



Physical Activity Promotion Strategies for Adolescent Girls:
Exploring Experiences, Co-Design and Intervention Development

By

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A thesis submitted in fulfilment of the requirements
for the degree of Doctor of Philosophy

Submitted to
Mary Immaculate College
-University of Limerick-
May 2019

Supervised by **Dr. Elaine Murtagh**

Abstract

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Globally, over 80% of adolescent girls aged 11-17 fail to reach the recommended physical activity (PA) guidelines (Sallis *et al.* 2016). Interventions aiming to increase girls' PA levels have only demonstrated modest effects (Pearson *et al.* 2015). This thesis aimed to: (i) conduct a qualitative synthesis of adolescent girls' perceptions of PA, (ii) assess the feasibility of involving girls in the design of a PA programme, (iii) explore maternal correlates of adolescent girls' PA and (iv) assess the feasibility of a 6-week mother-daughter multi-component PA programme.

Four papers are contained within this thesis. Paper one involved a literature review (n=24 included studies) examining adolescent girls' perceptions of PA. Findings indicated that girls from the included studies disliked the gendered nature of PA, had issues with low perceived competence levels and experienced competing priorities and expectations during adolescence. This paper informed the development of two behaviour change interventions and a cross-sectional study.

Paper two was a feasibility study in a co-educational post-primary school with adolescent girls aged 15-17 years (n=31). The study assessed the feasibility of involving girls in the design of a PA programme, guided by the Behaviour Change Wheel (BCW) (Michie *et al.* 2011). Successful recruitment, retention, adherence and acceptability rates demonstrated the feasibility of the school-based PA programme. Qualitative data indicated participants enjoyed experiencing "novel" activities (e.g. aerobics) during PE, and providing autonomy led to increased levels of accountability for participation.

While schools are frequently used locations for PA promotion, recent evidence has recognised the potential of family-based approaches, but there is a paucity of research investigating this approach with adolescents (Barnes *et al.* 2018). Therefore, paper three investigated maternal correlates of PA in mothers and adolescent daughters (n=84). Significant correlations were found for daughters' PA including mothers' PA, PA parenting practices and mothers' reports of daughters' physical well-being ($p < 0.05$). These findings support the involvement of mothers in PA promotion for adolescent girls. Finally, paper four assessed the feasibility of a PA programme for mothers and daughters (n=58). This study followed Orsmond and Cohn's (2015) objectives for feasibility studies, examining recruitment, data collection, acceptability, resources and participant responses. Positive feasibility metrics and a change in the primary outcome of daily steps indicate the likelihood of intervention success with the intended population.

This thesis demonstrates that PA promotion strategies, guided by the BCW, are feasible for adolescent girls. Papers one and two highlight the importance of providing alternative PA opportunities to girls aside from competitive sports. Papers three and four illustrate the potential of family-based PA promotion strategies. The effectiveness of an inter-generational PA programme should be evaluated in a randomised controlled trial (RCT).

Declaration

I hereby declare that:

This thesis is my own work. All quotations from other sources are duly acknowledged and referenced. This document as a whole is not the same as any that I have previously submitted or am currently submitting, whether in published or unpublished form, for a degree, diploma, or similar qualification at any university or third level institution. I am the author of this thesis and the principal author of the four articles which form its core.

Signature: _____

Méabh Corr

Date: _____

Acknowledgments:

“No one who achieves success does so without acknowledging the help of others. The wise and confident acknowledge this help with gratitude.”- Alfred North Whitehead

Numerous people have helped make my PhD journey a possibility, providing invaluable help, support and encouragement, and to those people I am extremely thankful.

I would like to begin by thanking my supervisor, Dr. Elaine Murtagh, who has guided me in my research journey over the past three years. Your constant encouragement, dedication and time not only helped me complete this journey but allowed me to grow both personally and professionally and for that I will always be grateful. I would also like to thank other staff members in the Arts Education and Physical Education Department, and in the Research and Graduate School for their help throughout this process.

I would also like to thank my undergraduate dissertation supervisor, Dr. Jaimie McMullen. Jaimie, without your initial encouragement I may never have undertaken postgraduate studies, thank you for believing in me and for continuing to support me during these early stages of my career.

To all my study participants, without your interest and dedication none of this research would have been possible. Thank you for your willing participation and for your honesty in sharing your thoughts and opinions.

To my co-authors in Ireland, America and in Australia, thank you for your time and insightful feedback in helping me to prepare the articles which form the base of this thesis.

To all my friends, both in Clonmel and Limerick, thank you for your constant support and encouragement. Thank you also for providing me with valuable study breaks when I needed them the most. To my teammates and management in Moyle Rovers LGFA, taking time out to train and play matches with you all was always a welcome break and distraction for my brain.

To Garreth, you have been with me since day one on this PhD journey and your patience and understanding has been invaluable. Thank you for listening to all my rants, dealing with my little meltdowns and for accompanying me to international conferences if I didn't want to travel alone. Your support has meant the world to me.

Finally, and most importantly, to my family. To my brother, Diarmaid, thank you for your moral support and encouragement. To my parents, Tony and Chris, for your absolute unconditional love, support and encouragement, not only over these past three years but throughout my whole life. You have always provided me with every opportunity I could ever wish for, and your unwavering support has been the source of my motivation and determination in everything that I do. I hope I can continue to make you both proud.

Dedication:

“Those who are not looking for happiness are the most likely to find it, because those who are searching forget that the surest way to be happy is to seek happiness for others”

- Martin Luther King Jr

***This thesis is dedicated to:
My parents, Tony and Chris***

*For their continued support, encouragement and unconditional
love*

*I can never fully express how much your support means to me,
and I will continuously strive to make you both proud*

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List of Abbreviations

ANOVA	Analysis of Variance
APEASE	Affordability, Practicality, Effectiveness and cost-effectiveness, Acceptability, Side effects and safety, Equity
BCT	Behaviour Change Technique
BCW	Behaviour Change Wheel
BMI	Body Mass Index
CASP	Critical Appraisal Skills Programme
COM-B	Capability, Opportunity, Motivation-Behaviour
CONSORT	Consolidated Standards of Reporting Trials
COREQ	Consolidated Criteria for Reporting Qualitative Research
CSPAP	Comprehensive School Physical Activity Programme
CSPE	Civic Social and Political Education
CSSPA	The Children's Sport Participation and Physical Activity Study
DAMET	Daughters and Mothers Exercising Together
DES	Department of Education and Skills
DFG	Daughter Focus Group
ENTREQ	Enhancing Transparency in Reporting the Synthesis in Qualitative Research
ERIC	Education Resources Information Centre
FAI	Football Association of Ireland
FG	Focus Group
FMS	Fundamental Movement Skills
GAA	Gaelic Athletic Association
G-PACT	Girls Peer Activity Trial
HELENA	Healthy Lifestyle in Europe by Nutrition in Adolescence
HRQoL	Health Related Quality of Life
IPAQ	International Physical Activity Questionnaire
IRFU	Irish Rugby Football Union
LEAP	Lifestyle Education for Activity Programme
LSP	Local Sport Partnership
MET	Metabolic Equivalent

MFG	Mother Focus Group
MIC	Mary Immaculate College
MRC	Medical Research Council
MVPA	Moderate to Vigorous Physical Activity
NCCA	National Council for Curriculum and Assessment
NCD	Non communicable disease
PA	Physical Activity
PACES	Physical Activity Enjoyment Scale
PACS	Parent-Adolescent Communication Scale
PAQ-A	Physical Activity Questionnaire for Adolescents
PE	Physical Education
PMC	Perceived Motor Competence
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols
RCT	Randomised Controlled Trial
SB	Sedentary Behaviour
SCT	Social Cognitive Theory
SD	Standard Deviation
SES	Socio Economic Status
SMART	Specific, Measurable, Achievable, Relevant, Time-bound
SOLE MATES	Supporting Our Lifelong Engagement: Mothers and Teens Exercising
SPHE	Social Personal and Health Education
SPSS	Statistical Package for the Social Sciences
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
TAAG	Trial of Activity for Adolescent Girls
TPB	Theory of Planned Behaviour
UK	United Kingdom
US	United States
WHO	World Health Organisation
W&T	Walk and Talk

Research Communications

Publications:

Corr, M., Murtagh, E., and McSharry, J. Adolescent girls' perceptions of physical activity: a systematic review of qualitative studies. PROSPERO 2017 CRD42017054944. Available from: http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42017054944

Corr, M., McSharry, J. and Murtagh, E. (2018) Adolescent Girls' Perceptions of Physical Activity: A Systematic Review of Qualitative Studies, *American Journal of Health Promotion*. [Epub ahead of print] doi: [10.1177/0890117118818747](https://doi.org/10.1177/0890117118818747) (Impact Factor 1.957).

Corr, M., Murtagh, E. (2019) “No One Ever Asked Us”: A Feasibility Study Assessing the Co-Creation of a Physical Activity Programme with Adolescent Girls. Accepted for publication in *Global Health Promotion* (Impact Factor 1.179).

Corr, M., Morgan, P., McMullen, J., Barnes, A. and Murtagh, E. (2018). Maternal influences on adolescent daughters to increase physical activity (Supporting Our Lifelong Engagement: Mothers and Teens Exercising [SOLE MATES]): a feasibility study. *The Lancet*, 392, p.S5. (Impact Factor 53.254).

Corr, M., McMullen, J., Morgan, P., Barnes, A. and Murtagh, E. (Under Review). Supporting Our Lifelong Engagement: Mothers and Teens Exercising (SOLE MATES); A Feasibility Trial. Submitted to *Women & Health* (Impact Factor 1.307).

Corr, M., Murtagh, E. (Under Review). Maternal Correlates of Adolescent Girls' Physical Activity Measured Via Device-Based and Self-Report Measures. Submitted to *Maternal and Child Health* for publication (Impact Factor 1.788).

Conference Presentations:

Corr M, McSharry J, Murtagh E. “Adolescent Girls' Perceptions of Physical Activity: A Systematic Review of Qualitative Studies” *All Ireland Postgraduate Conference in Sport Sciences, Physical Activity and Physical Education*, Carlow, 21st April 2017 (Poster Presentation).

Corr M, Murtagh E. “Designed by Us”: Assessing the Feasibility of involving adolescent girls in the development and design of a physical activity programme”. *Limerick Postgraduate Research Conference*. Limerick 24th May 2017 (Oral Presentation).

Corr M, Murtagh E. “No one ever asks us” Involving TY students in the design of a physical activity intervention to inform their Senior Cycle PE. *Annual Doctoral Conference in Education*. Dublin 27th May 2017 (Poster Presentation).

Corr M, Murtagh E. Using the Behaviour Change Wheel to Involve Participants in the Design of a Physical Activity Intervention. *Annual PEPAYS Forum*. Limerick 15th-16th June 2017 (Oral Presentation).

Corr M, Murtagh E. “There’s so many ways to be active” - Results of a Feasibility Study Involving Adolescent Girls in the Design of a Physical Activity Intervention. *Annual Conference of HEPA Europe*. Croatia, 15th-17th November 2017 (Oral Presentation).

Corr M, McSharry J, Murtagh E. “Adolescent girls’ perceptions of physical activity: A systematic review of qualitative studies”. *7th Annual International Society for Physical Activity and Health (ISPAH) Congress*. London, 15-17 October 2018 (E-Poster Presentation).

Corr M, Morgan P, McMullen J, Barnes A, Murtagh E. “Supporting our Lifelong Engagement; Mothers and Teens Exercising (SOLE MATES) – A Feasibility Study”. *Public Health Science Conference*, Belfast, 23rd November 2018 (Oral Presentation).

Awards:

Doctoral Studentship Award for academic year 2018/2019 from Mary Immaculate College.

Early Career Researcher Award for best oral e-poster presentation at International Society of Physical Activity and Health in London, 2018.

Early Career Researcher Award for best oral presentation at the Public Health Science Conference in Belfast, 2018.

Chapter 1: Introduction

This chapter provides the context, rationale and justification for investigating physical activity (PA) promotion strategies among adolescent girls. This includes the wide range of benefits that can be gained from engaging in regular PA, the current global inactivity levels of adolescent girls, interventions that have been designed to increase PA levels in this cohort and the current gaps in the literature.

1.1 Rationale for thesis

There is increasing evidence to support the promotion of PA with children and young people, given the current high inactivity levels of this population. Adolescents, particularly girls, do not engage in sufficient PA to reap health benefits, with an estimated 84.4% of adolescent girls globally failing to meet the recommended 60 minutes of moderate to vigorous physical activity (MVPA) each day (Sallis *et al.* 2016). There are numerous physical and psychological benefits that individuals can receive from regular engagement in MVPA, including, but not limited to, improved body composition, reduced cholesterol, improved blood pressure and reduced feelings of stress and anxiety (Dumith *et al.* 2011, Eime *et al.* 2013, Hills *et al.* 2015). In addition, regular PA can help reduce an individual's risk of developing several non-communicable diseases (NCDs), such as type II diabetes (World Health Organisation 2010).

Adolescents have been consistently targetted as a priority group for PA promotion, as some research indicates that the PA behaviours for both males and females adopted during childhood and adolescence can track into adulthood where they are maintained (Telama 2009). Therefore, the promotion of healthy lifestyle behaviours during youth has been highlighted as important from a future public health perspective (Tammelin *et al.* 2014). Moreover, the promotion of healthy PA behaviours has been prioritised for girls due to the gender disparities evident in PA participation, with 84% of females considered insufficiently active compared to 78% of males from the same age group (Sallis *et al.* 2016). To combat the high inactivity levels of this population, several interventions have been designed and implemented, particularly in the school setting, in an effort to increase PA levels (Camacho-Minano *et al.* 2011, Pearson *et al.* 2015, Owen *et al.* 2017, Love *et al.* 2019). However, the effects of these interventions to date have remained modest (Pearson *et al.* 2015). It has been suggested that a possible reason for these small effect sizes is due to a failure of the intervention to accurately

address the needs and interests of those involved (Pearson *et al.* 2015). Along with small effect sizes, the majority of research conducted to date has taken place in school settings, with little attention given to the importance of the family environment in the development and reinforcement of healthy PA behaviours. This is an important consideration, as some researchers have suggested that without the involvement of family members in PA interventions, the effects of PA interventions will continue to be modest and short term (Brown *et al.* 2016). There is also a paucity of research conducted in an Irish setting, with a large proportion of interventions to date being based in the United Kingdom (UK), the United States (US) or Australia (Camacho-Minano *et al.* 2011, Pearson *et al.* 2015, Owen *et al.* 2017, Love *et al.* 2019). Ireland has a very specific PA culture, with the Gaelic Athletic Association (GAA), Irish Rugby Football Union (IRFU) and the Football Association of Ireland (FAI) dominating a large portion of our PA culture in school settings and in the media. It is important to conduct research in a variety of countries with different PA cultures, outside of the UK, US or Australia, to strengthen the evidence base on interventions for adolescent girls.

In Ireland, to address the health and wellbeing of the nation, the Department of Health created the “*Healthy Ireland*” Framework for improved health and wellbeing 2013-2025, which aims to improve the proportion of people who are healthy at all stages of their life (Department of Health 2013). This framework highlighted that if current trends of inactivity continued in Ireland, then the prevalence of type II diabetes and cardiovascular disease would increase by 20-30% by 2020 (Department of Health 2013). Therefore, to combat this, one of the main aims of the framework was to increase the proportion of people engaging in regular PA by 20% (Department of Health 2013). To support this goal Ireland’s first ever National PA plan was developed in 2016, detailing eight action areas for the development of increased healthy PA behaviours in Ireland (Department of Health 2016). Action area two of this plan focuses specifically on children and young people, with action area 2.16 focused on including children and young people in the development and implementation of programmes in which they are involved (Department of Health 2016).

Along with the “*Healthy Ireland*” Framework, there are also specific frameworks and policies relating to the health and wellbeing of young people in Ireland in the school setting. These include the “*Guidelines for Wellbeing in the Junior Cycle*” developed by

the National Council for Curriculum and Assessment (NCCA) and the “*Wellbeing Policy Statement and Framework for Practice 2018-2023*” developed by the Department of Education and Skills (DES) (National Council for Curriculum and Assessment 2017, Department of Education and Skills 2018). Schools are recognised for the critical role they play in promoting students’ physical, social, mental and emotional wellbeing. Similar to the “*Healthy Ireland*” framework, there is an emphasis in both of these documents on ensuring learning in schools is student centred, inclusive, and that the voices of young people are respected and valued in an effort to promote overall wellbeing (National Council for Curriculum and Assessment 2017, Department of Education and Skills 2018). This involves providing an accessible, inclusive and broad extra-curricular programme in schools, involving students in the planning of their extra-curricular activities and ensuring that a co-ordinated approach to Physical Education (PE), Civic Social and Political Education (CSPE) and Social, Personal and Health Education (SPHE) is adopted (National Council for Curriculum and Assessment 2017, Department of Education and Skills 2018).

The studies described in this thesis aim to address some of the action areas and guiding principles of these frameworks, using extensive formative research to include participant perceptions and preferences in the design of PA interventions. Along with involving adolescent girls in the design of programmes in which they are involved, this thesis aims to address some of the gaps currently present in the literature, including an investigation of the potential maternal correlates of girls’ PA using valid and reliable self-report and device-based measures. As well as investigating maternal correlates, a mother-daughter multi-component PA intervention was conducted to assess the feasibility of a family-based approach with teenage girls. Further details, rationale and justification for the studies conducted in this thesis are presented in *Chapter 2*, which is a critical examination of the literature.

1.2 Aim and objectives of the thesis

The overall aim and objectives of this thesis are presented below. Information relating to the rationale, aims and objectives of specific studies can be found in their respective chapters (*Chapter 2, Chapter 4, Chapter 5 and Chapter 6*).

1.2.1 Aim and Objectives

The overarching aim of this thesis was to investigate potential PA promotion strategies for adolescent girls, exploring experiences, co-design and intervention development.

This was achieved through the following objectives;

1. To identify and synthesise relevant qualitative research that has examined the perspectives of adolescent girls regarding PA.
2. To co-create a school-based PA programme with adolescent girls using relevant behaviour change theory, assessing the feasibility of involving participants in programme design.
3. To conduct a cross-sectional study investigating potential maternal correlates of adolescent girls' device-based and self-report measures of PA.
4. To conduct a feasibility trial assessing the potential effectiveness of a mother-daughter multi-component PA programme and its potential to positively impact the PA behaviours of adolescent girls.

1.3 Structure of the thesis

This thesis contains seven chapters along with additional appendices. This chapter provides a brief introduction and rationale for the thesis, with further details being provided in *Chapter 2*. *Chapter 2* critically reviews the currently available evidence and presents a qualitative synthesis of adolescent girls' perceptions of PA. *Chapter 3* provides an overview of the various methods used with the studies described in *Chapter 4* to *Chapter 6*. The studies presented in *Chapter 2* and *Chapters 4* to *6* are those which were prepared for publication. Each study includes a brief rationale of the purpose of the chapter and its contribution to the field, the author's contribution to the paper, abstract, keywords, introduction, methods, results, discussion, references, and a chapter conclusion. Any relevant supplementary material (questionnaires etc.) are available in the appendices.

The following is a breakdown of the specific chapter contents:

Chapter 1: A brief introduction to the phenomenon of inactivity among adolescent girls and details of the current limitations of interventions conducted to date. The overarching aim and objectives of the thesis are also presented at the end of the chapter.

Chapter 2: Chapter two presents a critical review of the available literature and is presented in two parts. *Part A* details the current high inactivity levels of adolescent girls and examines the interventions which have been conducted to date with this sample, examining both school and community-based interventions. Potential gaps in the evidence are highlighted, and recommendations from other research are considered, providing a justification for the research undertaken in this thesis. *Part B* is a systematic qualitative synthesis of literature focusing on adolescent girls' perceptions of PA. This paper has been published in a peer reviewed journal and provides a deeper understanding of adolescent girls' perceptions of PA which must be considered when attempting to increase their PA levels.

Chapter 3: Chapter 3 describes in further detail some of the methods used across the studies described in *Chapter 4* to *6*, including details on study population, setting, data collection methods and analysis procedures.

Chapter 4: This chapter describes a study conducted in a post-primary school assessing the feasibility of involving adolescent girls in the design of a PA programme following guidance from the Behaviour Change Wheel (BCW). This is the second paper prepared for publication in this thesis.

Chapter 5: This chapter is a cross-sectional study investigating potential maternal correlates of adolescent girls' PA levels using valid and reliable self-report and device-based measures of PA. This is the third paper prepared for publication in this thesis.

Chapter 6: This chapter describes the preliminary feasibility of the Supporting Our Lifelong Engagement: Mothers and Teens Exercising (*SOLE MATES*) intervention, assessing the acceptability of a mother-daughter multi-component PA programme and the programme's potential to improve PA levels of adolescent girls. This is the fourth paper prepared for publication in this thesis.

Chapter 7: In this final chapter, the findings from the individual studies conducted as part of this thesis are considered and common themes across studies are discussed. The contribution to the current evidence base is highlighted, along with areas for future research and recommendations for policy and practice.

Chapter 2: Literature Review

2.1 Introduction

The following literature review is presented in two parts. Part A critically reviews the available evidence and describes the numerous health benefits associated with regular engagement in physical activity (PA) during youth and adolescence, as well as the high inactivity levels of this population. These high inactivity levels provide justification for the development of several school and community-based interventions to increase the PA levels of adolescents, particularly girls. Current PA interventions that have been conducted with adolescent girls are examined, while highlighting some gaps still present in the literature. Part A also discusses the importance of intervention design, including the consideration of theory and formative work prior to intervention development, and the importance of conducting feasibility studies. Part B is a qualitative synthesis of studies focusing on adolescent girls' perceptions of PA, providing insight into the commonly cited barriers to girls' participation in PA.

Part A

2.2 Physical Activity During Adolescence; An Introduction

Regular PA is fundamental for good health across all age groups, with evidence showing that PA can positively impact an individual's physical and psychological wellbeing (World Health Organisation 2010, Hills *et al.* 2015). Engagement in PA can result in the development of improved body composition and bone health as well as reduced cholesterol (Dumith *et al.* 2011, Eime *et al.* 2013, Hills *et al.* 2015). Along with these immediate health benefits, regular PA has been shown to help reduce the risk of the development of several non-communicable diseases (NCDs) such as cardiovascular disease, hypertension and type II diabetes (Warburton *et al.* 2010, World Health Organisation 2010, Sallis *et al.* 2016, Guthold *et al.* 2018). In addition, regular PA has been shown to improve psychological wellbeing through reduced feelings of stress and anxiety (Dumith *et al.* 2011, Hills *et al.* 2015).

Engaging in regular PA during childhood and adolescence is essential as the benefits gained at this stage are critical for healthy growth and development (Telama 2009, Hills *et al.* 2015). During adolescence, levels of cardiorespiratory fitness, muscular strength and body composition have been shown to be predictive of lower rates of cardiovascular disease and all-cause mortality later in life, when compared to those who had lower fitness levels during youth (Patton *et al.* 2016). However, engagement in risk

behaviours, such as tobacco use or alcohol consumption often emerge during adolescence, leading to an increased risk of the development of chronic NCDs in later life (Gore *et al.* 2011, Patton *et al.* 2012). There is some evidence to suggest that the PA habits developed during youth can track into adulthood where they are maintained, but our true knowledge of how PA tracks over time remains limited due to a lack of high quality, longitudinal studies (Telama 2009). However, as Telama (2009) noted in their review of studies tracking PA, enhancing child and adolescent PA is important from a public health perspective, providing rationale for intervention with this age group to promote healthy lifestyles for future populations (Telama 2009).

2.2.1 Physical Activity Guidelines and Current Activity Levels

The World Health Organisation (WHO) recommends that adolescents accumulate 60 minutes of moderate to vigorous physical activity (MVPA) a day to receive health benefits (World Health Organisation 2010). In Ireland, similar recommendations have been developed by the Department of Health, also advocating for 60 minutes of MVPA a day and muscle-strengthening, flexibility and bone-strengthening exercises three times a week (Health Service Executive 2009). Despite the well-documented benefits of PA, physical inactivity is rampant worldwide and is now recognised as the fourth leading risk factor of global mortality (World Health Organisation 2010). Globally, almost 81% of adolescents fail to achieve sufficient PA for health benefits, and girls are consistently reported as less active than males (Currie *et al.* 2009, Hallal *et al.* 2012, Sallis *et al.* 2016). It is estimated that 84.4% of adolescent girls aged 11-17 are failing to meet the recommended PA guidelines, higher than the 78.4% of males of the same age group (Sallis *et al.* 2016). In Ireland, the most recent evidence shows that 88% of adolescents, both male and female, fail to meet the PA guidelines (World Health Organisation 2018). The gender disparities in PA participation is evident within this data, with 85% of males aged 12-18 reported as failing to meet the guidelines versus 91% of Irish females (World Health Organisation 2018). A systematic review and pooled analysis by Dumith *et al.* (2011) investigating PA change during adolescence found a mean decline of 7% per annum of PA levels, resulting in a total decline of 60-70% in PA levels across the course of adolescence (Dumith *et al.* 2011). An interesting point to note from this review was that girls' PA participation levels declined more at younger ages (approx. 9 years) compared to boys. A decline of 7.1% per year for younger girls was noted, compared to a decline of 5.1% per year among boys, yet boys had a higher rate of

decline in older years compared to girls (Dumith *et al.* 2011). This earlier decline in PA participation among girls may be due to biological maturation, which normally occurs earlier for girls, however there may be other factors at play (Dumith *et al.* 2011). While PA declines earlier for girls, their participation levels still remain lower than boys throughout adolescence, and therefore they remain an important target group for the promotion of PA (Corder *et al.* 2015).

2.2.2 Correlates of Physical Activity

As the prevalence of inactivity continues to grow, it is important to understand the potential correlates or factors that may be associated with activity (Bauman *et al.* 2012). Over the years, several researchers have investigated potential correlates of PA, and a review by Bauman *et al.* (2012) found the most consistent individual correlates of PA to be age, sex, health status, previous PA and self-efficacy (Bauman *et al.* 2012). With adolescents specifically, family support for PA and self-efficacy have been repeatedly documented as positive correlates of PA (Bauman *et al.* 2012).

Studies investigating potential correlations have also showed positive associations between maternal PA levels and adolescent PA levels (Aarnio *et al.* 1997, Raudsepp and Viira 2000, Bauer *et al.* 2011, Jacobi *et al.* 2011, Langlois *et al.* 2017), adolescent PA and logistic maternal support (McGuire *et al.* 2002, Raudsepp 2006, Dowda *et al.* 2007, Verloigne *et al.* 2012, Hutchens and Lee 2018) and parental education level and adolescent PA (Schmitz *et al.* 2002, Ornelas *et al.* 2007, Price *et al.* 2008, Sherar *et al.* 2009, Hashem *et al.* 2018). A systematic review by Biddle *et al.* (2005), which contained 51 independent samples, found that family socio-economic status (SES) and higher parental education were positively associated with girls' PA levels (Biddle *et al.* 2005). However, this same review found an indeterminate relationship with participation in PA by the mother and the PA levels of their daughters (Biddle *et al.* 2005). Within the 51 studies included in this review, only 21% (n=11) used device-based measures of PA, with only 3 studies using a measure of PA that is valid and reliable (Biddle *et al.* 2005). Other reviews have been conducted and have yielded similar results with regards to how PA was measured, with very few studies reporting the use of device-based measurements (Sallis *et al.* 2000, Verloigne *et al.* 2012). In fact, a review by Ferreira *et al.* (2007) found that the majority of studies using device-based measures of PA were restricted to those focusing specifically on children (Ferreira *et al.*

2007). This may in part be due to the convenience, affordability and feasibility of using self-report measurements (i.e. questionnaires), particularly in large-scale studies (Troiano *et al.* 2012, Bauman *et al.* 2016). However, this is an important consideration when evaluating potential correlates of adolescent PA, as relying on self-reported measures of PA can possess several limitations in terms of reliability and validity (Shephard 2003). It has been noted that when using self-report measures, participants can either over or under-estimate their true activity levels (Prince *et al.* 2008). Despite this limitation, self-report measures of PA are widely used in research and do provide important data on PA levels, however there is a lack of research with adolescents using a combination of valid and reliable self-report and device-based measures of PA when investigating correlates.

2.3 Interventions

This section of the literature review focuses on PA interventions during adolescence, including those conducted in school-settings, multi-settings and with family members.

2.3.1 Overview of Physical Activity Interventions for Adolescent Girls

One of the most commonly used intervention settings for adolescent PA programmes are schools. In recent years, the school setting has received increased attention, specifically in relation to its potential to improve the health behaviours of adolescents (Demetriou and Höner 2012, Hynynen *et al.* 2016). Schools are recognised as an ideal location to conduct PA interventions, as adolescents spend the majority of their waking hours in school, allowing researchers access to a large target population (Hynynen *et al.* 2016). The types of interventions that have been conducted in schools vary and include multi-component interventions and single component interventions. Multi-component interventions often include modified physical education (PE) lessons, extra-curricular PA, modifications to the school environment, educational sessions and the provision of additional opportunities to engage in PA (e.g. a PA club at break or lunch time). Single component interventions tend to comprise a modified PE class or an after-school programme. It has been suggested that multi-component interventions are more successful with adolescent girls, and several reviews have assessed the effectiveness of the currently available PA interventions (Camacho-Minano *et al.* 2011, Pearson *et al.* 2015, Owen *et al.* 2017). Both Camacho-Minano *et al.* (2011) and Pearson *et al.* (2015)

focus on school and community-based interventions, while the review by Owen *et al.* (2017) focused on school-based interventions.

The review by Camacho-Minano *et al.* (2011) aimed to determine the effectiveness of interventions promoting PA among young and adolescent girls (age 5-18 years), while also identifying key characteristics of success. Of the 21 interventions included in this review, 10 studies reported favourable effects on PA outcomes, and 7 of these 10 studies were deemed to be of high methodological quality. Regarding adolescent girls (i.e. girls aged 12-18), 5 of the 7 high quality studies were focused specifically on this population, with the remaining two focusing on younger girls. The authors of this review noted that the promotion of PA among adolescent girls is difficult and complex, as even within the high quality, large randomised controlled trials (RCTs) the effects on PA were modest (Camacho-Minano *et al.* 2011). Limitations noted in this review were the lack of device-based measures of PA used. As well as this, 66% of the included studies (14/21) claimed to be based on a relevant theory, yet the authors found large variability in how the theory was reported to be used (Camacho-Minano *et al.* 2011). Included studies within this review were also mainly conducted in the United States and in school settings (17/21 included studies), and more research is needed in other developed countries and other settings as the high physical inactivity levels of this cohort is a global concern (Camacho-Minano *et al.* 2011)

In 2015, a meta-analysis by Pearson *et al.* (2015) echoed some of the findings presented by Camacho-Minano *et al.* (2011). A key difference in these reviews was that the review in 2011 focused solely on girls only interventions, whereas the meta-analysis by Pearson *et al.* (2015) focused on both single-sex and mixed-sex interventions, if the results for females were reported separately to males (Pearson *et al.* 2015). This was done to allow the authors to investigate if a single-sex approach to PA promotion was more effective for girls than a mixed-sex approach (Pearson *et al.* 2015). In line with the findings of Camacho-Minano *et al.* (2011), Pearson *et al.* (2015) found small but significant effects for interventions aiming to increase the PA of girls (Pearson *et al.* 2015). Within the included studies, 53% (n=18) were conducted in school settings and 41% (n=14) were conducted in school and also contained an out-of-school component. Stronger effects were found for interventions which were multi-component in nature, were based on a relevant theory and had a moderate study quality (Pearson *et al.* 2015).

However, comparable limitations were noted in this review, with authors relying on studies with low-to-moderate quality and those using self-report measures of PA. Studies based in school settings and that focused on girls only showed higher effect sizes, but overall these effects were modest in nature. Similar to Camacho-Minano *et al.* (2011), countries outside of the US and settings outside of the school were under-represented within the included studies of this meta-analysis.

A third, and more recent meta-analysis was conducted by Owen *et al.* (2017), which focused on school-based interventions for adolescent girls, assessing the impact and design of PA interventions targeting this population. Interventions in this review included both single-sex and mixed-sex interventions, similar to Pearson *et al.* (2015). Twenty studies were included in the narrative review and 17 provided sufficient data to be included in the meta-analysis (Owen *et al.* 2017). The meta-analysis concluded that school-based interventions only have a very small effect on girls' PA (Owen *et al.* 2017). While the school setting has been identified as being a promising setting for PA promotion with this cohort (Camacho-Minano *et al.* 2011, Pearson *et al.* 2015), the modest effect sizes observed in all three reviews demonstrate that increasing the PA levels of this group is difficult and challenging (Owen *et al.* 2017). One approach that did appear to be promising was the use of multi-component interventions underpinned by theory and it was recommended that future research adopt an approach similar to Comprehensive School PA Programmes (CSPAP) (Owen *et al.* 2017). Using a CSPAP approach involves intervening during PE time, before or after school and normally includes involvement from staff, family or the community. This method has been recommended as being an effective PA promotion strategy (SHAPE America and CSPAP America 2013). The CSPAP approach adopts a social ecological perspective, acknowledging the relationship between an individual and their environment (Carson *et al.* 2014). By using this perspective, it is recognised that children and youth are surrounded by multiple levels of influences on their school PA behaviour, and these influences must work together and be considered for an effective, sustainable CSPAP programme to be implemented (Carson *et al.* 2014). However, to date there is limited evidence available to support the effect of this approach with adolescents, as the majority of studies have been conducted with younger children (Brusseau *et al.* 2016, Burns *et al.* 2017).

Despite claims from these three reviews that PA interventions in schools may be successful in modestly increasing the PA levels of adolescent girls, a meta-analysis by Love *et al.* (2019) of cluster RCTs measuring PA with an accelerometer found interventions were not effective in increasing minutes spent in MVPA across the full day, and no differences were seen across gender or socio-economic status (Love *et al.* 2019). It should be noted that this review did focus solely on RCTs using accelerometers as the device-based measure of PA, criteria which was far more stringent than the aforementioned reviews. The authors of this review speculated that this null effect may be due to a failure to correctly implement the intervention as planned, leading to a recommendation to further examine intervention fidelity before dismissing the potential of schools to impact PA levels (Love *et al.* 2019).

This section has given a brief overview of some of the PA interventions that have been implemented for adolescent girls, looking specifically at systematic reviews and meta-analyses. The following sections of this literature review will examine the currently available evidence more closely, to see which approaches or strategies have worked, and which have not, to increase our understanding of PA interventions and their potential effects.

2.3.2 School-Based Interventions

This section will describe in further detail the characteristics of school-based PA interventions conducted with adolescent girls. School-based interventions include those conducted during school time (i.e. through modified PE lessons, during lunch or break time) and those conducted after-school on the school grounds. The studies discussed below were selected following a review of the literature, examining interventions that have previously been included in rigorous systematic reviews and meta-analyses. Sub-headings were chosen based on the types of interventions that are most commonly conducted and analysed within the evidence base. Several studies from the available evidence base are given below as examples.

2.3.2.1 Modified PE lessons

Using modified PE lessons is a strategy that has been employed as a method to increase PA levels. The following studies provide examples of interventions which offered choice to participants in their PA activities. Providing choice in activities is important for PA interventions to ensure the interests of the participants are met (Tannehill *et al.*

2013). A study conducted in Australia by How *et al.* (2013) sought to investigate if the provision of choice within school PE enhanced autonomous motivation, perceived support for PA and actual PA levels relative to a “regular PE” control group (How *et al.* 2013). The study included eight PE classes (n=4 control classes and n=4 intervention classes) with a total of n=257 participants (mean age 12.91 years) (How *et al.* 2013). PA levels were measured using an Actigraph accelerometer once a week over the 15 week study period (How *et al.* 2013). The findings from this study indicated that those in the experimental group displayed increased perceptions of autonomy support for PA. Female students who chose a self-designed PA plan engaged in significantly more MVPA than females in the control group or those who did not choose the self-designed PA plan (How *et al.* 2013). While these results are encouraging and show the potential effect of providing girls with a choice of activity on their levels of MVPA as measured by accelerometer, the percentage time spent in MVPA is still lower than the recommended 60 minutes of MVPA (World Health Organisation 2010) and further examination into how student autonomy can lead to increased levels of MVPA is needed.

Another school-based intervention which included modified PE lessons was “Project FAB”, conducted in the United States with inactive adolescent females (n=47) (Jamner *et al.* 2004). The intervention also included a modified PE lesson, however unlike the study by How *et al.* (2013), PA content was chosen based on focus group discussions with the participants, on five days a week for 60 minutes (average of 40 minutes of activity time) (Jamner *et al.* 2004). One of the weekly sessions was also devoted to educating the participants about a healthy lifestyle. Cardiovascular fitness was assessed by obtaining peak oxygen uptake (VO₂ peak L/min) through a progressive exercise test on a cycle ergometer (Jamner *et al.* 2004). Participants also completed a self-report measure of PA using a 2-day PA recall questionnaire (Jamner *et al.* 2004). “Project FAB” was successful in preventing a decline in cardiovascular fitness for inactive adolescent girls through modified PE classes as compared to those in the control group when follow-up data was collected four months after intervention initiation. Participants in the intervention group also reported engaging in more light or moderate PA, however these results were interpreted with caution by the authors as they relied solely on self-report measures to assess this (Jamner *et al.* 2004). The use of focus groups to aid the design of the intervention content is a strength of the study, as formative research has

been identified as a critical step in the design of health behaviour change interventions (Young *et al.* 2006), however without post-intervention discussions with the study participants it is difficult to know what aspects of the intervention worked well and why. Using a mixed-methods approach and including qualitative data collection methods involving participant opinion when evaluating the components of PA interventions such as “Project FAB” can help establish the reasons behind the success or failure of an intervention (Dugdill *et al.* 2009).

A third example of an intervention using modified PE lessons, also conducted in Australia by Dudley *et al.* (2010), assessed the feasibility and acceptability of a school-based programme to increase PA. This was a three month, two-arm parallel group pilot RCT with n=38 participants. Using similar methods adopted in “Project FAB”, focus groups were used prior to the intervention development to involve participant voice in the intervention development as well as gain insight into the consenting participants’ needs and interests (Dudley *et al.* 2010). These opinions and perceptions were considered when planning the activities included in the intervention. PA levels were measured using Actigraph accelerometers, worn for 90 minutes during the PA session, for three sessions before and after the intervention (Dudley *et al.* 2010). As this study was designed to assess feasibility it was not adequately powered to detect changes in PA, and the intervention itself only contained 6 PA sessions, each two weeks apart (Dudley *et al.* 2010). These limitations make it difficult to ascertain whether the intervention would be successful in increasing the PA levels of adolescent girls, however it was noted that there was a smaller decline in PA participation for the intervention group when compared to the control group, indicating an encouraging trend in PA participation (Dudley *et al.* 2010). It is also important to note the contribution studies assessing feasibility and acceptability add to the evidence base before conducting large scale trials (Abbott 2014). Examining initial intervention feasibility and acceptability should be a key priority for researchers given the current lack of available evidence of successful large-scale interventions improving the PA levels of adolescent girls.

While there are several other school-based interventions utilising modified PE lessons as an intervention strategy to increase the PA levels of adolescent girls, the above-mentioned studies are just some examples. These studies provide examples of how

formative research can be used to incorporate youth voice into intervention design. The study by How *et al.* (2013) and Jamner *et al.* (2004) also illustrate how providing autonomy in activities may lead to increased participation in PA. Going forward, further research is needed to investigate how school-based PA interventions using modified PE lessons for adolescent girls can meaningfully involve youth voice during the development stages. Similarly, those designing school-based interventions and those working to promote PA during school time must consider ways in which girls can have more autonomy over their PA choices in school.

2.3.2.2 *Peer-Led Interventions*

Other school-based PA programmes have adopted an approach which utilises peer leaders within the school to motivate and empower other students. The “Girls Active” intervention, which was based in the United Kingdom, aimed to provide a support framework for schools to allow them to review their sport, PA and PE provisions, as well as their school culture and practices to ensure they were relevant to their students (Edwardson *et al.* 2015). The intervention was guided by Social Cognitive Theory (SCT) (Bandura 1989). SCT, formally Social Learning Theory (SLT) aims to explain how people regulate their behaviour through control and reinforcement to achieve behaviours that can be maintained over time (Bandura 1989). The theory has six main constructs, including reciprocal determinism, behavioural capability, reinforcements, expectations, self-efficacy and observational learning (Bandura 1989). Using SCT to guide the intervention, the researchers aimed to address the multiple levels that influence behaviours through various intervention components (Edwardson *et al.* 2015). The intervention was conducted in 10 schools, with 10 other schools acting as the control. Levels of MVPA was measured via accelerometer at baseline, seven months and 14-month follow up. Within the intervention schools, teachers were encouraged to choose peer leaders who would influence PA, PE and sport within the school (Harrington *et al.* 2018). Significant differences in MVPA were evident at 7 months but not at 14 months (Harrington *et al.* 2018). The results of “Girls Active” demonstrate it is possible to increase the PA levels of adolescent girls, but the small effect sizes post-intervention demonstrate the difficulty in sustaining long-term effects.

Another example of a peer led intervention is the Girls Peer Activity (G-PACT) peer led mentoring intervention, also conducted in the United Kingdom (Owen *et al.* 2018a).

Unlike the “Girls Active” intervention, the primary aim of the G-PACT study was to assess the feasibility and acceptability of a three-tier peer led mentoring model (Owen *et al.* 2018a). The three-tier system involved Mentors (undergraduate students), Leaders (girls aged between 13-14 years as selected by teachers) and Peers (school cohort). Mentors delivered training to Leaders who were then encouraged to disseminate this information to their Peers in school (Owen *et al.* 2018a). The intervention lasted seven weeks and took place in three schools. One school received class-based fitness activities after school, one received a PA club where students could choose the activities and the third school did not receive a PA component (Owen *et al.* 2018a). A significant intervention effect was seen for both whole day and school day MVPA for girls who received the class-based fitness activities, while a negative effect on whole day and school day MVPA was noted from students who did not receive a PA component. The school which provided choice to students showed no significant changes in MVPA but the results were moving in a positive direction, indicating the likelihood of this approach to help increase MVPA levels (Owen *et al.* 2018b). An interesting point to note within this study is that qualitative results indicated that there was a disconnect between the leaders and the peers in the school with the fitness class, whereas the school with choice discussed better engagement between leaders and peers (Owen *et al.* 2018a).

These are just some examples of interventions which have attempted to use peer mentors as an intervention strategy to promote and increase PA for adolescent girls. Both the G-PACT and “Girls Active” study demonstrate the possible positive effects that involving peer mentors and providing autonomy to students can have on PA levels. However, limitations are still noted, including a difficulty in sustaining changes in PA levels long-term and a possible lack of communication between peer leaders and peers in the school. This raises questions about the use of this approach for future research, particularly in relation to who should choose the peer leaders and how can we be sure that the students chosen will be positive, motivating role models for their peers? Further investigation into the use of peer leaders in school-based interventions is needed to truly assess the effectiveness of this approach.

2.3.2.3 After-School Interventions

Several interventions have also been conducted in after-school settings. The Bristol Girls Dance Project, which was conducted in the United Kingdom, investigated the potential of an after school dance programme to improve MVPA levels of girls aged 11-12 years (Jago *et al.* 2015). The programme consisted of 75 minute dance classes, twice per week, for 20 weeks delivered straight after school by a qualified dance instructor (Jago *et al.* 2015). Girls were offered “taster sessions”, which were conducted during regular PE classes before the intervention commencement. PA was measured using accelerometer and of the 571 girls that participated in the programme, 508 had valid accelerometer data at both baseline and post-intervention (Jago *et al.* 2015). Data was collected at baseline (T0), during the intervention between week 17 and 20 (T1) and post intervention (T2). Post intervention data was collected approximately 52 weeks after baseline assessments (at least 4 months after the intervention had ended). Only n=15 students were lost to follow up during T1 and T2 (Jago *et al.* 2015). Girls in the intervention group completed an average of 53 minutes of weekday MVPA compared to 49 minutes in the control group. There was no statistical difference between the groups, however attendance to the dance sessions was lower than expected by the authors. A pre-specified adherence criteria of at least 2/3 of the sessions was defined, and only 1/3 of the intervention group met this criteria (Jago *et al.* 2015). This illustrates the difficulty researchers face in terms of attendance to PA programmes for adolescent girls.

Another after-school pre-to-post PA programme conducted in the United States by Robbins *et al.* (2013) encountered similar difficulties. This “Girls on the Move” study was a 90-minute after school programme which took place 5 days a week for 6 months (Robbins *et al.* 2013). Baseline assessments were completed by 73 girls and 69 girls completed post-assessments. The PA component involved a warm-up session, 60 minutes of MVPA, a cool down and weekly group discussions on PA and healthy eating (Robbins *et al.* 2013). Participants were also provided with a healthy snack as well as time to complete their homework after the PA component. Participants also attended three 20 minute sessions with the school nurse over the course of the 6 months to overcome negative issues they faced as well as to help increase their internal motivation for MVPA (Robbins *et al.* 2013). No significant changes were seen from pre-to-post measures; however, this could be attributed to girls receiving an inadequate intervention

dose. Only 7 of the girls within the study had three or more days of attendance per week at the PA programme, with transport home after-school being cited as the main barrier for most girls (Robbins *et al.* 2013). However, another possible explanation for participants receiving inadequate intervention dose is the high attendance demand, 5 days a week for 6 months. This is an extremely large commitment for girls to undertake and something that should be considered by researchers going forward.

Again, the above studies are just two examples of interventions aiming to increase the PA levels of adolescent girls in an after-school setting. While the school setting shows promise as a location to promote PA, both the “Bristol Girls Dance Project” (Jago *et al.* 2015) and the “Girls on the Move” intervention demonstrate the challenges faced regarding attendance and adherence to after school PA programmes.

2.3.2.4 A Note on School-Based Interventions

This section of the literature review has provided detail on some of the currently available school-based interventions, focusing specifically on their effects on the PA levels of adolescent girls. What is common among all interventions is a lack of feedback on PA behaviours for the adolescent girls, with the exception of the modified PE intervention by How *et al.* (2013), with one group planning and implementing personal PA programmes. Research into behaviour change interventions has shown that those which encourage participants to self-monitor their behaviour were more effective in eliciting change than those that did not (Michie *et al.* 2011a). The studies mentioned above did not provide details of any specific monitoring strategies or devices to provide feedback on behaviour to participants and encourage PA behaviours for girls.

Along with the lack of feedback on PA behaviours, the majority of studies collected mainly quantitative data at baseline and post-intervention. While some studies, including “Project FAB” and “Girls Active” used formative research in the design of the intervention, very few studies collected qualitative data post-intervention (Jamner *et al.* 2004, Harrington *et al.* 2018). The “G-PACT” study by Owen *et al.* (2018) did use focus group discussions post-intervention, providing the authors with valuable information relating to the use of peer leaders (Owen *et al.* 2018a). As multi-component interventions continue to be recommended as being an effective strategy with this cohort it is important that more qualitative research is conducted post-intervention. Due to the many elements each intervention contains, without rigorous qualitative work it is

very difficult to ascertain which components of the intervention are working and which are not. Using qualitative data collection methods can also provide researchers with valuable information which may not otherwise be detected through quantitative methods, especially when sample sizes are smaller.

And finally, very few of the currently available school-based interventions make meaningful efforts to change the PA behaviours of adolescent girls outside of the school setting. As many studies are conducted during school time (e.g. PE time), the results often heavily dwell on changes in MVPA during that time, with little to no consideration to the rest of the day. In order to sustain long-term changes to PA behaviours it is essential that girls are provided with the skills and knowledge to continue to be active outside of the school-setting. Therefore, it is important that interventions based in school settings contain specific components or strategies that encourage PA during leisure time or outside of school hours. This could be done by incorporating goal setting strategies with girls to plan their PA outside the intervention, planning and monitoring of behaviour through diaries or device-based measures or promoting out-of-school activity opportunities.

2.3.3 Multi-Setting Interventions

As has now been established, to date, the majority of interventions targeting adolescent girls have been focused on school-based settings, however due to the small effect sizes of these interventions it may be plausible to suggest researchers should focus on community and family based interventions as well (Bush and García Bengoechea 2015). Currently there is limited evidence available of the effects of school-based interventions on PA outside of school time or during leisure time, highlighting the need for interventions to extend beyond school settings (Casey *et al.* 2014, Bush and García Bengoechea 2015). In a mapping review by Bush *et al.* 2015, it found that within Europe, studies which focused on either family or community elements within the intervention have had larger effects than interventions focused solely on the school setting (effect sizes ranging from $d=.27$ to $d=2.07$) (Crutzen 2010, Bush and García Bengoechea 2015). This would suggest that in line with the recommendations from Pearson *et al.* (2015) and Camacho-Minano *et al.* (2011) advocating for multi-component interventions, that multi-setting interventions may also be required (Bush and García Bengoechea 2015).

2.3.3.1 School and Community Interventions

Two examples of interventions for girls which incorporate both school and community based components are the Trial of Activity for Adolescent Girls (TAAG) (Stevens *et al.* 2005) and the Lifestyle Education for Activity Programme (LEAP) (Dishman *et al.* 2004). The aim of the TAAG intervention was to reduce the age related decline of MVPA evident in adolescent girls by creating a PA programme that linked school and community organisations (Stevens *et al.* 2005). Within the TAAG intervention, PA opportunities were created for students before or after school and community partners worked with schools to provide appropriate PA opportunities for girls over a three year period (2003-2006) (Webber *et al.* 2008). As well as establishing these links, the intervention included education sessions to enhance participants' behavioural skills, TAAG PE classes which promoted engagement in MVPA and TAAG programme champions to foster intervention sustainability (Webber *et al.* 2008). A total of 36 schools were recruited and data was collected over three time points in 2003, 2005 and 2006. In 2003, 60 girls from each school were randomly selected for recruitment (n=1,721) and 120 girls from each school were recruited in 2005 and 2006 (n=3,504 and n=3,502 respectively) (Webber *et al.* 2008). PA was measured using accelerometer with the primary outcome being an increase in MET-weighted minutes of MVPA. There was no difference in MET-weighted minutes of MVPA from 2003 to 2005, however in 2006 students in the intervention group participated in 10.9 MET-weighted minutes of MVPA more than the control (p=0.03) (Webber *et al.* 2008). As well as differences in MVPA, participants in the control group in 2006 had higher levels of sedentary activity (8.2 minutes more than the intervention group) (p=0.05) (Webber *et al.* 2008). Although the TAAG intervention was well received by students, the changes in MVPA for the intervention schools compared to the control schools were modest (Webber *et al.* 2008). This again highlights the difficulties researchers face when aiming to increase the PA levels of this cohort.

Similarly, the LEAP intervention took place over two years and incorporated both school-based and community based elements (Dishman *et al.* 2004). Unlike TAAG, the primary aim of the LEAP intervention was to focus on variables derived from SCT (Bandura 1989) as mediators of change for PA (e.g. self-efficacy) (Dishman *et al.* 2004). Essential elements of the LEAP intervention included school PE, the school environment and ensuring it provided ample opportunities for girls to engage in PA,

school-community links (including family involvement) and organisational change (Felton *et al.* 2005). A total of 12 control and 12 intervention schools participated in the study, with students being assessed at baseline (Spring of 8th Grade) and post-intervention (Spring of 9th Grade) (Dishman *et al.* 2004). Data was collected from n=2744 students at baseline and n=2087 students post-intervention (76% retention rate) (Dishman *et al.* 2004). PA was assessed via self-report questionnaire, using the three-day physical activity recall questionnaire. The results of this intervention provided evidence that increased self-efficacy directly resulted in increased PA among adolescent girls (Dishman *et al.* 2004). This is an important finding as a review by Biddle *et al.* (2005) found a positive correlation between self-efficacy (an individual's beliefs in their ability to achieve a goal) and adolescent girls' PA. Interventions for adolescent girls should consider the important role that self-efficacy and perceived motor competence (PMC) play in relation to PA participation. Similar to self-efficacy, PMC is defined as an individual's beliefs or awareness of their ability to perform fine and gross motor tasks (Rudisill *et al.* 1993). While self-efficacy and PMC are both related to an individual's beliefs, it is important to recognise that they are separate concepts. In relation to PMC, it has been demonstrated that there is a relationship between an individual's PMC and actual motor competence which has a subsequent effect on PA (Barnett *et al.* 2013), and individuals with high PMC but low actual motor competence have been found to be more active than their peers with low PMC (De Meester *et al.* 2016). Building girls' PMC and self-efficacy may be a key strategy going forward to encourage life-long enjoyment and participation in PA.

While both the TAAG and LEAP intervention demonstrated positive effects on girls' PA, the effects were modest. Due to the multi-component nature of both the TAAG and LEAP interventions it is also difficult to conclude which elements of the intervention were most successful. When evaluating multi-component interventions, collecting qualitative data alongside quantitative data can provide essential context to findings and give the researcher insights into participant opinions. Both of these interventions were also conducted in the U.S, and there is a need for more interventions to be conducted in other geographical areas, taking into consideration different culture contexts and providing a larger evidence base for the effectiveness of such interventions (Murillo Pardo *et al.* 2013, Casey *et al.* 2014).

2.3.3.2 A note on multi-setting interventions

Similar to school-based interventions, multi-setting interventions often fail to include a qualitative data collection method post-intervention. As has already been mentioned, when interventions contain several components it is very difficult to pinpoint exactly which elements work, and which do not, without some direct feedback from the participants involved.

2.3.4 Role of the family

When aiming to increase the PA levels of adolescents, consideration of the family environment in influencing PA behaviours is essential (Brown *et al.* 2016, Uijtdewilligen *et al.* 2017). Parents are important role models for their children, and they can help shape their child's PA levels (Thompson *et al.* 2010, Stearns *et al.* 2016). Parents can provide essential encouragement, support (both logistic and financial) and positive role modelling behaviours, all of which are associated with higher PA levels among boys and girls (Beets *et al.* 2007, Thompson *et al.* 2010). There is some evidence to suggest there may be a differential effect of parents based on child and parent sex (Uijtdewilligen *et al.* 2017). A review of parental correlates of PA in youth found that mothers can have a more noticeable influence on their daughters' activity levels than their sons (Gustafson and Rhodes 2006). As mentioned earlier, other studies investigating correlates of youth PA have reiterated these findings, with positive associations between adolescent girls' PA and maternal PA levels (Aarnio *et al.* 1997, Raudsepp and Viira 2000, Bauer *et al.* 2011, Jacobi *et al.* 2011, Langlois *et al.* 2017), and logistic maternal support and adolescent PA being evident (McGuire *et al.* 2002, Raudsepp 2006, Dowda *et al.* 2007, Verloigne *et al.* 2012, Hutchens and Lee 2018). This maternal impact on girls' PA levels may be due to the unique relationship and bonds that females share across generations (Gustafson and Rhodes 2006). In comparison to other intergenerational relationships, females are more likely to have similar motivations, challenges, habits and beliefs in relation to their lifestyle behaviours (Marcus *et al.* 2006), therefore targeting mothers and daughters simultaneously may be an effective strategy to improve PA behaviours. As well as this unique relationship, mothers often serve as the first female role model for their daughters. As has been mentioned previously, Bandura's SCT considers the ways in which people acquire and maintain their behaviours while considering the social environment they perform this behaviour in (Bandura 1989). According to SCT

(previously Social Learning Theory), children learn from their parents' behaviours as well as their attitudes, and as a female role model a mother's attitude and behaviour can directly impact those of her daughter (Bandura and Walters 1977, Northrup and Kaye 2005). Capitalising on this relationship may help to address some of the current barriers evident within the literature, by encouraging family participation and aiming to increase PA participation across the whole day, rather than just within the school or other intervention setting.

It has been suggested that unless there is involvement from family members in PA interventions then it is unlikely that long-term changes to child and adolescent PA will be experienced (Brown *et al.* 2016). This may be because influences on PA participation are multi-factorial, and without consideration to other factors that impact health behaviours (e.g. family or community environment), meaningful change will not be possible (Ward *et al.* 2007, van Sluijs *et al.* 2011). Parental involvement in PA may be a successful intervention strategy for adolescent girls, with research showing that family PA can lead to enhanced parent-child communication and familial social interactions, as well as the potential health benefits of engaging in PA (Thompson *et al.* 2010, Uijtdewilligen *et al.* 2017). However, very few high-quality studies involving family members have been conducted with adolescents, and the effectiveness of this approach remains uncertain (van Sluijs *et al.* 2011).

2.3.4.1 Mother-Daughter Interventions

Several PA correlation studies have established the potentially positive effects mothers can have on their daughters' PA levels and involving family members has been recognised as a possible strategy to increase the PA levels of adolescents. However, to date, there is a paucity of research focusing specifically on mother-daughter interventions and how this approach can impact PA behaviours.

A review by Barnes *et al.* (2018) of mother-daughter interventions found only 14 studies which focused on PA, fitness, nutrition or adiposity, or a combination of these four. Ages of participants within the included studies ranged from 5 years old to 19 years old, and thirteen of the studies included adolescent girls who were at least 12 years old (Barnes *et al.* 2018). An example of a mother-daughter intervention is the "Daughters and Mothers Exercising Together (DAMET)" study by Ransdell *et al.* (2003), which aimed to compare the effectiveness of home and community based

programmes targeting mothers and daughters to increase PA (Ransdell *et al.* 2003a). Focus groups were conducted pre-intervention with a sub-sample of participants to gain insights into the needs and interests of the group. Participants were randomly assigned to a home-based group or a community-based group, with the community group meeting three times a week to engage in PA and the home-based group receiving PA plans to participate in at home (Ransdell *et al.* 2003a). The results of this study found both home-based and community-based PA interventions to be successful at increasing PA levels and health related fitness of mothers and daughters (Ransdell *et al.* 2003a). However, the authors of this study noted some potential limitations, including the lack of a control group and a relatively small sample size (n=34). Authors also noted the demographics of their participants, with the majority being white, well-educated and from middle to high income backgrounds, making it difficult to determine if the results are generalisable to a more diverse population (Ransdell *et al.* 2003a).

Another mother-daughter study, which was conducted in Iran, investigated the potential of an after-school programme to impact the PA levels of mother-daughter pairs (Kargarfard *et al.* 2012). The study had two groups, the intervention group contained mothers and their daughters (n=410) and the control group contained only adolescent daughters (n=60). All participants took part in similar exercise programmes, with the only difference being that mothers participated with their daughters in the intervention group (Kargarfard *et al.* 2012). Participants showed significant changes in all outcome measures from baseline to post-intervention (12 weeks) in both groups, however the changes in the intervention group were greater than that of the control group (Kargarfard *et al.* 2012). The authors hypothesised that this difference may be due to the supportive role played by the mother when participating in the exercise sessions (Kargarfard *et al.* 2012). However, this study had some limitations, including not randomly assigning participants to the intervention or control group and the lack of long-term follow-up (Kargarfard *et al.* 2012).

Both of these studies are examples of those included in the review by Barnes *et al.* (2018). The 14 studies included in the review were also found to have a high risk of bias due to analytic and methodological concerns, and while 13 of the studies contained a specific PA component, only 29% of these used device-based measures of PA (Barnes *et al.* 2018). As well as the low number of studies using device-based measures, only

36% of studies with a PA component included follow up assessments. These limitations make it very difficult to draw conclusions about the potential effectiveness of mother-daughter interventions (Barnes *et al.* 2018). The review also highlighted the lack of evidence available in this area, and in particular in diverse geographical locations, with only three of the included studies conducted outside of the United States (Barnes *et al.* 2018). This review indicates that while an inter-generational approach to increase the PA levels of adolescent girls may be successful there is currently insufficient high-quality evidence to determine the true effectiveness of mother-daughter interventions (Barnes *et al.* 2018).

2.3.4.2 *A note on family-based interventions*

This sub-section of the literature review has focused on the potential influence of the family environment, particularly the involvement of mothers, on the PA levels of adolescent girls. What is clear from the currently available evidence investigating correlates of PA is that mothers may have the ability to positively influence their daughters' PA levels through encouragement, logistic support, co-participation and positive role modelling. However, there is a lack of high-quality studies assessing maternal correlates with adolescent girls and also a paucity of research investigating the potential of an inter-generational PA programme with mothers and daughters to improve PA behaviours of adolescent girls. As this area is relatively underexplored, conducting feasibility studies is essential to assess areas of acceptability, recruitment, data collection, adherence and participant responses to see if this approach shows promise of being successful, before proceeding to full-scale trials (Orsmond and Cohn 2015).

2.4 Intervention development

Guidance on conducting complex interventions has been available to researchers since 2000, when the Medical Research Council (MRC) first published a framework for design and evaluation of complex interventions (Campbell *et al.* 2000). This guidance included four phases, beginning with defining intervention components. This was followed by defining trial and intervention design, then investigating methodological issues for main trial and finally promoting effective implementation (Campbell *et al.* 2000). The rationale for this phased approach was to enable improved study design, implementation and generalisability of findings (Campbell *et al.* 2000). This framework was then revisited and re-evaluated in 2008, after the identification of several

limitations. Some of these included a need for increased focus on the development work involved with complex interventions and a less linear model of evaluation (Craig *et al.* 2008). Some key points noted in the updated guidance were the importance of a good theoretical understanding of how the intervention causes change, advocating for the development of interventions systematically using appropriate theory and then testing them using a phased approach (Craig *et al.* 2008). Some of the most commonly used theories in behaviour change interventions for adolescent girls have been Bandura's SCT (Bandura 1989), the Theory of Planned Behaviour (TPB) (Ajzen 1985) or the Self Determination theory (Ryan and Deci 2000). SCT has been previously described within this thesis, and further explanation of the TPB and Self-Determination theory will be provided in section 2.4.2.

The updated MRC guidance includes four key elements which must be considered in the development and evaluation process of complex interventions (see Figure 2.1). These include the development stage, which involves identifying the evidence base and appropriate theory, the feasibility and piloting stage which involves testing procedures and examining key uncertainties in intervention design, the evaluation stage to assess effectiveness and the implementation stage to disseminate the intervention and monitor results with long term follow-up (Craig *et al.* 2008). While it is helpful to think of intervention development and evaluation in distinct phases, it is important to note that in practice it may not always be possible to follow such a linear route, and there may be a need to move back and forward between phases as the intervention develops (Craig *et al.* 2008). The updated 2008 MRC guidance places explicit importance on the conduct of pilot and feasibility studies to identify uncertainties in trial design or implementation that may cause problems in an ensuing randomised controlled trial (Eldridge *et al.* 2016b). The consequent sub-sections describing intervention development in this literature review will focus on some of these key areas, including incorporating relevant theory in intervention design, the importance of using formative work to identify the evidence base and conducting initial feasibility studies before large-scale trials.

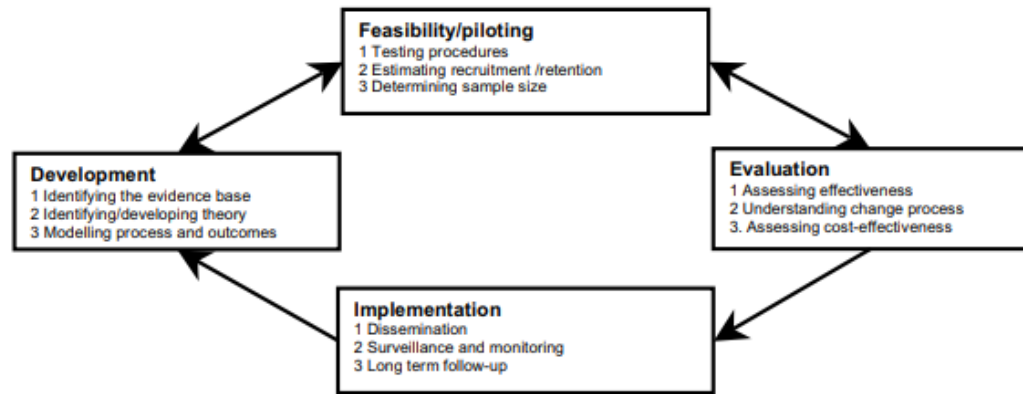


Figure 2.1 Key Elements of the Development and Evaluation Process (Craig *et al.* 2008)

2.4.1 Youth Voice

Formative research has been identified as a critical step in the development of behaviour change interventions, allowing researchers to design interventions which better meet the needs of those who will be involved in the intervention (Young *et al.* 2006). This also aligns closely with the concept of Public and Patient Involvement (PPI) in research, ensuring that programmes and interventions are designed “by” or “with” participants rather than “for” or “to” them (INVOLVE 2012). This includes involving young people in the design of programmes they are involved in, as well as seeking input from other representatives from the community (e.g. parents and teachers) (Goh *et al.* 2009). However, often due to time constraints or available resources, how formative data is used is rarely reported, and sometimes the true potential of the formative data to guide intervention development may be limited due to time or resource constraints (Newes-Adeyi *et al.* 2000, Young *et al.* 2006).

As has already been identified within this chapter, the majority of PA interventions currently available focus solely on quantitative outcomes, making it difficult to explain or understand why an intervention does or does not work. More often than not, the views of potential participants are ignored during the development and evaluation stages of an intervention, even though a comprehensive understanding of barriers faced by individuals and motivations to PA are essential in designing successful behaviour change interventions (Hesketh *et al.* 2005, Allender *et al.* 2006, Mackintosh *et al.* 2011). The modest effects of interventions to date suggest that perhaps, even though barriers to PA have been identified and strategies have been put in place to overcome

them, a true detailed understanding about how girls experience PA is lacking (Yungblut *et al.* 2012a). It has been proposed that this lack of understanding has led to the development of interventions which don't fully meet the needs or interests of those involved (Corder *et al.* 2013). Involving adolescent voice in the development and design of interventions should be a priority when creating opportunities for them to increase their PA levels (Tannehill *et al.* 2013). Doing so can produce vital information which can be used to guide the design of the intervention, ensuring it is tailored to the interests of those involved (Murillo Pardo *et al.* 2015). During adolescence, autonomy for many behaviours increases, therefore involving adolescents in intervention development may be an appropriate strategy to facilitate positive behaviour change (Wilson *et al.* 2008, Corder *et al.* 2013). Involving youth in their PA choices may result in increased intrinsic motivation for participation and, in turn, more long-term behaviour change (Wilson *et al.* 2008). Providing this choice or autonomy within PA interventions recognises the need for independence and desire for self-initiated behaviour change felt during youth and adolescence (Wilson *et al.* 2008).

Involving youth voice during the development stages will allow for the identification of barriers they face, how they can be best supported to increase their PA and the types of activities they find most inviting (Tannehill *et al.* 2013). Without involving and responding to the needs of young people, researchers will not be in a position to develop and implement interventions that are appealing to the needs of this cohort, and in turn will not be able to improve their PA behaviours (Tannehill *et al.* 2013).

2.4.2 Behaviour Change Theory in Intervention Development

As has now been established within this literature review, changing the PA behaviours of adolescent girls is complex, with interventions to date demonstrating little to no effects on PA (Camacho-Minano *et al.* 2011, Pearson *et al.* 2015, Owen *et al.* 2017). Reviews of PA interventions found that those which were based on theory were more effective, particularly for older adolescents, for example the LEAP intervention by Dishman *et al.* (2004) which focused on areas derived from the SCT as mediators of change for PA (e.g. self-efficacy) (Bandura 1989, Dishman *et al.* 2004, Pearson *et al.* 2015). As has been mentioned, using relevant theory in the design of interventions has been identified as a key step by the MRC in their guidance on developing and evaluating complex interventions (Craig *et al.* 2008). This guidance also suggests that

researchers should write clear and detailed reports on the intervention design, allowing for replication, wider implementation and synthesis of evidence (Craig *et al.* 2008). Improving the design and implementation of evidence-based practice is essential for successful behaviour change (Michie *et al.* 2011b).

One of the most commonly used theories within the currently available interventions is SCT, which has previously been described in this thesis (Bandura 1989). Another commonly used theory in behaviour change interventions is the TPB, which links an individual's beliefs to their behaviours (Ajzen 1985). Within TPB, an individual's attitude towards a behaviour, their subjective norms and perceived behavioural control shape their behavioural intention (Ajzen 1985). The more favourable an individual's attitude is towards a behaviour and the greater their perceived behavioural control is results in a stronger intention to perform a behaviour (Ajzen 1985). Finally, the Self-Determination theory is also commonly used in behaviour change interventions, which suggests that individuals have three psychological needs; autonomy, relatedness and competence, and when these needs are satisfied it leads to higher self-motivation to achieve behaviours (Ryan and Deci 2000). However, theories such as SCT, the TPB or Self-Determination theory don't always cover the full range of variables associated with behaviour change, such as habit and self-control, leading to the exclusion of some possibly important influences on behaviour (Michie *et al.* 2011b). As well as this, interventions are often said to be guided by theory but in practice they are only minimally guided or not at all (Michie *et al.* 2011b). Many frameworks exist which give guidance on behaviour change interventions, however an analysis by Michie *et al.* (2011b) suggests that none are conceptually coherent or comprehensive enough. In order to design successful evidence-based interventions a systematic method which allows for an understanding of the behaviour and the appropriate methods and components needed for change is essential (Michie *et al.* 2011b).

2.4.2.1 The Behaviour Change Wheel

The Behaviour Change Wheel (BCW) by Michie *et al.* (2011b) is a framework that provides clear, systematic guidance for the design of behaviour change interventions. It is a synthesis of 19 frameworks for behaviour change, equipping researchers with a comprehensive guide for intervention design (Michie *et al.* 2011b). At the core of the BCW is a model of behaviour known as COM-B, which stands for capability,

opportunity, motivation and behaviour (Michie *et al.* 2011b). This model of behaviour was developed by Michie *et al.* (2011) and draws on two key sources identifying necessary factors for behaviour change. These include a consensus meeting of behavioural scientists and the principle of criminal law in the United States (Michie *et al.* 2011b). Behavioural scientists recognised three factors for performance of a behaviour which included the skills to perform the behaviour, a strong intention to perform the behaviour and no environmental constraints making the behaviour impossible (Fishbein *et al.* 2001). The latter source was the principle of criminal law in the United States, which states in order to find an individual guilty of a crime it must be proved that they had the means or capability, opportunity and a motive (Michie *et al.* 2011b). Drawing from conclusions about the necessary conditions for behaviour change from both of these sources led to the development of the COM-B system (Michie *et al.* 2011b). This model recognises that behaviours are complex and are part of interacting system involving these three components (Michie *et al.* 2011b). The COM-B model of behaviour suggest that in order to successfully change an individual's behaviour, the outcome behaviour (e.g. increased PA) must be understood in context, with consideration given to the individuals' capabilities, opportunities and motivations to achieve this behaviour (Michie *et al.* 2011b). For this reason, at the hub of the BCW framework is the COM-B system, which suggests that an individual's capabilities, opportunities and motivations are related to their behaviour (Figure 2.2). Using the COM-B system provides insight into the areas participants perceive as being most important for behaviour change, and the BCW then guides the selection of the most appropriate intervention functions and behaviour change techniques (BCT) necessary to serve the areas of the COM-B which have been identified (Michie *et al.* 2011b).

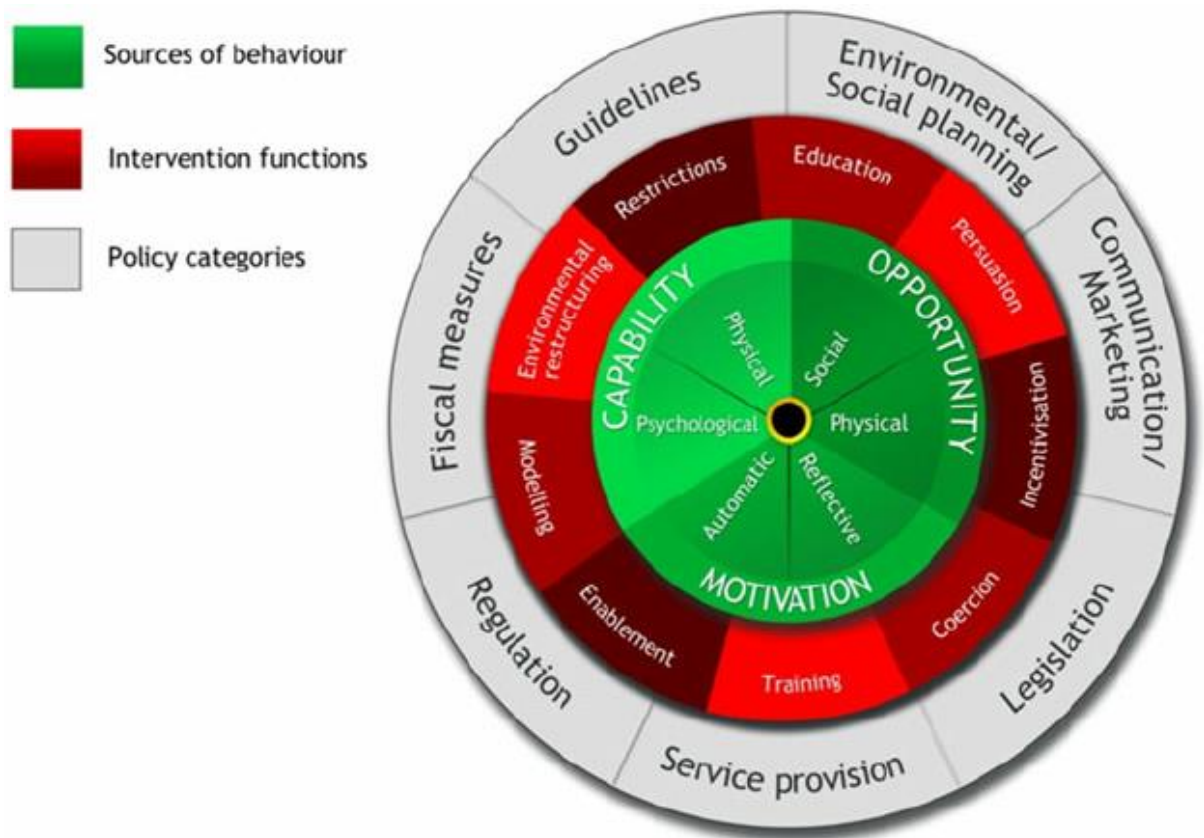


Figure 2.2 The Behaviour Change Wheel (Michie *et al.* 2011b)

The BCW is made up of three distinct stages, resulting in 8 steps for intervention design (Figure 2.3) (Michie *et al.* 2014). Stage one includes steps one to four, and these involve understanding the behaviour, including defining the problem in behavioural terms (e.g. physical inactivity), selecting the target behaviour (e.g. increasing PA), specify the target behaviour and identifying what needs to change (behavioural diagnosis) (Michie *et al.* 2014). Several methods can be used to conduct the behavioural diagnosis and identify the areas of capability, opportunity and motivation that relate to an individual’s behaviour. Some possible methods include using a 23-item self-evaluation questionnaire, focus group discussions or conducting a thorough literature review (Michie *et al.* 2014). Stage two involves identifying intervention options by selecting intervention functions and policy categories. Finally, stage three involves identifying content and implementation options by selecting BCTs and the mode of delivery (Michie *et al.* 2014). As well as these 8 steps, a specific criterion for determining which intervention functions, policy categories, BCTs and modes of delivery are most

appropriate for the context is described by Michie and colleagues. This is known as the APEASE criteria and it considers Affordability, Practicality, Effectiveness and cost-effectiveness, Acceptability, Side-effects/Safety and Equity (Michie *et al.* 2014). Using the APEASE criteria allows researchers to choose intervention functions and BCTs which are specific to their context. For example, within studies described in this thesis feedback on PA behaviour was identified as an important BCT, and pedometers were chosen as a method to provide feedback to participants as they were the most affordable and practical option in the given context.

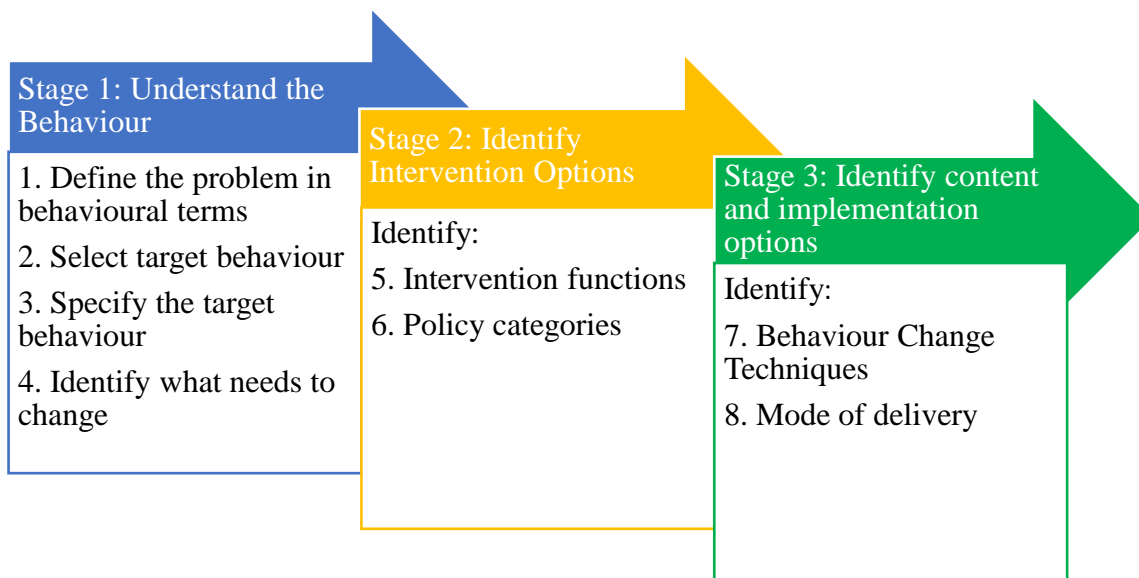


Figure 2.3 The 8 steps for intervention design (Michie *et al.* 2014)

Many studies have used the BCW to guide intervention design. One example is a case study by Webb *et al.* (2016) on developing an intervention to improve the frequency of advice on PA given by nurses to cancer patients (Webb *et al.* 2016). While the researchers in this study found using the BCW to be a time consuming process, they did note that an advantage of using this framework during development stages is that it can improve the replicability and evaluation of the intervention (Webb *et al.* 2016). A feasibility study assessing the acceptability of the intervention that was designed as a result of using the BCW is currently ongoing (Webb *et al.* 2016).

Another intervention which was guided by the BCW is the “Active Classrooms” intervention by Martin and Murtagh (2015) which aimed to integrate PA and educational content in a primary school setting, evaluating the effects this had on

children's PA (Martin and Murtagh 2015). The results of "Active Classrooms" showed an increase in time spent in MVPA, and these results were sustained at four months post-intervention (Martin and Murtagh 2017).

The use of this theory in the design of interventions provides clear guidance to future researchers, which may allow similar interventions to be widely disseminated. Using the BCW and conducting a thorough behavioural diagnosis can also result in the development of meaningful and effective interventions, which are tailored to the direct needs of participants. The use of the BCW will also allow for clear, detailed reporting, as the model is clearly and systematically laid out in 8 steps (Michie *et al.* 2011b).

2.4.3 Feasibility Studies

Another essential consideration in intervention development is the importance of conducting a feasibility study in the preliminary planning stages of a proposed full size intervention (Abbott 2014), and this is also highlighted in the MRC guidance (Craig *et al.* 2008). Feasibility studies allow researchers to determine whether an intervention is appropriate for further testing (Bowen *et al.* 2009). Orsmond and Cohn (2015) have identified five main objectives for feasibility studies that focus on behavioural or social interventions. These five objectives seek to assess recruitment capability and sample characteristics, data collection procedures and outcome measures, study procedures and acceptability of the intervention, resources needed to manage and implement the interventions and the preliminary evaluation of the participant responses to the intervention (Orsmond and Cohn 2015). Conducting a feasibility study before a larger scale trial can highlight any areas where potential threats to internal or external validity exist, allowing for these issues to be addressed before a full-scale trial (Hubbard *et al.* 2016).

2.4.4 A note on Intervention Development

Section 2.4 of this literature review has highlighted some important considerations when designing and implementing multi-component interventions. Guidelines for best practice have been identified through the MRC guidance (Craig *et al.* 2008), advocating for significant formative work and feasibility testing in the infancy stages of interventions. As well as this, the importance of relevant theory has been highlighted, identifying potential flaws in some of the more commonly used theories and providing rationale for the use of a comprehensive behaviour change framework, such as the

BCW. Finally, the importance of including youth voice in the development stages of intervention design was highlighted. To add to this point, using qualitative data collection methods both pre-and post-intervention can add to the currently available evidence base, providing important context to the quantitative data collected.

2.5 Conclusion

Part A of this literature review has provided an overview of the currently available evidence relating to adolescent girls' PA, looking specifically at school and community-based interventions. Based on the results of this review it is evident that while behaviour change with this population is possible, it is challenging, with current interventions demonstrating little to no effects on PA. Novel approaches, including those in different settings (i.e. outside of school, other countries outside of the U.S) are needed to strengthen the evidence base currently available. Consideration must also be given to the importance of the family environment and how involvement of mothers in interventions may impact adolescent girls' PA.

This section of the literature review has critically examined some of the available evidence relating to PA interventions for adolescent girls. In order to design effective interventions, it is imperative that the opinions and perspectives of adolescent girls in relation to PA participation are understood. Part B of this literature review will examine these perceptions through a qualitative synthesis of the available literature.

Part B: Adolescent Girls' Perceptions of Physical Activity: A Systematic Review of Qualitative Studies

Preamble

The following article reports a systematic literature review of qualitative studies focusing on adolescent girls' perceptions of physical activity. Evidence from qualitative studies is synthesised and themes are presented. This is an accepted manuscript of an article which has been peer reviewed and published in the *American Journal of Health Promotion* online [December 18, 2018], impact factor 2017; 2.197 (Journal Citation Reports®, 2018 release). The following is the citation for this article:

Corr, M., McSharry, J. and Murtagh, E. (2018) 'Adolescent Girls' Perceptions of Physical Activity: A Systematic Review of Qualitative Studies', *American Journal of Health Promotion*, <https://doi.org/10.1177%2F0890117118818747>

Statement of authorship;

I hereby declare that I, Méabh Corr, am the principal author of this article. The following statements outline my contributions to the work:

- Substantial contributions to the conception and design of the work; the acquisition, analysis and interpretation of data for the work; AND
- Drafting of work and revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

(See Appendix A for signed Statement of Authorship)

2.6 Purpose of Chapter

2.6.1 Rationale

As youth voice is an element that is often omitted during the intervention development stages, the aim of this chapter was to synthesise qualitative studies focusing on adolescent girls' perceptions of PA. Several studies have investigated adolescent girls' perceptions of PA, yet to date a synthesis of the available evidence was lacking. Conducting this review allowed for the development of overarching themes, providing a deeper understanding of how girls perceive PA, views which must be considered when attempting to change their PA behaviours.

2.6.2 Contribution to field

This review adds an important contribution to the field as it is, to the author's knowledge, the first review to synthesise qualitative studies relating to girls' perceptions of PA. Along with the four main themes identified, an important finding is the apparent inability of adolescent girls to distinguish between PA, PE and competitive sport. This has important implications for researchers and those working with adolescent girls, highlighting the importance of educating girls on the wide variety of PA opportunities outside of PE and competitive sports.

2.7 Abstract

Objective: To synthesise evidence from qualitative studies relating to adolescent girls' perceptions of physical activity participation. The protocol for this review is registered with PROSPERO (ID no. CRD42017054944)

Data Source: PubMed, Sports Discus, Academic Search Complete and Education Resources Information Centre (ERIC).

Inclusion and Exclusion Criteria: Studies reporting qualitative data that explored the views/opinions/perceptions of adolescent girls (>12 and <18 years old) published between 2001-2016 were included. Studies not in English, those focusing on school physical education or specific sports and those including special populations were excluded.

Extraction: Study characteristics and results were extracted to a form developed by the authors and managed using NVivo 10 (QSR International's NVivo 10 software). Data was extracted by one reviewer and a sample (25%) was checked by a second reviewer.

Synthesis: Data was synthesised using a thematic network and managed using NVivo 10. The validity of the included studies was assessed using the "Critical Appraisal Skills Programme" checklist. The ENTREQ and PRISMA statement was followed when reporting this qualitative synthesis.

Results: Of the 1,818 studies identified in the search strategy, 24 met the inclusion criteria and were included in the analysis. Global themes were identified using a thematic network. These themes were "Gender bias in sport"; "Motivation and perceived competence"; "Competing priorities during adolescence", and "Meeting societal expectations".

Conclusions: The results of this review provide insights into adolescent girls' views on physical activity. Future research is needed to investigate the potential impact of alternative activity programmes on adolescent girls with appropriate follow-up. Researchers and individuals working with young girls must consider the role of perceived motor competence in participation and how this can impact their perceptions.

Keywords: qualitative synthesis, adolescent, physical activity, exercise, female

2.8 Introduction

Participation in regular physical activity (PA) is associated with numerous physical benefits including reduced blood pressure, lower cholesterol, and reduced risk of coronary heart disease (Penedo and Dahn 2005, Dumith *et al.* 2011, Hills *et al.* 2015). PA can also positively impact psychological wellbeing, reducing stress and anxiety (Dumith *et al.* 2011, Hills *et al.* 2015). Despite the strong evidence for PA engagement, physical inactivity has been identified as the fourth leading risk factor of global mortality (World Health Organisation 2010).

Numerous benefits are associated with PA in school-aged children and adolescents (Janssen and LeBlanc 2010). However, adolescents do not accumulate sufficient PA, failing to reach the recommended 60 minutes of moderate to vigorous PA (MVPA) a day (Hallal *et al.* 2012). Girls are frequently reported as being inactive (Currie 2012, Hallal *et al.* 2012), with 95% of adolescent girls across 100 countries considered insufficiently active (Hallal *et al.* 2012). The influences on PA participation during adolescence are multifactorial (Barr-Anderson *et al.* 2008) and girls cite many barriers to their participation (Edwardson *et al.* 2015), including feeling incompetent and disliking structured sport (Rees *et al.* 2006, Woods *et al.* 2010). Adolescent girls have demonstrated lower life satisfaction than their male counterparts (Cavallo *et al.* 2015), and this evaluation of quality of life is an important indicator of well-being (Cavallo *et al.* 2015). Similar to PA levels, life satisfaction decreases with age for this population (Cavallo *et al.* 2015). The benefits gained from regular PA engagement are paramount during adolescence for growth and development (Hills *et al.* 2015), with health behaviours adopted during adolescence tracking into adulthood (Murillo Pardo *et al.* 2013). As adolescent behaviours are predictive of adult behaviours, promoting a healthy lifestyle at this stage is crucial to shape PA behaviours for life (Pearson *et al.* 2015).

Several interventions have targeted the PA behaviours of adolescents yet have only demonstrated modest effects (Pearson *et al.* 2015). In the U.S in particular, there have been some interventions targeting girls in both middle school (Trial of Activity in Adolescent Girls) (Webber *et al.* 2008) and high school (Lifestyle Education for Activity Project) (Pate *et al.* 2005). Interventions such as these, which were based on extensive formative research did demonstrate increased PA in adolescent girls, however, the effects were modest. Interventions have been documented as being unsuccessful to

date due to an inability to meet the interests of the participants, resulting in a contrast between the activities provided versus the participants' interests (James *et al.* 2018). Without the involvement of youth voice, interventions fail to accurately represent the needs of adolescents (Jacquez *et al.* 2012), therefore gaining an understanding of participant perceptions is integral for improving intervention design (Corder *et al.* 2013). Several qualitative studies have been conducted, providing insights into adolescent girls' perceptions of PA, identifying various barriers and facilitators to PA (Dwyer *et al.* 2006, Loman 2008, Bélanger *et al.* 2011, Gavin *et al.* 2016), however no previous review has synthesised qualitative studies to allow for the development of over-arching perceptions that go beyond individual study findings (Pope 1995).

2.9 Objective

To synthesise evidence from qualitative studies relating to adolescent girls' perceptions of physical activity participation.

2.10 Methods

The present paper is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and the Enhancing Transparency in Reporting the synthesis of Qualitative research (ENTREQ) statements (Appendices B&C) (Moher *et al.* 2009, Tong *et al.* 2012). The protocol for this review has been registered with PROSPERO (https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=54944).

2.10.1 Data sources

A pre-planned electronic search was carried out on 4 electronic databases; PubMed, Sports Discus, Education Resources Information Centre (ERIC) and Academic Search Complete. A record of the search strategy, which was developed in consultation with a librarian, is available in Appendix D. Forward and backward citation searches of results from the online searches were also conducted.

2.10.2 Inclusion and exclusion criteria

Studies published between 2001-2016 reporting qualitative data exploring the views and perceptions of adolescent girls >12 years and <18 years old with regards to PA were included. Studies including both males and females were included if the data on females was presented separately to males.

Studies with a sport or physical education (PE) focus were excluded as the aim of this review was to synthesis girls' perceptions of PA, not a specific sport or subject. Studies focusing on special populations were also excluded (e.g. individuals with cerebral palsy etc.). Studies not in English were excluded as translation resources were not available. Finally, studies where the qualitative data was part of an existing intervention or programme were excluded because the results pertained to adolescents' views of the intervention, rather than PA in general.

2.10.3 Screening and data extraction

Results from the searches were imported into EndNote reference management software and duplicates were removed. Remaining studies were imported into Covidence (2016) (Covidence Computer Software 2016), a web-based software to streamline systematic review production, and initially screened by title and abstract by two reviewers. Conflicts were resolved through discussion. Full text of studies were reviewed by two reviewers and again conflicts were resolved through discussion.

Study characteristics including setting, participants, data collection and analysis were extracted to a form developed by the authors. Text under the results sections were extracted and imported into NVivo 10, a qualitative data management software. Data was extracted by one reviewer and a sample (25%) was checked by a second reviewer.

2.10.4 Synthesis methodology and appraisal

A thematic synthesis following the guidelines of Thomas and Harden (2008) was conducted. Thematic networks were used to draw on core features that were common to several studies (Attride-Stirling 2001). Using a thematic network, basic, organising, and global themes were created. Initial coding took place inductively on a sub-set of papers, coding line by line. A sample of studies (10%) were coded by a second reviewer to ensure all themes were considered. Once all initial coding was completed, basic themes were created and were combined to form organising themes and subsequently grouped into global themes (Attride-Stirling 2001).

The quality and validity of included studies was assessed using the "Critical Appraisal Skills Programme" (CASP) (2018) toolkit (CASP Qualitative Checklist 2018), allowing the researchers to assess the appropriateness of the methodology, participants, study design, and data analysis. The toolkit comprises of 10 questions and two authors

appraised each study independently. The results of these appraisals were compared, and conflicts were resolved through discussion.

2.11 Results

1,818 studies were identified through database searches, 24 met the inclusion criteria and were included in the analysis (see figure 2.4). 29% (n=7) were conducted in Canada, 21% (n=5) in Australia, 16% (n=4) in the United Kingdom, 16% (n=4) in the United States and the remaining studies were set in Asia, South America, South Africa, and Ireland. The school setting was used by most of studies (n=20) and 5 studies included data from males and females. Content and thematic analysis was the most common analysis tool used within included studies. Activity levels of participants varied across studies, with 41% (n=10) involving a mixture of active and inactive participants (Mabry *et al.* 2003, Whitehead and Biddle 2008, Casey *et al.* 2009, Bélanger *et al.* 2011, Yungblut *et al.* 2012a, Yungblut *et al.* 2012b, Araki *et al.* 2013, Smith *et al.* 2015, Watson *et al.* 2015, Casey *et al.* 2016), 12% (n=3) involved active participants (Eime *et al.* 2010, Gillison *et al.* 2012, Gavin *et al.* 2016), and 4% (n=1) contained mostly inactive participants (Sleap and Wormald 2001). In 10 studies (41%) participants' activity levels were not explicitly stated (Dwyer *et al.* 2006, Humbert *et al.* 2008, Loman 2008, Monge-Rojas *et al.* 2009, Craike *et al.* 2011, Walia and Leipert 2012, Dagkas and Hunter 2015, Morrison *et al.* 2015, Phillips and Awotidebe 2015, McEvoy *et al.* 2016). The characteristics of included studies can be seen in Table 2.1.

In general, the included studies met the CASP criteria in terms of clarity of aims, appropriate design and rigorous data analysis (Appendix E). The majority (n=19) provided insufficient detail regarding a consideration of the researcher/participant relationship and details of ethical approval and informed consent.

Initial coding resulted in the development of 73 basic codes (Attride-Stirling 2001). Basic codes were then grouped into organising themes (n=18). Analysis of organising themes resulted in the development of 4 global themes (Appendix F); “Gender bias in sport”, “Motivation and perceived competence”, “Competing priorities during adolescence” and “Meeting societal expectations”. These themes and their subthemes are discussed below. Quotations from participants in included studies are presented in “*italics*”.

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
Araki <i>et al.</i> 2012	Experiences in Sport, Physical Activity, and Physical Education Among Christian, Buddhist and Hindu Asian Adolescent Girls	Gain knowledge and understanding about sociocultural factors that may explain adolescent girls' perceptions and behaviours toward sport, physical activity and physical education	Transcendental phenomenology (method which focuses on the description of the experiences of the participants)	Japan and Singapore	Interviews conducted where participants felt comfortable e.g. Home, church	N = 14 (Buddhist Japanese from Japan: N = 4) (Christian Chinese from Singapore: N= 5) (Hindu Indians from Singapore: N= 4) Mean age = 14.2 years	Demographic questionnaire (age, race/ethnicity/religion/ country of birth/ living situation/ current participation in sport and PA) 2 Focus groups (45 – 90 mins)	Horizontalization used to 1) highlight significant statements 2) understand how they experience the phenomenon 3) create clusters of meaning
Bélanger <i>et al.</i> 2011	Maintenance and decline of physical activity during adolescence: insights from a qualitative study	To use qualitative research methods to explore how adolescents who maintained high levels of physical activity differ from those who went from being very physically active to now taking part in little physical activity in relation to their PA related attitudes, subjective norms and	Theory of Planned Behaviour used as a framework	Canada	Secondary school	N = 165 (58 boys) (107 girls)	Physical Activity Questionnaire for Adolescents (PAQ-A) and focus group discussions Two focus groups were held with each of maintainer-boys, maintainer-girls,	Thematic Analysis

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
		perceived behavioural control					and decliner-girls, whereas only one group was held with decliner-boys	
Casey <i>et al.</i> 2016	“Power, regulation and physically active identities”: the experiences of rural and regional living adolescent girls	To explore the discourses and power relations operative between groups of girls that appeared to influence their participation in Physical Education (PE) and outside of school in sport and physical activity (PA) in rural and regional communities/ the nuanced effect of ‘what’ and ‘how’ messages about the body (and being physically active) are normalised and regulated amongst rural and regional living adolescent girls in the context of peer relations as enacted in school-based PE and sport.	Interpretations of Foucault’s techniques of power	Australia	Secondary school	N= 138 Age range: 14-16	Qualitative interviews (n = 48) and focus group discussions (n = 25)	Poststructuralist perspective that drew on Gore’s (1998) work of power relations in pedagogical practices, informed by Foucault’s theorising of power (1977, 1980), was used to analyse the girl’s narratives.

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
Casey <i>et al.</i> 2009	Using a Socioecological Approach to Examine Participation in Sport and Physical Activity among Rural Adolescent Girls	To use the socioecological model of health to identify a range of independent and interacting factors – individual, intrapersonal, organisational and environmental that influence participation in sports and/or physical activity	Socioecological model of health	Australia	Secondary school	Age range 12-13 N = 34	60 min focus groups with 5 – 7 participants in each and short form detailing participant demographics (age, country of birth etc.)	Thematic analysis
Craike <i>et al.</i> 2012	A comparative study of factors influencing participation in sport and physical activity for metropolitan and rural female adolescents	To provide a comparative analysis of the influence of behavioural alternatives, autonomy, competence and relatedness on participation in sport and physical activity for female adolescents within metropolitan and rural settings.	The Sport Commitment Model and the Self-Determination Theory	Australia	Secondary school	N = 123 Age 12- 13 and age 15-16	18 focus groups and Questionnaire about participant demographic	Content and thematic analysis

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
Dagkas and Hunter, 2015	“Racialised” pedagogic practices influencing young Muslims’ physical culture	To examine the “racialized” pedagogic practices in various fields that influence young Muslims’ dispositions to physical culture	Based on Bourdieu’s Social Theory Follows a case study approach	England	Secondary school	N = 40 (20 boys and 20 girls) Age 12 – 15	Semi-structured interviews	Thematic analysis
Dwyer <i>et al.</i> 2006	Adolescent Girls’ Perceived Barriers to Participation in Physical Activity	To explore perceived barriers to participation in moderate to vigorous physical activity among adolescent girls who live in a large diverse city	N/A	Canada	Secondary school	N = 73 15 – 16 years	7 Focus group interviews 90 minutes long with 8 – 12 participants in each	Constant comparison approach to inductively create themes
Eime <i>et al.</i> 2010	Transition in participation in sport and unstructured physical activity for rural living adolescent girls	To examine the views of active rural living girls regarding the factors affecting their sport and PA participation	Socioecological model	Australia	Secondary school	N = 27 Ages 16 – 17	Semi – structured focus group discussions	Content and thematic analysis
Gavin <i>et al.</i> 2016	Adolescents’	To explore adolescents’ perceptions of	Bandura’s concept of	Canada	Secondary school	N = 16 (8 male 8 female)	Semi-structured interviews	Thematic Analysis

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
	Perception of the Psychosocial Factors affecting Sustained Engagement in Sports and Physical Activity	psychosocial influences, personal characteristics, environmental factors and behavioural undertakings influencing their prolonged involvement in sports and PA	reciprocal determinism and the Health Action Process Approach (HAPA)			Mean age 15,9		
Gillison <i>et al.</i> 2012	What motivates girls to take up exercise during adolescence? Learning from those who succeed	To explore factors that underpin increased internalization (i.e. perceived autonomy) in motivation towards exercise over a one-year period in adolescent girls	Self-Determination Theory	England	Secondary school	N = 107 Mean age 13.28	PAQ-A to assess changes in exercise Behavioural Regulation for Exercise Questionnaire (BREQ-2) to measure motivation for exercise Goal Content for Exercise Questionnaire (GCEQ) to assess intrinsic	Thematic Analysis

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
							and extrinsic exercise goals	
							Semi – structured interviews	
Humber t <i>et al.</i> 2008	Using a Naturalistic Ecological Approach to Examine the Factors Influencing Youth Physical Activity Across Grades 7 - 12	Using a qualitative ecological framework to examine the intrapersonal, social and environmental factors influencing youth physical activity	Ecological Model	Canada	Secondary school	N = 160 Age 12- 18	Focus group interviews	Content analysis Categories clustered to identify themes
Loman, 2008	Physical Activity in Teen Girls: Insights from focus groups	To describe adolescent girls’ views about physical activity and explore strategies that nurses can use to promote PA	Social Cognitive Theory	USA	Schools and neighbourhood health centres	N = 28 Age 12 – 18	Focus Group interviews 1 – 1.5 hours	Content Analysis
Mabry <i>et al.</i> 2003	Physical Activity Attitudes of African	To identify and compare attitudes of African American adolescent girls toward physical activity	N/A	USA	Secondary school	N = 49 age 14 – 18	6 focus groups with adolescent girls lasting 90 minutes	Thematic analysis

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
	American and White Adolescent Girls	with the attitudes of white adolescent girls					Average 8 participants per group	
McEvoy <i>et al.</i> 2016	Physical Activity experiences of young people in an area of disadvantage: “There’s nothing there for big kids, like us”	To explore the forces which enable and constrain the participation of youths in physical activity and the interplay between such forces and how they experience and exercise agency	Social-constructivist paradigm	Ireland	Areas of disadvantage	N = 40 (21 males, 19 females) Age range 15 – 19	Focus group interviews 22 attended both interviews 11 attended only the initial and 7 only attended the follow up	Thematic Analysis
Monge-Rojas <i>et al.</i> 2009	Barriers to and Suggestions for a Healthful, Active Lifestyle as Perceived by Rural and Urban Costan Rican	To assess the perceptions of rural and urban Costan Rican adolescents regarding which barriers and motivators affect their adoption of an active lifestyle	N/A	Costa Rica	Secondary school	N = 108 male and female (53 male, 55 female) 12 – 18 years	Focus Group discussions	Content analysis

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
	Adolescent s							
Morriso n <i>et al.</i> 2015	Perceptions of Physical Activity and Influences of Participatio n in Young African- American Adolescent Girls	To explore African- American adolescent girls’ perceptions of physical activity participation, examine how PA is defined and identify the most preferred forms of PA	N/A	USA	Convenienc e sample used	N = 30 Mean age 14.3	Focus Group interviews 3 focus groups with 8 – 12 participants in each	Thematic Analysis
Phillips and Awotide be 2015	The influence of the social environmen t on youth physical activity	To explore the social environmental factors that influence the PA participation among female school-going adolescents in the Western Cape	N/A	South Africa	Secondary school	N = 55 Age between 15 and 18 (mean age 15.8)	Focus Group discussions	The Model of Tesch guided data analysis
Sleap and Wormal d 2001	Perceptions of Physical Activity Among Young Women aged 16	To learn about the relationships between young women, health and participation in physical activity	Critical Feminist model (this model suggests if there is a social expectation for young women to be sedentary this will act as a	UK	Part of “well woman” sessions – normally conducted by school nurses	N = 52 16 -17 years	Focus Group Discussions 8 focus groups, 30 – 45 minutes	Interpretative approach – content analysis technique

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
	and 17 years		powerful barrier to engagement in PA)					
Smith <i>et al.</i> 2015	Youth perceptions of how neighbourhood physical environment and peers affect physical activity: A focus group study	To assess youths' perceptions of their neighbourhood physical and peer environments as affecting physical activity	Youth-centred approach	USA	Secondary school	N = 33 (20 female, 13 male) 12- 14	Focus group discussions	Inductive content analysis
Walia <i>et al.</i> 2012	Perceived Facilitators and Barriers to Physical Activity for Rural Youth: An Exploratory Study using Photovoice	To identify activities in which rural youth in a secondary school participated, determine facilitators and barriers to physical activity for these rural youth, and examine how rural barriers and facilitators affect rural youths' physical activity	Photovoice	Canada	Secondary school	N = 9 (5 males, 4 females) Age 13 – 18	Photovoice Interviews	Photovoice methodology analysis of photographs and line-by-line content analysis of interview and logbook transcripts

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
Watson <i>et al.</i> 2015	Perceived barriers and facilitators to participation in physical activity during the school lunch break for girls aged 12 – 13 years	To understand influences on girls’ participation in PA during school lunch time to help increase PA levels for this demographic	Social Constructionist framework	Australia	Secondary school	N = 13 12 – 13 years	Focus Group Interviews 3- 4 per group	Thematic content analysis
Whitehead and Biddle, 2008	Adolescent girls’ perceptions of physical activity: A focus group study	To build a comprehensive picture of physical activity as it relates to adolescent girls	N/A	UK	Secondary school	N = 47 14 – 16 years	Exploratory focus group discussions 8 focus groups with 5-7 participants 45 min long Students studying General Certificate of Secondary	Thematic Analysis

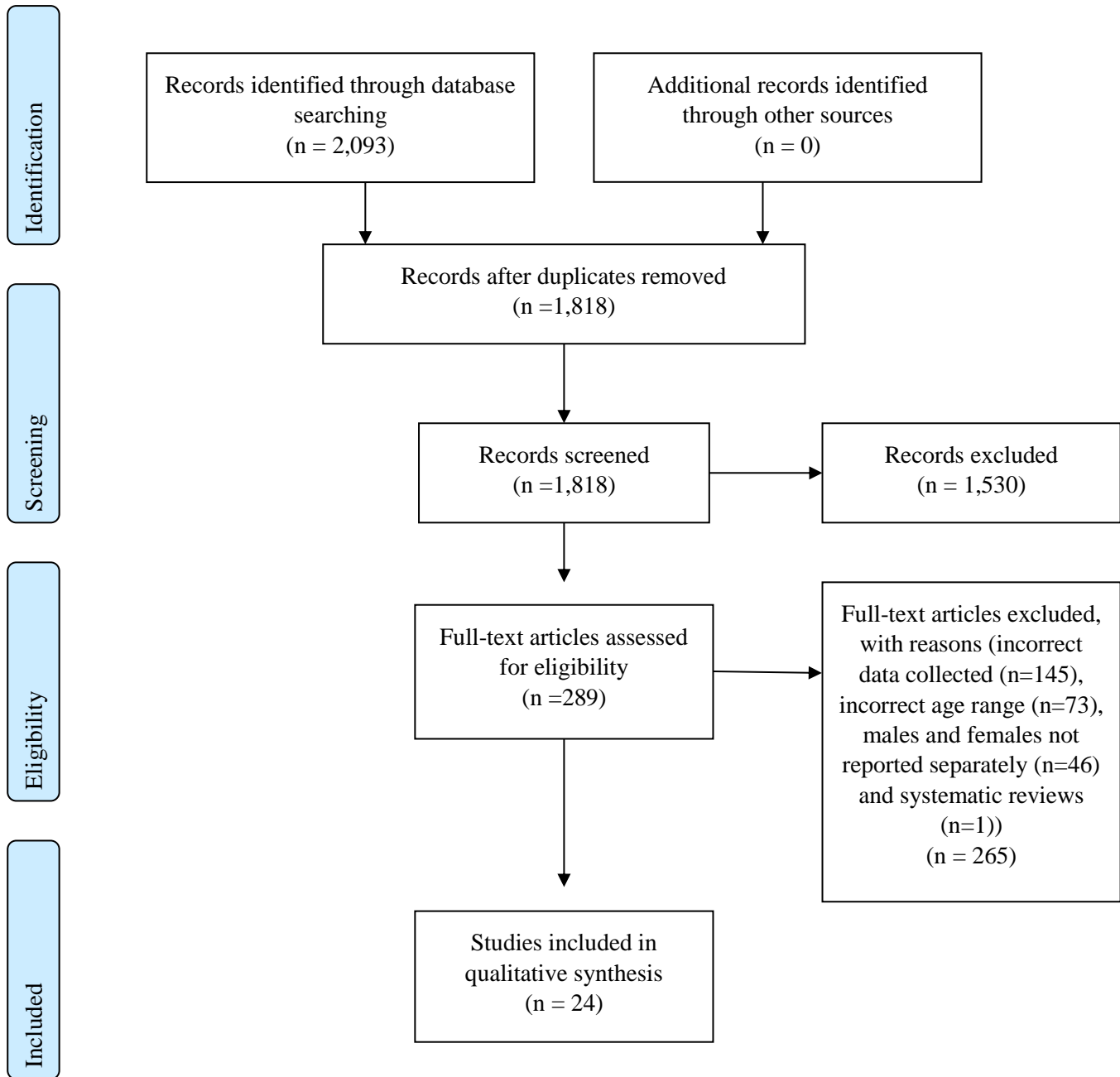
Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
							Education (GCSE) PE were interviewed separately to those not studying it as an examination subject	
Yungblut <i>et al.</i> 2012	Views of adolescent female youth on physical activity during early adolescence	To gain further understanding of the lived experiences during early adolescence, delineating their barriers to participation and the factors enabling participation	Interpretive Phenomenology	Canada	Secondary school	N = 35 12 – 14 years and 15- 18 years	Focus groups (6-8 in each) Individual interviews (45 minutes)	Thematic Synthesis
Yungblut <i>et al.</i> 2012	Understanding Physical Activity through the Experiences of Adolescent Girls	To extend previous qualitative research on adolescent female physical activity via an interpretive phenomenological approach, providing readers with a better understanding of how	Interpretive Phenomenological	Canada	Secondary school	N = 35 12 – 14 and 15 - 18	Open-ended, semi- structured interviews	Flexible Analysis

Table 2.1 Characteristics of Included Studies

Ref	Title	Research Question	Perspective/ Theoretical Base	Country	Setting	Participants	Data Collection	Analysis
		girls conceptualize PA during early adolescence						

Figure 2.4. PRISMA 2009 Flow Diagram



2.11.1 “Gender bias in sport”

The first major theme encompassed pressures from society to uphold a feminine image and internal barriers felt regarding participation in PA. Across studies, authors reported struggles faced by girls attempting to be active in a society which they perceived to portray PA as something masculine.

2.11.1.1 *Body image/body-centred issues*

Internal barriers, including body image and menstruation were discussed in 15 studies (Sleap and Wormald 2001, Mabry *et al.* 2003, Dwyer *et al.* 2006, Loman 2008, Whitehead and Biddle 2008, Casey *et al.* 2009, Monge-Rojas *et al.* 2009, Eime *et al.* 2010, Gillison *et al.* 2012, Yungblut *et al.* 2012a, Yungblut *et al.* 2012b, Araki *et al.* 2013, Morrison *et al.* 2015, Watson *et al.* 2015, Casey *et al.* 2016). Across these studies, girls with low perceived competence and high weight status discussed how this acted as a barrier for their participation. Many overweight girls lacked motor skills and held a negative attitude towards PA, finding the prospect of being active daunting, especially in the presence of males. A fear of embarrassment hindered participation, with several girls across studies noting it’s not possible to “look good” (Loman 2008) and be active at the same time as; “*what stops a lot of girls from doing sports is that they're worried about how they look, their make-up, and everything*” (Dwyer *et al.* 2006).

Biological changes experienced during puberty also deterred participation. In several studies girls discussed feeling “gross” (Yungblut *et al.* 2012a) and experiencing discomfort while menstruating, leading to increased self-consciousness and reduced PA. Some girls reported using menstruation as an excuse to opt of PE; “*Sometimes I lie and say I have my [menstrual] period and that I don't feel well, so the teacher lets me skip [the] class*” (Monge-Rojas *et al.* 2009).

2.11.1.2 *Societal pressure*

Societal pressure, including bullying and stereotypes of femininity were discussed in 18 of the studies (Sleap and Wormald 2001, Mabry *et al.* 2003, Dwyer *et al.* 2006, Humbert *et al.* 2008, Loman 2008, Whitehead and Biddle 2008, Casey *et al.* 2009, Monge-Rojas *et al.* 2009, Eime *et al.* 2010, Bélanger *et al.* 2011, Craike *et al.* 2011, Gillison *et al.* 2012, Walia and Leipert 2012, Yungblut *et al.* 2012b, Araki *et al.* 2013, Smith *et al.* 2015, Watson *et al.* 2015, Casey *et al.* 2016). Girls experienced teasing from peers due to low competence levels, and pressures to perform deterred their desire

to participate; *“If you are in a team with all the good people, you have to make sure that you do everything right, there’s always pressure”* (Casey et al. 2009).

Another common assumption across the studies was that PA was not suitable for girls. A fear of being viewed negatively for engaging in activities that were not considered gender appropriate deterred their participation. Girls were aware of the gendered nature of PA, discussing how they would be viewed as “masculine” if they did not conform to societal norms. Girls were reluctant to participate in what they considered to be “boys sports”; *“if some girls wanna play football or soccer (mm) and then some like other girls that don’t want to play it, [they] just look at them weirdly and say ‘you’re a boy, you’re playing a boy’s game”* (Watson et al. 2015). Being physically active contradicted the image of femininity portrayed to girls by society.

2.11.1.3 Peer and teacher feedback

The influence of both teacher and peer feedback was discussed in 21 of the included studies (Sleap and Wormald 2001, Mabry et al. 2003, Dwyer et al. 2006, Humbert et al. 2008, Loman 2008, Casey et al. 2009, Monge-Rojas et al. 2009, Eime et al. 2010, Bélanger et al. 2011, Craike et al. 2011, Gillison et al. 2012, Walia and Leipert 2012, Yungblut et al. 2012a, Yungblut et al. 2012b, Araki et al. 2013, Dagkas and Hunter 2015, Morrison et al. 2015, Phillips and Awotidebe 2015, Watson et al. 2015, Casey et al. 2016, McEvoy et al. 2016). The opinions of boys had a particularly strong influence on girls’ PA perceptions; *“Some of the girls ... when they’re trying to be, trying to join in and trying to be good sports (mm) and people [boys] are teasing them about it, so it can affect them so they just don’t”* (Watson et al. 2015). The influence of the PE teacher also impacted girls’ perceptions of PA, with several girls noting that male PE teachers were unsupportive, too competitive, and more interested in the boys in the class; *“Male [teachers] just make you think that you just don’t want to do it”* (Casey et al. 2009). There was an assumption that some PE teachers assumed that girls did not want to participate and did not encourage their participation. In fact, several girls across the studies found that PE teachers often discouraged their participation in PA, claiming the boys would be “too rough” on them, emphasising the gendered roles evident in PA and team sports.

However, active girls received positive feedback from both peers and teachers. Their high skill levels and perceived competence led to encouragement from teachers; *“One*

of the teachers said I was really good at netball at school and that's when I tried to get into netball" (Casey *et al.* 2009). Due to their higher skill levels, being able to participate with peers was fun, unlike the inactive girls who found trying to participate with skilled peers stressful. These active adolescents also discussed the benefits of PA to make new friends. Making new friends and being able to actively participate made PA fun, which helped sustain their motivation for engagement; *"Having friends there makes it a lot easier; it makes it more comfortable to do sports, and because you get to spend more time with friends, you look forward to the activities"* (Yungblut *et al.* 2012b).

2.11.2 "Motivation and perceived competence"

The second theme describes the contrast in motivation felt by active and inactive girls. Across studies, girls with low perceived competence discussed how their lack of motivation stemmed from low levels of perceived skill, a dislike of team sports and negative feedback from peers and teachers.

2.11.2.1 Low perceived skill

Ability levels and competition were discussed in 14 studies (Mabry *et al.* 2003, Dwyer *et al.* 2006, Humbert *et al.* 2008, Whitehead and Biddle 2008, Casey *et al.* 2009, Eime *et al.* 2010, Bélanger *et al.* 2011, Craike *et al.* 2011, Gillison *et al.* 2012, Walia and Leipert 2012, Yungblut *et al.* 2012a, Morrison *et al.* 2015, Watson *et al.* 2015, Casey *et al.* 2016). Within these studies, inactive girls discussed how their low motivation derived from their perceived low competence. Comparison of skill levels among peers led to disengagement. Girls often described enjoying PA yet withdrew because their peers were perceived to be more skilled. A reluctance to learn new skills or join new teams during adolescence was also seen, with girls explaining there was no point trying as you got older; *"I eventually stopped trying to do well in gym because I didn't care - I wasn't going to be good at it anyway"* (Yungblut *et al.* 2012a).

Levels of competition increased during adolescence, and pressure to perform well in a team setting led to high levels of disengagement. Girls within the studies discussed the burden of being placed on a "good team", with poor performances leading to ridicule from peers. Girls also noted that as competition levels increased, those with lower levels of motor competence would not be chosen for a team. The embarrassment of not being picked resulted in girls no longer feeling a desire to try, with one participant saying

“don’t bother trying (to get into a sport team) you know you won’t get in if you have limited skills” (Craike *et al.* 2011).

However, girls who perceived themselves to have high competence and skill were constantly cited as enjoying PA. Unlike their inactive peers, these girls thrived in competitive settings and enjoyed working to increase their skill levels. Being involved in competition provided an exhilarating rush; *“I like the flush you get out of being competitive, being competitive in sport, I love that”* (Eime *et al.* 2010). These girls enjoyed being able to socialize and compete with their friends. These active girls were constantly motivated by the prospect of improving themselves and reaching goals. In contrast to their inactive peers, these girls liked to participate with males, stating it was more fun as boys provided higher levels of competition; *“boys, they really bring the excitement!”* (Morrison *et al.* 2015).

2.11.2.2 Physical activity opportunities

Activities offered during PE, team sports and a desire for single sex classes was discussed in 21 of the included studies (Sleap and Wormald 2001, Mabry *et al.* 2003, Dwyer *et al.* 2006, Humbert *et al.* 2008, Loman 2008, Whitehead and Biddle 2008, Casey *et al.* 2009, Monge-Rojas *et al.* 2009, Eime *et al.* 2010, Bélanger *et al.* 2011, Craike *et al.* 2011, Gillison *et al.* 2012, Walia and Leipert 2012, Yungblut *et al.* 2012b, Araki *et al.* 2013, Dagkas and Hunter 2015, Morrison *et al.* 2015, Smith *et al.* 2015, Watson *et al.* 2015, Casey *et al.* 2016, McEvoy *et al.* 2016). Within studies reporting data from less active girls, competitive sports and school PE were discouraging to their engagement; *“And we had the bleep test like nearly every month. It was AWFUL - err I hated it. The dropout rate went up because we just couldn't be bothered to do it — we hated it — that awful taste in your mouth”* (Sleap and Wormald 2001). Negative PE experiences revolved around competitive team-based sports. The lack of variety and emphasis on skill did not appeal to these girls. A desire for single-sex classes and a wider variety of content was expressed, emphasising fun and involvement rather than skill and competition; *“There should be more boys’ classes and girls’ classes because it makes you feel more comfortable and you would make more effort and all the girls would encourage each other”* (Casey *et al.* 2009).

2.11.3 “Competing priorities during adolescence”

The third theme highlights competing priorities, including increased schoolwork, part-time jobs, and responsibilities at home. PA was not perceived to be important enough to be prioritised in the lives of many adolescent girls with competing priorities discussed in 14 of the included studies (Sleap and Wormald 2001, Mabry *et al.* 2003, Dwyer *et al.* 2006, Humbert *et al.* 2008, Whitehead and Biddle 2008, Monge-Rojas *et al.* 2009, Eime *et al.* 2010, Bélanger *et al.* 2011, Craike *et al.* 2011, Walia and Leipert 2012, Araki *et al.* 2013, Dagkas and Hunter 2015, Phillips and Awotidebe 2015, McEvoy *et al.* 2016).

2.11.3.1 School work and home responsibilities

The increased importance of education and performance in exams takes precedence over being physically active during adolescence. Many girls discussed not having time to do any PA due to increased workloads in school and the pressure from parents to perform well; *“Pretty much when I’m not at school I’m doing school work at home”* (Walia and Leipert 2012).

As well as increased school work, several adolescents within the studies described increased responsibilities at home which restricted their ability to participate in PA. Doing housework, looking after younger siblings, and part-time employment were given a higher priority than PA. Taking on these responsibilities, combined with their school work-load left girls feeling they didn’t have time to be physically active; *“There are things that hold me back, like work. Work is a big issue because you can't tell them, "Oh well, that's when I go to the gym, at night." They don't care. You're scheduled and you're going to have to work”* (Dwyer *et al.* 2006).

2.11.3.2 Parental expectations

The expectations of parents and grandparents also influenced the girls’ perceptions of the importance of PA. Several girls discussed how their parents devalued PA, encouraging their daughters to study different subjects in school and to focus on achieving high grades; *“But she doesn’t want me to; she said get that out of your mind, what’s PE going to do for you in your life?”* (Dagkas and Hunter 2015). From the included studies, several girls discuss how their parents would actively discourage their PA participation in favour of studying or working part-time. This discouragement impacts the girls’ perceptions of PA, leading them to devalue and de-prioritize it with the aim of pleasing their parents.

2.11.3.3 Changes in leisure activities

Another competing priority was the change in leisure experiences during adolescence. Adolescents have increased opportunities for leisure activities as they get older. The participants in several studies said they preferred to “hang out” with friends at shopping centres, go to the cinema or spend time with boyfriends rather than be physically active; *“I like hanging out with mates just chilling, actually partying”* (Craike *et al.* 2011). Some participants discussed how being physically active was not “cool” and opted to participate in alternative leisure activities.

2.11.4 “Meeting societal expectations”

The final theme discusses the influence of external factors, such as environments and the influence of peers and adults. For the self-proclaimed active girls, these influences are positive and encourage their involvement. Conversely, for those inactive girls, the influences in their lives are largely negative, leading to a disengagement from PA.

2.11.4.1 Peer influence

The influence of peers on adolescent girls’ perceptions of PA was discussed in 17 of the included studies (Sleap and Wormald 2001, Mabry *et al.* 2003, Dwyer *et al.* 2006, Humbert *et al.* 2008, Loman 2008, Whitehead and Biddle 2008, Casey *et al.* 2009, Eime *et al.* 2010, Bélanger *et al.* 2011, Gillison *et al.* 2012, Walia and Leipert 2012, Yungblut *et al.* 2012a, Araki *et al.* 2013, Dagkas and Hunter 2015, Morrison *et al.* 2015, Casey *et al.* 2016, McEvoy *et al.* 2016). This influence was either positive or negative. For some girls, if their friends were involved in PA then it became a motivating factor for them to be active too, as well as increasing enjoyment levels and providing positive activity experiences; *“My best friend dances with me and it’s way more motivating cause then you know you won’t be alone when you need to go somewhere, and you tell yourself it’s going to be real fun”* (Bélanger *et al.* 2011). However, in some cases within the included studies, girls discussed how they failed to participate in PA due to peer influence. This occurred for two reasons; firstly, girls didn’t want to participate in PA because their friends didn’t. If they participated it meant they missed opportunities to spend time with friends, and as discussed in theme 3, these alternative activities took precedence during adolescence. The second reason was a fear of ridicule from friends; *“Some of the guys they like gang up on the girls and they just like make fun of them, like the way they look, and... they don’t want you playing with them and stuff”* (Smith *et al.*

2015). Girls spoke of a reluctance to participate in activities because it led to their friends teasing them and excluding them from conversations.

2.11.4.2 Adult influence

Like peer influences, the influence of parents and adults on adolescents' perceptions of PA had both positive and negative impacts. These influences were discussed in 17 of the included studies (Sleap and Wormald 2001, Mabry *et al.* 2003, Dwyer *et al.* 2006, Humbert *et al.* 2008, Whitehead and Biddle 2008, Casey *et al.* 2009, Monge-Rojas *et al.* 2009, Eime *et al.* 2010, Bélanger *et al.* 2011, Craike *et al.* 2011, Walia and Leipert 2012, Araki *et al.* 2013, Dagkas and Hunter 2015, Phillips and Awotidebe 2015, Watson *et al.* 2015, Casey *et al.* 2016, McEvoy *et al.* 2016). Girls with parents and teachers who supported and encouraged them to participate in PA had positive perceptions, in comparison with girls who lacked these supportive role models. These adolescents discussed how their parents never engaged in PA, or encouraged them to be active, leading to the development of negative opinions of PA. Lack of support from adults resulted in adolescents failing to see the value of PA and led them to mimic the inactive lifestyles they had observed at home; *"I was just tired of asking them (parents) for drives so I just quit"* (Bélanger *et al.* 2011).

2.11.4.3 Community influences

The community and environment in which an adolescent lived also impacted their perceptions of PA, with adolescents in rural and urban settings having varying opinions. These issues were discussed in 12 of the included studies (Sleap and Wormald 2001, Mabry *et al.* 2003, Humbert *et al.* 2008, Casey *et al.* 2009, Monge-Rojas *et al.* 2009, Eime *et al.* 2010, Bélanger *et al.* 2011, Craike *et al.* 2011, Walia and Leipert 2012, Phillips and Awotidebe 2015, Casey *et al.* 2016, McEvoy *et al.* 2016). Those in rural settings found they were limited in their choice of activities, making it difficult to participate in PA; *"In a little town it is kind of hard because there are not many teams"* (Casey *et al.* 2009). If you failed to participate in a team sport the likelihood you participated in PA was very low. In urban settings however, there was a greater variety in activities, although financial constraints often hindered involvement, with girls discussing how gym membership was too expensive. Urban settings were also considered to have higher levels of competition; *"In the city its more tougher competition to here. There's more people and that makes it harder as well"* (Eime *et al.*

2010) therefore if girls didn't perceive themselves as competent in team sports they were likely to cease participation.

2.12 Discussion

The present review is the first synthesis of qualitative studies focusing on adolescent girls' perceptions of PA. The methods employed were transparent, rigorous, and reported according to published guidelines. The presented themes illustrate the opinions of active and inactive girls in relation to their PA participation. This qualitative synthesis provides valuable insights into opinions of adolescent girls which should be considered when creating opportunities to increase their PA levels. The results also provide practical application for researchers, policy makers, and individuals working to increase PA levels of adolescent girls in school or community settings.

Across studies participants discussed the gendered nature of sport and PA. Historically, PA has been categorised into masculine and feminine domains (Koivula 2001), with the majority of team-based sports being associated with traditional masculine qualities such as strength and competitiveness (McCallister *et al.* 2003, Jun and Kyle 2012). Within the media, PA has also been traditionally portrayed as masculine, emphasising aggression and strength (Hardin and Greer 2009). The gender roles in PA portrayed in society are adopted from a young age, and during adolescence there is a desire to align with peers and define oneself as either masculine or feminine (Paechter 2007). Several girls within the included studies perceived PA and sport to be unfeminine, and their desires to appear feminine and fit in with peers deterred PA participation. Therefore, to change perceptions and increase participation rates girls must feel empowered and motivated to be active and be given the tools to re-think their stereotyped perceptions of PA (Martins *et al.* 2015). The PA opportunities provided must be on their terms (Allender *et al.* 2006) and their ideas must be included in an effort to create a positive environment and increase PA levels (Martins *et al.* 2015).

Along with the gendered nature of PA, levels of perceived competence, fear of embarrassment and the type of activities provided influenced adolescent girls' perceptions of PA across studies. Many of the self-proclaimed inactive girls reported low perceived competence, experienced humiliation in front of peers and felt activities available did not encourage their participation. Perceived competence is central to self-esteem (Barnett *et al.* 2008), with motor skill proficiency developed as a child being a

key indicator of positive competence, and in turn PA participation (Barnett *et al.* 2008, Loprinzi *et al.* 2015). Given that much of school-based activities focus on team-based competitive sports (Brooks and Magnusson 2006), girls lacking motor competence are often marginalised within PA. The traditional team-based setting where individual failure is negatively viewed, results in girls opting out of PA, avoiding activities that require proficient motor competency to experience success (Solmon *et al.* 2003, Brooks and Magnusson 2007). Less competent girls within this review found PE placed too much emphasis on performance, and activities outside of school were heavily focused on competition and ability. PE is an ideal venue to increase actual motor competence and PMC of children and adolescents (Loprinzi *et al.* 2015), with several studies reporting the positive impact PE can have on perceived competence (Beurden *et al.* 2003, Veličković 2012, Cicović *et al.* 2015). While several studies focus on developing fundamental movement skills (FMS) in primary aged students, emphasis must also be placed on those adolescents who have failed to adequately develop FMS, as there is a relationship between PMC, actual motor competence, and subsequent development of PA (Barnett *et al.* 2008). Perceived competence is particularly important for adolescents, as De Meester *et al.* (2016) found adolescents with low actual motor competence but high PMC were more active than their peers with lower perceived competence, illustrating the importance of increasing PMC of this population (De Meester *et al.* 2016). Improving PMC and providing opportunities which encourage life-long PA, emphasising enjoyment over competition should be prioritised for adolescent girls.

Another prominent theme regarding PA perceptions was the concept of having “no time” to be active. Competing priorities such as homework, part-time jobs, and spending time with peers were some of the reasons cited by girls in this review. PA was not seen as valuable, and therefore was not prioritised over other responsibilities. Schools provide an optimal site for the promotion and encouragement of PA as young people spend most of their waking hours in school (Kriemler *et al.* 2011). However, due to increased pressure for schools to produce high-quality standardised test scores, time spent in academic subjects are often increased, while time spent in PE is decreased or eliminated (Wilkins *et al.* 2003, Ardoy *et al.* 2014). This illustrates to girls that PA should not be prioritised over academic subjects, and within this review it is evident that adolescent girls fail to see the value of PA. However, participation in regular PA has

been shown to have a positive impact on learning and memory (Trudeau and Shephard 2008), helping to improve cognitive performance and academic achievement (Arday *et al.* 2014, Hillman *et al.* 2014). Introducing more PA time in schools does not have a detrimental impact on academic performance (Keeley and Fox 2009) but rather it can improve concentration and attention levels (Trudeau and Shephard 2008). There is potential to increase the PA participation rates of girls if schools focused on the educational potential of PE rather than competition (Trudeau and Shephard 2008). Highlighting the full range of benefits of PA to adolescent girls could be a key strategy in shifting their perceptions and getting them to prioritise their PA habits.

Finally, the influence of peers and friendship groups play an important role in determining adolescents' perceptions of PA, and this was evident in the included studies in both positive and negative ways. Peer support for PA with adolescent girls declines with age, while the importance of peer support for PA participation increases (Kirby *et al.* 2011, Mitchell *et al.* 2015) . This trend was evident within this review, and participants with active peers were more likely to be active, while those with inactive peers were more likely to disengage from activity. The role of friendship groups must be considered when providing girls PA opportunities, as some girls will choose to participate in PA based on who else is participating, rather than the activity being offered (Mitchell *et al.* 2015). Choosing activities based on friendship groups can lead to the development of a positive learning environment and increase levels of fun and engagement (Mitchell *et al.* 2015).

It is important to note that while the aim of this review was to investigate adolescent girls' perceptions of PA without focusing specifically on school PE or sport, it became clear in this review that most adolescent girls cannot distinguish between the three. This would suggest that PE and team sports are the main sources of activity for adolescent girls, or that they do not identify other activities such as walking to school etc. as PA. This further emphasizes the importance of providing opportunities for girls to engage in life-long PA and introducing them to other forms of PA in both school and community settings that do not revolve around competitive team-based sports.

2.13 Implications for future research and practice

The results of this qualitative synthesis provide insights into adolescent girls' perceptions of PA which can inform attempts to increase the PA levels of this cohort.

However, the low number of included studies (n=24) indicates the need for additional research to be done to truly understand how the activity levels of this cohort can be increased. Based on the findings from this review, it is recommended that future interventions focus on developing PMC in adolescents, as low perceived competence was often cited as a barrier to participation. As well as increasing PMC, future research is needed to investigate the potential impact of PA programmes in schools incorporating peer leaders as peer support was found to be extremely important in this review. Studies should also aim to distinguish clearly between girls who are active and those who are not, to allow for researchers to learn from the girls who participate in PA.

PA programmes for girls in both school and community settings should focus on alternative activities aside from the competitive team-based sports often offered. Opportunities to engage in single-sex activities may also be important for girls. Future programmes should focus on developing PA habits for life-long engagement. Educating girls on the range of benefits of PA is also important as the findings from this review illustrate the PA is not prioritised during adolescence. Doing so will allow for a shift in thinking, allowing adolescents to view PA as an important priority in their life.

2.14 Strengths and Limitations

The qualitative nature of this synthesis is a strength of the review, allowing for the development of themes and ideas which go beyond the findings of individual papers. The reporting of this review followed the PRISMA and ENTREQ guidelines, as well as adopting a rigorous search strategy and analysis of the findings. Limitations included the homogeneous nature of the settings for included studies, with over half being conducted in Canada and the USA. Additional research is needed in other countries to investigate the perceptions of adolescent girls from different cultures and countries. Similarly, there was inconsistency in the reporting of activity levels of participants within studies, with not all studies identifying the views of perceived “active” or “inactive” girls. Another potential limitation is that 19 of the 24 included studies provided insufficient detail regarding informed consent, ethical approval and consideration of researcher/participant relationship. This may reflect issues with reporting, rather than the actual conduct of the studies, however, it is important that future studies are explicit in their reporting with regards consent, ethical approval and the participant/researcher relationship.

2.15 Conclusion

This qualitative synthesis of studies examining adolescent girls' perceptions of PA demonstrates that PA behaviours in this group is a complex topic, and many factors impact their perceptions. We have highlighted possible directions for future research and practice; however, more work is needed to investigate the potential impact of alternative PA programmes on adolescent girls. Researchers and individuals working with young girls must also consider the important role of PMC in PA and how this can positively or negatively impact PA participation.

2.16 So What?

The present qualitative synthesis provides a thorough review of adolescent girls' perceptions of physical activity (PA), makes recommendations for future research and reveals potential limitations in the existing evidence base.

It is important to note that within the included studies, adolescent girls conflated PA, sport and physical education (PE). This would suggest that adolescent girls do not identify other forms of PA outside of these domains (e.g. walking to school). Our findings suggest PA programmes for girls in both school and community settings should focus on alternative activities aside from the competitive team-based sports often offered. Opportunities to engage in single-sex activities may also be important for girls. Future programmes should also focus on developing PA habits for life-long engagement. Educating girls on the range of benefits of PA is also important as the findings from this review illustrate that PA is not prioritised during adolescence.

More high-quality studies are needed to increase the overall body of evidence on this topic. Future studies should report detailed information on informed consent, participant/researcher relationship and ethical approval. Qualitative studies should also be diligent in distinguishing between the perceptions of girls who currently engage in PA and those who do not, allowing for the identification of strategies that work to engage girls in PA.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

Méabh Corr is supported by a PhD Studentship from Mary Immaculate College, Limerick. The funders played no role in the study.

2.17 Chapter Conclusion:

The findings from both part A and part B of this literature review informed the development of two PA interventions for adolescent girls and a cross-sectional study to identify any potential correlates of PA. Gaps identified within the literature included a lack of participant voice within intervention design, little available evidence detailing how relevant behaviour change theory was incorporated during intervention development and a paucity of research focusing on the potential of family based (i.e. mother-daughter) PA interventions for adolescent girls. Results from the qualitative synthesis also highlighted some important perceptions that girls have in relation to their PA participation, including issues around gender bias within sport, a desire to fit in with societal expectations and experiencing competing priorities during adolescence. The following chapters of this thesis aim to add to the evidence base by addressing some of the current gaps in the literature as identified by this review.

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Chapter 3: Methods

3.1 Introduction

This chapter provides an overview and justification of the various methods used in the studies conducted as part of this thesis described in *Chapter 4*, *Chapter 5* and *Chapter 6*. As part of this research investigating PA promotion strategies among adolescent girls, three distinct studies were undertaken. These included a mixed-methods feasibility study conducted in a school setting (*Chapter 4*), a cross-sectional study investigating maternal correlates of adolescent PA (*Chapter 5*) and a mixed-methods feasibility study conducted in a community setting (*Chapter 6*). Further details of the individual studies can be seen in Table 3.1.

Table 3.1 Characteristics of studies conducted as part of this thesis

	Study 1	Study 2	Study 3	Study 4
Chapter	2	4	5	6
Study Type	Systematic Review	Quasi-experimental feasibility	Cross-sectional	Quasi-experimental feasibility
Sample Size	N=24 Studies	N=31	N=84 (N=42 mothers, N=42 daughters)	N=58 (N=27 mothers, N=31 daughters)
Data Collection Dates	Searches carried out on 12.01.17	March 2017- May 2017	January – March 2018 and January 2019	January – March 2018
PA outcome measures	N/A	Steps per day (pedometer) and self-report PA measured using PAQ-A	Steps per day (pedometer) and self-report PA (PAQ-A: daughters and IPAQ: mothers)	Steps per day (pedometer) and self-report PA (PAQ-A: daughters and IPAQ: mothers)
Other outcomes	N/A	Enjoyment of PA (physical activity enjoyment scale)	Co-participation in PA, Parent-adolescent communication, HRQoL and Parenting Practices (mothers)	Co-participation in PA, Parent-adolescent communication, HRQoL and Parenting Practices (mothers)

PA: Physical Activity; PAQ-A: Physical Activity Questionnaire for Adolescents; IPAQ: International Physical Activity Questionnaire; HRQoL: Health Related Quality of Life.

3.2 Participants

Within this thesis, adolescent girls approximately 12-16 years old were chosen as the target group. This age group was chosen as girls within this category are normally attending post-primary school, giving the researcher easy access to many eligible participants. Given that a systematic review and pooled analysis by Dumith *et al.* (2011) found that on average PA declines by 7% per annum during adolescence, resulting in an overall decline between 60-70% between the ages of 9 and 19, it justifies the need to intervene with this population and promote healthy lifestyle behaviours.

3.3 Research Design

3.3.1 Mixed-methods approach

The studies described in both *Chapter 4* and *Chapter 6* of this thesis adopt a mixed-methods approach. As has been previously established in *Chapter 2* of this thesis, PA interventions for adolescent girls to date have only yielded small to moderate changes in PA behaviours. Qualitative data was collected to understand human behaviour, emotions, attitudes, and experiences. This was combined with quantitative data to assess other outcome variables including PA levels. Collecting data from different sources avoids problems associated with evidentiary inadequacy (Erickson 1986) and allows triangulation between data sources to support findings and assertions (Glesne 1999).

The rationale for the use of both qualitative and quantitative methods within the studies described in this thesis is two-fold. In *Chapter 4*, qualitative data was collected pre-intervention as a method of involving participant opinions in the design of a PA intervention they would be participating in. The qualitative data pre-intervention also aided in the behavioural diagnosis conducted, which was necessary to ensure appropriate intervention functions and behaviour change techniques were being selected for the target group when designing the PA intervention. Post-intervention qualitative data was used to gain further insight into participant perceptions of the programme and provide vital opinions that otherwise may not have been detected through quantitative data alone. In *Chapter 6* qualitative data was also collected post-intervention for similar reasons, to delve further into participant perceptions of the PA programme they had participated in and provide the researchers with a valuable context for the quantitative data collected.

3.3.2 Cross Sectional Design

Chapter 5 of this thesis is cross-sectional in design, investigating potential maternal correlates of adolescent girls' device-based measured PA and self-report PA. A cross-sectional design was used as this method can highlight associations that may exist between certain variables, and therefore can provide justification for the development of future research and interventions (Levin 2006). Conducting a cross-sectional study is useful as correlations between variables can be identified, however the design is limited as causation cannot be determined. Despite this limitation, a cross-sectional design is useful in estimating the prevalence of a behaviour within a certain population (Sedgwick 2014), and therefore was chosen as the method to assess maternal correlates of adolescent girls' PA.

3.4 Setting

3.4.1 School Setting

In *Chapter 4* a school setting was used as the location for the PA intervention involving adolescent girls. For the study described in *Chapter 4*, a co-educational post primary school was selected. In co-educational settings, females can often be at a disadvantage when it comes to PA as PE tends to privilege boys due to its game based, competitive nature (Kane and LaVoi 2007). Research has suggested that single-sex groupings are more beneficial to females when it comes to PA (Bender and Litfin 2015). For this reason, a co-educational post primary school was chosen to provide additional opportunities for adolescent females to be active outside of the traditional PE setting.

3.4.2 Community Setting

In *Chapter 5* and *Chapter 6* a PA intervention conducted in a community setting is described. There is currently a paucity of research focusing on PA interventions for adolescent girls in community settings, with the large majority being conducted in school (i.e. before, after or during school time), therefore the feasibility of a community-based intervention is investigated in this thesis.

3.5 Measures

3.5.1 Physical Activity Measures

In relation to measuring PA, the chosen device used in all three studies described in *Chapter 4*, *5* and *6* was pedometers. Pedometers were used as they are an objective form of PA measurement and are especially useful to document relative changes in PA over time (Troost 2001). Pedometers are not the most commonly used device to measure PA,

and as evident from the interventions examined in *Chapter 2*, many interventions for adolescent girls have used accelerometers as a means of measuring and classifying baseline and post-activity levels. However, accelerometers are expensive devices and often provide large quantities of data which can lead to difficulties in relation to statistical analysis (Troiano 2005). In contrast, pedometers are relatively inexpensive devices which can monitor PA and they are particularly sensitive to walking or ambulatory PA (Tudor-Locke and Myers 2001). Along with their low cost and simplicity to administer, the units of measurement (i.e. steps per day) can be universally understood, allowing for comparison of results across various populations (Clemes and Biddle 2013). A systematic review by McNamara *et al.* (2010) investigating the validity, reliability and feasibility of pedometers for children (ages 4-20) found consistently high validity and reliability for pedometers with children. In fact, in terms of practicality, pedometers offer one of the best solutions for a low cost, objective monitoring tool (Welk *et al.* 2000).

3.5.1.1 Sealed Pedometers

In both intervention studies described in *Chapter 4* and *Chapter 6* sealed pedometers were used both pre-and post-intervention. In the cross-sectional study described in *Chapter 5* pedometer data was also derived from sealed pedometers. Sealed pedometers were worn by participants for a period of seven consecutive days to account for both weekday and weekend measurements, allowing for an overall average measurement of PA levels (Trost *et al.* 2000). Currently the most appropriate time frame needed to estimate habitual activity in children and adolescents is unknown, with studies reporting a range of monitoring time-frames between two to nine consecutive days (Clemes and Biddle 2013). However, seven consecutive days is the most common monitoring method used, and in this thesis it was chosen as it is considered as an adequate time-frame to estimate the habitual habits of individuals without burdening the participant (Clemes and Griffiths 2008, Clemes and Biddle 2013). Participants were instructed to wear their pedometer for seven consecutive days, except when bathing or swimming and were given a logbook to document any non-wear time. Pedometers were sealed at baseline and post-intervention using a Yamax CW701 pedometer which has a built in 7-day memory. The Yamax CW701 has demonstrated concurrent validity and reliability in free-living conditions, as well as walking at a fast pace and walking on a track (Coffman *et al.* 2016). Using a sealed pedometer with a 7-day memory reduces the risk

of data loss due to accidental resetting of the pedometer. A sealed pedometer may also prevent some reactivity issues, however to date the limited evidence available on this topic provides conflicting reports on the presence of reactivity with pedometers in both children and adolescents (Clemes and Biddle 2013).

3.5.1.2 Unsealed Pedometers

Pedometers were also used as a tool for monitoring and encouraging PA behaviours in the studies described in *Chapter 4* and *Chapter 6*. By using unsealed pedometers, individuals could receive immediate feedback on their daily activity levels measured through step counts, which is seen as a key motivational factor of pedometers (Clemes *et al.* 2006). All participants were given a small, lightweight pedometer (Yamax Digiwalker SW700), a pedometer record book to record their daily steps along with individualised, weekly, progressive step goals.

3.5.1.3 Physical Activity Questionnaire for Adolescents

Self-report measures of PA for adolescent girls was measured using the Physical Activity Questionnaire for Adolescents (PAQ-A) in all three experimental studies in this thesis (Kowalski *et al.* 2004). The PAQ-A is a valid and reliable instrument used to measure general PA levels of children and adolescents (Kowalski *et al.* 1997). It is a 7-day recall questionnaire which provides a summary score of PA derived from 8 items, each scored on a 5-point Likert scale (Kowalski *et al.* 2004). A summary score of 1 indicates low PA and a score of 5 indicates high PA. A score of at least 2.7 or higher can identify those who are meeting the PA guidelines versus those who are not (Voss *et al.* 2013, Benítez-Porres *et al.* 2016) (Appendix G).

3.5.1.4 International Physical Activity Questionnaire

The International Physical Activity Questionnaire (IPAQ) short form was administered to mothers who took part in the studies described in *Chapter 5* and *Chapter 6*. The IPAQ has demonstrated adequate reliability and validity when tested across 12 countries, with results comparable to other self-report measures (Craig *et al.* 2003). Similar to the PAQ-A questionnaire, the IPAQ is a 7-day recall questionnaire and provides information on time spent engaged in walking activities, moderate activities, vigorous activities and sedentary behaviours (Craig *et al.* 2003). A score for PA is then calculated in the form of metabolic equivalent (MET) minutes. Categories of low active, moderate active or high active can then be assigned to individuals based on their total MET minutes for walking, moderate and vigorous activities (Appendix H).

3.5.2 Other Measures

3.5.2.1 Co-Participation in Activity

Co-participation in activity between mothers and daughters was measured in the studies described in *Chapter 5* and *Chapter 6*. Levels of co-participation were measured by participants reporting the number of days and the average amount of time (hours and minutes) they spent engaged in activity with their mother/daughter over the past 7 days (Lee *et al.* 2010). This is a single item questionnaire asking how many days mothers/daughters participate in activity together, with a score of 1 indicating 1 day of co-participation (Appendix I). Average time spent in activity together was also calculated using means and standard deviations.

3.5.2.2 Physical Activity Enjoyment Scale

Enjoyment of PA was measured using the Physical Activity Enjoyment Scale (PACES), which has also been demonstrated as a valid and reliable measure of enjoyment of PA among adolescents (Kendzierski and DeCarlo 1991, Motl *et al.* 2001). The original PACES questionnaire included 18 statements scored on a 7-point scale. However, this was adapted in 2001 by Motl *et al.* (2001) to a 16 item questionnaire scored on a 5 point Likert scale, and this version was shown to be a valid and reliable method of assessing enjoyment of PA in adolescent girls (Motl *et al.* 2001). Summary scores are calculated by adding the scores for each statement, with a score of 80 being the highest possible score. A higher score on the PACES questionnaire indicated higher levels of enjoyment. This adapted version of the questionnaire was used in this thesis in the study described in *Chapter 4* (Appendix J).

3.5.2.3 COM-B 23 Item Self-Evaluation Questionnaire

As part of the behavioural diagnosis conducted in *Chapter 4*, participants completed a COM-B 23 item self-evaluation questionnaire to highlight areas of behaviour they felt needed to change for them to increase their PA levels (Michie *et al.* 2011b). The COM-B questionnaire assesses areas of an individual's capability, opportunity and motivation and how these relate to their PA behaviours. Participants circle as many of the statements from capability, opportunity and motivation they feel relate to their PA behaviours, and total percentages for each statement are calculated. The areas of the questionnaire highlighted by participants are then used to inform the appropriate selection of intervention functions and behaviour change techniques necessary for the group to reach the target behaviour (i.e. increased PA) (Appendix K).

3.5.2.4 Parent-Adolescent Communication

Parent-adolescent communication was measured using the Parent Adolescent Communication Scale (PACS) questionnaire in *Chapter 5* and *Chapter 6* (Barnes and Olson 1985). The PACS is a valid and reliable questionnaire for assessing communication between adolescent females and their parents (Sales *et al.* 2008). The questionnaire comprises 20 items relating to communication between parents and adolescents with each item being scored on a 5-point Likert scale. Ten of the questions are related to “open communication” and 10 are related to “problem communication”. Scores for the problem communication scale are negatively scored, with the highest possible score for each subscale being 50. The entire questionnaire is scored out of 100 and each subscale is also scored out of 50. A higher score indicates better parent-adolescent communication (Appendix L).

3.5.2.5 KIDSCREEN-27 Questionnaire

Health related quality of life (HRQoL) of adolescents was assessed using the KIDSCREEN-27 questionnaire (Ravens-Sieberer *et al.* 2007) in *Chapter 5* and *Chapter 6*, which has been shown to be a valid and reliable measure of HRQoL (Ravens-Sieberer *et al.* 2007, Robitail *et al.* 2007) A parent proxy was also used, with mothers evaluating their daughter’s HRQoL. The questionnaire contains 5 dimensions assessing physical wellbeing, psychological wellbeing, social support and peers, autonomy and parents and school environment. Each item of the 5 dimensions is scored using a 5-point Likert scale. T-values for each dimension are calculated, with higher T-values indicating better HRQoL (Appendix M).

3.5.2.6 Parenting Practices Questionnaire

Parenting practices of mothers was measured using an 8-item questionnaire in *Chapter 5* and *Chapter 6* (Davison *et al.* 2003). This questionnaire, developed by Davison *et al.* (2003) is a valid and reliable measure of PA parenting practices (Sleddens *et al.* 2012). Each item is scored on a 4-point scale to assess mothers’ logistic support for PA and their explicit modelling of PA. Means for both logistic support and explicit modelling are calculated, with higher scores indicating higher levels of positive PA parenting practices. Scores for each scale range from 1-4 (Appendix N).

3.5.2.7 Focus Groups

Focus groups were used within the studies described in this thesis for two reasons; to involve participant voice during intervention development stages and to gain further

insight into participant perceptions post-intervention. Focus groups were conducted by female researchers who had experience facilitating discussions. All focus groups were recorded and transcribed verbatim using pseudonyms to protect participant identities. Topic guides (Appendix O) were used to facilitate discussion. Further details on the focus groups can be found in the relevant chapters (*Chapter 4* and *Chapter 6*).

3.6 Analysis

3.6.1. Focus Group Analysis

Two main types of qualitative analysis were used as part of this thesis. In *Chapter 2* and *Chapter 4* thematic analysis was used to identify, analyse and report themes or patterns that emerged within the data (Braun and Clarke 2006). In *Chapter 2 Part B* the data comprised of qualitative data extracted from studies included in the qualitative synthesis. In *Chapter 4* the data that was analysed thematically was derived from the post-intervention focus groups. As mentioned previously, all focus group data was transcribed verbatim. These transcriptions and extracted data were then managed and analysed using the qualitative data management software NVivo 10 (QSR International Pty Ltd 2012). By using NVivo to manage the data, a thematic network was created (Attride-Stirling 2001). The first step in the process involved generating a list of codes of any potential themes or patterns evident in the data. These codes formed the basic themes within the data, and basic themes were then grouped together to form organising themes. Finally, the combination of organising themes resulted in the development of global themes, used to illustrate key patterns in the text as a whole (Attride-Stirling 2001). Details of the thematic maps developed for the qualitative synthesis described in *Chapter 2* and the feasibility study in *Chapter 4* can be found in Appendices F and P.

Analysis of the focus group data collected pre-intervention in *Chapter 4* and post-intervention in *Chapter 6* was analysed using directed content analysis (Hsieh and Shannon 2005). Directed content analysis is a structured approach, and often existing theory or prior research is used when conducting the analysis and coding the data (Hsieh and Shannon 2005). In the case of the data collected pre-intervention in *Chapter 4*, directed content analysis was used to map the data onto the COM-B frame, further aiding the behavioural diagnosis to identify which intervention functions and BCT's were most appropriate. In *Chapter 6*, the focus group data collected post-intervention informed some of the participant preliminary responses to the intervention. As the main

aim of the study described in *Chapter 6* was to assess the feasibility of a mother-daughter multi-component PA programme, data from the focus groups was mapped onto the 5 key feasibility benchmarks defined prior to commencement. The focus group data allowed the researchers to gain further insight into the feasibility and acceptability of different aspects of the intervention.

3.6.2 Statistical Analysis

Various methods of analysis were used in relation to the quantitative data collected depending on the aim of the study in question. In *Chapter 4* and *Chapter 6*, data was managed and analysed using Excel (Microsoft Excel, Office 365). Mean steps per day from pedometers were calculated and self-report data from the various questionnaires used were scored according to their relevant scoring protocol. A paired t-test was used to compare mean scores at pre and post measurements. Statistical significance was set at $P < 0.05$.

In *Chapter 5*, which investigates maternal correlates of device-measured PA and self-report PA for adolescent girls, bivariate correlations and a two-way analysis of variance (ANOVA) was used to identify any significant correlations between mothers' PA levels, age, education, SES and daughters' PA levels as measured through pedometers and self-report measures. Analysis was conducted using the statistical software programme SPSS (IBM Corp 2017). Before investigating potential correlations, means, standard deviations and frequencies were assessed to ensure the data was normally distributed.

3.7 Chapter Conclusion

This chapter has provided an overview of the methods used in the studies described in this thesis, along with a brief justification for doing so. The next three chapters will provide more detail on the individual studies and the methods used. These upcoming chapters are presented as research articles and have been prepared for publication in peer-reviewed journals.

**Chapter 4: “No-one Ever Asked Us” A Feasibility Study
Assessing the Co-Creation of a Physical Activity Programme
with Adolescent Girls**

Chapter 4: “No-one ever asked us”: A Feasibility Study Assessing the Co-creation of a Physical Activity Programme with Adolescent Girls

Preamble

The following article reports a feasibility study conducted in a post-primary school which aimed to involve girls in the design of a physical activity programme in which they were involved. The design of this study was guided by the Behaviour Change Wheel by Michie *et al.* (2011). This manuscript has been accepted for publication in *Global Health Promotion*, impact factor 2017; 1.179 (Journal Citation Reports®, 2018 release).

The following is the citation for this article:

Corr, M., Murtagh, E. (2019) “No One Ever Asked Us”: A Feasibility Study Assessing the Co-Creation of a Physical Activity Programme with Adolescent Girls. Accepted for publication in *Global Health Promotion* (Impact Factor 1.179).

Statement of authorship;

I hereby declare that I, Méabh Corr, am the principal author of this article. The following statements outline my contributions to the work:

- Substantial contributions to the conception and design of the work; the acquisition, analysis and interpretation of data for the work; AND
- Drafting of work and revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

(See Appendix A for signed Statement of Authorship)

4.1 Purpose of Chapter

4.1.1 Rationale

To date, very few studies have aimed to involve youth voice in the design of PA interventions, resulting in the development of interventions which may not actually meet the needs and interests of those involved. As this area is relatively unexplored, this study aimed to assess the feasibility of involving girls in the design of a PA programme guided by appropriate behaviour change theory (the BCW).

4.1.2 Contribution to the field

This study makes an important contribution to the field, demonstrating that it is feasible to involve girls in the design of PA programmes in a school setting. It also adds to the evidence base supporting the use of behaviour change theory when designing PA interventions for adolescents. Following guidance from the BCW resulted in the development of an intervention using BCTs and intervention functions specifically tailored to the study participants. Finally, this study provides insights for PE teachers, highlighting the benefits of single-sex PA opportunities for girls and the importance of including a wide variety of activities aside from competitive team sports.

4.2 Abstract

Background: Globally, poor activity levels of adolescent girls is a public health concern. Little research has involved adolescents in the design of interventions. This study assessed the feasibility of involving girls in the co-creation of an activity programme.

Methods: Thirty-one students (15-17 years) were recruited from a post primary school. The Behaviour Change Wheel guided intervention design, providing insights into participants' capability, opportunity, and motivation for change. Step-counts and self-report physical activity levels were recorded pre- and post-intervention. Feasibility benchmarks assessed recruitment, data collection, acceptability, and adherence.

Results: Activity and educational sessions were delivered for 6-weeks during physical education class. Average attendance was 87% (benchmark= 80%). Eligibility was 61% (benchmark = 60%). There was a 100% retention rate (benchmark 90%). All participants (n=31) completed baseline measures and 71% (n=22) completed post measures. A total of 54% (n=17) of students completed pedometer measurements, with 32% (n=10) having complete data. Average daily steps were 13,121 pre-intervention and 14,128 post-intervention ($P>0.05$). Data collection was feasible, receiving a mean score $>4/5$ (benchmark $>3.5/5$).

Conclusions: The Behaviour Change Wheel can be used to co-create an activity programme with adolescent girls. Predetermined benchmarks, except for pedometer recordings, were reached or exceeded, providing evidence for a randomised controlled trial to test effectiveness.

Keywords: Physical Activity, Physical Education, Adolescent Girls, School-based Intervention, Feasibility Study

4.3 Background

Globally, adolescents don't accumulate sufficient physical activity (PA) (Hallal *et al.* 2012), with almost 95% of adolescent girls considered insufficiently active (Hallal *et al.* 2012). The influences on PA during adolescence are multifactorial (Barr-Anderson *et al.* 2008), and several barriers can hinder participation (Edwardson *et al.* 2015), including feeling incompetent and disliking sport (Rees *et al.* 2006, Woods *et al.* 2010). Adolescent behaviours are predictive of adult behaviours, therefore promoting a healthy lifestyle at this stage is crucial to shape healthy adult behaviours (Pearson *et al.* 2015).

Interventions to date aiming to improve PA levels of adolescent girls have demonstrated modest effects (Pearson *et al.* 2015), and it is suggested this is partly due to the failure of the intervention to address participants' needs (Corder *et al.* 2013). Exploring adolescent girls' views of PA can produce vital information to guide intervention design (Murillo Pardo *et al.* 2015). There have been some studies conducted which involved formative work to involve participant perceptions in intervention design, such as the Trial of Activity for Adolescent Girls (TAAG) in the U.S and other studies conducted in Australia and the US (Gittelsohn *et al.* 2006, Dudley *et al.* 2010, Okely *et al.* 2011), however there remains a paucity of research focusing on involving adolescent girls in programme design. Without the involvement of youth voice, interventions may fail to accurately represent the needs of the participants (Jacquez *et al.* 2012).

Recent systematic reviews and meta-analysis (Pearson *et al.* 2015, Owen *et al.* 2017) have found that school-based PA interventions are more effective when based on relevant theory. Many frameworks exist providing guidance on designing interventions, however for this study, the Behaviour Change Wheel (BCW) (Michie *et al.* 2011b), a synthesis of 19 frameworks for behaviour change, guided intervention design. The BCW provides insight into the motivations, capabilities and opportunities perceived by participants, and how these relate to their behaviours (Michie *et al.* 2011b).

As involving adolescent girls in PA programme design is a relatively unexplored area, it is vital to conduct a feasibility study to identify any key uncertainties, allowing for modifications to be made before a full-scale trial (Craig *et al.* 2008, Hubbard *et al.* 2016). The aim of this study was to assess the feasibility of co-creating a PA intervention with adolescent girls, assessing recruitment, data collection, acceptability, and adherence.

4.4 Methods

The reporting of this study followed the CONSORT statement (Eldridge *et al.* 2016a) and the COREQ guidelines (Tong *et al.* 2007) (Appendices R&S).

This study comprised of two phases; formative research for intervention design, and assessment of intervention practicability.

4.4.1 Participants

Participants (n=31), approx. 15-17 years old, were recruited from a post-primary school using a convenience sample. Participants were approached in a face-to-face manner.

The target group was insufficiently active girls (based on a Physical Activity Questionnaire for Adolescents (PAQ-A) (Kowalski *et al.* 2004) score of >2.7 (Voss *et al.* 2013) however no interested participants were excluded. The majority of participants were inactive (80%, n=25) with a mean PAQ-A score of 2.1 ± 0.3 . Active participants (20%, n=6) had a mean PAQ-A score of 2.9 ± 0.4 , slightly above the threshold of >2.7.

A co-educational school was chosen as in these settings females can be at a disadvantage when it comes to PA (Kane and LaVoi 2007). This research aimed to provide opportunities for females to be active in a single-sex environment, which can be more beneficial (Bender and Litfin 2015).

Participants received study information and appropriate consent was sought before programme commencement (Appendix T).

4.4.2 Formative research phase

The BCW guided the intervention design (Michie *et al.* 2014). In the hub of the BCW is the COM-B system, suggesting an individual's motivations, capabilities and opportunities are related to their behaviour (Michie *et al.* 2014). The BCW and the COM-B system systematically guided the intervention design, selecting the most appropriate intervention functions and behaviour change techniques (BCT) necessary to reach the target behaviour (Michie *et al.* 2014).

The 8 steps of intervention design as outlined in the BCW guide (Michie *et al.* 2014) were followed, beginning at step 4 as steps 1-3 have been established in literature. Students completed a COM-B 23 item self-evaluation questionnaire assessing their capability, opportunity and motivation relating to their PA behaviours (Michie *et al.* 2011b).

The areas of capability, opportunity and motivation that participants identified as being most important for their behaviour change in the COM-B questionnaire (Table 4.1) were explored further during the focus groups. Two focus groups lasting 30 minutes were held with approx. 8 students in each. The female researcher, who had previous focus group experience, facilitated the discussion using a semi-structured guide. Focus groups were transcribed verbatim using pseudonyms to protect participant identity. The data was coded by the researcher and analysed using directed content qualitative analysis (Hsieh and Shannon 2005), mapping the data onto the COM-B frame.

Using both the questionnaire data and the focus group results collected from the participants, intervention functions were identified (step 5). The BCW outlines which intervention functions are appropriate to address the COM-B areas identified (Michie *et al.* 2011b). Using the APEASE criteria (assessing affordability, practicality, cost-effectiveness, acceptability, safety and equity) (Michie *et al.* 2014) intervention functions were selected. Step 6 was not relevant for this study. BCTs designed to serve the chosen intervention functions were then selected (step 7). Frequently used BCTs were chosen from a possible 94 options (Michie *et al.* 2013). Finally, an appropriate mode of delivery was chosen (Michie *et al.* 2014).

The completion of these 8 steps provided an outline for a 6-week intervention to address areas of the COM-B system identified by participants (Table 4.2). Participant voice and opinions were gathered and considered when choosing the most appropriate components for the intervention, and guidance from the BCW allowed the researcher to design an intervention directly suited to the participants' needs. Intervention content, including PA and educational components were designed using direct suggestions from participants discussed in the focus groups.

4.4.3 Measures

4.4.3.1 Feasibility benchmarks

Feasibility benchmarks were defined to assess recruitment, data collection, acceptability, and adherence.

Recruitment was assessed via recruitment records. As the target participants were insufficiently active girls, eligibility was determined based on participants self-report PAQ-A score using the cut-point of >2.7 to distinguish between those meeting PA

guidelines and those not (Voss *et al.* 2013). A predefined eligibility rate of 60% was deemed feasible (Dudley *et al.* 2010).

Acceptability of measures (pedometers, questionnaires, focus groups) was assessed via a questionnaire using a 5-point Likert scale. A score of 1 indicated low acceptability and a score of 5 indicated high acceptability. A predefined mean score of $\geq 3.5/5$ for positive statements and $\leq 1.5/5$ for negative statements was deemed feasible (Casey *et al.* 2014, Barnes *et al.* 2015b).

Acceptability was assessed via attendance and a side-by-side matrix. A pre-defined attendance rate of 80% was deemed feasible (Kelty *et al.* 2012). A side-by-side matrix assessed importance of programme content etc. versus satisfaction levels of this aspect. A mean score of $\geq 3.5/5$ was deemed acceptable (Casey *et al.* 2014, Barnes *et al.* 2015b).

Adherence was assessed using the retention rate and the number of participants who completed both measures. A retention rate of 90% was deemed feasible (Okely *et al.* 2017) and a 60% completion rate for both measures was deemed feasible (Dudley *et al.* 2010).

4.4.3.2 Physical activity and “enjoyment”

Participants completed the PAQ-A questionnaire to assess PA levels (Kowalski *et al.* 2004) and the “Physical Activity Enjoyment Scale” (PACES) at baseline and post measures, a valid measure of PA enjoyment among adolescent girls (Motl *et al.* 2001).

Pedometers were worn for 7 consecutive days at baseline and post-intervention, a sufficient period to estimate habitual behaviour without burdening participants (Clemes and Biddle 2013). Participants received instructions for wearing their pedometer and a record sheet to log non-wear times (Appendix U).

4.4.4 Analysis

Pedometer and questionnaire data were managed using excel. Mean steps per day for pre-and-post measurements were calculated. Participant summary scores for the PAQ-A and PACES were calculated using the relevant scoring protocols (Motl *et al.* 2001, Kowalski *et al.* 2004). A paired t-test was used to compare mean scores at pre-and post-measures. All participants (100%; n=31) completed the PAQ-A and PACES at baseline assessments and 71% (n=22) completed both measures post-intervention. A total of 32% (n=10) of participants had full sets of pedometer data.

Qualitative data from focus groups were analysed thematically allowing for the identification of recurring themes (Braun and Clarke 2006). The qualitative data analysis software, NVivo 10, was used to manage the focus group data (QSR International Pty Ltd 2012). A thematic network was created by first generating a list of codes of any potential themes or patterns. These codes then formed the initial basic themes within the data. Categories of basic themes were then grouped together, resulting in organising themes. Global themes were created by combining organising themes to encapsulate the principal metaphors in the text as a whole (Attride-Stirling 2001) (Appendix P). Similar procedures adopted during pre-intervention focus groups were used during post-discussions.

4.5 Results

4.5.1 Phase 1 Results

4.5.1.1 Behavioural diagnosis

Participants are identified by pseudonyms (e.g. P1) and focus groups are labelled as FG1 and FG2. Participants discussed their capability to be active. Acquiring physical skills and physical stamina were important for behaviour change. Some students felt incapable of being active, due to poor skills and instructions. Girls spoke of an ultimate Frisbee PE class, and how they felt they lacked the skills needed to participate: *“They didn’t show us how to throw it [the Frisbee] they just expected us to know how to do it” (FG1; P3)*. Students also discussed barriers to exercising outside of school; *“When I go to the gym I use machines I feel like I’m not doing anything properly and people are judging you” (FG1, P3)*. Students also felt they were limited by their own lack of knowledge: *“We don’t know what else we can do apart from sports” (FG2, P4)*.

Within psychological capability, students identified mental stamina and needing an ability to overcome mental obstacles. During focus group discussions, overcoming mental obstacles was discussed: *“When I run, my mind says, “I can’t do it”. I would like that to be “you can do it” (FG1, P4)*. Other students agreed saying: *“Yeah if you’re on a treadmill 15 minutes feels like 2 hours!” (FG1, P1)*.

When considering physical opportunity, time was the most prominent factor. Students noted how study takes priority over exercise: *“We’ll be in school all day then study after school” (FG2, P3)*. These concerns particularly pertained to preparing for State Examinations. Participants also discussed social opportunity, noting having people

around was motivating. Students felt cautious about participating alone but found enjoyment in exercising with others; *“It’s fun with someone with you and time goes quicker” (FG1, P4).*

When discussing motivation, participants identified needing to *“feel they wanted to do it”*. Students discussed their lack of motivation and felt the gender roles evident in PA contributed to this: *“Girls aren’t really taught that they should want to do it [be physically active]” (FG2, P3).* When discussing reflective motivation, specifically developing habits of being active students suggested the following: *“I think it would be good if we had a plan to follow” (FG1, P2).* The development of a structured plan would allow them to work towards goals.

Findings from the COM-B 23 questionnaire can be found in Table 4.1.

4.5.1.2 Intervention functions

The behavioural diagnosis arising from the COM-B questionnaire and focus groups were combined to design a 6-week intervention.

All 9 intervention functions were considered; however, restriction and environmental restructuring were excluded due to impracticality. Intervention functions and BCT’s used can be seen in Table 4.2 (Michie *et al.* 2013).

4.5.1.3 PA Programme

Students participated in weekly 90-minute PA and educational sessions during PE for 6 weeks. Students tracked their steps using a pedometer, working to meet individualised incremental step goals. Students also kept a PA diary, monitoring steps and weekly goals. Using pedometers in conjunction with a PA diary make them an effective way of improving PA levels (Tudor-Locke 2002).

Table 4.1 Results from the COM-B Questionnaire.

COM-B component	Menu of possibly relevant factors	N = 31	%
CAPABILITY			
Physical	have more physical stamina	17	54%
	have more physical strength	18	58%
	have better physical skills	17	54%
	overcome physical limitations	9	29%
Psychological	have more mental strength	14	45%
	know more about why it is important	6	19%
	overcome mental obstacles	19	61%
	know more about how to do it	12	38%
	have better mental skills	9	29%
	have more mental stamina	17	54%
OPPORTUNITY			
Physical	have more time to do it	23	74%
	have it more easily accessible	14	45%
	have the necessary materials	11	35%
	have more money	9	29%
Social	have more people around me doing it	10	32%
	have more triggers to prompt me	8	25%
	have more support from others	7	22%
MOTIVATION			
Automatic	feel that I want to do it enough	22	71%
	feel that I need to do it enough	10	32%
Reflective	develop a habit of doing it	20	64%
	believe that it would be a good thing to do	15	48%
	develop better plans for doing it	17	54%

Table 4.2 Weekly Schedule of activities including Behaviour Change Techniques and Intervention Functions

	Intervention Function	Behaviour Change Technique	Content – School Based	Content- Home based
WEEK 1	Education	Demonstration of the behaviour	Theory: Benefits of Physical Activity	Record Daily Steps
	Training		Practical: Aerobics	Plan PA Sessions
		Instruction on how to perform a behaviour	Set SMART Goal (Specific, Measurable, Attainable, Realistic, Timed) Weekly SMART Goals will be set in school to be completed at home	Follow SMART Goal
		Feedback on the behaviour		
		Information about health consequences		
		Goal setting		
WEEK 2	Enablement	Goal setting	Theory: Planning for PA	Record Daily Steps Plan to exercise with a friend
	Modelling	Action planning	Practical: Kickboxing	Follow SMART goal
	Training	Habit formation	Set Week 2 SMART Goal	
		Demonstration of the behaviour		
		Instructions on how to perform a behaviour		
	Feedback on the behaviour			

Table 4.2 Weekly Schedule of activities including Behaviour Change Techniques and Intervention Functions

	Intervention Function	Behaviour Change Technique	Content – School Based	Content- Home based
WEEK 3	Education	Self-monitoring of behaviour	Theory: Nutrition and fuelling your body for exercise	Monitor how you feel after exercise in your PA diary
	Enablement	Biofeedback	Practical: Yoga	Record daily steps
	Coercion	Monitoring of emotional consequences	Set Week 3 SMART Goal	Follow SMART goal Commitment to activity: This week I will...
WEEK 4	Education	Self-monitoring of behaviour	Theory: Time Management	Monitor how you feel after exercise in your PA diary
	Training	Monitoring of emotional consequences	Practical: Pilates	Record daily steps
	Enablement	Feedback on behaviour	Set Week 4 SMART goal	Follow SMART Goal
	Incentivisation	Demonstration of the behaviour		Identify time management strategies to fit in PA
WEEK 5	Education	Credible Source	Theory: PA Promotion Strategies	Identify your PA female role model
	Training	Biofeedback	Practical: HITT Training (High Intensity Interval Training)	Record daily steps
	Persuasion	Instruction on how to perform a behaviour	Set Week 5 SMART Goal	Follow SMART Goal Include at least 1 at home HITT session
WEEK 6	Education	Instruction on how to perform a behaviour	Theory: Review of what has been covered + planning for summer months	Plan for the summer – how will you continue your new PA habits?
	Enablement	Monitoring of emotional consequences Goal Setting	Practical: Fun Team Games	

4.5.2 Phase Two Results

4.5.2.1 Feasibility benchmarks

Recruitment was feasible, exceeding the predetermined 60% benchmark, with 80% (n=25) of participants scoring ≤ 2.7 in the PAQ-A.

Acceptability rates were high. The average attendance was 87.16%, exceeding the 80% target, except for the last week of school. Each aspect of the side-by-side matrix scored greater than 3.5/5 for satisfaction levels, exceeding the benchmark.

Using pedometers motivated students to be active. One student commented she *“didn’t realise how lazy I was until I put it on.”* (FG1, P4). Others agreed, stating that comparing steps with peers was motivating. However, recording steps was a burden, and students desired a device that could synchronise with their phones.

Students also enjoyed using PA diaries and found sharing goals with others supportive as articulated by one student; *“who cares if you make goals... but if you’ve told someone you can’t get away with not doing it”* (FG1, P5). Students were encouraged to write down how they felt after exercise, which proved to be effective in increasing motivation to exercise: *“When I could see that I was writing down that I felt better it made it a bit easier”* (FG2, P5). Using diaries also enabled students to overcome mental obstacles: *“after school the last thing I want to do is go for a run, but when you look back and see I did it yesterday and I felt great after...”* (FG2, P2).

The study had a 100% retention rate, exceeding the 90% benchmark. All participants (n=31) completed baseline questionnaires and 71% (n=22) completed the post-assessments, exceeding the 60% benchmark. All students invited to participate in focus groups agreed, exceeding the 60% benchmark. Use of pedometers to measure step count did not meet the benchmark of 60%, with 32% of students with full sets of data.

The average scores assessing acceptability of the measures exceeded the predetermined benchmarks, with each item scoring $\geq 3.5/5$ and $\leq 1.5/5$ for positive and negative statements respectively.

4.5.2.2 Physical activity

Mean PAQ-A score pre (n=31) and post-intervention (n=22) was 2.39 ± 0.51 and 2.51 ± 0.45 respectively. There was no difference in PAQ-A scores from pre-to post intervention ($P > 0.05$).

Full pedometer data was received from 10 participants. Mean steps per day pre-and post-intervention were 13,121 \pm 4,883 and 14,128 \pm 5,637 respectively (n=10). No other pedometer data was recorded or returned to the researcher.

The mean PACES score pre-intervention (n=31) was 64.4 \pm 7.21 and post intervention (n=22) was 65.4 \pm 9.02 (P>0.05).

4.5.2.3 Student perceptions

Focus groups post-intervention were used to gain an understanding of the participants' perceptions of the intervention. Two themes emerged; programme novelty and unleashing potential.

4.5.2.3.1 Programme novelty

Students discussed the novelty of the programme and activities provided. The programme allowed students to participate in PA away from males; *"I didn't dread coming because the boys weren't there"* (FG1, P5). Participants also enjoyed the activities; *"it was something different not just the stuff we always do in PE"* (FG1, P3). The exposure to new activities provided alternative forms of PA to the participants. Several of the participants had never experienced Yoga, and one student commented on the benefits of this; *"None of us have really done it [the activities] so we're all on the same page"* (FG2, P4).

Students also enjoyed having ownership of the programme. Providing autonomy within activities increased accountability for participation; *"like they [the activities] were things that we suggested then so we couldn't not do it"* (FG2, P3).

4.5.2.3.2 Unleashing Potential

Participation in this programme also led to a realisation of other PA opportunities available. Girls discussed how prior to this programme, sport and PA were synonymous; *"I always just associated physical activity with games from PE"* (FG2, P5). Other students further illustrated their lack of awareness of their PA opportunities: *"When you said on the first day that walking was physical activity, I just never considered it."* Students noted they felt more capable to be active, gaining an awareness of the possibilities available: *"Now I feel like I know there is other things to do apart from play sports"* (FG1, P3).

4.6 Discussion

The aim of this study was to assess the feasibility of co-creating a PA programme with teenage girls using guidance from the BCW (Michie *et al.* 2011b). Both intervention content and study procedures were feasible as demonstrated by successful recruitment, retention, adherence and acceptability. The use of focus groups provided girls with autonomy and ownership of the programme and is therefore a key element of the intervention design. A future RCT would include the intervention functions and BCTs used in this study as they were selected as a result of the behavioural diagnosis. However, the exact content and activities provided would depend on the interests of the girls involved in the study. Some possible changes that may occur in an RCT based on feedback from the participants includes a longer programme duration, and better links with other subjects, particularly for the education component. Within this study girls felt the educational component would be better suited to a classroom setting and suggested the involvement of other teachers to deliver this component, moving towards a more whole-school approach.

While unintended, this intervention was delivered during regular PE time, which may illustrate the reluctance of girls to participate in additional PA opportunities outside of school PE. Girls within this study discussed that they would not participate in a programme outside of PE for fear of ridicule from male peers. Along with the participants' reluctance to participate in additional PA opportunities, previous research has identified that many girls fail to participate in school PE (Brooks and Magnusson 2006, Mitchell *et al.* 2015), often citing feelings of self-consciousness as a barrier to participation, particularly in front of males (Biddle *et al.* 2005). Single-sex environments have been shown to be more beneficial for females (Kane and LaVoi 2007), and this intervention provided an opportunity for girls to be active away from their male counterparts. Another important element of this intervention was the autonomy and ownership given to students in the programme design, resulting in increased accountability for their participation. Research has shown that girls often disengage from PE due to the activities provided, with team sports dominating the curriculum (Flintoff and Scraton 2001, Brooks and Magnusson 2007). While it may not be possible for physical education teachers to conduct a behavioural analysis as was done in this study, it would be possible for them to include the opinions of students in the selection of activities during PE. This could be facilitated through discussions or

questionnaires at the beginning of the year, or by creating shared expectations and plans for the yearly PE curriculum. Providing girls with more choice and a variety of activities may lead to increased participation levels in PE class. The results of this study demonstrate that it is feasible to co-create a PA programme with adolescent girls and similar approaches could be adapted by researchers and teachers aiming to increase the PA levels of this cohort.

Within this study the one procedure which was not acceptable was the use of pedometers with only 10 students having full sets of data. Allowing girls to choose the evaluation methods used is an important consideration for the intervention moving forward. In recent years there has been a surge in the number of people using wearable wrist worn devices to monitor and track their PA levels. While the idea of using these consumer wearables has grown in popularity, it is important to ensure valid and reliable devices are chosen for use within research (Evenson *et al.* 2015). It is also important to consider the feasibility and cost-effectiveness of using such trackers in a school setting. A possible solution to this measurement issue is to use the pedometers in conjunction with an app on a smartphone. However, monitoring and tracking methods of PA should be agreed upon with the participants to ensure it is acceptable. This suggestion aligns closely with the model of Public and Patient Involvement (PPI) in research, ensuring that research is designed ‘by’ or ‘with’ the public rather than ‘about’, ‘for’ or ‘to’ them, which can result in improved quality of research as well as making the research more relevant to the participants (INVOLVE 2012).

Lessons to be learned from this study include the importance of formative research in intervention design and the importance of providing autonomy to participants. As previously mentioned, the disengagement of girls from PE and PA often comes from a dislike of activities on offer, therefore providing choice of activities is imperative in increasing participation rates. Researchers looking to develop similar interventions should focus on creating multi-component programmes and identifying an appropriate theory to underpin the study, as a recent meta-analysis by Owen *et al.* (2017) found these interventions to be more effective at increasing PA. The methods for monitoring PA should also be considered for future studies, ensuring the method chosen is acceptable to the participants.

4.7 Strengths and Limitations

The co-creation of this programme between the researcher and students, underpinned by the BCW, is a strength. Involving the participants in the design of the content within provided them with ownership and autonomy. However, the researcher's involvement in the evaluation is a potential limitation. Future studies should use different methods of monitoring PA that are acceptable to adolescent girls.

4.8 Conclusion

It is feasible to involve adolescent girls in the co-creation of a PA programme under the guidance of the BCW. This study makes an important contribution to existing evidence on the development of theory-driven school-based public health interventions.

4.9 Link with Previous Chapters

The findings of this chapter link to some of the previously identified gaps in the literature (*section 2.4*), assessing the feasibility of involving youth voice in the design of a PA intervention using relevant behaviour change theory.

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Chapter 5: Maternal Correlates of Pedometer and Self-Report Assessed Physical Activity in Adolescent Girls

Chapter 5: Maternal Correlates of Pedometer and Self-Report Assessed Physical Activity in Adolescent Girls

Preamble

The following article reports a cross-sectional study investigating potential maternal correlates of adolescent girls' physical activity measured via pedometers and self-report questionnaires. This manuscript has been submitted for peer review for publication in *Maternal and Child Health*, impact factor 2017; 1.788 (Journal Citation Reports®, 2018 release).

The following is the citation for this article:

Corr, M., Murtagh, E. (Under Review). Maternal Correlates of Adolescent Girls' Physical Activity Measured Via Device-Based and Self-Report Measures. Submitted to *Maternal and Child Health* for publication (Impact Factor 1.788).

Statement of authorship;

I hereby declare that I, Méabh Corr, am the principal author of this article. The following statements outline my contributions to the work:

- Substantial contributions to the conception and design of the work; the acquisition, analysis and interpretation of data for the work; AND
- Drafting of work and revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

(See Appendix A for signed Statement of Authorship)

5.1 Purpose of Chapter

5.1.1 Rationale

The following cross-sectional study was conducted to assess any potential maternal correlates of adolescent girls' device-based and self-report PA. Available evidence demonstrates that it is possible to increase the PA levels of adolescent girls through school-based interventions, however effects are often modest in nature. As was established in the literature review, there is some evidence to support the involvement of family members in PA interventions, with some research even suggesting that without family involvement long-term changes to PA behaviours may not be possible. One of the aims of this thesis is to investigate PA promotion strategies for adolescent girls, but to date research involving mothers and teenage daughters is scarce. There is also a paucity of research investigating maternal correlates using valid and reliable measures of PA. Therefore, this study aimed to investigate potential correlates using such measures.

5.1.2 Contribution to the field

This study adds an important contribution to the field, identifying several significant positive maternal correlates of girls' PA. This study is novel in that it uses a combination of valid and reliable self-report and device-based measures of PA. The findings support the involvement of mothers in PA promotion strategies for adolescent girls.

5.2 Abstract

Objectives:

Some evidence exists to suggest that mothers can impact the health behaviours of their daughters (Jacobi *et al.* 2011). The aim of this study was to investigate maternal correlates of activity in girls (age 12-16 years).

Methods:

A cross-sectional design assessed maternal correlates of physical activity in adolescent daughters (n=42 mothers, n=42 daughters). Physical activity levels of mothers and daughters was measured for 7 days via sealed pedometer (Yamax Digiwalker CW701) and daughters also completed the Physical Activity Questionnaire for Adolescents (PAQ-A). Maternal outcomes included age, occupation, education and body mass index (BMI) daughters' health related quality of life (reported by mothers), co-participation in activity, parenting practices and parent-adolescent communication. Correlations were calculated using Pearson's correlations and differences were calculated using a two-way ANOVA.

Results:

Daughters' steps were positively correlated with mothers' steps ($r=.310$), open communication ($r=.322$) and physical well-being as reported by mothers ($r=.517$) ($p < 0.05$). Daughters' PAQ-A scores were also positively correlated with mothers' steps ($r=.353$), mothers' total MET mins ($r=.344$), logistic support ($r=.385$) and explicit modelling of PA ($r=.365$) ($p < 0.05$). No correlation was found between mothers' age, education or occupation and daughters' physical activity.

Conclusions for Practice:

Mothers' activity levels were positively associated with pedometer-measured and self-report physical activity of adolescent girls. These findings highlight the potentially important role mothers can play in physical activity promotion for their daughters. Further research into mother-daughter interventions is needed to assess the effectiveness of an inter-generational approach to physical activity promotion.

Keywords: Physical Activity, Correlates, Adolescent Girls, Pedometer, Maternal Influence

5.3 Background

Regular physical activity (PA) can positively impact physical and psychological health (Hills *et al.* 2015). However, rising levels of global inactivity have contributed to the development of many non-communicable diseases and preventable deaths worldwide (World Health Organisation 2010). Physical inactivity is now recognised as the fourth leading risk-factor for global mortality (World Health Organisation 2010). Women are less active than men and almost 95% of adolescent girls are considered insufficiently active (Hallal *et al.* 2012). The low levels of activity among adolescent girls is a global concern, and the marked difference in PA between males and females increases with age (Hallal *et al.* 2012). Adolescent behaviours are predictive of adult behaviours, therefore promoting a healthy lifestyle at this stage is crucial to shape healthy adult behaviours (Pearson *et al.* 2015).

There are several influences on PA participation during adolescence, and girls cite many barriers to their participation (Edwardson *et al.* 2015), including feeling incompetent, having competing priorities during adolescence and disliking organised sport (Corr *et al.* 2018a). Several interventions have targeted the PA behaviours of this cohort, yet to date have only demonstrated modest effects (Pearson *et al.* 2015). The promotion of PA within this group is complex, and novel approaches are needed along with a deeper understanding of the potential influences on girls' PA. There is some evidence to suggest that mothers can have a positive influence on their daughters' PA levels (Jacobi *et al.* 2011). Studies investigating potential correlates have showed positive associations between maternal PA levels and adolescent PA levels (Jacobi *et al.* 2011), maternal logistic support and adolescent PA (Raudsepp 2006) and parental education level and adolescent PA (Sherar *et al.* 2009). However, a review by Biddle *et al.* (2005) found an indeterminate relationship with mothers' PA and daughters' PA (Biddle *et al.* 2005). Eleven of the 51 studies in this review used device-based and self-report measures of PA, and of these 11, only 3 studies used a combination of valid and reliable self-report and device-based measures of PA (Biddle *et al.* 2005). The other studies within this review that used a combination of device-based and self-report measures did not use valid or reliable methods of measuring PA, leading to a scarceness of high-quality research in this area.

There is some available evidence to demonstrate positive maternal correlations with girls' PA using valid device-based measures. In a study by Barnes *et al.* (2015), there was a significant relationship between daughters' PA (mean age 8.8 years) and mothers' PA measured via accelerometer (Barnes *et al.* 2015a). Other studies using accelerometer data have found positive associations between adolescent PA and maternal education, with ages of participants ranging from 9 to 14 years (Sherar *et al.* 2009). Alternative device-based measures have been used to investigate the potential correlation between maternal and adolescent PA, including a study using pedometers by Jacobi *et al.* (2011). Participants in this study ranged in age from 8 to 18 years and PA was measured over a 7-day period, with step counts recorded by participants in a diary. The results of this study indicated significant parent correlations in mothers, and these were stronger between mothers and daughters (Jacobi *et al.* 2011). However, the age of participants within these studies varies, and there is a paucity of research focusing on maternal correlates of adolescent PA using valid and reliable measures.

Understanding why adolescent girls engage or disengage from PA is important and can contribute to the continued evidence-based planning of PA interventions by targeting specific factors shown to influence or be related to activity (Bauman *et al.* 2012). More recent evidence has highlighted the potential of mother-daughter interventions to increase the PA levels of girls, but there is little available evidence to support this approach with adolescents (Barnes *et al.* 2018). Therefore, investigating maternal correlates of adolescent girls' PA could aid the design of mother-daughter interventions, allowing specific factors to be targeted in an intervention. The aim of this study was to investigate the maternal correlates of PA in adolescent girls (age 12-16 years) using device-based measures (daily steps measured via pedometer) and self-report measures of PA (PAQ-A questionnaire). Maternal correlates included mothers' PA (measured via pedometer and the International Physical Activity Questionnaire), mothers' age, occupation and education, parent-adolescent communication (Barnes and Olson 1985), co-participation in activity (Lee *et al.* 2010) and health related quality of life (HRQoL) (Ravens-Sieberer *et al.* 2007) and physical activity parenting practices, which includes logistic support for PA and explicit modelling of PA (Davison *et al.* 2003). The correlates investigated in this study included a combination of those shown previously to demonstrate positive relationships, as well as modifiable factors that could be

targeted in an intervention (e.g. PA levels or encouragement of explicit modelling of PA).

5.4 Methods

The reporting of this study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (von Elm *et al.* 2008) (Appendix V).

5.4.1 Study Design

This study was cross-sectional in design to assess maternal correlates of adolescent girls' PA. Correlations were calculated using Pearson correlations and differences in adolescent girls' PA levels based on mothers' age, occupation and education level were calculated using a two-way ANOVA.

5.4.2 Participants

Mothers and their teenage daughters (12-16 years) in this study were recruited into the Supporting Our Lifelong Engagement: Mothers and Teens Exercising (SOLE MATES) feasibility trial in January 2018 (Corr *et al.* 2018b). Baseline data collection from SOLE MATES included data from 58 participants (n=31 daughters, n=27 mothers). Of the 27 mother-daughter dyads recruited, four had more than one daughter. For analysis, mothers and their eldest daughters were included. A further 30 participants (n=15 mothers and n=15 daughters) were recruited January 2019 and included in the analysis. This resulted in a total of n=84 participants (n=42 mothers; n=42 daughters). Participants were recruited via social media and through information leaflets distributed in post-primary schools. Participant and parental consent was required. Ethical approval was obtained from an institutional review board prior to study commencement.

5.4.3 Measures

Various measures were used within this cross-sectional study and an overview of those chosen can be seen below in Table 5.1.

5.4.3.1 Physical Activity

Sealed pedometers (Yamax Digi-walker CW701) with a 7-day memory were worn by participants for 7 consecutive days, measuring their total PA (mean weekly step count). Participants (mothers and daughters) were instructed to wear the pedometer for 7 consecutive days, except when swimming or bathing. A 7-day period was chosen as it is considered as an adequate time-frame to estimate the habitual habits of individuals without burdening the participant (Clemes and Griffiths 2008, Clemes and Biddle 2013)

Participants completed a log book to document non-wear time. Self-report questionnaires were also used to assess activity. Girls completed the Physical Activity Questionnaire for Adolescents (PAQ-A) (Kowalski *et al.* 2004), which is a 7-day recall questionnaire that has been proven to be valid and reliable among adolescents (Kowalski *et al.* 1997). Validity of the PAQ-A has been previously demonstrated by examining correlations between the PAQ-A and other PA measures, including three questionnaires and a Caltrac Motion Sensor accelerometer (Kowalski *et al.* 1997). It was hypothesised that the PAQ-A would be moderately correlated with other PA measures (Kowalski *et al.* 1997). Students in the study (n=85, 41 males, 44 females) were assessed over separate two-week periods. Results confirmed the study hypothesis, as the PAQ-A was positively correlated to other PA measures, with Pearson correlations ranging from $r=.33$ to $.73$ ($p<.05$) (Kowalski *et al.* 1997). The PAQ-A provides an overall summary score for PA derived from 8 items which are scored on a 5-point Likert scale. Scores can range from 1 (indicating low activity) to 5 (indicating high activity) (Kowalski *et al.* 2004). Mothers' self-report PA was measured using the International Physical Activity Questionnaire (IPAQ), which has been shown to demonstrate acceptable reliability and validity (Craig *et al.* 2003) with results from the questionnaire presented as total metabolic equivalent (MET) minutes. Criterion validity and test-retest reliability of the IPAQ short version has been demonstrated across 12 countries, with participants completing the questionnaire over two time points and wearing an accelerometer to monitor PA levels (Craig *et al.* 2003). Criterion validity between the questionnaire and the accelerometer showed fair to moderate agreement when tested on n=781 participants ($\rho= 0.30$, 95% CI 0.23–0.36) (Craig *et al.* 2003). The questionnaire also demonstrated acceptable levels of reliability, with 75% of the Spearman correlation coefficients above $\rho=.65$, and ranging from $\rho=.32$ -.88 (Craig *et al.* 2003).

5.4.3.2 Anthropometric Characteristics

Weight of both mothers and daughters was measured to the nearest 0.1kg, in light clothing and without shoes (Seca 899 flat scales). Height was measured using a stadiometer (Leicester Height Measure) to the nearest 1mm. Body mass index was calculated using the standard equation, weight kg/height m².

5.4.3.3 Maternal Correlates

Maternal correlates included mothers' anthropometric characteristics (BMI), demographic characteristics, parenting practices for PA (Davison *et al.* 2003), parent-adolescent communication (Barnes and Olson 1985), co-participation in PA (Lee *et al.* 2010) and HRQoL (Ravens-Sieberer *et al.* 2005). All the following questionnaires were completed by mothers. Basic demographic characteristics were recorded via questionnaire designed by the researchers (e.g. age, education, work situation and ethnicity). Mothers' parenting practices were measured using the parents' activity-related parenting practices questionnaire (Davison *et al.* 2003). This questionnaire assesses explicit modelling of PA and logistic support for PA. The questionnaire was developed by assessing girls' PA levels and developing a questionnaire to assess ways parents promoted PA for their daughters (Davison *et al.* 2003). Exploratory and confirmatory factor analysis identified the two sub-scales of the questionnaire, logistic support and explicit modelling (Davison *et al.* 2003). Acceptable internal consistency for both scales was demonstrated (Cronbach's α ranging from 0.61-0.75) (Davison *et al.* 2003). Parent-adolescent communication was measured using the Parent Adolescent Communication Scale (PACS) (Barnes and Olson 1985). This scale is divided into "open" and "problem" communication, with the "open" scale measuring the degree of openness in family communication and the "problem" scale measuring perceived problems with communication (Barnes and Olson 1985). This questionnaire has demonstrated acceptable internal consistency, with alpha's of $r=.87$ and $r=.78$ for the open and problem subscale respectively (Barnes and Olson 1985). Test-retest reliability of both scales has also been demonstrated, with alpha's of $r=.78$ for the open communication scale and $r=.77$ for the problem scale (Barnes and Olson 1985). Co-participation in activity was also measured, using a questionnaire assessing the number of days per week when mothers and daughters were active together (Lee *et al.* 2010). This questionnaire has previously demonstrated acceptable reliability and validity and has been used as a measure of co-participation between parent-child dyads in other family based PA interventions (Morgan *et al.* 2011, Morgan *et al.* 2018). Finally, HRQoL was measured using the KIDSCREEN-27 questionnaire parent-proxy (Ravens-Sieberer *et al.* 2007). Mothers reported their perceptions of various aspects of their daughter's health (Ravens-Sieberer *et al.* 2005), examining areas of physical wellbeing, psychological wellbeing, autonomy and parents, social support and peers and school

environment. The KIDSCREEN-27 was developed as part of a project promoted by the European Union to allow for international comparability of HRQoL for children and adolescents (Ravens-Sieberer *et al.* 2014). A total of 13 European countries were involved in the development of the questionnaire, and it has demonstrated acceptable reliability (Cronbach's alpha ranging between 0.80-0.84) and moderate to high convergent validity between other quality of life questionnaires measuring similar constructs (Ravens-Sieberer *et al.* 2014).

Table 5.1 Measures used for mothers and daughters

Outcome	Description
Daughters only	
Self-report Physical Activity	Self-report physical activity levels of the daughters was assessed using the Physical Activity Questionnaire for Adolescents (Kowalski <i>et al.</i> 2004) (PAQ-A). The PAQ-A is a 7-day re-call instrument which produces a summary score of PA levels ranging from 1-5.
Mothers only	
Quality of Life	Quality of Life was assessed using the KIDSCREEN-27 Health Questionnaire for children and young people (Ravens-Sieberer <i>et al.</i> 2005). The questionnaire assesses the following domains; physical wellbeing, psychological wellbeing, autonomy and parents, social support and peers and school environment. Mothers reported their perception of their daughters' health and well-being using the parent-proxy of the questionnaire
Physical Activity Parenting Practices	Parenting practices will be measured using the parents' activity-related parenting practices questionnaire (Davison <i>et al.</i> 2003). This questionnaire assesses explicit modelling of physical activity and logistic support for physical activity.
Demographics	A questionnaire was used to record basic demographic characteristics of mothers (e.g. age, education, work situation and ethnicity)
Communication	Communication was measured using the <i>Parent Adolescent Communication Scale</i> (PACS) (Barnes and Olson 1985)
Co-participation in activity	Co-physical activity was assessed using a questionnaire on the number of days per week when mothers and daughters were active together (Lee <i>et al.</i> 2010)
Mothers and Daughters	
Total Physical Activity	Mothers' and daughters' total physical activity (mean weekly step count) was measured using a sealed pedometer with a 7-day memory (Yamax CW701). Participants were instructed to wear the pedometer for 7 consecutive days, except when swimming or bathing. A 7-day period was chosen as it is considered as an adequate time-frame to estimate an individual's habitual habits without burdening the participant (Clemes and Griffiths 2008, Clemes and Biddle 2013). To be included in the analysis, participants were required to have at least 4 full days of pedometer data, including one weekend day (Tudor-Locke <i>et al.</i> 2009). Outliers in data were identified as days with <1,000 or >30,000 steps (Rowe <i>et al.</i> 2004). Average daily step counts were then calculated for mothers and daughters. Participants completed a logbook to document non-wear time. Logbooks were used as a tool to encourage compliance with wearing the pedometer.

5.4.4 Analysis

Data was managed and analysed using the statistical software package SPSS (version 25) (IBM Corp 2017). Frequencies were calculated to ensure the data was normally distributed. Homogeneity of variances was tested using Levene's test of normality of SPSS, with all data meeting the assumptions of normality. Maternal associations of girls' PA measures were calculated using Pearson's correlations and a two-way ANOVA was used to examine differences in girls' PA based on mothers' age, occupation and education level (95% CI). Maternal correlates for daughters' PA included daily step counts, age range, BMI, work status, education level, parenting practices (logistic support and explicit modelling), co-participation in activity, parent-adolescent communication and HRQoL (as reported by mothers). Strengths of the correlations were interpreted using Cohen's suggested guidelines, indicating $r = .10-.29$ as a small correlation, $r = .30-.49$ as a medium correlation and $r = .50-1.0$ as a large correlation (Cohen 1988).

5.5 Results

Demographic characteristics, PA results and other outcome variables measured are summarised in Table 5.2. A total of 42 mothers and 42 daughters were included in the analysis. Most mothers who took part had a body mass index (BMI) in the overweight category, with an average BMI of 27.7 ± 5.6 . Daughters were primarily in the normal weight category, with an average BMI of 22.2 ± 4.3 , based on the WHO growth reference for school-aged children and adolescents (Onis *et al.* 2007). Just over half of mothers (51%) had completed third level education, with 38% completing postgraduate degrees. Pedometer assessed activity levels were low, with an average of $7,653 \pm 3,066$ and $6,465 \pm 2,092$ daily steps for mothers and daughters respectively. This is significantly lower than the recommended 10,000-11,700 steps a day for adolescents (Tudor-Locke *et al.* 2011a) and 10,000 steps a day for adults (Tudor-Locke *et al.* 2011b). Self-report levels of PA of adolescent girls were also low, with an average summary score of 2.3 ± 0.5 , as cut-off points for the PAQ-A have indicated a score of 2.7 is best used to discriminate between those meeting PA guidelines and those not (Voss *et al.* 2013, Benítez-Porres *et al.* 2016).

Table 5.2 Participant Characteristics

		Daughters		Mothers	
		MEAN (SD)		MEAN (SD)	
Variable		<i>N=42</i>		<i>N=42</i>	
Age in years		14.2 (1.3)		45.5 (5.8)	
Body Mass Index (BMI)		22.2 (4.3)		27.7 (5.6)	
Education	<i>First Year</i>	32.3%	<i>Leaving cert¹</i>	9.5%	
	<i>Second Year</i>	23.5%	<i>Diploma</i>	28.5%	
	<i>Third Year</i>	18.6%	<i>Degree</i>	19%	
	<i>Transition Year</i>	25.5%	<i>Postgraduate</i>	38%	
Employment Status (% of mothers)		-	<i>Employee</i>	73.8%	
		-	<i>Self-employed</i>	2.3%	
		-	<i>Unemployed</i>	2.3%	
		-	<i>Home Duties</i>	11.9%	
		-	<i>Other</i>	9.4%	
Average Steps		6,465 (2,092)		7,653 (3,066)	
PAQ-A		2.3 (0.5)		-	
Co-Participation		-		1.5 (1.7)	
PACS	<i>Total</i>	-		75.6 (9.8)	
	<i>Open</i>	-		39.1 (4.8)	
	<i>Closed</i>	-		36.6 (6.5)	
KIDSCREEN	<i>Physical Wellbeing</i>	-		45.1 (11.3)	
	<i>Psychological Wellbeing</i>	-		46.7 (10.0)	
	<i>Autonomy & Parents</i>	-		49.6 (10.1)	
	<i>Social Support</i>	-		42.9 (10.4)	
	<i>School Environment</i>	-		53.0 (8.4)	
Parenting Practices	<i>Logistic Support</i>	-		2.9 (0.7)	
	<i>Explicit Modelling</i>	-		2.8 (0.8)	

¹ The Leaving Certificate Examinations, commonly referred to as the Leaving Cert, is the final set of State Examinations completed in Irish Post-Primary Schools.

Bivariate correlations for maternal outcomes of girls' PA are presented in Table 5.3. Significant positive correlations were found between daughters' mean daily steps and the following maternal correlates; mothers' mean daily steps, levels of open communication and physical wellbeing of daughter as reported by their mother. Other significant positive correlations were found between daughters' PAQ-A score and the following maternal correlates; mothers' daily steps, mothers' total MET mins, mothers' logistic support and explicit modelling and daughters' physical wellbeing. Most correlations were small to medium in nature, with large associations found for daughters' PA and mothers' perceptions of physical wellbeing.

Table 5.3 Maternal correlates of adolescent girls' physical activity

Maternal Variables (N=42)	Daughter's Variables (N=42)	
	Mean Daily Steps	PAQ-A Score
Daily Steps	.310*	.353*
Body Mass Index (BMI)	.097	-.0145
Total MET Mins (Self-report from IPAQ)	.266	.344*
Logistic Support	.186	.385*
Explicit Modelling	.106	.364*
Open Communication	.322*	-.137
Problem Communication	-.025	-.071
Co-participation with daughter	-.018	-.042
Physical Wellbeing	.517**	.536**
Psychological Wellbeing	.199	.268
Autonomy & Parents	.188	-.144
Social Support and Peers	.220	.023
School Environment	.208	.175

*Correlation is significant at the 0.05 level ** Correlation is significant at the 0.01 level.

A two-way analysis of variance (ANOVA) examined the differences and interaction effects of mothers' age, occupation and education level on daughters' mean daily steps. There was no statistically significant interaction between the effects of mothers' age and work ($F(1, 23) = .365, p = .551$), mothers' age and education level ($F(2, 23) = .1142, p = .353$) and mothers' work and education level ($F(3, 23) = .272, p = .845$) on daughters' PA levels. A Tukey post-hoc analysis revealed there was not any statistically significant individual interactions between mothers' age, education or work on daughters' steps ($p > 0.05$).

5.6 Discussion

The main objective of this study was to investigate maternal correlates of PA in adolescent girls using valid and reliable device-based measures and self-report measures of PA. Several maternal factors were found to be significant, including mothers' PA levels and specific parenting practices (i.e. logistic support and explicit modelling).

This current study found a significant medium positive association between adolescent girls' daily step counts with mothers' daily step counts ($r = .310$) (Cohen 1988). Mothers' activity (as measured by pedometer and self-report IPAQ questionnaire) also showed significant medium positive correlations with daughters' self-report PA as measured through the PAQ-A ($r = .353$ and $r = .344$ respectively) (Cohen 1988). Medium correlations have also been demonstrated in previous research investigating maternal correlates of daughters' PA. In a study by Jacobi et al. (2011) investigating parent-offspring correlations of pedometer assessed activity, a significant positive relationship was found between mothers' steps and daughters' steps ($r = .24$) (Jacobi *et al.* 2011). Similarly, in a study by Raudsepp and Viira (2000) mothers' moderate intensity PA was significantly related to daughters' PA levels ($r = 0.17, p < 0.01$) (Raudsepp and Viira 2000). As previously mentioned, there is a paucity of research with adolescents investigating maternal correlates using valid and reliable device-based and self-report measures to assess PA. Within this study, the use of a pedometer to record PA provides a general overview of the volume of PA engaged in by the participants measured through daily step counts, and the PAQ-A questionnaire provides an overall summary score for PA participation. The positive associations between mother and daughter PA, through both device-based and self-report measures, have important implications for those designing interventions aiming to increase the PA levels of adolescent girls. While

causation cannot be determined, the findings indicate that a potential strategy to improve adolescent girls' PA is to target mothers and daughters simultaneously. In a paper by Trost *et al.* (2003) evaluating a model of parental influence on youth PA it was recommended that interventions should include components which allow parents to increase the frequency of co-participation in PA with their children (Trost *et al.* 2003). These findings from this study support the idea of family-based interventions, particularly mother-daughter interventions, to help increase the PA levels of adolescent girls due to the positive correlations between mothers' activity levels and daughters' activity levels.

No significant relationship was found between daughters' steps or self-report PA and mothers' education or occupation status. This finding contradicts some of the available evidence, as other research has shown that higher family socio-economic status (SES), and in particular higher maternal education, is positively associated with adolescent girls' PA (Biddle *et al.* 2005, Ferreira *et al.* 2007, Gorely *et al.* 2009, Sherar *et al.* 2009, Stearns *et al.* 2016). SES is one of the most commonly cited factors that contributes to health disparities evident in populations (Shavers 2007), and can have an impact on future occupational opportunities and earning potential (Shavers 2007). The disparities in the adoption of healthy behaviours between SES groups has been well documented in childhood, adolescence and adulthood, with lower levels of SES often being associated with negative health behaviours (Sallis *et al.* 1992, Hanson and Chen 2007). In particular when examining education, a study by Sherar *et al.* (2009) found girls of university educated mothers participated in higher levels of MVPA when compared to girls with non-university educated mothers. In this current study, over half of the mothers who participated (57%) were university educated yet this did not appear to significantly influence the association with activity levels of their daughters. When measuring SES, education is one of the most widely used indicators of SES as it is easy to categorise and therefore was used as the main measure of SES in this study. Our findings suggest that some maternal characteristics (i.e. education and occupation) are not associated with the PA levels of adolescent girls. This is an important finding, especially when considering the family environment and its role in influencing the PA behaviours of adolescent girls (Brown *et al.* 2016). The influences on adolescent PA are multi-factorial, and parental involvement in PA has been recommended as a potential intervention strategy for adolescent girls, yet to date very few high-quality studies have

been conducted and the effectiveness of this approach remains uncertain (van Sluijs *et al.* 2011, Uijtdewilligen *et al.* 2017). The findings from this study indicate that mothers' PA levels are positively associated with the PA levels of their adolescent daughters, regardless of education or SES. While our findings do not take causation into account, the lack of association between maternal occupation and daughters' PA and maternal education level and daughters' PA is an interesting finding, as it contradicts previous research. However, it must be noted that our sample contained a largely homogenous group of participants from similar backgrounds, making it difficult to generalise these findings to a wider population.

A significant and large correlation was found between both daughters' daily steps and PAQ-A score and mothers' perception of their child's physical well-being ($r=.517$, $p<0.01$ and $r=.536$, $p<0.01$ respectively) (Cohen 1988). Physical well-being refers to a child/adolescent's PA, energy and fitness and the extent to which the adolescent feels unwell or complains of poor health (Ravens-Sieberer *et al.* 2005). Increased energy levels, improved feelings of health and wellbeing and improved cardiovascular health are well documented benefits of regular PA (Strong *et al.* 2005, Janssen and LeBlanc 2010). Our results indicated a positive association between daughters' PA levels and their mothers' perceptions of their physical wellbeing. To the author's knowledge, there is little evidence available for parental perception of adolescent physical well-being and actual adolescent PA levels. While a large positive association was found, it is important to note that girls participating in this study had low levels of PA, with average daily steps of $6,465 \pm 2,092$ and a mean PAQ-A score of 2.3 ± 0.5 . It is recommended that adolescents accumulate between 10,000-11,700 steps a day (Tudor-Locke *et al.* 2011a), and as already stated a PAQ-A score of less than 2.7 indicates an individual who is failing to accumulate 60 minutes of MVPA (Voss *et al.* 2013). Only 9.5% ($n=4$) girls in this study had an average weekly step count of at least 10,000 steps and 19% ($n=8$) scored over 2.7 in the PAQ-A questionnaire. This could indicate that, despite the positive association between the two variables, perhaps mothers are not fully aware of the extent to which their daughter is or is not achieving sufficient PA for optimal physical well-being. Therefore, it is important that future interventions aim to educate mothers on the PA guidelines and equip them with the necessary skills and knowledge to support their daughters' PA levels and help them increase their daily PA.

Finally, significant positive correlations were found for adolescent girls' PAQ-A score and mothers' levels of logistic support ($r=.385$, $p<0.05$) and explicit modelling ($r=.364$, $p<0.05$). The positive correlation between girls' PA and mothers' logistic support confirms findings noted in several other studies (Sallis *et al.* 2000, McGuire *et al.* 2002, Davison *et al.* 2003, Raudsepp 2006, Bauman *et al.* 2012, Verloigne *et al.* 2012). Our findings are very similar to those reported by Raudsepp (2006), who found a significant positive correlation between adolescent girls' PA and mothers' logistic support ($r=.33$, $p<0.05$) and mothers' explicit modelling ($r=.31$, $p<0.05$) (Raudsepp 2006). These results illustrate the importance of maternal support for girls and the positive impact it can have on PA levels. The positive association between adolescent girls' PA and mothers' levels of explicit modelling (i.e. using their behaviour to encourage their daughter) is novel, as this hasn't been demonstrated to the same extent that logistic support has in the literature, particularly with adolescents. Mothers are often the first female role model for their daughters, and as such, their attitudes and behaviours can directly impact those of their daughters (Bandura and Walters 1977, Northrup and Kaye 2005). This theory is evident within the findings, as higher self-report levels of PA for daughters was positively associated with mothers' PA and mothers' levels of explicit modelling. Like the association between mothers' PA and daughters' PA, this finding demonstrates that perhaps targeting mothers and daughters simultaneously may be a promising intervention strategy to increase PA levels. Interventions targeting both mothers and daughters should include components for mothers to encourage their logistic support for PA for their daughters, providing advice on how best to support their daughter to live a physically active lifestyle. Interventions should also advocate for increased explicit modelling of PA. Mothers should be encouraged to be active role models for their daughters, as our results indicated higher levels of explicit modelling was positively associated with girls' PA levels.

5.7 Strengths and Limitations

A strength of this study is the examination of maternal correlates of device-based and self-report measures of PA for adolescent girls using valid and reliable methods, as much of the research to date has focused mainly on primary school aged children. Limitations include the cross-sectional design of the study which does not allow for causality to be determined. Another important limitation is the small sample size used within this study, making it difficult to generalize the findings to a wider population.

Similarly, the sample size contained a relatively homogenous sample of mothers and daughters from the same geographic area.

5.8 Conclusion

This study adds to the currently available literature relating to maternal correlates of device-based measures of PA in adolescent girls and supports recommendations for including family members in PA interventions, particularly mothers. This study indicates that daughters' PA is positively correlated with mothers' PA, perceptions of physical well-being and levels of logistic support and explicit modelling. Future interventions should aim to target mothers and daughters simultaneously, as there is a positive association between mothers' PA levels and daughters' PA levels. It is important to note that participants within this group were inactive in comparison to recommended guidelines, supporting the need to intervene and increase PA levels. This should include involvement from mothers, with intervention components designed to educate them about the PA guidelines and provide strategies and knowledge to enable them to help their daughters increase their PA levels.

5.9 Link to Previous Chapters

This study adds to the evidence base of maternal correlates for adolescent girls' PA as discussed in *section 2.2.2* of the literature review which highlighted the potential positive effects of family members in PA interventions. However, very little evidence exists demonstrating the potential effectiveness of this approach. Conducting a cross-sectional study identified several positive maternal correlations of girls' PA and supports the involvement of mothers in PA programmes for their daughters.

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Chapter 6: Supporting Our Lifelong Engagement: Mothers and Teens Exercising (SOLE MATES): A Feasibility Trial

Chapter 6: Supporting Our Lifelong Engagement: Mothers and Teens Exercising (SOLE MATES): A Feasibility Trial

Preamble:

The following article reports the results of a feasibility study assessing the preliminary acceptability of a mother-daughter multi-component PA programme to increase the PA levels of adolescent girls. This manuscript is currently undergoing peer review for publication in *Women & Health*, impact factor 2015; 1.377 (Journal Citation Reports®, 2018 release).

The following is the citation for this article:

Corr, M., McMullen, J., Morgan, P., Barnes, A. and Murtagh., E (Under Review). Supporting Our Lifelong Engagement: Mothers and Teens Exercising (SOLE MATES); A Feasibility Trial. Submitted to *Women & Health* (Impact Factor 1.307).

Statement of authorship;

I hereby declare that I, Méabh Corr, am the principal author of this article. The following statements outline my contributions to the work:

- Substantial contributions to the conception and design of the work; the acquisition, analysis and interpretation of data for the work; AND
- Drafting of work and revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

(See Appendix A for Signed Statement of Authorship)

6.1 Purpose of Chapter

6.1.1 Rationale

To date, most PA interventions for adolescent girls have been conducted in school settings. The potentially positive role of family members, particularly mothers for their daughters, has been highlighted, however very few studies have assessed the effectiveness of an inter-generational approach to PA promotion with adolescent girls. Therefore, *SOLE MATES* aimed to assess the feasibility of this approach before conducting a full RCT.

6.1.2 Contribution to the field

SOLE MATES was the first inter-generational multi-component PA programme conducted in the Republic of Ireland and the study results add an important contribution to the field. Outcome measures moved in the expected direction and feasibility metrics demonstrated the acceptability of the programme, all of which are indicative of programme success. This study strengthens the evidence base of the available mother-daughter PA promotion literature, illustrating that multi-component PA programmes are feasible and acceptable, providing justification for the development of an RCT to assess the true effectiveness of *SOLE MATES* on PA levels and mother-daughter relations.

6.2 Abstract

Purpose: The purpose of this study was to examine the feasibility of the Supporting Our Lifelong Engagement; Mothers and Teens Exercising (*SOLE MATES*) programme, a multi-component physical activity programme.

Methods: *SOLE MATES* was a single-arm feasibility trial conducted between January-March 2018. Participants were mothers (n=27) with daughters (n=31) approximately 12-16 years. *SOLE MATES* comprised of 6 face-to-face sessions lasting 90 minutes, home based tasks and media-based resources. Feasibility benchmarks examined recruitment, data collection, acceptability, resources and preliminary participant responses. The primary outcome was daughters' daily step count, measured via sealed pedometer for 7 consecutive days at baseline and post assessments, conducted immediately post-intervention. Secondary outcomes included mothers' daily step count, and questionnaire-based measures of parent-adolescent communication, co-participation in physical activity, health related quality of life and parenting practice. A sub-set of mothers (n=9) and daughters (n=10) also participated in post-intervention focus groups to discuss programme satisfaction. Ethical approval was granted by institutional review board. Written informed consent was obtained.

Results: Feasibility benchmarks were reached or exceeded, except for retention. Eligibility rates were 93.4%, and baseline activity levels of participants were low. Programme content, measures and facilitators were acceptable as demonstrated through a mean score of 4.14 (SD 0.3) on a 5-point Likert Scale. Positive preliminary findings for outcome measures included changes in daily steps of mothers (2,875 step increase, p=0.009) and daughters (1,393 step increase, p=0.007).

Conclusion: Positive feasibility metrics, including acceptability of programme content, facilitators, and high eligibility rates demonstrate the programme appeal. Positive participant responses for outcome measures also indicate the likelihood of programme success. The intervention should be evaluated in a randomised controlled trial.

Keywords: Physical Activity, Adolescence, Behaviour Change, Maternal, Feasibility Study, Female

6.3 Introduction

Regular participation in physical activity (PA) provides numerous physical and psychological health benefits (Dumith *et al.* 2011, Eime *et al.* 2013, Hills *et al.* 2015), including improved cardiovascular health and mental wellbeing (Dumith *et al.* 2011, Eime *et al.* 2013, McMahon *et al.* 2017). However, despite the benefits of engaging in regular PA, physical inactivity had been identified as the fourth leading risk factor of global mortality (World Health Organisation 2010).

PA guidelines recommend that adolescents engage in 60 minutes of moderate to vigorous physical activity (MVPA) a day to achieve health benefits (World Health Organisation 2010). However, globally, adolescents do not accumulate sufficient PA (Hallal *et al.* 2012) with 78.4% of males and 84.4% of females being considered inactive (Sallis *et al.* 2016). There is a marked decline in PA participation from childhood to adolescence, with this decline being greater in girls than boys (Camacho-Minano *et al.* 2011, Farooq *et al.* 2018). Adolescent PA behaviours are predictive of adult behaviours (Gordon-Larsen *et al.* 2004, Telama 2009), therefore promoting a healthy lifestyle at this stage is crucial to shape the PA behaviours for adulthood (Pearson *et al.* 2015).

In response to low activity levels, several interventions have been designed with the aim of improving adolescent PA yet have only demonstrated modest effects to date (Pearson *et al.* 2015). A large proportion of interventions have been based in school settings, however consideration of the family environment in influencing PA behaviours is essential (Brown *et al.* 2016, Uijtdewilligen *et al.* 2017). Parents play an important role in shaping their child's PA levels (Thompson *et al.* 2010, Stearns *et al.* 2016) and there may be a differential impact of parents based on parent and child sex (Uijtdewilligen *et al.* 2017).

Mothers and daughters have a unique relationship, and girls with maternal support are more likely to engage in PA (Cleland V *et al.* 2011, Jacobi *et al.* 2011). A daughter's beliefs or behaviours can often develop as a response to those of their mother and mothers can play an important role in shaping or promoting the healthy behaviours of their children, in particular their daughters (Aronowitz *et al.* 2005, Northrup and Kaye 2005). Therefore, there is some evidence to suggest that the influence of mothers can have a positive effect on adolescent girls' PA levels (Jacobi *et al.* 2011, Cleland and

Ball 2013), and therefore an intergenerational approach to PA promotion may be successful with this population. However, only a limited number of studies to date have focused specifically on mother-daughter interventions (Barnes *et al.* 2018). A review by Barnes *et al.* (2018) found many of the current mother-daughter studies had a high risk of bias due to methodological and analytic concerns. Along with high risk of bias, of the 14 studies included in the review, 13 had a specific PA component but only 29% assessed PA using objective measures (Barnes *et al.* 2018). This review highlighted that there is currently insufficient evidence to determine if this inter-generational approach to PA promotion will be successful with this population (Barnes *et al.* 2018). As this is a relatively unexplored area, it is vital to conduct a feasibility study to identify any potential issues before the development of a full-scale trial (El-Kotob and Giangregorio 2018). The aim of this study was to assess the feasibility of *SOLE MATES*, a 6-week mother-daughter multi-component PA programme.

6.4 Methods

The reporting of this study followed the CONSORT extension statement for pilot and feasibility trials (Eldridge *et al.* 2016a) (Appendix W). Formative research conducted under the guidance of the Behaviour Change Wheel (Michie *et al.* 2011b) detailing intervention design has been reported elsewhere (Murtagh *et al.* 2018).

6.4.1 Study Design

Supporting Our Lifelong Engagement: Mothers and Teens Exercising (*SOLE MATES*) was a 6-week one-arm feasibility trial. The design of the intervention, including content and behaviour change techniques used was based on rigorous formative research, the results of which have been reported elsewhere (Murtagh *et al.* 2018).

6.4.2 Participants

Participants were recruited through social media (e.g. Facebook, Twitter) and by distributing flyers to local post-primary schools². Eligible participants were mothers with a daughter approximately 12-16 years old, or in first–fourth year of post-primary school. A total of 145 participants (n=66 mothers, n=79 daughters) expressed interest in the study and were assessed for eligibility. Those who met the inclusion criteria (n=137) were invited to attend baseline assessments at Mary Immaculate College (MIC),

² The post-primary education sector comprises secondary, vocational, community and comprehensive schools catering for students aged 12-18 years in the Republic of Ireland.

Limerick. Of those invited to baseline assessments, n=58 attended (n=27 mothers, n=31 daughters), with n=69 declining to participate and n=10 failing to attend their appointment. Further details on participant flow through the study can be found in Figure 6.1. Participant and parental consent was required. Ethical approval was obtained from an institutional review board prior to study commencement (application no. A17-034).

6.4.3 Interventions

SOLE MATES comprised of group sessions, home based tasks, media strategies and participant resources. Weekly content along with corresponding behaviour change techniques (BCT's) (Michie *et al.* 2011b) used are displayed in Table 6.1.

Face-to-face sessions took place once a week for 6 weeks, lasting approximately 90 minutes. Mothers and daughters attended an introductory meeting (10 mins), and then attended separate education components, delivered by females. Group walking components were completed after the educational sessions. Media strategies included twice weekly text messages to reinforce walking behaviour and a private Facebook group for mothers where relevant content was shared. Participants were asked to complete at least one walk together outside of the programme and received weekly “walk and talk” topics to encourage communication and add an engagement hook (Table 6.1). Individualised, progressive weekly step goals were provided based on participants’ baseline activity levels, encouraging them to increase their daily steps by 1,500 steps on a fortnightly basis. Step goals progressively got more challenging until participants reached an average of 11,000 steps/day for daughters and 10,000 steps/day for mothers on at least five days of the week. These step goal targets were designed during formative research for this study which has been published elsewhere (Murtagh *et al.* 2018).

Table 6.1. Weekly Intervention Components and Corresponding Behaviour Change Techniques

Week	Education	Practical	Home-based	Mobile-Device Strategies (sample text messages)
1	PA and Health – What are the benefits?	Walking with a pedometer	Step goals W&T; What do you hope to get out of SOLE MATES?	Have you gone for a walk this weekend? There is still time! Remember that regular physical activity brings lots of health benefits. (M+D)
2	Overcoming barriers to PA (Mums) Time Management (Daughters)	Walking intensity – walking to music	Step goals W&T; Daughters- pick a news item and discuss it with your mam	Being active reduces your risk of developing cancer. Why not try a group walk on Sat 3 rd Feb for World Cancer day? Check out the list of local walks in your SOLE MATES folder (M+D)
3	Female Role Models (Mums) Challenging Gender Stereotypes (Daughters)	Walking with apps	Step goals W&T; Something I like about myself/something I'm good at	Being active helps build confidence and makes you feel good. Keep an eye out for female role models who are being active around you. This Girl Can! (D)
4	Screen Time	Geocaching	Step goals W&T; Overall, how do you think screen-based devices make teenagers lives better/worse	Have you made your Family Screen-Time agreement yet? Consider screen-free times and zones for every day. Work as a family towards a weekly reward. (M+D)
5	Communication	Incorporating hills	Step goals W&T; Mum – share a time you failed at something, what did you do, how did you handle it?	Good communication between parents and their children is important to maintain healthy lifestyle behaviours in the teenage years. Keep walking, keep talking! (M)
6	Being a PA parent (Mums) Empowerment (Daughters)	Colour Walk	Step goals W&T; Overall impressions of SOLE MATES	Have you made time for walking this week? Make a plan for when you are going to walk with your Mum. Every step counts! (D)
BCT's used	Information about health consequences	Social support (unspecified)	Goal setting (behaviour) Feedback on behaviour	Prompts/cues Information about health consequences

Table 6.1. Weekly Intervention Components and Corresponding Behaviour Change Techniques

Week	Education	Practical	Home-based	Mobile-Device Strategies (sample text messages)
	Information about social and environmental consequences Information about emotional consequences Identification of self as role model Verbal persuasion about capability	Social support (practical) Demonstration of the behaviour Credible source	Self-monitoring of behaviour Social support (unspecified)	Information about social and environmental consequences Credible source

BCT's= Behaviour Change Techniques used during intervention. W&T= Weekly “walk and talk” topic given to participants to encourage parent-adolescent communication when walking together. Text messages; M+D = text sent to mothers and daughters; M=mothers only, D=daughters only

6.4.4 Outcomes

6.4.4.1 Feasibility Benchmarks

Feasibility benchmarks were defined under the guidance of Orsmond and Cohn's objectives for feasibility studies (Orsmond and Cohn 2015). Benchmarks were set by examining the results of previous feasibility studies to ascertain what was deemed acceptable. Recruitment capabilities and sample characteristics were examined from data collected during the recruitment process. An eligibility rate of $\geq 60\%$ of those who expressed interest was deemed feasible (Ashe *et al.* 2015). Participant characteristics were examined, including baseline step counts, socio-economic status (SES) and body mass index (BMI).

Acceptability of data collection procedures and outcome measures were assessed via questionnaires and evaluated in further detail via focus group discussions. A 5-point Likert scale assessed the acceptability of measures used (pedometers, focus group, questionnaires). A pre-determined score of ≥ 3.5 out of 5 was deemed feasible (Barnes *et al.* 2015b).

The acceptability of the intervention and study procedures were assessed by examining retention and adherence rates. Retention was examined by noting the percentage of dyads who remained in the study and a benchmark of 85% was deemed feasible (Ransdell *et al.* 2001). Adherence was assessed through weekly attendance records, with 65% attendance at weekly sessions for dyads being deemed feasible (Ransdell *et al.* 2001). Overall satisfaction levels were assessed using a 5-point Likert scale. A mean score of ≥ 3.5 out of 5 was deemed feasible (Barnes *et al.* 2015b).

The evaluation of the resources and ability to implement the intervention was assessed through records kept by the researchers. Data was stored on password protected computers. Original data, e.g. questionnaires, will be kept in a locked file cabinet for the duration of the project + 3 years, in line with the MIC Record retention Schedule. Reflective questions included examining if the study could be conducted within the allocated budget, could the study be conducted in an ethical manner and if the available technology was sufficient to conduct the study, including the management and analysis of data collected. Participant responses were assessed through data collected at baseline and post-intervention in January 2018 and March 2018 respectively. When examining preliminary participant responses to the intervention the primary outcome was

daughters' daily step counts. Secondary outcomes included mothers' daily step counts, parent-adolescent communication (Barnes and Olson 1985), health related quality of life (Ravens-Sieberer *et al.* 2005), co-participation in activity (Lee *et al.* 2010) and parenting practices for PA (Davison *et al.* 2003). Details of the measures used can be seen in Table 6.2. Preliminary responses were also examined through post-intervention focus groups, allowing the researchers to gain further insights into the participant opinions.

All participants who attended post-assessments completed a feedback questionnaire, assessing acceptability of content, facilitators, measures and the timing of the intervention. A subset of mothers (n=9) and daughters (n=10) completed focus group interviews to examine their satisfaction level with the programme. Four focus groups took place, two for mothers and two for daughters, lasting approximately 35 minutes. The semi-structured focus group interviews were conducted by female researchers who were not involved in programme delivery and who had previous experience facilitating focus groups. Focus groups were transcribed verbatim and pseudonyms were assigned to protect participant identity.

Table 6.2 Measures used at baseline and post-intervention

Outcome	Description
Daughters only	
Self-report Physical Activity	Self-report physical activity levels of the daughters was assessed using the Physical Activity Questionnaire for Adolescents (Kowalski <i>et al.</i> 2004) (PAQ-A). The PAQ-A is a 7-day re-call instrument which produces a summary score of PA levels ranging from 1-5.
Quality of Life^a	Quality of Life was assessed using the KIDSCREEN-27 Health Questionnaire for children and young people (Ravens-Sieberer <i>et al.</i> 2005). The questionnaire assesses the following domains; physical wellbeing, psychological wellbeing, autonomy and parents, social support and peers and school environment.
Mothers only	
Physical Activity Parenting Practices	Parenting practices will be measured using the parents' activity-related parenting practices questionnaire (Davison <i>et al.</i> 2003). This questionnaire assesses explicit modelling of physical activity and logistic support for physical activity.
Demographics	A questionnaire was used to record basic demographic characteristics of mothers (e.g. age, education, work situation and ethnicity)
Mothers and Daughters	
Communication	Communication was measured using the <i>Parent Adolescent Communication Scale</i> (PACS) (Barnes and Olson 1985)
Co-participation in activity	Co-physical activity was assessed using a questionnaire on the number of days per week when mothers and daughters were active together (Lee <i>et al.</i> 2010)
Total Physical Activity	Mothers' and daughters' total physical activity (mean weekly step count) was measured using a sealed pedometer with a 7-day memory (Yamax CW701). Participants were instructed to wear the pedometer for 7 consecutive days, except when swimming or bathing. A 7-day period was chosen as it is considered as an adequate time-frame to estimate an individual's habitual habits without burdening the participant (Clemes and Griffiths 2008, Clemes and Biddle 2013). To be included in the analysis participants were required to have at least 4 full days of pedometer data, including one weekend day (Tudor-Locke <i>et al.</i> 2009). Outliers in data were identified as days with <1,000 or >30,000 steps (Rowe <i>et al.</i> 2004). Average daily step counts were then calculated for mothers and daughters. Participants completed a

logbook to document non-wear time. Logbooks were used as a tool to encourage compliance with wearing the pedometer.

^aMothers also reported their perception of their daughters' health and well-being using the parent version of the KIDSCREEN-27 Health Questionnaire for children and young people (Ravens-Sieberer *et al.* 2005)

6.4.5 Analysis

Mean steps per day for pre and-post measurements were calculated. Questionnaire data were scored according to the relevant scoring protocols, with a paired t-test being used to compare mean scores at pre-and post-measures. Effect sizes for pedometer data were calculated using Cohen's d (Cohen 1988).

Post-intervention focus groups were analysed using directed content qualitative analysis (Hsieh and Shannon 2005), mapping data from the focus groups onto pre-determined codes. Results from the focus group discussions are presented below, with participation quotations in "*italics*". The daughters' focus groups are identified as DFG1 and DFG2 and the mothers' focus groups are identified as MFG1 and MFG2. Participants are identified with participant numbers, e.g. P1, P2.

6.5 Results

6.5.1 Feasibility Benchmarks

6.5.1.1 Evaluation of Recruitment Capability and Resulting Sample Characteristics

From the 66 mothers who expressed interest in the study, 6.06% (n=4) had daughters older than our specified age range, resulting in a 93.4% eligibility rate, exceeding the $\geq 60\%$ benchmark. A total of 27 mothers and 31 daughters (n=58) attended the baseline assessments. This is a large drop in participants from those who expressed interest and may indicate difficulty in recruiting adequate participants for an RCT. During focus groups, participants discussed their motivations to participate in *SOLE MATES* and for all but one dyad, it was the mother who expressed the initial desire to participate in the programme. Mothers saw *SOLE MATES* as an opportunity to improve communication levels, with one mother saying, "*we went through this phase of killing each other, and I saw this on twitter and I thought this'd be good for us, she's gonna do it and love it and we're gonna be great together*" (MFG1, P4). Others saw it as an opportunity to engage in something together "*I just loved the idea of mother and teenage daughter, I thought it was a good excuse to spend time together*" (MFG2, P1). Some daughters were

sceptical at the beginning, saying they “*didn’t want to be seen walking around in this group*” (DFG2, P2). After baseline assessments, 24% (n=14; 6 mothers, 8 daughters) never attended a weekly session. Refusal reasons given included unsuitable day (n=3), daughter was already active (n=1) and unable to participate due to school commitments (n=2).

Baseline activity levels of both mothers and daughters were low, indicating the relevance of the intervention to the population. Average daily steps at baseline were 6,791 (2,705, n=26) and 5,788 (1,595, n=24) for mothers and daughters respectively. A total of n=15 mothers and n=12 daughters had 7 full days of pedometer data, with a subsequent n=11 mothers and n=12 daughters meeting the minimum recording criteria of 4 full days including one weekend day (Tudor-Locke *et al.* 2009). An independent t-test was used to assess any statistically significant differences in average step counts between participants with full pedometer data and those with at least four days. No statistically significant differences were seen for mothers’ average steps (p=0.12) or daughters’ average steps (p=0.47). Baseline characteristics of participants are included in Table 6.3.

6.5.1.2 Evaluation and Refinement of Data Collection Procedures and Outcome Measures

Data collection procedures lasted 30 minutes pre-intervention and 20-25 minutes post-intervention, with the addition of 35-minute focus groups. Questionnaire results assessing programme satisfaction and acceptability are presented in Table 6.3. Overall, the length and number of assessments was deemed acceptable. The timing of the programme (including session and programme length) and venue were also acceptable. The content and facilitators were also highly rated (See table 6.3). Questionnaire results indicated that the sealed pedometers were appropriate and acceptable to participants, with a mean score of 4.1 (0.7) and 3.7 (0.9) on a 5-point Likert scale for mothers and daughters respectively. However, during focus groups, participants discussed issues they experienced with the sealed pedometers, finding it “*bigger and harder to hide*” (DFG2, P1) versus the unsealed pedometer. Some mothers felt they were uncomfortable, particularly those with sedentary jobs. The flow of participants through assessments including any loss of data is detailed in Figure 6.1 below.

Figure 6.1. Participant Flow and Data Collection at Baseline and Post-Assessments

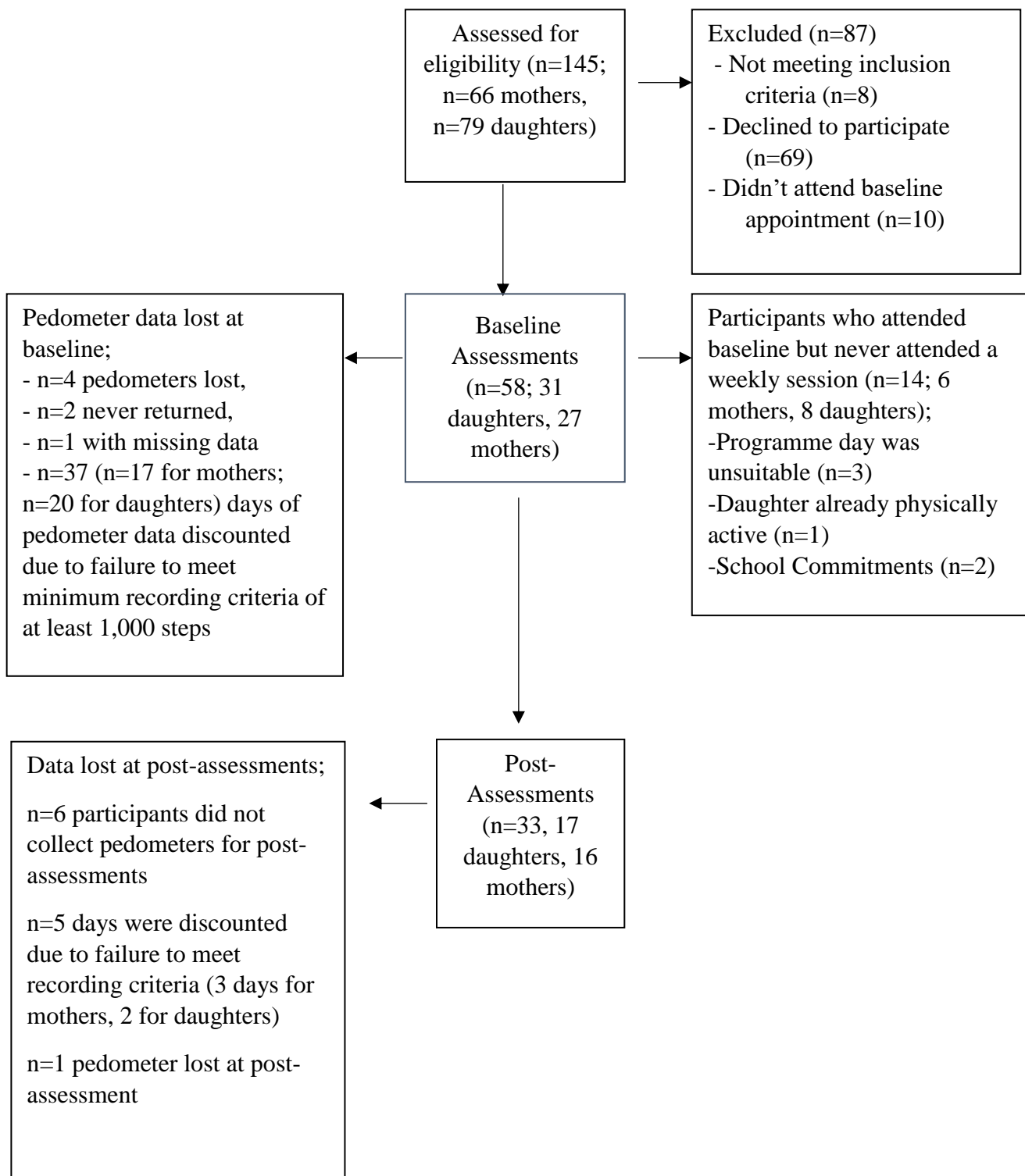


Table 6.3 Participant Characteristics and Baseline and Post-assessment results

Variable	Daughters		Mothers	
	PRE MEAN (SD) N=31	POST MEAN (SD) N=17	PRE MEAN (SD) N=27	POST MEAN (SD) N=16
Age in years	14 (1.2)	-	44.9 (6.08)	-
Body Mass Index (BMI)	21.9 (4.6)	-	27.3 (5.3)	-
Education	<i>First Year</i>	29.60% -	<i>Leaving cert</i>	14.87% -
	<i>Second Year</i>	25.40% -	<i>Diploma</i>	29.62% -
	<i>Third Year</i>	19.60% -	<i>Degree</i>	18.51% -
	<i>Transition Year</i>	25.40% -	<i>Post grad</i>	37% -
Employment Status (% of mothers)			<i>Employee</i>	70% -
			<i>Unemployed</i>	3.7% -
			<i>Home Duties</i>	14.8% -
			<i>Retired</i>	3.7% -
			<i>Other</i>	7.4% -
Average Steps	5,788 (1,595)	7,181 (1,926)*	6,791 (2,705)	9,666 (3,157)*
PAQ-A	2.2 (0.5)	2.4 (0.4)*		
Co-Participation	1.68 (0.7)	2.69 (1.5)*	1.58 (0.99)	2.16 (1.33)
PACS	70.5 (10.9)	69 (13.3)	75.8 (10.4)	69.1 (20.2)
KIDSCREEN-27	<i>Physical Wellbeing</i>	41.9 (4.9)	45.3 (8.4)	39.2 (5.3)
	<i>Psychological Wellbeing</i>	43.1 (8.4)	46.7 (9.7)	43.9 (9.1)
	<i>Autonomy & Parents</i>	48.9 (7.7)	44.0 (6.5)	49.06 (10.3)
	<i>Social Support & Peers</i>	49.0 (9.9)	48.8 (8.7)	40.63 (8.31)
	<i>School</i>	48.2 (9.7)	47.3 (7.4)	51.48 (8.63)
				49.9 (9.2)

Table 6.3 Participant Characteristics and Baseline and Post-assessment results

Variable	Daughters		Mothers	
	PRE MEAN (SD) N=31	POST MEAN (SD) N=17	PRE MEAN (SD) N=27	POST MEAN (SD) N=16
Parenting Practices				
	<i>Logistic Support</i>		2.6 (0.7)	2.6 (0.5)
	<i>Explicit Modelling</i>		2.6 (0.7)	2.75 (0.6)
Process Evaluation	<i>Assessment</i>	-	4.2 (0.4)	-
Questionnaire	<i>Timing</i>	-	3.9 (0.2)	4.4 (0.4)
	<i>Venue</i>	-	4.4 (0.8)	3.9 (0.3)
	<i>Facilitators</i>	-	4.4 (0.5)	4.3 (0.6)
	<i>Content</i>	-	3.9 (0.5)	4.7 (0.3)
				4.1 (0.6)

PAQ-A; Physical activity questionnaire for adolescents (Kowalski *et al.* 2004), results are presented as summary scores ranging from 0-5. Co-participation questionnaire (Lee *et al.* 2010), results are presented as average number of days spent being active together. PACS, Parent Adolescent Communication Scale (Barnes and Olson 1985), results are presented as a summary score for communication which can range from 0-100. Parenting Practices (Davison *et al.* 2003) results are presented as logistic and explicit support summary scores. Process Evaluation Questionnaire was scored using a 5-point Likert scale assessing participant satisfaction. *Indicates a statistically significant change from baseline to post measures

6.5.1.3 Evaluation of Acceptability and Suitability of Intervention and Study Procedures

Prior to the intervention, retention was defined as “the number of mother-daughter dyads who remained in the study”. Of the 27 dyads who attended baseline assessments, 16 remained in the study (59%). However, 6 of these 27 dyads who completed baseline assessments never attended a weekly session, resulting in 21 dyads attending the programme. Of these 21 dyads who attended at least one of the weekly sessions, 16 remained in the study (76%). This was slightly lower than the predetermined benchmark of 85%. A total of 75% (n=33) participants completed all measures. It is important to note in terms of programme acceptability that our participant numbers almost halved from baseline to post-intervention, indicating issues regarding recruitment and retention capability of *SOLE MATES*. Average weekly attendance was 67% and 17 (80%) dyads attended at least 4/6 sessions. A breakdown of weekly attendance is presented in Table 6.4. Attendance overall was high, except for week 6, due to an unusual weather event.

Participants’ weekly step averages and percentages reaching weekly goals are reported in Table 6.4. While weekly step goals were individualised based on baseline activity, less than 50% of participants met their goals on 4/6 weeks (see Table 6.4). Some barriers cited by mothers included sedentary desk jobs and weather barriers; “*I would have done more steps and hit the target more if the evenings were brighter*” (MFG2, P3). The weather barrier was prominent for rural living participants, noting it was difficult “*on dark evenings, it’s difficult to motivate yourself to go out again*” (MFG1, P4). Girls discussed struggling to reach step goals due to other commitments; “*sometimes you have homework or study then it’s a bit frustrating*” (DFG1, P3). Other issues with the step goals discussed by daughters included their incremental nature; “*I didn’t like how the target increased every week*” (DFG2, P3), while another “*didn’t like that you had to track for the whole week*” (DFG2, P2). However, participants did appear to be more motivated when using the unsealed pedometers, with one mother mentioning her daughter forgot her pedometer one day and she was “*devastated, she wasn’t walking anywhere that day because it wouldn’t count for anything*” (MFG1, P4).

During focus group discussions participants provided further comments on the study procedures and intervention content, highlighting possible suggestions and improvements for *SOLE MATES*. Participants had conflicting opinions about the programme timing (January – March). Some felt it would have been easier if there was

more daylight in the evening time. However, others felt that participating in the programme during the darker evenings was a good way to be active during a normally inactive period. Girls noted how the programme would have to be conducted during the school term *“as long as we’re still in school, I wouldn’t want to do it if I was on holidays or something”* (DFG2, P3). Girls also commented on the programme structure, with several wishing there was more time for the walking activities and less time spent in the classroom. Most girls enjoyed the novel walking activities; *“like we did the geocaching thing, which was really fun, because like the walks, they’re grand like but they can get a bit boring”* (DFG1, P3). However, mothers didn’t appear to enjoy the novel walks as much and sometimes found the activities *“distracting”* stating they *“couldn’t concentrate on the walk”* (MFG1, P2). Interestingly, some girls commented on how prior to the programme, they had never really considered walking as a form of PA before and that walking for exercise in the city was a new experience for them *“I felt really weird just walking for like exercise, like it was just something I hadn’t thought of as exercise before”* (DFG1, P4).

Table 6.4 Average Weekly Steps and Average Weekly Attendance

Variable	Week 1 Mean (SD)	Week 2 Mean (SD)	Week 3 Mean (SD)	Week 5 Mean (SD)	Week 6 Mean (SD)	Week 7 Mean (SD)	Group Mean (SD)
<i>Daughters</i>	n=15	n=17	n=17	n=17	n=17	n=16	
Average Steps	6,977 (1,598)	7,448 (1,846)	8,706 (1,748)	8,320 (1,703)	9,108 (1,325)	7,942 (2,209)	8,084 (793)
% Meeting Step Goal	66% (n=10)	41% (n=7)	76% (n=13)	35% (n=6)	53% (n=9)	6.2% (n=1)	41% (n=7)
<i>Mothers</i>	n=15	n=17	n=17	n=16	n=16	n=16	
Average Steps	8,469 (3,590)	9,271 (2,930)	9,202 (2,370)	9,414 (2,580)	10,090 (2,280)	8,390 (2,425)	9,139 (634)
% Meeting Step Goal	66% (n=10)	47% (n=8)	53% (n=9)	33% (n=4)	44% (n=7)	6.2% (n=1)	40% (n=6)
<i>Attendance</i>							
Weekly attendance	86% (n=38)	84% (n=37)	72% (n=32)	79% (n=35)	22% (n=10)*	63% (n=28)	68% (n=30)

*Unusual extreme weather event in Ireland affected attendance

6.5.1.4 Evaluation of Resources and Ability to Manage and Implement the Study and Intervention

The study obtained ethical approval from an institutional review board, and protocols outlined were followed throughout the study. The study was conducted within the allocated budget.

Overall, equipment and technology used to conduct the study were easily managed. However, it is important to note the possibility of data loss when using the sealed pedometers with a 7-day memory. Participants were advised to contact a member of the research team if they could not return their pedometer on time to minimise data loss.

6.5.1.5 Preliminary Evaluation of Participant Responses to Intervention

Results of the measures used at baseline and post-intervention can be seen in Table 6.3. Using intention to treat analysis (Gupta 2011), a statistically significant change was seen in daily steps for both mothers ($P=0.009$) and daughters ($P=0.007$) from pre-to-post assessment. Effect sizes were also calculated using Cohen's d (Cohen 1988) and for both mothers and daughters a large effect size was seen ($d=1.00$ for mothers, $d=0.81$ for daughters). When examining participants who completed both assessments and attended at least one session, a statistically significant increase and a similar effect size was found ($d=0.85$ and $d=0.90$ for mothers and daughters respectively). The changes in daily steps moved in the expected direction, and it indicates that the intervention shows promise of being successful with the intended population. In relation to secondary outcome measures, a statistically significant change was seen in the PAQ-A questionnaire for daughters ($P=0.01$). An increase was also seen in the number of days daughters reported being active with their mother in the co-participation questionnaire ($P=0.02$), however this difference was not evident in the mothers' responses. There was no change from baseline to post-assessment for parent-adolescent communication, health related quality of life or parenting practices ($P>0.05$).

While not detected in the quantitative data, during focus groups, participants discussed communication between mother and daughter, with several stating their communication with each other had improved since starting the programme. One daughter noted how the increased activity levels had a positive impact on communication levels with her mother; *"we actually haven't argued or like got in a bad mood because we've been more active"* (DFG1, P2). Others agreed with this, stating *"I'd say the same about the arguments, like I don't think I've argued with my mom since doing it [SOLE MATES]"*

(DFG1, P4). Mothers also noticed a change in communication levels, commenting on how their daughters were more forthcoming with information *“there was just small things that I noticed that she said about school, and things she wouldn’t normally have come up with”* (MFG1, P4).

Overall, participants provided positive feedback about the programme. Mothers liked the concept of mother and teenage daughter being together; *“I thought it was a good idea because they’re getting to that age where they don’t want to be around us, so trying to get that bond back”* (MFG2, P3). Another mother commented on how, despite her daughter’s initial reluctance, she was going to miss their weekly walking sessions;

“when we were coming up here tonight [to the post-assessments] she said oh I’m going to miss the me and you thing we had going on mom, and I was like well we can still go out and do our walk and she said oh that would be cool mom, so I kind of had this little moment with her” (MFG1, P4).

Interestingly, despite some of them having reservations at the beginning, daughters also commented on how they enjoyed spending time with their mothers. One girl said; *“I enjoyed having a reserved time of the week just to walk and spend time with her”* (DFG1, P3). Others felt the same and enjoyed being able to talk to their mothers about different topics; *“I liked it, going on the walks and stuff and being able to actually talk to my mother about things”* (DFG2, P3).

6.6 Discussion

The aim of this study was to assess the feasibility of *SOLE MATES*, a novel physical activity intervention targeting mothers and their teenage daughters. The programme and methods were highly feasible, as demonstrated by successful recruitment, acceptability of content, acceptability of study procedures and increases in daily step counts.

Previous mother-daughter interventions have demonstrated mixed results regarding their potential to impact PA levels. A review by Barnes *et al.* (2018) examining mother-daughter interventions with daughters aged between 5 to 19 years old reported only 29% of studies focusing on PA used objective measures, making it difficult to conclude if this intergenerational approach to PA promotion is effective. Sample sizes of studies included in this review ranged from small studies with 11 mother-daughter dyads to 206 mothers and 266 daughters (Barnes *et al.* 2018). Within this review, only three out of eight studies found significant effects for daughters and mothers respectively in favour of the PA intervention (Barnes *et al.* 2018). The authors of this review did not report whether any of the included studies found negative effects for PA (Barnes *et al.* 2018). Similarly, a review by Camacho-Minano *et al.* (2011) found that PA interventions targeting adolescent girls had mixed results, with only 4 of the 11 included studies with a family component showing a positive effect for this strategy. To date, only a limited number of studies have focused specifically on mother-daughter interventions, and more high quality studies are needed to fully test the effectiveness of this approach (Barnes *et al.* 2018). This current study is the second step in intervention development as outlined by the Medical Research Council guidance for the development of complex interventions (Craig *et al.* 2008). The findings from the previous development stage have already been published elsewhere (Barnes *et al.* 2018, Murtagh *et al.* 2018). As per this guidance, the next phase of the development process involves assessing programme effectiveness (Craig *et al.* 2008).

In terms of preliminary participant responses to the intervention, the qualitative and quantitative data suggest that the intervention is likely to be successful with the intended population. This was evidenced by an increase in daily steps of mothers and daughters ($d=0.85$ and $d=0.90$ for mothers and daughters respectively). While some changes were detected from our secondary outcomes, positive changes were alluded to by participants in focus groups, which indicated the likelihood that the intervention will be successful.

The use of focus group discussions post-intervention provided valuable feedback and context to our quantitative findings. The use of both qualitative and quantitative data collection measures is an important aspect of *SOLE MATES*, as guidance on proceeding to evaluations of public health interventions encourages the use of qualitative data to assess intervention acceptability in feasibility studies (Hallingberg *et al.* 2018). While these preliminary participant responses are moving in the expected direction and indicate the intervention may be successful, it is important to acknowledge the limitations of this study regarding the recruitment and retention capability, which now need to be evaluated in a fully powered trial.

In relation to our other feasibility benchmarks (i.e., recruitment and acceptability), the majority of those outlined before the study were reached or exceeded, except for retention, which was slightly lower than other mother-daughter studies. It must be strongly acknowledged that the biggest limitations of this study were recruiting an adequate number of participants and retaining these participants in the study. Due to difficulties with recruitment and retention it remains uncertain whether the results of this intervention can be generalised to a larger population. In terms of retention, several reasons were provided by participants who dropped out, most of which were commonly cited barriers to PA participation, including school commitments, weather and time constraints (Allison 1999, Salmon 2003). Several suggestions and recommendations were provided by participants which may help to increase the recruitment and retention capability of *SOLE MATES*, including incorporating a wider variety of activities as well as walking and alternative recruitment strategies. As preliminary feasibility has been demonstrated in this trial, the next stage involves examining effectiveness and making the necessary changes to the intervention from lessons learned during feasibility testing.

Other objectives such as attendance and acceptability of measures were high. While 67% average attendance may seem low, an unusual weather event in week 6 resulted in low attendance, and apart from this attendance was 76%, which is closer to commonly reported results from other studies (Ransdell *et al.* 2003a, Ransdell *et al.* 2003b). An interesting point to note is that in week 6, which had the lowest recorded attendance, participants recorded their highest average step counts that week (see Table 6.4). This may be due to the fact that many participants did not have school or work in that particular week due to the weather conditions and perhaps had more free time to go for

a walk. Other measures assessing acceptability and suitability demonstrated the appeal of the programme, with all items assessed being deemed acceptable to participants. A conceptual model for targeted health behaviour interventions promoting PA by Morgan *et al.* (2016) noted the important but under-recognised impact facilitators can have on the effectiveness of interventions. In this current study facilitators were highly rated on their content knowledge, motivation, communication skills and approachability.

Research has shown that it is important that facilitators are perceived as credible, likable and motivated, and these characteristics may lead to increased participant engagement (Morgan *et al.* 2016). The *SOLE MATES* facilitators developed positive relationships with participants, and this was evident both in the questionnaire data and the focus groups and may be an important contributing factor to programme acceptability. The high acceptability is also likely to be due to the formative work conducted under the guidance of the BCW, ensuring the intervention functions and BCT implemented were appropriate for the target population (Murtagh *et al.* 2018).

One study procedure which did not appear to be acceptable was the weekly step goals. Despite the fact that step goals were designed based on methods used in previous literature (i.e., increasing by 1,500 steps on a fortnightly basis based on baseline step counts) (Baker *et al.* 2008) and were individualised to each participant, less than 50% of participants were successful in reaching them on a weekly basis. Within the literature there is a lack of consensus of how step goals should be formulated and inconsistent reporting of steps goal attainment in interventions makes it difficult to conclude if individualised step goals are more beneficial than a 10,000 step goal (Bravata *et al.* 2007). Some studies have concluded that an individual's baseline PA levels are more important than the actual goal, and a generic 10,000 step a day goal is more beneficial to higher active participants (Sidman *et al.* 2004, Kang and Brinthaup 2009). A meta-analysis by Kang *et al.* (2009) found studies using individualised step goals had lower effect sizes than those with a generic group goal (Kang *et al.* 2009). In *SOLE MATES* the incremental goals were set based on the participants' baseline step counts. An alternative approach that has been used in previous research is self-selected step goals, with participants being encouraged to set a goal between 1,000 to 3,000 steps higher than their baseline average (Sidman *et al.* 2004), or to increase their steps by 5%, 10% or 15% compared to their baseline average (Kang and Brinthaup 2009). However, as the effectiveness of self-selected versus generic step goals remains unclear, perhaps

further consultation with participants is needed about step goals, allowing participants to choose either a generic or self-selected goal. This may result in setting motivating but realistic goals, particularly for those with lower baseline activity levels.

Another important consideration in relation to low step goal attainment is the use of the pedometers. Participants in *SOLE MATES* discussed issues with the pedometers, particularly relating to them falling off or resetting, and several expressed a desire to use a wrist-based wearable device to monitor their daily steps. The use of consumer wearables to track PA has grown in popularity in recent years and these devices are beginning to be used in research studies (Evenson *et al.* 2015). A systematic review examining the validity and reliability of some wearable devices found high validity of steps, indicating these may be an appropriate tool to allow participants to track and monitor their PA behaviour (Evenson *et al.* 2015). The use of wearable devices may be more acceptable to participants in *SOLE MATES*, but it is imperative that if this method is used to monitor and track PA in future that a valid and reliable device is used.

Another interesting point to note in relation to step goals and average step counts is that mothers from the study consistently obtained higher average weekly step counts than their adolescent daughters. This is worrying, especially considering that step count recommendations are higher for adolescents than they are for adults in terms of meeting PA guidelines (Tudor-Locke *et al.* 2011a, Tudor-Locke *et al.* 2011b). While average girls' step counts did increase throughout the course of the intervention, their average daily steps were still below the recommended 11,000 steps a day (Tudor-Locke *et al.* 2011a) and less than 50% of participants reached their step goal on three out of six weeks. These findings echo those illustrated in previous systematic reviews of interventions aimed at adolescent girls, showing that behaviour change with this population is possible but can be challenging, with changes in PA often being modest in nature (Camacho-Minano *et al.* 2011, Pearson *et al.* 2015, Owen *et al.* 2017).

Finally, a positive change was noted in parent-adolescent communication by several mothers and daughters within the focus groups. It has been shown that changes to the psycho-social environment (i.e. increased or improved communication) can positively impact PA behaviours (Whitchurch and Constantine 2009, Brown *et al.* 2016). Positive family functioning through healthy communication can be beneficial for a range of healthy behaviours for adolescent girls (Berge *et al.* 2013). Our qualitative findings

indicated that participants experienced improved communication and overall better moods as a result of increased levels of activity together. This aligns with findings from a longitudinal study by Ornelas *et al.* (2007) which found adolescent MVPA was positively predicted by family-cohesion, parent-child communication and parent engagement. For family based PA, parents often value the opportunity to improve communication and spend more time with their children, over and above the actual PA component (Thompson *et al.* 2010). This motivation was evident with the mothers in *SOLE MATES*, as many of them cited wanting to spend more time with their daughter as their main reason for taking part. This is an important consideration going forward and efforts should be made in the recruitment stages to emphasize this opportunity to improve communication while being active together to both mothers and daughters.

6.7 Strengths and Limitations

Our positive feasibility metrics demonstrate the appeal of *SOLE MATES*, with high acceptability and positive feedback from participants being a strength of the study. The use of both qualitative and quantitative methods aligns with guidance by Hallingberg *et al.* (2018) on proceeding to full scale evaluations of public health interventions, as our focus groups provided important context to the quantitative findings. *SOLE MATES* was also based on rigorous formative research, providing rationale for the design and selection of content within the intervention.

Some possible limitations include the lack of a control group and a lack of follow up post-intervention. Another limitation of this study was the issues with recruitment and retention, with less than half of the participants who initially expressed interest in the study taking part. As this was a single-group feasibility study we cannot accurately estimate our recruitment capability or our ability to retain control subjects in an RCT. Finally, the sample size included within this study must be acknowledged as a limitation, making it difficult to generalise the findings to a larger population.

6.8 Conclusion

This study demonstrates that it is feasible to increase the PA levels of teenage girls through an inter-generational multi-component PA programme. It makes an important contribution to the current literature, as to date most studies focusing on maternal influences on PA have focused specifically on primary school-aged children. While this study possessed limitations in terms of recruitment and retention capability, the positive

feasibility results relating to acceptability and increases in the primary outcome of daily steps provide justification for the conduct of a fully powered RCT to evaluate the effectiveness of the *SOLE MATES* programme.

Acknowledgements

We acknowledge the assistance of Cara Cremen and Jean Walsh with programme delivery. We thank Tony Corr, Chris Corr and Garreth Grogan for conceiving the programme title and acronym: *SOLE MATES*.

Funding

This work was supported by the Mary Immaculate College Research Directorate Seed Funding Scheme and Get Ireland Walking. Méabh Corr is supported by a Doctoral Studentship from Mary Immaculate College. The funders had no role in the study.

Conflicts of Interest

The author(s) have no conflicts of interest to declare.

6.9 Link to Previous Chapters

In line with some of the gaps identified in the literature review, this study aimed to assess the feasibility of a mother-daughter multi-component PA programme as a potential PA promotion strategy. The positive maternal correlations found in Chapter 5 provided further justification and support for the development of a PA intervention involving mothers with their daughters to increase PA levels.

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Chapter 7: Discussion and Conclusions

7.1 Introduction

The purpose of this thesis was to investigate potential PA promotion strategies with adolescent girls, exploring perceptions, co-design and intervention development. The aims of this chapter are to discuss and highlight the contributions these studies make to the existing evidence base, to discuss the strengths and limitations of the thesis and finally to outline recommendations for future research, policy and practice.

The studies conducted as part of this thesis are novel in that the design of the interventions was based on rigorous formative research using appropriate behaviour change theory, and participant voices were considered and included in the development stages. This ensured that the intervention functions and BCT's chosen were tailored specifically to the target group. The interventions conducted (*Chapter 4* and *Chapter 6*) are also novel given they follow the MRC guidance for the development and evaluation of complex interventions by first conducting the necessary feasibility testing in the development stages (Craig *et al.* 2008) Finally, this thesis adds significant contributions to the evidence base, particularly in relation to the use of family-based interventions (i.e. mother-daughter) as a possible PA promotion strategy for adolescent girls.

7.2 Contributions to the Evidence Base

This thesis makes several contributions to the evidence base and throughout this chapter the following will be discussed: the importance of encouraging lifelong PA engagement, providing feedback on PA behaviour, the maternal impact on PA, systematic approaches to intervention design and adolescent voice and autonomy.

7.2.1 Encouraging Lifelong PA Engagement

An important finding across studies in this thesis is adolescent girls' apparent lack of understanding of the wide variety of opportunities available to engage in PA. In *Chapter 2*, adolescent girls from the studies included in the qualitative synthesis seemed to consistently conflate PA, school PE and competitive team sports. Similarly, participants from *Chapter 4* associated PA predominately with the activities they did in school PE, which tended to comprise competitive sports. Girls were so unaware of the PA opportunities available that, in fact, many girls in *Chapter 6* noted how they never really considered walking as a form of PA before. This would suggest that a lot of girls don't seem to identify other activities or forms of PA (e.g. walking) and consider PA and team-sports to be synonymous. For this reason, the activities included in the

intervention in *Chapter 4*, which were suggestions from the students, included more ‘non-traditional’ PE activities such as aerobics, kickboxing and yoga. This was done to expose students to other forms of PA aside from their regular PE activities and because students directly requested these alternative activities. Similarly, the PA component of the *SOLE MATES* study included walking, an activity that does not require any specific equipment or facilities and is likely to overcome some of the barriers to PA frequently cited by girls e.g. dislike of team sports. These alternative forms of PA were chosen in an attempt to illustrate to girls that there are other PA opportunities available aside from competition-based activity. Another strategy aimed at encouraging more lifelong PA engagement used in both *Chapter 4* and *Chapter 6* was the tracking of PA using pedometers. Girls were encouraged to increase their daily PA through walking more, using pedometers to monitor and track their progress, an activity which participants prior to the intervention did not consider or recognise as PA.

Adolescent girls had an apparent inability to identify other forms of PA outside of competitive sports, perhaps due to a lack of understanding and education about what PA is. This is an important finding, as longitudinal data from the Children’s Sport Participation and Physical Activity Study (CSPPA) indicated a decline in participation in organised sports at least twice a week for girls aged 12-18 from 59% in 2009 to just 34% in 2014 (Murphy *et al.* 2016, Hardie Murphy *et al.* 2017). This age-related decline in participation is not unique to Ireland, and globally there are gender disparities evident with PA participation during childhood and adolescence (Dumith *et al.* 2011). One of the biggest barriers identified by adolescent girls regarding their PA participation is a dislike of highly competitive, team-based sports (Martins *et al.* 2015). Along with the dislike of the perceived competitive nature of sport and PA, the majority of adolescent girls report disengaging from activity due to perceived low levels of competence (Martins *et al.* 2015). The dislike of team sports, which normally require participants to be proficient in certain motor skills to experience success, combined with low levels of competence leads to high levels of disengagement from PA for adolescent girls.

However, this thesis would indicate that while girls do have reservations about competitive sports and their perceived competence levels, their reason for disengaging may be due to a dislike of the opportunities available or an unawareness of other forms of PA. This was articulated by girls in *Chapter 4*, with one participant claiming, “*We don’t know what else we can do apart from sports*” (*Chapter 4, page 93*). Other

participants from *Chapter 6* echoed some of these feelings, with some admitting they hadn't considered walking as a form of activity before "*I felt really weird just walking for like exercise, like it was just something I hadn't thought of as exercise before*" (*Chapter 6, page 149*). Similarly, in *Chapter 2* girls from included studies consistently discussed their negative PE experiences, which often revolved around competitive team-based sports.

Providing opportunities to engage in lifetime activities is important as they are normally defined as those that require minimal structure or equipment and can be easily carried over into adulthood (e.g. walking or running) (Fairclough *et al.* 2002). As PA behaviours can track into adulthood where they are maintained, ensuring girls are equipped with the skills and knowledge to engage in PA is essential from a future health perspective (Telama 2009). An example of a campaign which seeks to promote life-long PA participation for both girls and women is the "This Girl Can" campaign in England. "This Girl Can", which is supported by Sport England, aims to celebrate active girls and women, regardless of their ability or background. Some of the key principles of this campaign include ensuring what is offered suits participants, to differentiate between sport and exercise and highlight the additional benefits of being active (e.g. social aspect) and ensure the girls/women are appropriately supported throughout (Sport England, 2015). Since the campaign launched in 2015, the number of women and girls playing sport and getting active once a week, every week, has increased by 250,000 (Sport England Active People Survey Results, 2016).

There has been some specific policies and initiatives put in place in Ireland which aim to encourage girls' participation in sport and PA, including the 20x20 campaign supported by the Federation of Irish Sports and a new Women in Sport committee established by Sport Ireland (Federation of Irish Sport 2019, Sport Ireland 2019). While both are separate policies and initiatives, they have a common goal of aiming to increase the number of women and girls in Ireland participating in sport. The Women in Sport policy has four main target areas where Sport Ireland hope to make significant and positive impacts, looking at coaching and officiating, active participation, leadership and governance and finally visibility (Sport Ireland 2019). This policy is complimented by the 20x20 campaign, which seeks to shift Ireland's cultural perception of women in sport by 2020 by increasing media coverage of women in sport, increasing

sport participation and increasing attendance at sporting events (Federation of Irish Sport 2019). Both are examples of how Irish society is attempting to encourage sport participation; however, they are heavily focused on competitive sports, with very little mention of PA participation for lifelong benefits. It has already been established that competitive sports and issues with PMC can deter girls from participating in PA, therefore it is important that policies and initiatives in Ireland promote all forms of PA, not just competitive sports. Implementing campaigns like “This Girl Can” from the UK in Ireland may help to educate girls on the variety of ways in which they can be active. It also reduces the risk of marginalising those girls who aren’t interested in competitive sports, illustrating that PA is for everyone, regardless of skill levels or abilities.

7.2.2 Providing Feedback on PA behaviour

Along with preparing girls for lifelong PA participation, providing appropriate and acceptable methods for them to monitor and receive feedback on their PA behaviours may be an important strategy to help increase PA levels. Both studies described in this thesis in *Chapter 4* and *Chapter 6* required participants to monitor their daily step counts using a pedometer. The use of pedometers yielded several results which participants discussed in focus groups, including experiencing an increased awareness of their PA levels, a prompt/motivation to be active, especially when combined with a step goal, and friendly competition/comparison with their mother or peers in school. Pedometers were chosen because they are cheap, easy to administer and provide an overall estimate of an individual’s habitual activity (Welk *et al.* 2000, Tudor-Locke 2002). While participants in both studies were mainly positive about the pedometers, particularly their capacity to provide easy to understand, immediate feedback on PA, the actual device itself wasn’t overly acceptable. Pedometers used were worn on the waist, had to be reset every day and participants had to record their step counts in a diary. Research into the use of pedometers with children and youth has found that while receiving real-time feedback on PA through daily step counts can be motivating for participants, the act of manually recording daily steps everyday can be burdensome (Lubans *et al.* 2015).

Participants within the studies described in this thesis expressed a desire for a wrist-worn monitoring device that had the capacity to sync with their phone, therefore eliminating the burden of resetting the pedometer daily and manually recording step

counts. The development and use of wearable technology to monitor and track PA behaviours has grown in recent years, and given the fact that there has been a pronounced increase in the time adolescents spend using electronic media (Rideout *et al.* 2010), the use of wearable technology should be considered as a method to promote PA within this population (Salmon 2010, Kerner and Goodyear 2017). While the validity and reliability of the various available activity trackers is mixed (Evenson *et al.* 2015), they may have the potential to provide an important motivational prompt for adolescents (Ridgers *et al.* 2016). As the use of wearable technology is still emerging within research, there is a paucity of research assessing the potential of such devices to increase PA levels (Ridgers *et al.* 2016). In fact, a systematic review by Ridgers *et al.* (2016) found only 5 studies assessing the feasibility and effectiveness of wearable technology with children and youth (Ridgers *et al.* 2016). Due to the small number of available studies, it is difficult to draw conclusions about the effectiveness and acceptability of these devices, however within this review there was some evidence to suggest that the devices were viewed positively by youth and they reported that they liked using them (Ridgers *et al.* 2016). Therefore, the use of wearable technology for youth may be an acceptable intervention strategy to provide feedback on behaviour when used as part of a broader intervention. Using such devices allows participants to self-monitor their behaviour and receive real-time feedback, strategies which have been identified as key behaviour change techniques necessary to elicit change (Michie *et al.* 2011b, Ridgers *et al.* 2016).

7.2.3 The Maternal Impact on PA

The positive association between mothers' PA levels and their daughters' PA levels is a key finding of this thesis. As has now been well-established through a detailed literature review, increasing the PA levels of adolescent girls is challenging, with most efforts to date focusing on school-based settings. However, a possible avenue for PA promotion which has been somewhat ignored is the potential influence that mothers can have on their daughters' PA levels. The rationale for an inter-generational approach to PA promotion is due to the unique relationship shared between a mother and her daughter, with many of a daughter's beliefs or behaviours developing as a response to those of her mother (Aronowitz *et al.* 2005, Northrup and Kaye 2005). Therefore, mothers can play an extremely important role in shaping the healthy behaviours of their children, particularly their daughters (Aronowitz *et al.* 2005, Northrup and Kaye 2005). As has

been established previously in this thesis, only a limited number of studies have investigated the potential of mother-daughter PA interventions. There is also a scarcity of cross-sectional studies investigating maternal correlates of adolescent PA using valid and reliable methods. Two of the studies described in this thesis aimed to expand the current evidence base relating to the potential maternal impact on adolescent PA through a cross-sectional study and a PA intervention. *Chapter 5* is one of very few studies to assess maternal correlates of adolescent girls' device-based and self-report measures of PA using valid and reliable measures. *Chapter 6*, to the author's knowledge, describes the first multi-component PA programme for mothers and daughters aiming to increase PA levels conducted in the Republic of Ireland, demonstrating that an inter-generational approach to PA promotion is feasible and acceptable.

It has been claimed that when attempting to increase the PA levels of children and youth, unless adequate consideration is given to the family environment and incorporates family engagement then long-term adherence to behaviour change is not possible (van Sluijs and McMinn 2010, Kipping *et al.* 2014, Brown *et al.* 2016). The overall findings from the *SOLE MATES* study (*Chapter 6*) illustrate that it is possible to increase the PA levels of adolescent girls through a mother-daughter multi-component PA programme. However, of interest is also the unintended positive consequences of the intervention through improved communication levels between mothers and daughters. It is important that interventions aimed at increasing PA through a family-based approach also focus on improving family-cohesion, parental involvement in PA and parent-adolescent communication levels as these factors have been shown to be significant predictors of adolescents meeting PA guidelines (Ornelas *et al.* 2007). The improved communication levels between mother-daughter dyads illustrate that multi-component family-based interventions can have positive benefits that extend beyond merely increasing PA levels. The positive relationship between levels of open parent-adolescent communication and PA levels of adolescent girls was found in the cross-sectional data in *Chapter 5*. While no statistically significant changes were seen in the communication questionnaire results from pre-to-post measures in *SOLE MATES*, our focus group results indicated that positive changes to communication levels had occurred as a result of mothers and daughters engaging in increased PA together. Adolescent girls tend to report lower life-satisfaction, poorer mental health and more

difficulty communicating with parents compared to males (Brooks *et al.* 2017, Bruckauf 2017). The results of *SOLE MATES* indicate that a multi-component mother-daughter PA programme also has the potential to enhance other aspects of health and well-being, such as communication, in addition to PA levels, to improve overall health related quality of life.

7.2.4. Systematic Approach to Intervention Design

The studies described in this thesis (*Chapter 4* and *Chapter 6*) were guided by the BCW, a synthesis of 19 frameworks for behaviour change developed by Michie *et al.* (2011b). The justification for selecting a behaviour change theory to guide the design of these interventions was two-fold. The first reason being identifying an appropriate theory is one of the key steps outlined by the MRC in their guidance for the development and evaluation of complex interventions (Craig *et al.* 2008). Secondly, in a review of interventions for adolescent girls, Pearson *et al.* (2015) found that interventions which were multi-component and based on relevant theory were more effective for adolescent girls. Along with these two reasons, incorporating relevant behaviour change theory in intervention design is important to improve the effective implementation of evidence-based practice (Michie *et al.* 2011b). As has been mentioned previously in this thesis, behaviours are complex, and in order to improve intervention design it is essential that a systematic approach is used (Michie *et al.* 2011b). This involves ensuring there is an appropriate understanding of the behaviour to be changed (e.g. increased PA), as well as a system to characterise interventions and their components (BCTs) (Michie *et al.* 2011b). To date, very few published interventions give clear details on how a specific theory was used to guide the design of the intervention.

Using the BCW and conducting detailed behavioural diagnosis with participants prior to intervention development ensures that factors which are deemed as important to participants in relation to their PA behaviours are addressed in the intervention (Michie *et al.* 2011b). Participants identify areas relating to their capability, opportunity and motivation to be active, and then specific intervention functions and BCT's which are anticipated to be effective in helping girls overcome their barriers to PA participation are identified (Michie *et al.* 2011b). In this thesis, by using the COM-B 23-item self-evaluation questionnaire and then expanding on the areas identified in focus group

interviews, it ensured that the resulting intervention was designed with the specific needs and interests of the participants in mind. Interventions to date have been documented as being unsuccessful due to an inability to meet the interests of the participants, resulting in a contrast between the activities provided versus the participants interests (James *et al.* 2018). However, following the BCW wheel guidance and undertaking the necessary formative research ensured the participants' needs were considered during the development stages.

While the use of the BCW has been previously noted as being a time-consuming process (Murtagh *et al.* 2018), it is an extremely comprehensive model and overcomes some of the shortcomings of other models by considering a wide range of factors relating to behaviour change (Michie *et al.* 2011b, Murtagh *et al.* 2018). Using the BCW and the COM-B system allows for the systematic development of an intervention, selecting intervention functions and BCT's most appropriate to serve the target population and behaviour (Barker *et al.* 2016). By using a systematic approach in the development stages of the intervention, it should result in interventions that are more likely to be successful and it can help to clarify which components of an intervention are effective and which are not (Barker *et al.* 2016). The use of the BCW also increases the potential for successful implementation, evaluation and replication of interventions, aspects which can be difficult to achieve using other theories or frameworks due to their complexity or diversity (Michie *et al.* 2011b). Both studies in *Chapter 4* and *Chapter 6* clearly indicated which BCTs, intervention functions and modes of delivery were appropriate for the target group and target behaviour. Appropriate levels of detail about the intervention components were also provided, allowing for similar interventions to be replicated and implemented in different settings. Finally, along with the systematic approach to intervention design, the use of qualitative data post-intervention in the studies allowed the researcher to explore participants' perceptions of the intervention further. The qualitative data can also highlight important aspects of the intervention that are/are not acceptable to participants, information which otherwise may not be detected through quantitative data alone.

7.2.5 Voice and Autonomy

Finally, the use of qualitative methods to include participant voice within intervention design is also a novel aspect of this thesis. For years, within PA research and research in

school PE, girls have often been identified as “the problem” when it comes to their low engagement levels (Flintoff and Scraton 2001, Enright and O'Sullivan 2010). However, in more recent years, a shift in thinking has led researchers to believe that perhaps the problem isn't the girls themselves, but rather the PA opportunities provided to them both in and outside of school (Enright and O'Sullivan 2010). Several studies have investigated adolescent girls' perceptions of PA, and this was reviewed extensively in the qualitative synthesis in *Chapter 2*. However, while there is a vast amount of literature examining adolescent girls' opinions of PA, very little research has actually responded to student voice and made a meaningful effort to include the opinions and needs of participants in their PA opportunities (Fisette 2013). Without the involvement of youth voice, interventions fail to accurately represent the needs of adolescents (Jacquez *et al.* 2012). Therefore, listening to and responding to participant voices was a key aspect of the formative research conducted in this thesis as part of *Chapter 4* and *Chapter 6*. As mentioned in *Chapter 4*, this approach of involving participants in research design is closely aligned to PPI, ensuring that interventions are designed “by” or “with” participants (INVOLVE 2012). Given that the majority of PA interventions for adolescent girls to date fail to produce significant increases in PA levels (Pearson *et al.* 2015), it is imperative that the opportunities provided to girls are aligned with their needs and interests. In future, following a PPI approach may lead to the development of programmes and opportunities that are suited to adolescent girls and include their voice and opinions during the development stages (INVOLVE 2012).

Talking to adolescents about their PA opportunities and the barriers they perceive is important if we are to strive to improve their PA behaviours. The qualitative synthesis (*Chapter 2*) demonstrated that PA programmes for girls should focus on alternative activities aside from competitive sports, and to provide girls with an opportunity to engage in single-sex activities. The important role of peers was also highlighted in this review, with peer support for PA being evident in 17 of the included studies. Therefore, to address some of these recommendations, a co-educational post-primary school was chosen as the location for the first PA intervention study (*Chapter 4*), to provide girls with an alternative opportunity to be active, and a non-competitive activity (walking) was chosen as the main form of PA for the intervention in *Chapter 6*. Peer support was also emphasised in both interventions, with girls in *Chapter 4* exercising with peers in

class and being encouraged to share their weekly PA goals with friends, and girls in *Chapter 6* participated in weekly group walks, again emphasising peer support.

It was evident in *Chapter 4* that within their PE setting, students were rarely given any choices or opportunities to express their opinions, with one student claiming, “*no-one ever asks us!*”. However, when asked, students expressed a desire to be active through a variety of activities, and when given the opportunity to participate were enthusiastic and motivated because they had chosen the activities themselves. This level of accountability has been noted in other research, with adolescents stating that the activities in which they have choice and control over are often the most enjoyable (Brooks and Magnusson 2007). This is an important consideration for future PA promotion programmes, as a lack of choice can be one of the main reasons that girls disengage from PA (Mitchell *et al.* 2015). Providing girls with an opportunity to express their opinions allows them to be involved in their own learning in a meaningful way, and it also helps to create an environment for learning that reflects the needs and interests of the girls (Enright and O'Sullivan 2010, Fissette 2013). In a qualitative study conducted by James *et al.* (2018) asking teenagers for their recommendations on how to improve PA levels of their age group, the two main recommendations were to provide choice in activities and to provide enjoyable activities, rather than consistently focusing on competitive team games dependent on performance (James *et al.* 2018). Similarly, in line with an earlier recommendation of educating girls on the lifelong benefits of PA, it is essential when providing choice that teachers and researchers are willing to reconsider and expand on their beliefs of what PA is, and focus more attention on improving overall health and wellbeing of young people, and not just on performance of skills (Timken *et al.* 2017).

7.3 Research and Policy and Practice Implications

As this thesis focused primarily on investigating potential feasibility of PA interventions for adolescent girls there is scope for further research to investigate the true effectiveness of the approaches presented. Therefore, the following research recommendations are;

- To assess the potential of co-creating a PA programme with adolescent girls in a post-primary school setting for a longer period, e.g. across a full school year, using both intervention and control groups.

- Following on from this, as outlined in *Chapter 4*, the potential effectiveness of a school-based intervention such as the one described may be higher if a whole-school approach to implementation is taken, like that of a Comprehensive School Physical Activity Programme (CSPAP), as there is a lack of research using this approach in post-primary schools. Participants in *Chapter 4* felt similar PA programmes would be more acceptable and become more part of school life if there was involvement from other teachers and subjects. Therefore, a CSPAP may be a potential strategy to contribute to an overall active school culture and improve PA behaviours.
- A fully powered randomised controlled trial of the *SOLE MATES* programme should be conducted to assess the effectiveness of the programme to increase the PA levels of mothers and their teenage daughters. A future trial should also aim to include a more diverse sample of participants, as the sample from the feasibility trial was rather homogenous, leaving it difficult to draw conclusions on whether such a programme would be effective for those from different socio-economic backgrounds.
- The potential of using wearable technology in PA interventions as a tool to monitor and motivate PA behaviours should also be investigated further in research trials. Due to the growing popularity of technology, particularly with teenagers, wearable tech devices may be an appropriate medium to use with this population to encourage healthy behaviours. However, as there are many devices available with unknown validity and reliability they should not be used as a method to detect changes in PA from pre-to-post measurements, but rather as a motivational tool for participants to provide immediate feedback on their PA behaviours.
- Finally, the importance of promoting lifelong PA and educating girls on the variety of PA opportunities available is important to foster healthy behaviours for adulthood. Any initiative such as the “This Girl Can” campaign, the Irish 20x20 initiative or the Women in Sport policy, which could be a good strategy to spread the message to teenage girls about the benefits of PA and show them that all women and girls can engage in PA, regardless of their background or ability levels, should be formally evaluated.

Along with research recommendations, the results of this thesis present several recommendations for both policy and practice. For teachers working with young girls in school it is imperative that they are provided with opportunities to express their interests in relation to their PA opportunities. This could be done by seeking feedback at the beginning of an academic year and then using this feedback to plan appropriate and acceptable PE activities, as well as providing out-of-class activities for girls as well. Similarly, pre-service teachers should be made aware of the importance of promoting life-long PA to their students and avoid stereotyping activities. These recommendations align with both the Wellbeing Policy Statement and Framework for Practice 2018-2023 and the Wellbeing guidelines for the Junior Cycle (National Council for Curriculum and Assessment 2017, Department of Education and Skills 2018). Both documents make specific reference to the importance of ensuring students' voices are valued and respected, and that young people are involved in the planning of extra-curricular activities (National Council for Curriculum and Assessment 2017, Department of Education and Skills 2018). Adopting a student-centred approach to wellbeing ensures that all students receive a broad, accessible and inclusive programme of extra-curricular activities. The studies within this thesis, particularly *Chapter 2 Part B* and *Chapter 4* illustrate the importance of listening to adolescent voice, particularly when providing them with opportunities to be active.

Those seeking to promote PA in community settings could also learn from the research conducted as part of this thesis, particularly the results from *Chapter 5* and *Chapter 6*, illustrating the importance of mothers' involvement in their daughter's PA promotion. The *SOLE MATES* study could be adapted for implementation at local sports partnerships (LSP) across the country. In 2018, €6.07 million was allocated to the 29 LSPs from Sport Ireland, and only €115,000 of this is specifically allocated for Women in Sport programmes. This section of LSPs implements programmes for target female groups, including teenage girls. LSPs have already adopted programmes based on research, and 7 LSPs across the country are currently involved in a National research evaluation of the "Men on the Move" programme (Richardson *et al.* 2017). If LSPs adopted the programmes such as *SOLE MATES* as part of their Women in Sport initiative, then the programme could be delivered to a wide range of participants across the country to improve health behaviours.

Finally, in Ireland's National PA plan, some of the key guiding principles include creating increased opportunities for people to be active every day and to create a supportive environment for PA participation (Department of Health 2016). As well as these principles, more recently Healthy Ireland have launched their campaign for 2019, aimed at boosting community engagement in healthy behaviours in all counties, with a "be well" section of the campaign, emphasising the importance of walking for every day health (Department of Health 2013). Based on the findings of this thesis, the following recommendations should be considered in relation to the guiding principles of the National PA plan;

- Ensure when creating opportunities to boost community engagement in PA that participant voices are sought and responded to, ensuring the opportunities are tailored to their needs/interests.
- To ensure the timing of programmes is acceptable to participants (e.g. *SOLE MATES* participants noted how they desired the programme to be run during school terms rather than summer months).
- To highlight the social aspect of engaging in community-based PA opportunities, particularly for girls as peer support has been consistently documented as important for PA participation for girls.
- Finally, policy makers and practitioners must emphasise the wide range of benefits of engaging in PA programmes (e.g. in a mother-daughter programme, to emphasise increased opportunities to spend time with your mother/daughter or possibility of improving communication levels).

7.4 Strengths and Limitations

The strengths of this thesis include the systematic approach to intervention design, guided by appropriate theory. The detailed account of how the BCW was used in intervention design also allows for wider implementation and replication of similar interventions in different settings. Another strength of this thesis is the use of formative research in intervention design and involving participants in the intervention design. Using mixed methods within the studies is also a strength, as the qualitative data provides important context and insight into the quantitative data collected. Finally, the use of feasibility studies to assess preliminary acceptability of recruitment, retention, adherence and participant responses prior to the commencement of an RCT is a

strength, in line with the MRC guidance on developing and evaluating complex interventions (Craig *et al.* 2008).

In addition to the individual study limitations described in sections 2.14, 4.7, 5.7 and 6.7, the following overall thesis limitations should be noted. These include the relatively homogenous samples within the included studies, and future research should investigate if similar interventions can be implemented and be acceptable in settings with diverse populations. Along with a lack of diversity among participants, it must be noted that all participants volunteered to participate in the studies described in *Chapter 4, 5 and 6*, and therefore had an interest in increasing their PA levels and may not be representative of the true Irish population. Another important limitation that must be acknowledged is the small sample sizes used within the studies described in this thesis. These small sample sizes result in difficulty generalising results to a wider population, as well as issues with assessing effectiveness due to a lack of power. Finally, the lack of follow-up post intervention and lack of a control group in both studies was also a limitation. Although, as mentioned, the main aim was to assess feasibility therefore these limitations should be addressed in a full RCT.

7.5 Conclusion

This thesis aimed to examine PA promotion strategies for adolescent girls, looking specifically at perceptions of PA, co-design and intervention development. The series of papers presented demonstrate that PA promotion strategies in both school and community settings are feasible and can include participant voice in the development stages. The qualitative synthesis (*Chapter 2, Part B*) highlighted adolescent girls' perceptions of PA, specifically noting how girls consistently conflated PA, PE and sport. The feasibility study conducted in a post-primary school (*Chapter 4*) aimed to address some of the recommendations for PA interventions for adolescent girls by using appropriate theory in intervention design and incorporating participant voice. The results of this study showed it is feasible to involve participants in the design of a PA programme, and that providing autonomy within activities may lead to increased accountability for participation. To address further gaps in the literature, *Chapter 5* and *Chapter 6* aimed to assess the potential positive impact mothers can have on their daughters' PA levels, through a cross-sectional study on maternal correlates of PA and a 6-week multi-component PA programme. The results of both studies add significant

contributions to the currently sparse evidence base relating to PA promotion for adolescent girls using family-based approaches and provide justification for the involvement of mothers in PA promotion strategies for teenage girls. Future research should aim to expand on the findings of this thesis using the recommendations for practice, strengthening the evidence base for theory-based PA interventions for adolescent girls.

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Appendices

Appendix A: Statements of Authorship

A.1 Statement of Authorship Chapter 2: Part B:

Article Title: 'Adolescent Girls' Perceptions of Physical Activity: A Systematic Review of Qualitative Studies' *American Journal of Health Promotion*,
doi: [10.1177/0890117118818747](https://doi.org/10.1177/0890117118818747) [Epub ahead of print] (Impact factor 1.957).

Statement of authorship:

We hereby declare that Méabh Corr (Ph.D. candidate) is the principal author of this article. The following statements outline her contributions to the work:

- Substantial contributions to the conception and design of the work; the acquisition, analysis, and interpretation of data for the work; AND
- Drafting the work and revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Signed: _____

(Ph.D. candidate)

Signed: _____

(Supervisor & Co-author)

A.2 Statement of Authorship Chapter 4:

Article Title: "No One Ever Asked Us": A Feasibility Study Assessing the Co-Creation of a Physical Activity Programme with Adolescent Girls. Accepted for publication in *Global Health Promotion* (Impact Factor 1.179).

Statement of authorship:

We hereby declare that Méabh Corr (Ph.D. candidate) is the principal author of this article. The following statements outline her contributions to the work:

- Substantial contributions to the conception and design of the work; the acquisition, analysis, and interpretation of data for the work; AND
- Drafting the work and revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Signed: _____

(Ph.D. candidate)

Signed: _____

(Supervisor & Co-author)

A.3 Statement of Authorship Chapter 5:

Article Title: 'Maternal Correlates of Adolescent Girls' Physical Activity Measured Via Device-Based and Self-Report Measures', (Under Review), *Maternal and Child Health* (Impact Factor 1.788).

Statement of authorship:

We hereby declare that Méabh Corr (Ph.D. candidate) is the principal author of this article. The following statements outline her contributions to the work:

- Substantial contributions to the conception and design of the work; the acquisition, analysis, and interpretation of data for the work; AND
- Drafting the work and revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Signed: _____

(Ph.D. candidate)

Signed: _____

(Supervisor & Co-author)

A.4 Statement of Authorship Chapter 6:

Article Title: 'Supporting Our Lifelong Engagement: Mothers and Teens Exercising (SOLE MATES): A Feasibility Trial, (Under Review), *Women & Health* (Impact Factor 1.307).

Statement of authorship:

We hereby declare that Méabh Corr (Ph.D. candidate) is the principal author of this article. The following statements outline her contributions to the work:

- Substantial contributions to the conception and design of the work; the acquisition, analysis, and interpretation of data for the work; AND
- Drafting the work and revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Signed: _____

(Ph.D. candidate)

Signed: _____

(Supervisor & Co-author)

Appendix B: PRISMA Statement from Qualitative Synthesis

Section/Topic	#	Checklist Item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	37
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	39
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	40-41
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	41
METHODS			
Protocol and Registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	41
Eligibility Criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	41
Information Sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	41
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendices page 218-220

Section/Topic	#	Checklist Item	Reported on page #
Study Selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	42
Data Collection Process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	42
Data Items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	42
Risk of Bias of Individual Studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	42
Summary Measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	n/a
Synthesis of results for each meta-analysis	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I ²) for each meta-analysis.	42
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	42
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study Selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	56
Study Characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	44-55
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Appendices page 221-224

Section/Topic	#	Checklist Item	Reported on page #
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	n/a
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	n/a
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15)	43
Additional Analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16])	n/a
DISCUSSION			
Summary of Evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	57-63
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	67
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	66-67
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	69

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Appendix C: ENTREQ Statement from Qualitative Synthesis

No.	Item	Guide and Description	Reported on page #
1	Aim	State the research question the synthesis addresses.	41
2	Synthesis Methodology	Identify the synthesis methodology or theoretical framework which underpins the synthesis and describe the rationale for choice of methodology (e.g. meta-ethnography, thematic synthesis).	42
3	Approach to searching	Indicate whether the search was pre-planned (comprehensive search strategies to seek all available studies) or iterative (to seek all available concepts until theoretical saturation is achieved).	41
4	Inclusion criteria	Specify the inclusion/exclusion criteria (e.g. in terms of population, language, year limits, type of publication, study type).	41
5	Data Sources	Describe the information sources used (e.g. electronic databases (MEDLINE, EMBASE, CINAHL, psycINFO, Econlit), grey literature databases (digital thesis, policy reports), relevant organisational websites, experts, information specialists, generic web searches (Google Scholar) hand searching, reference lists) and when the searches conducted; provide the rationale for using the data sources.	41
6	Electronic Search strategy	Describe the literature search (e.g. provide electronic search strategies with population terms, clinical or health topic terms, experiential or social phenomena related terms, filters for qualitative research, and search limits).	41
7	Study Screening Methods	Describe the process of study screening and sifting (e.g. title, abstract and full text review, number of independent reviewers who screened studies).	42
8	Study Characteristics	Present the characteristics of the included studies (e.g. year of publication, country, population, number of participants, data collection, methodology, analysis, research questions).	44-55
9	Study Selection Results	Identify the number of studies screened and provide reasons for study exclusion (e.g., for comprehensive searching, provide numbers of studies screened and reasons for exclusion indicated in a figure/flowchart).	56

No.	Item	Guide and Description	Reported on page #
10	Rationale for Appraisal	Describe the rationale and approach used to appraise the included studies or selected findings (e.g. assessment of conduct (validity and robustness), assessment of reporting (transparency), assessment of content and utility of the findings).	42
11	Appraisal items	State the tools, frameworks and criteria used to appraise the studies or selected findings.	42
12	Appraisal Process	Indicate whether the appraisal was conducted independently by more than one reviewer and if consensus was required.	42
13	Appraisal Results	Present results of the quality assessment and indicate which articles, if any, were weighted/excluded based on the assessment and give the rationale.	43
14	Data Extraction	Indicate which sections of the primary studies were analysed and how were the data extracted from the primary studies? (e.g. all text under the headings “results /conclusions” were extracted electronically and entered into a computer software).	42
15	Software	State the computer software used, if any.	42
16	Number of Reviewers	Identify who was involved in coding and analysis.	42
17	Coding	Describe the process for coding of data (e.g. line by line coding to search for concepts).	42
18	Study Comparison	Describe how were comparisons made within and across studies (e.g. subsequent studies were coded into pre-existing concepts, and new concepts were created when deemed necessary).	42
19	Derivation of themes	Explain whether the process of deriving the themes or constructs was inductive or deductive.	42
20	Quotations	Provide quotations from the primary studies to illustrate themes/constructs and identify whether the quotations were participant quotations of the author’s interpretation.	57-63
21	Synthesis output	Present rich, compelling and useful results that go beyond a summary of the primary studies (e.g. new interpretation, models of evidence, conceptual models, analytical framework, development of a new theory or construct).	57-63

Appendix D: Search Strategy for Qualitative Synthesis (Carried out on 12/01/17)

PubMed:

1. Adolescent
2. Teenager
3. 1 OR 2 (search all fields)
4. Girl
5. Female
6. 5 OR 6 (search all fields)
7. "physical activity"
8. Sport
9. Exercise
10. "physical education"
11. 7 OR 8 OR 9 OR 10 (search title and abstract)
12. "focus group"
13. interview
14. Qualitative
15. "qualitative research"
16. 12 OR 13 OR 14 OR 15
17. 3 AND 6 AND 11 AND 16

Results: Search #17 = 1,386

Filters: Publication date from 2001/01/01 to 2016/12/31

Academic Search Complete:

1. Adolescen*
2. Teenage*
3. 1 OR 2
4. Girl*
5. Female*
6. 4 OR 5
7. physical activit*
8. Sport
9. Exercis*
10. "physical education"
11. 7 OR 8 OR 9 OR 10
12. focus group*
13. interview*
14. Qualitative
15. "qualitative research"
16. 12 OR 13 OR 14 OR 15
17. 3 AND 6 AND 11 AND 16

Results: Search #17= 358 results

Filters: Publication date from 2001/01/01 to 2016/12/31

English only

Articles only

ERIC:

1. Adolescenc*
2. Teenage*
3. 1 OR 2
4. Girl*
5. Female*
6. 4 OR 5
7. physical activit*
8. Sport
9. Exercis*
10. "physical education"
11. 7 OR 8 OR 9 OR 10
12. focus group*
13. interview*
14. Qualitative
15. "qualitative research"
16. 12 OR 13 OR 14 OR 15
17. 3 AND 6 AND 11 AND 16

Results Search #17= 93

Filters: Publication date from 2001/01/01 to 2016/12/31

English only

Articles only

SPORTDiscus with Full Text:

1. Adolescenc*
2. Teenage*
3. 1 OR 2
4. Girl*
5. Female*
6. 4 OR 5
7. physical activit*
8. Sport
9. Exercis*
10. "physical education"
11. 7 OR 8 OR 9 OR 10
12. focus group*
13. interview*

- 14. Qualitative
- 15. “qualitative research”
- 16. 12 OR 13 OR 14 OR 15
- 17. 3 AND 6 AND 11 AND 16

Results Search #17 = 256

Filters: Publication date from 2001/01/01 to 2016/12/31

English only

Articles only

Appendix E: CASP Checklist and results

Each checklist item will be used to assess the quality of the chosen studies.

Checklist Items	Criteria	Assessment of Quality (guiding questions)
1. Was there a clear statement of the aims of the research?	Initial Screening Question	what was the goal of the research? why it was thought important? What is its relevance?
2. Is a qualitative methodology appropriate?	Initial Screening Question	If the research seeks to interpret or illuminate the actions and/or subjective experiences of research participants Is qualitative research the right methodology for addressing the research goal?
3. Was the research design appropriate to address the aims of the research?	Research Design	Does the researcher justify why they have chosen a specific design? Is there a discussion on why this method was chosen?
4. Was the recruitment strategy appropriate to the aims of the research?	Recruitment Strategy	Does the researcher explain how the participants were selected? Does the researcher explain why these participants are most appropriate to access the information sought by the study?
5. Was the data collected in a way that addressed the research issue?	Data Collection	Is the data collection setting justified? Is it clear how data was collected (e.g. focus group)? Are data collection methods justified and has the researcher explicitly explained the methods?

		Is the form of data clear? (e.g. tape recordings)
6. Has the relationship between the researcher and the participants been adequately considered?	Researcher relationship	Has the researcher critically examined their own role and potential risk of bias?
7. Have ethical issues been taken into consideration?	Ethical Considerations	Does the researcher discuss issues around informed consent and confidentiality? Did the researcher obtain ethical approval from a committee?
8. Was the data analysis sufficiently rigorous?	Data Analysis	Is there an in-depth description of the analysis process? If thematic analysis is used- is it clear how themes were derived? Is sufficient data presented to represent findings?
9. Is there a clear statement of findings?	Findings	Are the findings explicit? Does the researcher discuss the credibility of the findings? Are the findings discussed in relation to the original research question?
10. How valuable is the research?	Relevance of research	Does the researcher discuss the contribution of this study to existing knowledge? Does the researcher discuss how/if these findings can be transferred to other populations? Does the researcher identify any new areas where more research is necessary?

Reference	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	No. of YES
Araki et al. 2012	YES	YES	YES	CAN'T TELL	YES	YES	CAN'T TELL	CAN'T TELL	NO	CAN'T TELL	5
Bélangier et al. 2011	YES	YES	YES	YES	YES	CAN'T TELL	CAN'T TELL	YES	YES	YES	8
Casey et al. 2016	YES	YES	YES	YES	YES	YES	CAN'T TELL	CAN'T TELL	YES	YES	8
Casey et al. 2009	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9
Craike et al. 2012	YES	YES	YES	YES	YES	NO	CAN'T TELL	YES	YES	YES	8
Dagkas and Hunter, 2015	YES	YES	CAN'T TELL	YES	CAN'T TELL	NO	CAN'T TELL	YES	YES	YES	6
Dwyer et al. 2006	YES	YES	YES	YES	YES	NO	CAN'T TELL	YES	YES	YES	8
Eime et al. 2010	YES	YES	CAN'T TELL	YES	YES	NO	CAN'T TELL	YES	YES	YES	7
Gavin et al. 2016	YES	YES	YES	CAN'T TELL	YES	NO	YES	YES	YES	YES	8
Gillison et al. 2012	YES	YES	YES	YES	YES	NO	CAN'T TELL	YES	YES	YES	8
Humbert et al. 2008	YES	YES	YES	YES	YES	YES	CAN'T TELL	YES	YES	YES	9
Loman, 2008	YES	YES	CAN'T TELL	YES	YES	NO	CAN'T TELL	YES	YES	YES	7
Mabry et al. 2003	YES	YES	YES	YES	YES	NO	NO	YES	YES	YES	8

Reference	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	No. of YES
McEvoy et al. 2016	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	10
Monge-Rojas et al. 2009	YES	YES	YES	YES	YES	NO	NO	YES	YES	YES	8
Morrison et al. 2015	YES	YES	YES	YES	YES	CAN'T TELL	NO	YES	YES	YES	8
Phillips and Awotidebe 2015	YES	YES	YES	YES	YES	NO	NO	YES	YES	YES	8
Sleap and Wormald 2001	YES	YES	YES	YES	YES	NO	NO	YES	YES	YES	8
Smith et al. 2015	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9
Walia et al. 2012	YES	YES	YES	YES	YES	NO	NO	YES	YES	YES	8
Watson et al. 2015	YES	YES	YES	YES	YES	NO	NO	YES	YES	YES	8
Whitehead and Biddle, 2008	YES	YES	YES	NO	YES	NO	NO	YES	YES	YES	7
Yungblut et al. 2012	YES	YES	YES	NO	YES	NO	YES	YES	YES	YES	8
Yungblut et al. 2012	YES	YES	YES	NO	YES	NO	NO	YES	YES	YES	7

Appendix F: Thematic Map for Qualitative Synthesis

Theme 1: Gender Bias in Sport

Gender Bias in Sport	Internal Barriers	Body Image
		Body Centred (menstruation)
		Stereotypes of femininity
	Peer and Teacher Feedback	Peer support
		Teacher feedback
		Boyfriends
		Coach feedback
	Societal Pressure	Social Media/TV
		Societal Expectations
		PA Identity
		Bullying/Teasing
		Respect

Theme 2: Motivation and Perceived Competence

Motivation and Perceived Competence	Support Networks (Negative/Positive)	Friends
		Parents
		Teachers
		Community
	Ability/Skill Levels	Higher Competition
		Competence
		Perceived Competence
	Disengagement	Joining new clubs (fear of)
		Lack of Autonomy
		Activities Provided
	Types of physical activity	Single VS Mixed Activity
		Team Sports
		Intensity of Activity
		Activity During School
		Masculine Activities in PE
	Competition	Pressure on performance
		Competition as a positive
		Competition as a negative
		Competition preference with age

Theme 3: Competing Priorities

Competing Priorities	School and Homework	Exams
		Homework
		PE not priority in school
	Parental Expectations	Parent views of PA
		Religion/Ethnic backgrounds
		Helping with housework
		Discouragement of PA
	Changes in Leisure Activities	“Hang out” with friends
		Physical Activity “not cool”
		Cinema, shopping

Theme 4: Societal Expectations

Societal Expectations	Peer Influence	Friend Groups
		Team Sports
		Positive Peer Support
		Negative Peer support
	Adult Influence	Supportive Parents
		Parental Priorities re PA
		Teacher Expectations
	Community Influence	Rural Living
		Urban Living
		Facilities/Opportunities

Appendix G: Physical Activity Questionnaire for Adolescents (PAQ-A)

Name: _____ **Age:** _____ **DOB:** _____ **Date:** _____

We are trying to find out about your level of physical activity from the last 7 days (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember:

1. There are no right and wrong answers — this is not a test.
2. Please answer all the questions as honestly and accurately as you can — this is very important.

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rowing/canoeing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walking for exercise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jogging or running	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aerobics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swimming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baseball, softball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Football	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Badminton	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skateboarding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soccer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volleyball.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hockey.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Basketball.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Camogie.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other: _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Tick one only.)

- I don't do PE
- Hardly ever
- Sometimes
- Quite often
- Always

3. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Tick one only.)

- Sat down (talking, reading, doing schoolwork).....
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

4. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Tick one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 times last week
- 5 times last week

5. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Tick one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 or 5 times last week
- 6 or 7 times last week

6. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Tick one only.)

- None
- 1 time
- 2 — 3 times
- 4 — 5 times
- 6 or more times

7. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

- A. All or most of my free time was spent doing things that involve little physical effort
- B. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics)
- C. I often (3 — 4 times last week) did physical things in my free time
- D. I quite often (5 — 6 times last week) did physical things in my free time
- E. I very often (7 or more times last week) did physical things in my free time ..

8. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tuesday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wednesday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thursday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saturday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sunday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Tick one.)

- Yes
- No

If Yes, what prevented you?

Thank you for taking the time to fill out this questionnaire 😊

Appendix H: International Physical Activity Questionnaire (IPAQ)

Name: _____

Date: _____

**INTERNATIONAL PHYSICAL ACTIVITY
QUESTIONNAIRE**

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**.

Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Part 1: Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

No vigorous physical activities *Skip to question 3*

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

Don't know/Not sure

Part 2: Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

No moderate physical activities *Skip to question 5*

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**
_____ **minutes per day**

Don't know/Not sure

Part 3: Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

No walking *Skip to question 7*

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**
_____ **minutes per day**

Don't know/Not sure

Part 4: The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**
_____ **minutes per day**

Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix I: Co-Participation Questionnaire

Name: _____

Date: _____

This short questionnaire asks about co-physical activity (i.e. being physical active with your mother at the same time). We want to see how much time in a week you spend being physically active with your mother/daughter. Please think about the **LAST 7 DAYS** specifically when answering these questions.

Section 1:

1. In the **PAST 7 DAYS**, how many **DAYS** did you do any physical activities with your mother/daughter, including things like active games, sports, or other physical activities, and so forth? Please only consider activities where both you and your mother/daughter were active

_____ days

2. Thinking about the **PAST 7 DAYS**, please tick the days where you did any physical activity (including things like active games, sports, or other physical activities) with your **MOTHER/DAUGHTER ENROLLED IN SOLE MATES** and **NO OTHER** family members (please tick all that apply):

Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	
Not applicable	

3. Thinking about these occasions, how many **MINUTES** were you active together for **ON AVERAGE** on:

Weekdays (Monday to Friday): _____ minutes or write n/a if not applicable

AND

Weekend days (Saturday and Sunday): _____ minutes or write n/a if not applicable

PLEASE TURN OVER

Section 2

-The following questions are similar to those on the previous page.

- However, these questions ask about your physical activity participation when you were active with your mother and at least ONE other family member.

4. Thinking about the **PAST 7 DAYS**, please tick the days where you did any physical activity (including things like active games, sports, or other physical activities) with **your MOTHER/DAUGHTER ENROLLED IN SOLE MATES** and **AT LEAST ONE OTHER** family member (please tick all that apply):

Monday	<input type="checkbox"/>
Tuesday	<input type="checkbox"/>
Wednesday	<input type="checkbox"/>
Thursday	<input type="checkbox"/>
Friday	<input type="checkbox"/>
Saturday	<input type="checkbox"/>
Sunday	<input type="checkbox"/>
Not applicable	<input type="checkbox"/>

5. Thinking about these occasions, how many **MINUTES** were you active together for **ON AVERAGE**

Weekdays (Monday to Friday): _____ minutes or write n/a if not applicable

AND

Weekend days (Saturday and Sunday): _____ minutes or write n/a if not applicable

6. Thinking about the **PAST 7 DAYS**, please tick any physical activities you and your mother/daughter did **TOGETHER**:

Bike riding	<input type="checkbox"/>
Soccer	<input type="checkbox"/>
Cricket	<input type="checkbox"/>
Basketball	<input type="checkbox"/>
Running	<input type="checkbox"/>
Walking	<input type="checkbox"/>
Handball	<input type="checkbox"/>
Tennis	<input type="checkbox"/>
Swimming	<input type="checkbox"/>
Throw and Catch games	<input type="checkbox"/>

Other (please specify)

Thank you for completing this questionnaire! 😊

Appendix J: Physical Activity Enjoyment Scale (PACES)

Name: _____ Age: _____ Date: _____

Physical Activity Enjoyment Scale

Rate each of the following statements with a one of the following answers

1= Disagree a lot 2= Disagree 3 = Unsure 4= Agree 5= Agree a lot

When I am active. . . (Tick one box per statement)

	1	2	3	4	5
I enjoy it					
I feel bored					
I dislike it					
I find it pleasurable					
It's no fun at all					
It gives me energy					
It makes me depressed					
It's very pleasant					
My body feels good					
I get something out of it					
It's very exciting					
It frustrates me					
It's not at all interesting					
It gives me a strong feeling of success					
It feels good					
I feel as though I would rather be doing something else					

Appendix K: COM-B 23-Item Self Evaluation Questionnaire

Name: _____ Age: _____ DOB: _____ Date: _____

When it comes to you regularly **exercising or being physically active**, what do you think it would take for you to do it?

(**Circle** as many of the items on the list that you think apply; you can circle as many or as few as you think appropriate).

I would have to....

CAPABILITY

1. Know more about why it is important	e.g. have a better understanding of the benefits of exercising more
2. Know more about how to do it	e.g. have a better understanding of effective ways of exercising or being physically active
3. Have better physical skills	e.g. learn different exercises or movements to help me be physically active
4. Have better mental skills	e.g. learn how to reason more effectively
5. Have more physical strength	e.g. build up muscles for demanding physical work
6. Have more mental strength	e.g. develop stronger resilience against barriers to being more active
7. Overcome physical limitations	e.g. to overcome problems of stature or disability
8. Overcome mental obstacles	e.g. develop stronger resilience against the temptation to not exercise
9. Have more physical stamina	e.g. develop a greater capacity to maintain physical effort
10. Have more mental stamina	e.g. develop greater capacity to maintain mental effort

OPPORTUNITY

1. Have more time to do it	e.g. create dedicated time during the day
2. Have more money	e.g. be given or earn funds to support the behaviour
3. Have the necessary materials	e.g. acquire better clothes/shoes/other equipment for the task
4. Have it more easily accessible	e.g. easier access to facilities
5. Have more people around me doing it	e.g. be part of a “crowd” who are doing it
6. Have more triggers to prompt me	e.g. have more reminders at strategic times
7. Have more support from others	e.g. have my family or friends behind me

MOTIVATION

1. Feel that I want to do it enough	e.g. feel more of a sense of pleasure or satisfaction from exercise
2. Feel that I need to do it enough	e.g. care more about the negative consequences of not doing it
3. Believe that it would be a good thing to do	e.g. have a stronger sense that I should do it
4. Develop better plans for doing it	e.g. have a clearer and better developed plan for exercising regularly
5. Develop a habit of doing it	e.g. get into a pattern of exercising regularly without having to think
6. Something else (please specify)	

Please use the space below to make any observations you have or why you think certain items might be important for you.

Thank you

Appendix L: Parent-Adolescent Communication Scale

Name: _____ Date: _____

The Parent-Adolescent Communication Scale

This questionnaire assesses how you currently feel about your communication with your mother. Answer all questions as honestly as possible.

Using the scale below, please indicate how much you agree or disagree with EACH of the following statements about the general communication between you and your mother

Response choices: Strongly Disagree; Disagree; Neither Agree or Disagree; Agree; Strongly Agree

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
1. I can discuss my beliefs with my mother/daughter without feeling restrained or embarrassed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Sometimes I have trouble believing everything my mother/daughter tells me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. My mother/ daughter is always a good listener.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I am sometimes afraid to ask my mother/ daughter for what I want.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. My mother/ daughter has a tendency to say things to me which would be better left unsaid.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. My mother/ daughter can tell how I'm feeling without asking.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I am very satisfied with how my mother/ daughter and I talk together.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. If I were in trouble, I could tell my mother/ daughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I openly show affection to my mother/ daughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. When we are having a problem, I often give my mother/ daughter the silent treatment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
11. I am careful about what I say to my mother/daughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. When talking to my mother/ daughter, I have a tendency to say things that would be better left unsaid.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. When I asked questions, I get honest answers from my mother/ daughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. My mother/ daughter tries to understand my point of view.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. There are topics I avoid discussing with my mother/ daughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. I find it easy to discuss problems with my mother/ daughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. It is very easy for me to express all my true feelings to my mother/ daughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. My mother/ daughter nags/bothers me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. My mother/ daughter sometimes insults me when she is angry with me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I don't think I can tell my mother/daughter how I really feel about some things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you for completing this questionnaire ☺

Appendix M: KIDSCREEN-27

Name: _____

Date: _____

The following questionnaire asks questions about your general health and well-being. We would like to know how you have been feeling over the **past 7 days**.

Please read every question carefully. What answer comes to your mind first? Choose the box that fits your answer best and cross it.

Remember: This is not a test so there are no wrong answers. It is important that you answer all the questions and that we can see your marks clearly. When you think of your answer please try to remember the last week.

You do not have to show your answers to anybody. Also, nobody who knows you will look at your questionnaire once you have finished it.

1. Physical Activities and Health

Q1. In general, how would you say your health is?

- Excellent
- Very Good
- Good
- Fair
- Poor

Thinking about the last week...

	Not at all	Slightly	Moderately	Very	Extremely
Q2. Have you felt fit and well?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q3. Have you been physically active? (e.g. running, climbing, biking)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q4. Have you been able to run well?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thinking about last week...

	Never	Seldom	Quite Often	Very Often	Always
Q5. Have you full of energy?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. General Moods and Feelings about Yourself

Thinking about the last week...

	Not at all	Slightly	Moderately	Very	Extremely
Q1. Has your life been enjoyable?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thinking about the last week...

	Never	Seldom	Quite Often	Very Often	Always
Q2. Have you been in a good mood?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q3. Have you had fun?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thinking about the last week....

	Never	Seldom	Quite Often	Very Often	Always
Q4. Have you felt sad?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q5. Have you felt so bad that you didn't want to do anything?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q6. Have you felt lonely?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q7. Have you been happy with the way you are?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Family and Free Time

Thinking about the last week...

	Never	Seldom	Quite Often	Very Often	Always
Q1. Have you had enough time for yourself?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q2. Have you been able to do the things that you want to do in your free time?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q3. Have your parent(s) had enough time for you?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q4. Have your parent(s) treated you fairly?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q5. Have you been able talk to your parent(s) when you wanted to?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Q6. Have you had enough money to do the same things as your friends?
- Q7. Have you had enough money for your expenses?

4. Friends

Thinking about the last week...

- | | Never | Seldom | Quite Often | Very Often | Always |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Q1. Have you spent time with your friends? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Q2. Have you had fun with your friends? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Q3. Have you and your friends helped each other? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Q4. Have you been able to rely on your friends? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

5. School and Learning

Thinking about last week...

- | | Not at all | Slightly | Moderately | Very | Extremely |
|-------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Q1. Have you been happy at school? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Q2. Have you got on well at school? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Thinking about the last week...

- | | Never | Seldom | Quite Often | Very Often | Always |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Q3. Have you been able to pay attention? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Q4. Have you got along well with your teachers? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Thank you for filling out this questionnaire 😊

Appendix N: Parenting Practices Questionnaire

Name: _____

Date: _____

The following is an activity related parenting practices scale. The questions in this questionnaire ask about what you do to encourage your daughter(s) physical activity levels. Read each of the statements and choose a response which best fits your current situation. Tick those which apply

1. How <i>active</i> are you in enrolling your daughter in sport/physical activity?	I <i>rarely</i> enroll my daughter in sports.	
	I enroll my daughter <i>once in a while</i> .	
	I <i>frequently</i> enroll my daughter in sports	
	I <i>go out of my way</i> to enroll my daughter in sports	
2. How <i>often</i> do you go to your daughter's sporting events?	Rarely	
	Sometimes	
	Usually	
	Always	
3. How <i>important</i> is it to you to be actively involved in your daughter's physical activity levels?	It is <i>not particularly</i> important to me to be involved.	
	It is sort of important to me to be involved.	
	It is <i>important</i> to me to be involved.	
	It is <i>extremely</i> important to me to be involved.	
4. How much do you <i>enjoy</i> sport/physical activity?	Don't enjoy	
	Sort of enjoy	
	Really enjoy	
	Thoroughly enjoy	
5. How <i>frequently</i> (on average) do you participate in sport/physical activity each week?	_____ Times per week	
6. How <i>often</i> does your family use sport/physical activity as a form of family recreation (e.g., going on bike rides together, hiking, ice skating)?	Rarely	
	Once in a while	
	Relatively often	
	Frequently	

P.T.O

7. How much do you use <i>your own behaviour</i> to encourage your daughter to be physically active?	I <i>don't</i> use my own behaviour to encourage my daughter to be active.	
	I <i>rarely</i> use my own behaviour to encourage my daughter to be active.	
	I <i>often</i> use my own behaviour to encourage my daughter to be active	
	I <i>constantly</i> use my own behaviour to encourage my daughter to be active.	
8. Compared to peers my child is...	Very active	
	Moderately active	
	Quite sedentary	
	Extremely sedentary	
9. I find "parenting for physical activity" difficult because I...	Don't know enough about how to be active	
	Don't know how to encourage my daughter to be active	
	Don't know about why physical activity is important	
	Other (please specify)	

Thank you for filling out this questionnaire ☺

Appendix O: Question Topic Guides

O.1 Topic Guide for Behavioural Diagnosis Pre intervention

- Tell me a little bit about the types of activities you participate in out of school? If none, why?
- Tell me a little bit about the types of activities you participate in at school? If none, why?
- If you could change something about the physical activity opportunities available to you what would you change and why?
- If you could create the perfect physical activity opportunity, describe what it would look like.
- A lot of girls don't like to be physically active, why do you think that is? Is there anything we could do to try and change that?
- Do you think you need more motivation to be physically active? How could we help you feel more motivated?
- Do you think you have enough opportunities to be physically active? How could we help to change the opportunities currently available?
- Are there areas related to your capability that impact your physical activity? Can we help to change this? For example, if you were more educated on the benefits of physical activity would you feel more capable to participate?
- In the questionnaire, a lot of people mentioned that motivation was a factor for them when it comes to being physically active. Do you think that you need to try develop a habit of doing it or develop better plans? Do you think having a well-planned programme in place every week would help you?
- Another aspect mentioned in the questionnaire was around opportunities, factors such as money or access to facilities and time were barriers for some people. How can we help you overcome these barriers with this programme? What would be the best time for it to take place/ where should it take place?
- Having support from others and having triggers or prompts was identified by some people as being necessary for them to change their behavior. What kind of prompts do you think we could use to encourage people to be physically active and take part in the programme?
- Developing better plans/habit was identified as an area people needed to change to change their behavior. Would some practical sessions on goal setting and planning help, is that something you would be interested in?
- In relation to motivation, some people mentioned they needed to feel like they needed to do it/feel they want to do it more. How do you think we could help achieve this? Is there any people you can think of that you feel are good role models that would help increase your motivation?

O.2 Post Intervention Topic Guide School Feasibility Study

- The aim of this focus group is to get a sense of what you thought about participating in the programme, how you felt about being involved in designing the content, things you liked or didn't like and maybe some changes that could be made. We'll also talk a little bit about how you feel about your capabilities, opportunities and motivations to be active.
- Overall what were your impressions of the programme?
- How did you feel about being involved in the design of the programme? Did you feel this impacted your participation or did it change your opinion somehow?
- Is there anything you didn't like about it, or anything you would change?
- Is this closer to what you would like your senior cycle PE to look like? If you did a programme like this in PE how long do you think you should be spending on each activity e.g. yoga?
- What did you think about the educational aspects of the programme?
- How did you feel about the measures we used? Were they okay or were they not okay? (pedometers, questionnaires, focus groups)
- Any issues with pedometers mentioned – what alternatives would you suggest to monitor your PA or is that something you're interested in?
- Tasks outside of school- PA diary. Was this a good motivational tool? Did it help you stay on track and adhere to your goals?
- Opinion on girls only versus mixed group – did you like that this programme was a girl's only programme?
- Do you think your perceptions of PE or PA have changed positively or negatively having participated in this programme?

O.3 Question Topic Guide SOLE MATES (Mothers)

- Tell me your first name and a little bit about yourself...
- Prior to the start of the programme, how much physical activity did you engage in?
- Has that changed since your participation in the programme?
- Prior to the start of the programme, how much physical activity did your daughter engage in?
- Has that changed since her participation in the programme?
- What motivated you to choose to “sign-up” for SOLE MATES?
- Was your daughter(s) as motivated?
- If not, how did you encourage her to take part?
- For any of you, was it your daughter who initiated involvement in SOLE MATES?
- Switching to talking about the initiative... what are your overall thoughts about SOLE MATES?
- General impressions, things you liked, things you didn’t like...
- What about the format of the sessions (i.e., educational for half and then the walk)?
- Is there anything you would change to improve the format?
- Particular things you really like?
- How did you feel about the weekly themes/walk and talk topic?
- How did you feel about the assessments that were conducted at the beginning and after the programme ended (i.e., pedometer for 7 days, height/weight, and series of questionnaires)?
- Were any of the questions hard to understand or confusing?
- Was the time commitment involved ok to attend these appointments?
- When you think about the “work” you had to do on a weekly basis (i.e., recording the pedometer steps, the walk with your daughter outside of the programme, etc.) – how do you feel about the amount of “work” you had to do?
- What barriers did you face trying to do those things?
- What additional supports could have eliminated those barriers?
- How did you feel about the two weekly text messages?
- Did you engage with the Facebook group?
- If so, tell me your thoughts about that?
- If not, tell me what other ways might be useful for communicating with a group such as SOLE MATES.
- How did you feel about the small incentives such as the water bottle, the t-shirt, the high vis vest, etc.
- Did you enjoy the walks that included a novel component such as the geocaching, the walking to music, the colour walk?
- What did you like about those?
- If not, what would you prefer?

- When thinking about the amount of time you spent participating in this intervention...do you feel the requirements included a reasonable or unreasonable amount of time on your part?
- Did it fit within your daily life schedule?
- Were the schedule/requirements acceptable...as in do you think other people who find the intervention appealing with a similar schedule?
- Do you feel you have the knowledge/skills necessary to encourage or motivate your daughter to be active now compared to at the start of the programme?
Discuss.
- The intervention lasted 7 weeks – tell me what you think about that length?
- I heard that it did not rain for any of your sessions (WOW!) – discuss the impact the weather has on your decision to go outside and be active.
- If you were to provide the research team with any advice on what essential components of SOLE MATES to keep unchanged what would they be?
- If you were to provide the research team with any advice on what essential components of SOLE MATES to change what would they be?
- Discuss your overall level of satisfaction with the SOLE MATES programme.
- How satisfied with the programme do you think your daughter was?
- Right now, do you have plans to continue walking with your daughter on a regular basis?
- Is there anything else you would like to share about the programme, your experience, your daughter's experience?

O.4 Question Topic Guide SOLE MATES (Daughters)

- Tell me your first name and a little bit about yourself...
- Prior to the start of the programme, how much physical activity did you engage in?
- Has that changed since your participation in the programme?
- Prior to the start of the programme, how much physical activity did your mother engage in?
- Has that changed since her participation in the programme?
- What was your initial reaction when you heard about the programme?
- What motivated you to choose to “sign-up” for SOLE MATES?
- If it was your mother, how did she convince you to take part?
- Switching to talking about the programme....what are your overall thoughts about SOLE MATES?
- General impressions, things you liked, things you didn’t like...
- What about the format of the sessions (i.e., educational for half and then the walk)?
- Is there anything you would change to improve the format?
- Particular things you really like?
- How did you feel about the weekly themes/walk and talk topic? Did you have a favourite?
- How did you feel about the assessments that were conducted at the beginning and after the programme ended (i.e., pedometer for 7 days, height/weight, and series of questionnaires)?
- Were any of the questions hard to understand or confusing?
- Did you have any problem attending these appointments?
- When you think about the “work” you had to do on a weekly basis (i.e., recording the pedometer steps, the walk with your mum outside of the programme, etc.) – how do you feel about the amount of “work” you had to do?
- What made it hard to do those things?
- How did you feel about the two weekly text messages?
- Did you engage with the Facebook group?
- If so, tell me your thoughts about that?
- If not, tell me what other ways might be useful for communicating with a group of teen girls?
- How did you feel about the small gifts you got such as the water bottle, the t-shirt, the high vis vest, etc.
- Did you enjoy the walks that included the fun/different component such as the geocaching, the walking to music, the colour walk?
- What did you like about those?
- If not, what would you prefer?
- When thinking about the amount of time you spent participating in this programme...do you feel the requirements included a reasonable or unreasonable amount of time on your part?

- Did it fit within your daily life schedule?
- Were the schedule/requirements acceptable...as in do you think other teen girls would want to do the programme with a similar schedule?
- The intervention lasted 7 weeks – tell me what you think about that length?
- I heard that it did not rain for any of your sessions (WOW!) – discuss the impact the weather has on your decision to go outside and be active.
- If you were to provide the research team with any advice on what essential components of SOLE MATES to keep unchanged what would they be?
- If you were to provide the research team with any advice on what essential components of SOLE MATES to change what would they be?
- Discuss your overall level of satisfaction with the SOLE MATES programme.
- How satisfied with the programme do you think your mother was?
- Right now, do you have plans to continue walking with your mum on a regular basis?
- Is there anything else you would like to share about the programme, your experience, your mother's experience?

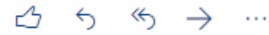
Appendix P: Thematic Map for Feasibility Study

Programme Novelty	Activities	Yoga
		Pilates
		Aerobics
		Kickboxing
	Single-Sex	Different from PE
		No Pressure to Perform
		Away from males
	Ownership	Choice in activities
		Involvement in programme design
		Feeling more accountability for participation

Unleashing Potential	PA Opportunities	Exposure to new activities
		Distinction b/w PA and team sports
		Desired link with other subjects
	Knowledge	Increased knowledge about PA benefits
		Initial Impressions
		Programme content (non-PA based)
	Motivation	PA Diaries
		Using Pedometers
		PA goals

Appendix Q: Letter of Acceptance for Publication

Global Health Promotion <onbehalf@manuscriptcentral.com>



Sun 28/04/2019 10:05
Meabh Corr (Postgrad) ▾

28.4.19

Dear Ms. Corr:

It is a pleasure to accept your manuscript entitled ""No One Ever Asked Us": A Feasibility Study Assessing the Co-Creation of a Physical Activity Programme with Adolescent Girls" in its current form for publication in Global Health Promotion.

If you would like your article to be freely available online immediately upon publication (as some funding bodies now require), you can opt for it to be published under the SAGE Choice Scheme on payment of a publication fee. Please simply follow the link to the Contributor Agreement form in the next email and you will be able to access instructions and further information about this option within the online form.

Thank you for your fine contribution. On behalf of the Editors of Global Health Promotion, we look forward to your continued contributions to the Journal.

Sincerely,
Dr. Antony Morgan
Global Health Promotion
antony.morgan@gcu.ac.uk

Appendix R: CONSORT Statement (Chapter 4)

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a pilot or feasibility randomised trial in the title	85
	1b	Structured summary of pilot trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	88
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale for future definitive trial, and reasons for randomised pilot trial	89
	2b	Specific objectives or research questions for pilot trial	89
Methods			
Trial design	3a	Description of pilot trial design (such as parallel, factorial) including allocation ratio	90
	3b	Important changes to methods after pilot trial commencement (such as eligibility criteria), with reasons	n/a
Participants	4a	Eligibility criteria for participants	90
	4b	Settings and locations where the data were collected	90
	4c	How participants were identified and consented	90
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	93-94

Section/Topic	Item No	Checklist item	Reported on page No
Outcomes	6a	Completely defined pre-specified assessments or measurements to address each pilot trial objective specified in 2b, including how and when they were assessed	91-92
	6b	Any changes to pilot trial assessments or measurements after the pilot trial commenced, with reasons	n/a
	6c	If applicable, prespecified criteria used to judge whether, or how, to proceed with future definitive trial	91-92
Sample size	7a	Rationale for numbers in the pilot trial	n/a
	7b	When applicable, explanation of any interim analyses and stopping guidelines	n/a
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	n/a
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	n/a
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	n/a
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	n/a
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	n/a
	11b	If relevant, description of the similarity of interventions	n/a

Section/Topic	Item No	Checklist item	Reported on page No
Statistical methods	12	Methods used to address each pilot trial objective whether qualitative or quantitative	91-92
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	n/a
	13b	For each group, losses and exclusions after randomisation, together with reasons	99
Recruitment	14a	Dates defining the periods of recruitment and follow-up	March – May 2017
	14b	Why the trial ended or was stopped	6-week duration
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	99-100
Numbers analysed	16	For each objective, number of participants (denominator) included in each analysis. If relevant, these numbers should be randomised by group.	99-100
Outcomes and estimation	17	For each objective, results including expressions of uncertainty (such as 95% confidence interval) for any estimates. If relevant, these results should be by randomised group	99-100
Ancillary analyses	18	Results of any other analyses performed that could be used to inform the future definitive trial	n/a
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	n/a
	19a	If relevant, other important unintended consequences	n/a

Section/Topic	Item No	Checklist item	Reported on page No
Discussion			
Limitations	20	Pilot trial limitations, addressing sources of potential bias and remaining uncertainty about feasibility	103
Generalisability	21	Generalisability (applicability) of the pilot trial methods and findings to future definitive trial and other studies	101-103
Interpretation	22	Interpretation consistent with pilot trial objectives and findings, balancing potential benefits and harms and considering other relevant evidence	101-103
	22a	Implications for progression from pilot to future definitive trial, including any proposed amendments	101-103
Other information			
Registration	23	Registration number for pilot trial and name of trial registry	n/a
Protocol	24	Where the pilot trial protocol can be accessed, if available	n/a
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	n/a

Appendix S: COREQ Statement (Chapter 4)

No	Item	Guide questions/description	Reported on page #
Domain 1: Research team and reflexivity			
Personal Characteristics			
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	91
2.	Credentials	What were the researcher's credentials? <i>E.g. PhD, MD</i>	BSc.
3.	Occupation	What was their occupation at the time of the study?	Researcher
4.	Gender	Was the researcher male or female?	Female
5.	Experience and training	What experience or training did the researcher have?	91
Relationship with participants			
6.	Relationship established	Was a relationship established prior to study commencement?	No
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? <i>e.g. personal goals, reasons for doing the research</i>	Participants received study information

No	Item	Guide questions/description	Reported on page #
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? <i>e.g. Bias, assumptions, reasons and interests in the research topic</i>	Reasons for interest shared
Domain 2: study design			
Theoretical framework			
9.	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? <i>e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis</i>	Thematic content analysis and directed content analysis
Participant selection			
10.	Sampling	How were participants selected? <i>e.g. purposive, convenience, consecutive, snowball</i>	Convenience sample
11.	Method of approach	How were participants approached? <i>e.g. face-to-face, telephone, mail, email</i>	Face-to-Face
12.	Sample size	How many participants were in the study?	Page 91

No	Item	Guide questions/description	Reported on page #
13.	Non-participation	How many people refused to participate or dropped out? Reasons?	0
Setting			
14.	Setting of data collection	Where was the data collected? <i>e.g. home, clinic, workplace</i>	School Setting
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	No non-participants
16.	Description of sample	What are the important characteristics of the sample? <i>e.g. demographic data, date</i>	Page 90
Data collection			
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 91
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	2
19.	Audio/visual recording	Did the research use audio or visual recording to collect the data?	Audio
20.	Field notes	Were field notes made during and/or after the interview or focus group?	No

No	Item	Guide questions/description	Reported on page #
21.	Duration	What was the duration of the interviews or focus group?	Page 91
22.	Data saturation	Was data saturation discussed?	No
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
Domain 3: analysis and findings			
Data analysis			
24.	Number of data coders	How many data coders coded the data?	1
25.	Description of the coding tree	Did authors provide a description of the coding tree?	Page 93
26.	Derivation of themes	Were themes identified in advance or derived from the data?	Derived from data
27.	Software	What software, if applicable, was used to manage the data?	Page 93
28.	Participant checking	Did participants provide feedback on the findings?	No
Reporting			
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each	Yes

No	Item	Guide questions/description	Reported on page #
		quotation identified? e.g. <i>participant number</i>	
30.	Data and findings consistent	Was there consistency between the data presented and the findings?	Yes
31.	Clarity of major themes	Were major themes clearly presented in the findings?	99
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	No

Appendix T: Participant Information Sheets and Consent Forms

T.1 Parent Information Sheet (School Feasibility Study)

If you have questions about the study or do not understand something, you may contact:

Méabh Corr

Department of Arts Education and Physical Education,

Mary Immaculate College,
South Circular Road,
Limerick
Tel: 061 204569
Email: meabh.corr@mic.ul.ie

OR

Dr. Elaine Murtagh

Department of Arts Education and Physical Education,

Mary Immaculate College,
South Circular Road,
Limerick
Tel: 061 204569

**Adolescent Girls and their
Perceptions of Physical Activity:
Improving our Understanding to
Enhance Intervention Design**

Parent / Guardian Information Sheet



**Adolescent Girls and their
Perceptions of Physical Activity:
Improving our Understanding to
Enhance Intervention Design.**

Information for parents/guardians

Invitation to Participate

Méabh Corr, a postgraduate student in Mary Immaculate College, under the supervision of Dr. Elaine Murtagh, is conducting a study to explore the views of adolescents regarding the promotion of physical activity. The views expressed by the adolescents will then be used to help design an intervention aimed at promoting positive physical activity behaviours. Your child is being asked to participate.

What is the study about?

We are interested in finding out what would encourage teenage girls to regularly participate in physical activity and what the ideal physical activity opportunity would look like to them.

Why is the study being undertaken?

Recent studies have indicated that Irish adolescents are not achieving sufficient activity to achieve health benefits. The results of the study will help inform the development of future programmes to help teenage girls to be physically active.

What will my child have to do?

If your child agrees to participate in this study, she will be asked to complete a questionnaire. Some children will then be also asked to participate in a focus group interview with the research team and other children from the school. Children will be asked their views about the promotion of physical activity. Based on the information collected a physical activity programme will then be designed and it will run for 4 weeks. Children will be asked for feedback about the programme in a focus group interview at the end of the 4 weeks.

Children will also have to wear a pedometer for a total of 14 days (7 days pre-intervention and 7 days post-intervention). A pedometer is a lightweight, unobtrusive device that attaches to the waist band of trousers/skirts. It is approximately the size of a box of matches. Your child will wear it each day during waking hours, except when swimming and bathing. The pedometer will record the number of steps that your child takes each day.



What are the risks?

There are no risks in this research greater than those involved in everyday practices.

What are the benefits?

If you wish you can receive information on the results of the study.

What happens to the information?

The study will be published as a research paper in a peer-reviewed journal and presented at a research conference.

How will confidentiality be kept?

Any personal identification will be omitted so that your child will not be identifiable in the written analysis. Only the Researchers will have access to the data. The study has been approved by the Research Ethics Committee at Mary Immaculate College (MIREC).

What if I do not want my child to take part?

Participation in this study is voluntary. Your child does not have to participate in this study if you or your child does not want to. If you agree for your child to be in this study, but later change your mind, you may withdraw your child at any time. There are no consequences of any kind if you decide you do not want your child to participate.

You can keep this form for your records

T.2 Participant Information Sheet (School Feasibility Study)

If you have questions about the study or do not understand something, you may contact:

Méabh Corr

Department of Arts Education and Physical Education,

Mary Immaculate College,
South Circular Road,
Limerick
Tel: 061 204569
Email: meabh.corr@mic.ul.ie

OR

Dr. Elaine Murtagh

Department of Arts Education and Physical Education,

Mary Immaculate College,
South Circular Road,
Limerick
Tel: 061 204569
Email: elaine.murtagh@mic.ul.ie

**Adolescent Girls and their
Perceptions of Physical Activity:
Improving our Understanding to
Enhance Intervention Design**

Participant Information Sheet



**Adolescent Girls and their
Perceptions of Physical Activity:
Improving our Understanding to
Enhance Intervention Design.**

Information for participants

Introduction:

You have been invited to participate in a project which is trying to gather the views of teenage girls about physical activity and what the ideal physical activity opportunity would look like. The project is being carried out by postgraduate student Méabh Corr (Mary Immaculate College) under the supervision of Dr Elaine Murtagh (Mary Immaculate College).

What will I have to do?

1. Questionnaires

You will be asked to complete a questionnaire which asks questions about the amount of physical activity you do now and how you could be encouraged to be more physically active.

2. Focus Groups

A random number of students will then be asked to participate in a 30-minute focus group interview led by a member of the research team. A focus group is an interview taking place with your classmates where your opinions on physical activity can be discussed. During this interview, you will be asked to be open and honest when discussing your opinions about physical activity and what you need to be physically active. The information from this interview will be used to design a physical activity program which will run for 4 weeks. You will also be invited to participate in this program, but involvement is optional. Students who participated on a regular basis will then be invited to take part in a second focus group after the program to receive feedback on what they thought of the program

3. Pedometers

If you choose to participate in the study you will be asked to wear a pedometer for 14 days (7 days before the program and 7 days after). A pedometer is a small light device that attaches onto the waistband of your trousers/skirts. It records the number of steps you take each day and should be worn while you are awake, except when swimming or bathing. You will be given a record sheet to record the number of steps you take each day while wearing the pedometer.



What are the risks?

There are no risks in this research greater than those involved in everyday practices.

What are the benefits?

If you wish you can receive information on the results of the study.

What happens to the information?

The study will be published as a research paper in a peer-reviewed journal and presented at a research conference.

How will confidentiality be kept?

Any personal identification will be omitted so that your child will not be identifiable in the written analysis. Only the Researchers will have access to the data. The study has been approved by the Research Ethics Committee at Mary Immaculate College (MIREC).

What if I do not want to take part?

Participation in this study is voluntary. You do not have to participate in this study if you do not want to. If you agree to be in the study, but later change your mind, you may withdraw at any time. There are no consequences of any kind if you decide you do not want to participate.

You can keep this form for your records



T.3 Principal Information Sheet (School Feasibility Study)

Study title: Adolescent Girls and their Perceptions of Physical Activity: Improving our Understanding to Enhance Intervention Design

09/03/17

Dear Principal,

I'm writing to invite your school to take part in a research project which seeks to gain the views of teenage girls on physical activity and what they need in order to become more physically active. This is important as female teenagers are particularly at risk of leading an inactive lifestyle. Participation in this study would involve granting us access to the transition year students in your school.

Before inviting the students to participate in the study, their parents will be given information on the research. Once they have been given the necessary information they will be invited to give consent for their child's involvement before the child receives the information, is invited to participate and receives a consent form.

All transition year students would be invited to complete a questionnaire. This will take approx. 20 minutes to complete. The research team would come to the school to distribute the questionnaires and answer any questions. A random subsample of approx. 24 students will then be invited to take part in a focus group interview with their peers, lasting 30 – 40 minutes. We would like to conduct 3 interviews with 6 – 8 students in each group. The focus group will be used as a means of expanding on the answer's students gave in the questionnaires to allow the research group to gain a deeper understanding of the views and opinions of students. This information will then be used to design a physical activity programme which is aimed specifically at the needs and interests of this group of students. Students who chose to participate will also be asked to wear a pedometer for a total of 14 days (7 days pre-intervention and 7 days' post-intervention). A pedometer is a lightweight, unobtrusive device that attaches to the waist band of trousers/skirts. It is approximately the size of a box of matches. Participants will wear it each day during waking hours, except when swimming and bathing. The pedometer will record the number of steps taken each day by the student. The programme will run for 4 weeks and once it is finished students who regularly participated will be invited to take part in another focus group to gain feedback on the programme itself.

The Researchers responsible for data collection are familiar with the Mary Immaculate College Child Protection Guidelines and signed an acceptance of these guidelines. The Researchers will also comply with the Child Protection Guidelines/Policies of your school. Participation in the study is voluntary and will require parental consent. I've enclosed the Parent Information Sheet which provides more details.

This research project has been approved by the Research Ethics Committee at Mary Immaculate College (MIREC). If you have concerns about this study and wish to

contact someone independent, you may contact: MIREC Administrator, Mary Immaculate College, South Circular Road, Limerick, Tel: 061 204980, Email: mirec@mic.ul.ie

I hope you will be willing to participate. This project will help us design physical activity programmes that meet the needs of teenage girls. For your convenience a 'reply form' is enclosed with this letter. Feel free to contact me or my supervisor at the telephone number or email address below if you would like to discuss the project in more detail. I look forward to hearing from you.

Yours sincerely,

Méabh Corr

Department of Arts Education and Physical Education,

Mary Immaculate College,

South Circular Road,

Limerick.

Email: meabh.corr@mic.ul.ie

Phone: 061-204569

Supervisor:

Dr. Elaine Murtagh

Lecturer in Physical Education

Dept. Arts Education and Physical Education

Mary Immaculate College

Direct Tel: 061 204569

Email: elaine.murtagh@mic.ul.ie

PARENT/GUARDIAN INFORMATION SHEET

Title of study

Patterns of physical activity in mothers and daughters.

Invitation to Participate

Dr. Elaine Murtagh of Mary Immaculate College and Méabh Corr, a PhD student in Mary Immaculate College are conducting a study to explore the patterns of physical activity between mothers and daughters. The results of this study can help to inform future policy and practice and improve physical activity levels. You and your child are being asked to participate.

What is the study about?

We are interested in finding out what the potential maternal correlate associated with adolescent girls' physical activity levels are. A correlate is something that has a mutual relationship or connection, in which one thing affects or depends on another.

Why is the study being undertaken?

Adolescents and children are required to engage in regular physical activity to maintain good physical and mental health. However, recent studies have indicated that many Irish children are not achieving sufficient activity to achieve health benefits. The results of the study will help inform the development of future programmes to help teenage girls to be physically active.

What will I have to do?

If you agree to participate in this study, you will be asked to complete some questionnaires that assess your physical activity levels, your feelings towards participating in physical activity with your child and some basic demographic information about yourself.

You will also have to wear a pedometer for a total of 7 days. A pedometer is a lightweight, unobtrusive device that attaches to the waist band of trousers/skirts. It is approximately the size of a box of matches. You will wear it each day during waking hours, except when swimming and bathing. The pedometer will record the number of steps that you take each day.

All participants will also have their height and weight discretely measured. This is so we can compare the physical activity results to other similar studies.

What will my child have to do?

If your child agrees to participate in this study, she will be asked to complete a questionnaire assessing her physical activity levels, emotional wellbeing and communication levels with her parents.

Children will also have to wear a pedometer for a total of 7 days. A pedometer is a lightweight, unobtrusive device that attaches to the waist band of trousers/skirts. It is approximately the size of a box of matches. Your child will wear it each day during waking hours, except when swimming and bathing. The pedometer will record the number of steps that your child takes each day.

What are the risks?

There are no risks in this research greater than those involved in everyday practices.

What are the benefits?

If you wish you can receive information on the results of the study.

What happens to the information?

The study will be published as a research paper in a peer-reviewed journal and presented at a research conference.

How will confidentiality be kept?

Any personal identification will be omitted so that you or your child will not be identifiable in the written analysis. Only the Researchers will have access to the data. The study has been approved by the Research Ethics Committee at Mary Immaculate College (MIREC).

What if you do not want your child to take part?

Participation in this study is voluntary. Your child does not have to participate in this study if you or your child does not want to. If you agree for your child to be in this study, but later change your mind, you may withdraw your child at any time. There are no consequences of any kind if you decide you do not want your child to participate.

If you have questions about the study or do not understand something, you may contact:

Dr. Elaine Murtagh

Department of Arts Education and Physical Education,
Mary Immaculate College, South Circular Road, Limerick

Tel: 061 204569

Email: elaine.murtagh@mic.ul.ie

If you have concerns about this study and wish to contact someone independent, you may contact:

MIREC Administrator, Mary Immaculate College, South Circular Road, Limerick
Email: mirec@mic.ul.ie

You will be given a copy of this form to keep for your records.

PARTICIPANT INFORMATION SHEET

Title of Study

Patterns of physical activity in mothers and daughters.

Introduction

You have been invited to participate in a project which involves mothers and their daughters (you) completing a variety of questionnaires and wearing a pedometer (step counter) for 7 days. The project is being carried out by Dr Elaine Murtagh (Mary Immaculate College) and Méabh Corr, a 3rd year PhD student (Mary Immaculate College).

What will I have to do?

If you choose to participate in the study, you will be asked to wear a pedometer for 7 days. A pedometer is a small light device that attaches onto the waistband of your trousers/skirts. It records the number of steps you take each day and should be worn while you are awake, except when swimming or bathing. After the 7 days you will return the pedometers and we will record your step counts. You will also be asked to complete several questionnaires which look at various things such as your physical activity levels, your emotional wellbeing and your communication with your mother.

You will also have your height and weight taken at the assessment, but this is just to allow us to compare our physical activity results to similar studies.

Confidentiality

This project has been approved by the Mary Immaculate College Research Ethics Committee. All information gathered in this project will remain completely anonymous and strictly confidential. Interviews will be identified using a code number and your name will not be recorded or used in any part of this project.

Withdrawing from the project

Participation in this project is completely voluntary. You have the right to withdraw from the project at any time without any penalty.

If you would like further information please contact:

Dr Elaine Murtagh,

Department of Arts Education and Physical Education,

Mary Immaculate College, South Circular Road, Limerick

Tel: 061 204569

Email: elaine.murtagh@mic.ul.ie

If you have any concerns about this study and wish to contact someone independent, you may contact:

MIREC Administrator, Mary Immaculate College

South Circular Road, Limerick

061-204980

mirec@mic.ul.ie

You may ask questions if you do not understand something on this form.

You will be given a copy of this form to keep for your records.

PARENT/GUARDIAN INFORMATION SHEET

Title of study

SOLE MATES

Supporting Our Lifelong Engagement: Mothers and Teens Exercising

Invitation to Participate

Dr. Elaine Murtagh of Mary Immaculate College and Méabh Corr, a PhD student in Mary Immaculate College are conducting a study to explore the possible benefits of a mother-daughter physical activity programme. The results of this study can help to inform future policy and practice and improve physical activity levels. You and your child are being asked to participate.

What is the study about?

We are interested in finding out what the potential benefits are to conduct a mother-daughter physical activity programme to assess whether parental support can have a positive impact on adolescent girl's physical activity levels.

Why is the study being undertaken?

Adolescents and children are required to engage in regular physical activity to maintain good physical and mental health. However, recent studies have indicated that many Irish children are not achieving sufficient activity to achieve health benefits. The results of the study will help inform the development of future programmes to help teenage girls to be physically active.

What will I have to do?

If you agree to participate in this study, you will be asked to complete some questionnaires that assess your physical activity levels, your feelings towards participating in physical activity with your child and some basic demographic information about yourself.

You will also have to wear a pedometer for a total of 14 days (7 days pre-intervention and 7 days post-intervention). A pedometer is a lightweight, unobtrusive device that attaches to the waist band of trousers/skirts. It is approximately the size of a box of matches. You will wear it each day during waking hours, except when swimming and bathing. The pedometer will record the number of steps that you take each day.

All participants will also have their height and weight discretely measured. This is so we can compare the physical activity results to other similar studies.

At the end of the 6-week programme you will be invited to participate in a focus group. During this time, you can express your thoughts and opinions about the programme and engage with other mothers who participated.

The 6-week physical activity programme includes a face-to-face session once a week with a group of other mothers and daughters. During this session you will walk with your daughter, under the guidance of Dr. Elaine Murtagh and Méabh Corr. You will also participate in weekly educational sessions to introduce you to potential parenting strategies to promote physical activity.

What will my child have to do?

If your child agrees to participate in this study, she will be asked to complete a questionnaire assessing her physical activity levels, emotional wellbeing and communication levels with her parents. Some children will then be also asked to participate in a focus group interview with the research team and other children from the school at the end of the programme. Your child will also participate in 6 weeks of a physical activity programme. The educational sessions for the children will be different to those offered to adults and will educate participants on the importance of physical activity and how to lead a more physically active lifestyle.

Children will also have to wear a pedometer for a total of 14 days (7 days pre-intervention and 7 days post-intervention). A pedometer is a lightweight, unobtrusive device that attaches to the waist band of trousers/skirts. It is approximately the size of a box of matches. Your child will wear it each day during waking hours, except when swimming and bathing. The pedometer will record the number of steps that your child takes each day.

What are the risks?

There are no risks in this research greater than those involved in everyday practices.

What are the benefits?

If you wish you can receive information on the results of the study.

What happens to the information?

The study will be published as a research paper in a peer-reviewed journal and presented at a research conference.

How will confidentiality be kept?

Any personal identification will be omitted so that you or your child will not be identifiable in the written analysis. Only the Researchers will have access to the data. The study has been approved by the Research Ethics Committee at Mary Immaculate College (MIREC).

What if you do not want your child to take part?

Participation in this study is voluntary. Your child does not have to participate in this study if you or your child does not want to. If you agree for your child to be in this study, but later change your mind, you may withdraw your child at any time. There are no consequences of any kind if you decide you do not want your child to participate.

If you have questions about the study or do not understand something, you may contact:

Dr. Elaine Murtagh

Department of Arts Education and Physical Education,
Mary Immaculate College, South Circular Road, Limerick

Tel: 061 204569

Email: elaine.murtagh@mic.ul.ie

**If you have concerns about this study and wish to contact someone independent,
you may contact:**

MIREC Administrator,

Mary Immaculate College,

South Circular Road, Limerick.

Tel: 061 204980

Email: mirec@mic.ul.ie

You will be given a copy of this form to keep for your records.

ADOLESCENT INFORMATION SHEET

Title of Study

SOLE MATES:

Supporting Our Lifelong Engagement: Mothers and Teens Exercising

Introduction

You have been invited to participate in a project which involves mothers and their daughters (you) participating in a physical activity programme together once a week. The project is being carried out by Dr Elaine Murtagh (Mary Immaculate College) and Méabh Corr, a 2nd year PhD student (Mary Immaculate College)

What will I have to do?

If you choose to participate in the study, you will be asked to wear a pedometer for 14 days (7 days before the programme and 7 days after). A pedometer is a small light device that attaches onto the waistband of your trousers/skirts. It records the number of steps you take each day and should be worn while you are awake, except when swimming or bathing. After the 7 days you will return the pedometers and we will record your step counts. You will also be asked to complete several questionnaires which look at various things such as your physical activity levels, your emotional wellbeing and your communication with your mother.

After the 6-week programme you will be invited to participate in a focus group interview. Focus group interviews follow a relaxed structure and it will give you an opportunity to share your thoughts and opinions about the programme. The focus groups will be audio recorded however no names will be used to ensure your privacy is maintained.

You will participate in a 6-week physical activity programme with your mother and a group of other mothers and teenage girls. Each week one session will take place in Mary Immaculate College. You and your mother will walk together with the rest of the group. Each week there will also be an educational session. You will be with other teenage girls for this part of the session and we will cover several topics such as why physical activity is important and how to plan to be more active. You will also have your height

and weight taken at the beginning of the program, but this is just to allow us to compare our physical activity results to similar studies.

Confidentiality

This project has been approved by the Mary Immaculate College Research Ethics Committee. All information gathered in this project will remain completely anonymous and strictly confidential. Interviews will be identified using a code number and your name will not be recorded or used in any part of this project.

Withdrawing from the project

Participation in this project is completely voluntary. You have the right to withdraw from the project at any time without any penalty.

If you would like further information please contact:

Dr Elaine Murtagh,
Department of Arts Education and Physical Education,
Mary Immaculate College, South Circular Road, Limerick
Tel: 061 204569
Email: elaine.murtagh@mic.ul.ie

If you have any concerns about this study and wish to contact someone independent, you may contact:

MIREC Administrator, Mary Immaculate College

South Circular Road, Limerick

061-204980

mirec@mic.ul.ie

You may ask questions if you do not understand something on this form.

You will be given a copy of this form to keep for your records

T.8 Principal Consent Form

PRINCIPAL INFORMED CONSENT FORM

Study title: Adolescent Girls and their Perceptions of Physical Activity: Improving our Understanding to Enhance Intervention Design

- I have read and understood the **recruitment letter** which gives details of the study.
- I understand what the project is about, and what the results will be used for.
- I know that my school's participation is voluntary and I can withdraw from the project at any stage without giving any reason.
- I am aware that the results will be kept confidential and that the research will be published in an academic journal.
- I consent to _____ (insert name of school) taking part in this research study.

Name of school principal (PRINTED)

Signature of school principal

Date

T.9 Parent/Guardian Consent Form (School Feasibility Study)

PARENT/GUARDIAN INFORMED CONSENT FORM

Study title: Adolescent Girls and their Perceptions of Physical Activity: Improving our Understanding to Enhance Intervention Design

- I have read and understood the **parent/guardian information sheet**.
- I understand what the project is about, and what the results will be used for.
- I am fully aware of **all** of the procedures involving my child, and of any **risks and benefits** associated with the study.
- I know that my child's participation is voluntary and that she can withdraw from the project at any stage without giving any reason.
- I am aware that the results will be kept confidential and that the research will be published in an academic journal.
- I consent to my child taking part in this research study.

Child's name (PRINTED)

Name of School

Child's Date of Birth

Parent/Guardian's Name (PRINTED)

Parent/ Guardian's signature

Date

Please return this page to school

T.10 Participant Consent Form (School Feasibility Study)

PARTICIPANT INFORMED CONSENT FORM (Student)

Study title: Adolescent Girls and their Perceptions of Physical Activity: Improving our Understanding to Enhance Intervention Design

- I have read and understood the **participant information sheet**.
- I understand what the project is about, and what the results will be used for.
- I am fully aware of **all** of the procedures involving myself, and of any **risks and benefits** associated with the study.
- I know that my participation is voluntary and that I can withdraw from the project at any stage without giving any reason.
- I am aware that the results will be kept confidential and that the research will be published in an academic journal.
- I consent to taking part in this research study.

Your Name (PRINTED)

Your signature

Date

T.11 Parent/Guardian Consent Form (Cross-Sectional Study)

PARENT/GUARDIAN INFORMED CONSENT FORM

Study title: Investigating Patterns of Physical Activity in Mothers and Teenage Girls

- I have read and understood the **parent/guardian information sheet**.
- I understand what the project is about, and what the results will be used for.
- I am fully aware of **all** of the procedures involving my child, and of any **risks and benefits** associated with the study.
- I know that my child's participation is voluntary and that she can withdraw from the project at any stage without giving any reason.
- I am aware that the results will be kept confidential and that the research will be published in an academic journal.
- I consent to my child taking part in this research study.

_____ Child's name (PRINTED)	_____ Child's year in school	_____ Child's Date of Birth
_____ Parent/Guardian's Name (PRINTED)	_____ Parent/ Guardian's signature	_____ Date
_____	_____	_____

Please return this page to Méabh

T.12 Participant Consent Form (Cross-Sectional Study)

PARTICIPANT INFORMED CONSENT FORM

Study title: Investigating Patterns of Physical Activity in Mothers and Teenage Girls

- I have read and understood the **participant information sheet**.
- I understand what the project is about, and what the results will be used for.
- I am fully aware of **all** of the procedures involving myself, and of any **risks and benefits** associated with the study.
- I know that my participation is voluntary and that I can withdraw from the project at any stage without giving any reason.
- I am aware that the results will be kept confidential and that the research will be published in an academic journal.
- I consent to taking part in this research study.

Your Name (PRINTED)

Your signature

Date

T.13 Parent/Guardian Consent Form (SOLE MATES)

PARENT/GUARDIAN INFORMED CONSENT FORM

Study title: SOLE MATES: Supporting Our Lifelong Engagement: Mothers and Teens Exercising

- I have read and understood the **parent/guardian information sheet**.
- I understand what the project is about, and what the results will be used for.
- I am fully aware of **all** of the procedures involving me and my child, and of any **risks and benefits** associated with the study.
- I know that my participation and my child's participation is voluntary and that we can withdraw from the project at any stage without giving any reason.
- I am aware that the results will be kept confidential and that the research will be published in an academic journal.
- I consent to taking part in this research study and I consent to my child taking part in this research study.

Child's name (PRINTED)

Age

Child's Date of Birth

Parent/Guardian's Name (PRINTED)

Parent/ Guardian's signature

Date

Please return this page to Elaine or Méabh

T.14 Participant Consent Form (SOLE MATES)

PARTICIPANT INFORMED CONSENT FORM

Study title:

SOLE MATES:

Supporting Our Lifelong Engagement – Mothers and Teens Exercising

- I have read and understood the **participant information sheet**.
- I understand what the project is about, and what the results will be used for.
- I am fully aware of **all** of the procedures involving myself, and of any **risks and benefits** associated with the study.
- I know that my participation is voluntary and that I can withdraw from the project at any stage without giving any reason.
- I am aware that the results will be kept confidential and that the research will be published in an academic journal.
- I consent to taking part in this research study.


Your Name (PRINTED)

Your signature

Date

Appendix U: Pedometer Information and Instructions

U.1: Pedometer Information Sheet

<p style="text-align: center;">To wear the pedometer:</p> <ul style="list-style-type: none"> ➤ Clip the pedometer onto your belt or waistband on your left hip. It should be in line with your knee. ➤ The pedometer must remain upright – not tilted forward or backward. ➤ The pedometer must be level – not tilted to either side. ➤ Go about your day as normal – do not mess or tamper with the pedometer during the day 	<p style="text-align: right;">Always ensure your pedometer is level on your belt or waist band</p>  <p>The illustration shows a woman in a blue tank top and black leggings with a pedometer clipped to her belt. To her right are two diagrams of a white shirt with a dark belt. The first diagram shows the pedometer level and upright, marked with a red checkmark. The second diagram shows the pedometer tilted to the side, marked with a red 'X'.</p>								
<p style="text-align: center;">Remember:</p> <ul style="list-style-type: none"> ➤ Write down the time you put the pedometer on, the time you take it off. ➤ Put on the pedometer soon after getting up ➤ Try to wear the pedometer until just before you go to bed ➤ If you take the pedometer off at any time write this down in the 'notes' column. ➤ Do not open your pedometer at any stage – the seal should not be broken when it is returned 	<p style="text-align: center;">Example Log Sheet</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Day</th> <th style="width: 15%;"></th> <th style="width: 15%;"></th> <th style="width: 55%;">Notes</th> </tr> </thead> <tbody> <tr> <td>Tue</td> <td>Start Time</td> <td>7.35am</td> <td>The pedometer was off for 50 minutes - swimming</td> </tr> </tbody> </table>	Day			Notes	Tue	Start Time	7.35am	The pedometer was off for 50 minutes - swimming
Day			Notes						
Tue	Start Time	7.35am	The pedometer was off for 50 minutes - swimming						
<p style="text-align: center;">To Return your pedometer:</p> <ul style="list-style-type: none"> ➤ Place your pedometer and your daughter's pedometer in the envelope provided ➤ Make sure you and your daughter's name are clearly written on the envelope ➤ You must return your pedometer to _____ 	<p style="text-align: center;">Your pedometer must be returned on _____</p> <p style="text-align: center;">If you can't return your pedometer on this day, please contact Méabh at solemates.mic@gmail.com or on 0860549210</p>								

U.2: Non-Wear Time Record Sheet (Sealed Pedometer)

My Record Sheet

Name: _____ **Pedometer No.** _____

Use the tables below to note any non-wear time for your pedometer:

Date:		Notes (any non-wear time – for how long was the pedometer off)
Time pedometer put on in morning		
Time pedometer taken off at night		

Date:		Notes (any non-wear time – for how long was the pedometer off)
Time pedometer put on in morning		
Time pedometer taken off at night		

Date:		Notes (any non-wear time – for how long was the pedometer off)
Time pedometer put on in morning		
Time pedometer taken off at night		

P.T.O

Date:		Notes (any non-wear time – for how long was the pedometer off)
Time pedometer put on in morning		
Time pedometer taken off at night		

Date:		Notes (any non-wear time – for how long was the pedometer off)
Time pedometer put on in morning		
Time pedometer taken off at night		

Date:		Notes (any non-wear time – for how long was the pedometer off)
Time pedometer put on in morning		
Time pedometer taken off at night		

Date:		Notes (any non-wear time – for how long was the pedometer off)
Time pedometer put on in morning		
Time pedometer taken off at night		

Please remember to fill out this sheet every day. Log your pedometer non-wear time as accurately as possible

Appendix V: STROBE Statement (Chapter 5)

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	110
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	110
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	111-112
Objectives	3	State specific objectives, including any prespecified hypotheses	112
Methods			
Study design	4	Present key elements of study design early in the paper	112
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	113-114
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	113-114
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	113-114
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	113-115
Bias	9	Describe any efforts to address potential sources of bias	n/a
Study size	10	Explain how the study size was arrived at	n/a
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable,	118

	Item No	Recommendation	Page No
		describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	118
		(b) Describe any methods used to examine subgroups and interactions	118
		(c) Explain how missing data were addressed	n/a
		(d) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(e) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	118
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	119
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	120
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	120
		(b) Report category boundaries when continuous variables were categorized	n/a

	Item No	Recommendation	Page No
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	121
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	124
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	121-123
Generalisability	21	Discuss the generalisability (external validity) of the study results	123
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	n/a

Appendix W: CONSORT Statement (*Chapter 6*)

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a pilot or feasibility randomised trial in the title	131
	1b	Structured summary of pilot trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	134
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale for future definitive trial, and reasons for randomised pilot trial	135-136
	2b	Specific objectives or research questions for pilot trial	140-141
Methods			
Trial design	3a	Description of pilot trial design (such as parallel, factorial) including allocation ratio	136
	3b	Important changes to methods after pilot trial commencement (such as eligibility criteria), with reasons	n/a
Participants	4a	Eligibility criteria for participants	136
	4b	Settings and locations where the data were collected	136
	4c	How participants were identified and consented	136

Section/Topic	Item No	Checklist item	Reported on page No
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	137
Outcomes	6a	Completely defined pre-specified assessments or measurements to address each pilot trial objective specified in 2b, including how and when they were assessed	140-141
	6b	Any changes to pilot trial assessments or measurements after the pilot trial commenced, with reasons	n/a
	6c	If applicable, prespecified criteria used to judge whether, or how, to proceed with future definitive trial	140-141
Sample size	7a	Rationale for numbers in the pilot trial	n/a
	7b	When applicable, explanation of any interim analyses and stopping guidelines	n/a
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	n/a
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	n/a
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	n/a
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	n/a

Section/Topic	Item No	Checklist item	Reported on page No
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	n/a
	11b	If relevant, description of the similarity of interventions	n/a
Statistical methods	12	Methods used to address each pilot trial objective whether qualitative or quantitative	140-141
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	n/a
	13b	For each group, losses and exclusions after randomisation, together with reasons	145
Recruitment	14a	Dates defining the periods of recruitment and follow-up	134
	14b	Why the trial ended or was stopped	6-week duration
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	146-147
Numbers analysed	16	For each objective, number of participants (denominator) included in each analysis. If relevant, these numbers should be randomised by group.	145

Section/Topic	Item No	Checklist item	Reported on page No
Outcomes and estimation	17	For each objective, results including expressions of uncertainty (such as 95% confidence interval) for any estimates. If relevant, these results should be by randomised group	143-151
Ancillary analyses	18	Results of any other analyses performed that could be used to inform the future definitive trial	n/a
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	n/a
	19a	If relevant, other important unintended consequences	151
Discussion			
Limitations	20	Pilot trial limitations, addressing sources of potential bias and remaining uncertainty about feasibility	157
Generalisability	21	Generalisability (applicability) of the pilot trial methods and findings to future definitive trial and other studies	157
Interpretation	22	Interpretation consistent with pilot trial objectives and findings, balancing potential benefits and harms and considering other relevant evidence	157
	22a	Implications for progression from pilot to future definitive trial, including any proposed amendments	157
Other information			
Registration	23	Registration number for pilot trial and name of trial registry	n/a

Section/Topic	Item No	Checklist item	Reported on page No
Protocol	24	Where the pilot trial protocol can be accessed, if available	n/a
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	158