research Centre in Physical Activity and Nutrition.


Presentations related to PhD

I was responsible for presenting at both national and international conferences (both poster and oral presentations). In 2012, I placed first in the School of Education, Faculty of Education and Arts, Three Minute Thesis (3MT) competition and competed as a finalist in the University of Newcastle 3MT final. I have presented on local radio stations on four occasions, one television news story and two print media articles in local newspapers.