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The role of social support on physical activity in adolescent girls

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Abstract

Background: Adolescent girls are insufficiently active to achieve health benefits. As a result they have been targeted as a priority group for increasing physical activity levels. However, physical activity interventions for this population have had limited effect. A better understanding of the correlates of physical activity in adolescent girls may better inform intervention design. Social support describes interactions, resources, and assistance from others to influence physical activity behaviour. Social support has been linked to physical activity in adolescent girls and could be a modifiable correlate of physical activity. This thesis aimed to identify: (1) if there is a positive association between social support and physical activity in adolescent girls, and if so, (2) explore the potential pathways through which social support influences behaviour.

Method: Firstly, a systematic review and meta-analysis was conducted to explore the role of different providers (e.g. parents/friends) and types of social support (e.g. emotional/instrumental) on adolescent girls' physical activity, providing effect size estimations for different combinations of associations. Secondly, an analysis of an 8-week school based physical activity intervention for adolescent girls was conducted. This involved a mediation analysis to examine: (1) if self-efficacy mediated associations between social support and physical activity at baseline; and (2) if social support or self-efficacy mediated the effectiveness of the intervention. Finally, a qualitative study using constructivist grounded theory was conducted to investigate the mechanisms through which social support influences physical activity behaviour through conducting individual interviews with adolescent girls ($n = 18$).

Results: The systematic review and meta-analysis identified small but significant positive associations between social support and physical activity in adolescent girls. Similar magnitudes were identified for parent and friend support effect sizes. The mediation analysis found that self-efficacy mediated the relationship between social support and physical activity, however, social support did not mediate the effectiveness of a physical activity intervention for adolescent girls. The results of the grounded theory study suggest that social support can influence adolescent girls' physical activity through enjoyment, self-efficacy, overcoming barriers to physical activity, motivation, and performance improvements, as well as enabling physical activity.

Conclusions: Whilst only small significant associations between social support and physical activity in adolescent girls were identified, social support may also indirectly influence physical activity through enjoyment, self-efficacy, overcoming barriers, motivation, performance improvements and enabling physical activity. There may be promise in targeting these constructs through social support behaviour change strategies in physical activity interventions for adolescent girls.

Lay summary

Adolescent girls are insufficiently active to achieve health benefits. Friends, families, teachers and coaches can support girls to be more physically active. This could involve providing financial support, equipment, encouragement, praise, talking about physical activities, doing physical activities together, or providing advice or instruction. This is known as social support. This research explored if and how social support influences adolescent girls' physical activity.

A systematic review of the literature was conducted to investigate if there is a positive relationship between social support and physical activity in adolescent girls. This involved compiling and analysing all available research that investigated the relationship between social support and physical activity in adolescent girls. Social support from families and friends was found to be positively related to physical activity in adolescent girls. The next study evaluated the effectiveness of a physical activity intervention (Health 4 U) on increasing girls' physical activity. We aimed to understand if Health 4 U could increase perceptions of social support, and if any increases in support resulted in increased physical activity. Health 4 U did not lead to changes in social support or physical activity. The final study investigated how social support influences adolescent girls' physical activity. We found that social support was related to girls' enjoyment, motivation, confidence, and their performance in physical activities. Social support also enabled girls to be active through provision of equipment, transport and money. We also found that having active friends and family inspired girls' to be active and provided opportunities for girls' to be active.

The findings of this thesis suggest that there is a positive relationship between social support and physical activity in adolescent girls and that social support may increase girls' enjoyment, motivation, confidence and skills in physical activity, and enable them to be active. Further research should explore how to increase perceptions of social support in girls', and explore if increases in social support lead to increases in physical activity.

Declaration

In compliance with the regulations of the University of Edinburgh, I declare that this work has not been submitted for any other degree or professional qualification and that the author of this study is the undersigned.

Yvonne Laird

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Knowledge Exchange

Internship

I completed a 3 month internship as part of my PhD between June and September 2015 within the Population Health Analytical Team at the Scottish Government. I was responsible for completing physical activity evidence reviews and contributing to ongoing work.

Publications

Laird, Y., Fawcner, S., Kelly, P., McNamee, L., & Niven, A (2016). The role of social support on physical activity behaviour in adolescent girls: A systematic review and meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity*.

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Presentations

Laird, Y. (2016). Investigating the role of social support on physical activity in adolescent girls. Paper presented to the Active Scotland Division, The Scottish Government, 24th February.

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Chapter 1: Introduction

Overview of the research area

Young people are shaped by their relationships, and these relationships have a role in their intellectual, social, emotional, physical and behavioural development. This thesis contributes to knowledge about how social support from friends, family, teachers and coaches influences adolescent girls' physical activity behaviour. Understanding social support is important to inform strategies to help adolescent girls to be more active. This chapter provides an introduction to the thesis including a background to physical activity for health in young people, an overview of previous physical activity interventions for adolescent girls, an introduction to social support, and an outline of the context and the format of the thesis.

Benefits of physical activity

Physical activity describes any bodily movement produced by the skeletal muscles that results in energy expenditure (Caspersen, Powell, & Christenson, 1985). For young people, this could include activities such as active travel, play, organised sports, leisure activities and physical education (PE).

Regular physical activity has well established benefits on the current and future health of children and adolescents (Janssen & LeBlanc, 2010). Extensive research has been conducted that demonstrates physiological health benefits associated with regular physical activity in youth populations; including weight status, cardiovascular health, and bone health (Hallal, Victora, Azevedo, & Wells, 2006; Janssen & LeBlanc, 2010). Sustained physical activity throughout childhood and adulthood reduces the risk of developing chronic lifestyle related diseases including type II diabetes, coronary heart disease, and stroke (Lee et al., 2012; Thompson, Medicine, Gordon, & Pescatello, 2009; Warburton, Nicol, & Bredin, 2006). There is

also growing evidence to suggest that physical activity is associated with positive psychological health in children and adolescents. Physical activity may positively influence self-esteem (Biddle & Asare, 2011; Ekland, Heian, Hagen, Abbott, & Nordheim, 2004), lower incidences of anxiety and depression (Biddle & Asare, 2011; Larun, Nordheim, Ekland, Hagen, & Heian, 2006), and may also positively influence academic achievement (Biddle & Asare, 2011; Booth et al., 2013; Rasberry et al., 2011; Singh, Uijtdewilligen, Twisk, van Mechelen, & Chinapaw, 2012).

Physical activity guidelines

To achieve the associated health benefits of physical activity, the United Kingdom (UK) government issued physical activity guidelines for children and young people aged 5 to 18 years (Department of Health, 2011). The guidelines suggest:

1. Young people should achieve a minimum of 60 minutes of moderate to vigorous physical activity (MVPA) per day.
2. Vigorous activities, including bone and muscle strengthening activities, should be included at least three times per week.
3. Young people should limit the amount of time spent in sedentary activities.

Trends in physical activity behaviour

There is considerable evidence that shows the extent to which boys and girls reach these recommended physical activity levels. It is cause for concern that many young people, particularly girls, are not achieving physical activity guidelines. In Scotland, population level data from the Scottish Health Survey shows that physical activity levels decline in children from 5 to 7 years until 13 to 15 years. As shown in Figure 1, the steepest decline seems to occur after the transition to secondary school, particularly amongst girls. At age 11 to 12 years (equivalent to the end of primary school) 80% of boys and 73% of girls are reaching the guidelines. At 13 to 15 years

(early secondary school) 72% of boys and just 53% of girls are reaching the guidelines (see Figure 1) (Gill, 2015).

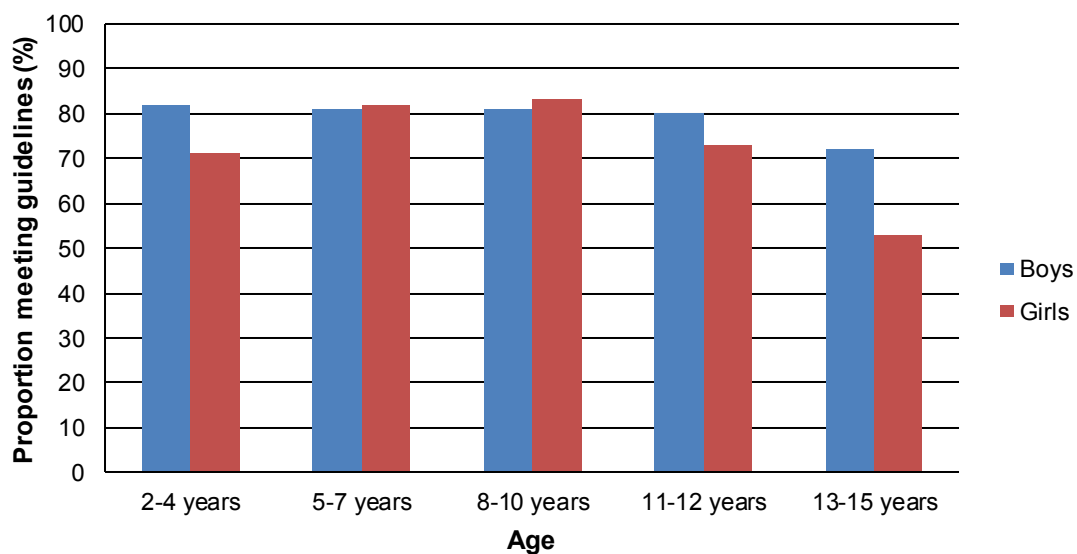


Figure 1 Proportion of children in Scotland meeting physical activity guidelines in 2014 (Gill, 2015)

Data taken from the 2009 to 2014 Scottish Health Survey was used to plot a graph of trends in physical activity levels amongst 13 to 15 year olds in Scotland over time. The figure shows that trends in activity levels have remained relatively stable over time, with boys consistently found to be more active than girls (see Figure 2).

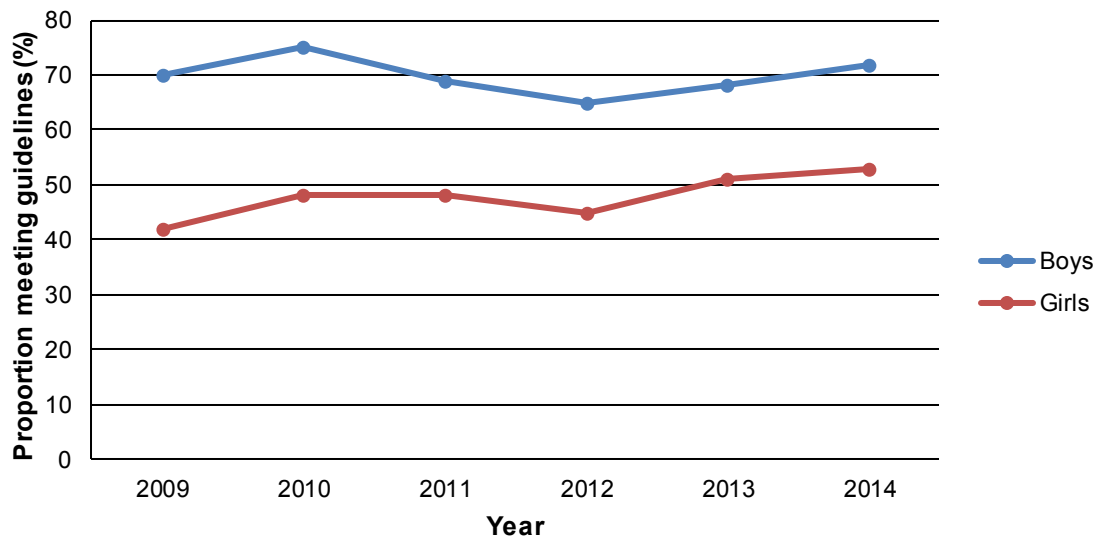


Figure 2 Proportion of 13 to 15 year olds in Scotland reaching physical activity guidelines between 2009 and 2014

There is some evidence to suggest the population level questionnaire used to estimate children’s physical activity in the Scottish Health Survey overestimates activity levels, partly due to the shortcomings of self-report measures (Basterfield et al., 2008). However, the decline in physical activity from childhood to adolescence is a consistent finding in the literature, both in a Scottish context (Currie et al., 2015; Inchley, Kirby, & Currie, 2008) and internationally (Currie et al., 2012). For example, the 2014 Health Behaviour in School-Age Children Study (HBSC) found that 21% of 11 year old girls, 13% of 13 year old girls and 11% of 15 year old girls in Scotland met physical activity guidelines (Currie, et al., 2015). Although the percentage of girls estimated to reach guidelines in the HBSC study is much more modest than the Scottish Health Survey, both studies found that girls’ physical activity levels decline with age. Further research suggests that this decline is particularly pronounced after the primary to secondary school transition (Inchley, et al., 2008), and research consistently identifies girls as less active than boys (Biddle, Whitehead, O'Donovan, & Nevill, 2005; Inchley, et al., 2008; Riddoch et al., 2004). Furthermore, there are some indications that physical activity levels track from adolescence into adulthood (Telama et al., 2005).

These concerning trends have implications for the current and future health of young people, with more girls seemingly at risk of poor health associated with physical inactivity than boys. Adolescent girls have, therefore, been identified as a high priority group by researchers (Cavill, Biddle, & Sallis, 2001), and for the promotion of physical activity in Scotland (The Physical Activity for Health Alliance, 2010), and internationally (Bailey, Wellard, & Dismore, 2005).

Responding to the problem

Due to the well established health benefits of regular physical activity and the low levels of participation amongst all populations, promotion of physical activity has been identified as a key global health priority (The World Health Organization, 2013). This is evident in global physical activity strategy documents (The World Health Organization, 2004, 2013) and implementation plans detailing strategies to increase physical activity. The Toronto Charter is a global call for action on the issue of physical inactivity, created by the Global Advocacy for Physical Activity group (Bull et al., 2010). It suggests nine guiding principles and a framework for action to increase physical activity levels at multiple levels. For example, they suggest that educational policies should support compulsory PE and active travel, and school environments should be conducive to physical activity. They encourage partnerships between non-profit groups, government agencies, and research. They also highlight a need to tackle both large populations and smaller sub-groups of at-risk groups; and they recommend the use of evidence-based research, behaviour change techniques, and modifiable correlates (e.g. psychosocial, social) of physical inactivity to do this.

In Scotland, one of the first physical activity implementation plans of its kind was created by the Scottish Executive called “Let’s make Scotland more active” (The Physical Activity for Health Alliance, 2003). A five year review of this strategy identified adolescent girls as a high priority group for the promotion of physical activity due to their particularly low levels of physical activity (The Physical Activity for Health Alliance, 2010). An updated plan was implemented in Scotland in 2014 to coincide with the Glasgow Commonwealth Games, “A more active Scotland –

Building a legacy from the Commonwealth Games” (The Physical Activity for Health Alliance, 2014). This implementation plan draws on the Toronto Charter, applying it to a Scottish context. For schoolchildren, the document set a target for all schools in Scotland to provide a minimum of 2 hours of PE per week for children until the fourth year of secondary school (S4) by the end of 2014.

The research process

In order to achieve these ambitions of a more active Scotland and increase the proportion of adolescent girls achieving physical activity guidelines we need to understand how to increase physical activity in this population. The behavioural epidemiology framework (Sallis, Owen, et al., 2000) is a useful framework to highlight the different research required to identify effective methods of promoting physical activity. Sallis, Owen and Fotheringham (2000) suggest there are five phases of research required to inform effective promotion of physical activity (see Figure 3). Applied to youth physical activity, these phases involve establishing links between physical activity and health in youth populations and effectively measuring young peoples’ physical activity to identify trends and patterns. Identifying correlates of physical activity is important to define target populations (e.g. adolescent girls) or identify potentially effective intervention components (e.g. self-monitoring physical activity). Then, these interventions are tested in a controlled setting and the findings can inform correlational research through testing mediators and moderators of behaviour change in interventions. In the final phase of the behavioural epidemiology framework, effective interventions from the previous stage should be translated in broader community settings outside of research settings. Findings from this implementation phase can also be used to inform further research.

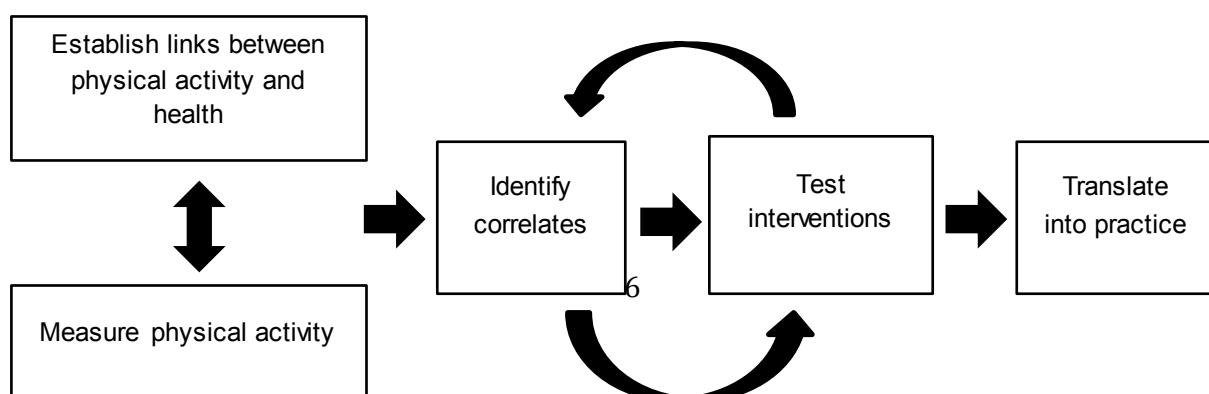


Figure 3 Behavioural epidemiology framework (Sallis, Owen, & Fotheringham, 2000)

Physical activity interventions for adolescent girls

Within research and practice there is evidence of many physical activity interventions targeting young people, such that systematic reviews have summarised the effectiveness of these interventions. Some of these reviews have focused on boys and girls (Dobbins, Husson, DeCorby, & LaRocca, 2013; van Sluijs, McMinn, & Griffin, 2007) and some have focused specifically on girls (Camacho-Miñano, LaVoi, & Barr-Anderson, 2011; Pearson, Braithwaite, & Biddle, 2015; The National Institute for Health and Care Excellence, 2008). As there are several systematic reviews of physical activity interventions for young people, a review of reviews has been conducted to summarise the main findings (Kriemler et al., 2011).

A systematic review and meta-analysis by Pearson and colleagues (2015) is the most comprehensive review of interventions for adolescent girls to date. The researchers synthesised and meta-analysed 45 studies of 35 independent interventions, including both mixed and single sex interventions to make comparisons between girl only and mixed sex interventions. They found a small but significant average treatment effect ($g = .35$, 95% confidence interval 0.12-0.58, $P < .001$). The most effective interventions were multicomponent, theory based, took place in a school setting, targeted girls only and involved strategies both to increase physical activity and reduce sedentary time. Previous systematic reviews have also identified small average effects of physical activity interventions for young people (Dobbins, et al., 2013; van Sluijs, et al., 2007), with a review of reviews identifying that 57% of

studies included in reviews had a significant effect on physical activity (Kriemler, et al., 2011). Whilst the findings of these reviews suggest promise for physical activity interventions, they also highlight that interventions for adolescent girls have had mixed effectiveness and it is not currently known how best to increase physical activity in youth populations.

Social support for physical activity in adolescent girls

To inform more effective interventions aimed at increasing physical activity in adolescent girls, the behavioural epidemiology framework highlights the importance of understanding correlates of behaviour. Research has identified numerous factors that are linked to adolescent girls' physical activity including individual, interpersonal and environmental correlates. It is important to investigate the factors associated with physical activity in depth to better understand them.

The social environment may have an important role in adolescent girls' physical activity levels. The social environment influences physical activity in two main ways: through social influence and through provision of social support. Social support describes resources provided from interactions with others that can influence behaviour (Sheridan & Radmacher, 1992). Social support can be provided by anyone within a girls social network, for example parents or friends (providers), and it can involve various types of support, such as doing activities together or providing encouragement to be active. Systematic reviews have consistently found social support to be positively associated with physical activity in children and adolescents (Beets, Cardinal, & Alderman, 2010; Mendonça, Cheng, Mélo, & de Farias Júnior, 2014; Yao & Rhodes, 2015). Therefore, as social support is potentially modifiable there may be promise in including behaviour change strategies that aim to increase perceptions of support in physical activity interventions.

However, there are several gaps in the literature that need to be addressed: (1) there is a need to identify if there are positive associations between social support and

physical activity in adolescent girls, and if so, (2) explore whether these associations vary by type and provider of social support; and (3) explore *how* social support influences behaviour. Addressing these gaps could inform more effective physical activity intervention design. In particular, addressing these gaps could inform strategies to increase perception of social support for physical activity in adolescent girls. This thesis aims to explore the relationship between social support and physical activity and specifically consider these gaps.

Epistemological stance of the research

Epistemology refers to the philosophy of the origins and nature of knowledge. There are two distinct philosophical approaches or paradigms to discovering knowledge and truth: positivist and interpretivist. Each paradigm is underpinned by a different set of assumptions, therefore, researchers operate differently under each philosophical approach. These assumptions guide data collection and interpretation of evidence and data (Allsop, 2013).

The positivist paradigm employ quantitative methodologies. A key assumption of the positivist paradigm is that there is an objective truth that can be discovered. Data is collected numerically and analysed statistically. Common approaches to data collection include survey questionnaires and common study designs include randomised controlled trials, quasi-experimental studies, observational and longitudinal studies (Creswell, 2014).

The interpretivist paradigm employ qualitative methodologies. The interpretivist paradigm is based on the assumption that reality is subjective and is different for different people. Interpretivist methodology aim to understand phenomenon from an individuals' perspective (Creswell, 2014). The data to be analysed are text, which is different from the numerical approach in quantitative methodologies. The most common approaches to data collection are interviews, focus groups, and observations. Transcripts of interviews and field notes are the most common data to be analysed but images and documents can also be analysed. When analysing

qualitative data the focus is on meanings rather than on quantification, the data collected are much richer and more detailed for a smaller sample than would normally be collected using a quantitative approach and the research is open to new ideas and findings, rather than a quantitative approach where the analysis categories are determined in advance (Adams, Khan, Raeside, & White, 2014).

This research is underpinned by pragmatism. Pragmatists draw from both positivist and interpretivist assumptions. Pragmatic researchers employ methodologies that will allow them to best understand the research question or problem (Creswell, 2014). The research questions inform the methodological approaches used, with different approaches taken to address different research questions. This research utilised a combination of qualitative and quantitative research and neither approach was thought to be superior to the other. Rather, different methodological approaches were deemed most appropriate to answer different research questions.

Format of the thesis

A review of the literature that provided the background to this research is presented in Chapter 2. The literature review provides an overview of correlates of physical activity in adolescent girls, evidence on social influences on behaviour, and evidence considering social support and physical activity. Gaps in the literature are highlighted and the literature review concludes with the thesis aims and research questions.

These aims and research questions are addressed in three separate studies presented in Chapters 3 to 5. Chapter 3 presents a systematic review and meta-analysis. Studies that reported associations between social support and physical activity in adolescent girls were synthesised, and effect sizes for different types and providers of social support were estimated. Following this, Chapter 4 presents an evaluation of a school-based physical activity intervention for adolescent girls. This chapter had two main aims: (1) to identify baseline associations between social support and physical activity in adolescent girls, and to test if self-efficacy mediated these associations; and (2) to identify if the intervention was effective at increasing physical activity, and testing social support and self-efficacy as potential mediators of the effectiveness

of the intervention. Chapter 5 presents a qualitative school-based project utilising constructivist grounded theory. Expanding on the results of Chapter 3 and 4, this study investigated participants' perspectives of how social support influences their physical activity behaviour. The thesis concludes with Chapter 6, which synthesises the key findings from each chapter and discusses the implications of these findings for policy, practice and future research.

Chapter 2: Literature Review

Overview

This chapter provides a review of the literature on the role of social support on physical activity in adolescent girls. First, an overview of the correlates of physical activity in adolescent girls is presented. Following this, evidence on the role of social relationships, and more specifically, social support in influencing health and physical activity behaviour is reviewed. The chapter concludes by presenting research questions and aims based on gaps identified in the review of the literature and by outlining the studies that address these aims that are presented in subsequent chapters.

Correlates of physical activity in adolescent girls

As outlined in the behavioural epidemiology framework in Chapter 1, identifying correlates of behaviour is important to inform interventions aimed at increasing physical activity in adolescent girls. Physical activity is a complex behavior with many contributing factors influencing participation. This section will provide an overview of the numerous factors that influence adolescent girls' physical activity.

Ecological models can provide a useful framework to describe the factors that influence physical activity behaviour to help researchers and practitioners develop more comprehensive interventions (Sallis, Owen, & Fisher, 2008). Sallis and colleagues (2006) developed an ecological model of physical activity to describe the multiple levels of influence on physical activity behaviour. Findings and concepts were synthesised from health, behavioural science, transportation, policy studies, economics, and leisure studies to develop the model (Sallis, et al., 2008). More recently, Bauman and colleagues (2012) presented an updated ecological model of physical activity (see Figure 4). This updated model highlights individual, interpersonal, environmental, regional or national policy, and global factors as categories that influence physical activity behaviour. Individual and interpersonal

factors are amongst the most commonly investigated correlates of physical activity. Individual factors include psychological correlates (e.g. self-efficacy, enjoyment of physical activity) and biological factors (e.g. genetic, evolutionary physiology). Interpersonal factors include social support and cultural norms and practices. Environmental factors (e.g. built environment), policy (e.g. health, education, transport policies) and global factors (e.g. economic development, media, physical activity advocacy) have been less widely researched although they are thought to be important influencers of physical activity on a larger scale (Bauman, et al., 2012).

A key principle of ecological models is that these multiple sources of influence (e.g. social influences, environmental influences) must be addressed in interventions to successfully change behaviour (Sallis, et al., 2008). For example, an intervention that aims to increase adolescent's school based physical activity through provision of peer support may not be effective if school policies and equipment limit the capacity of young people to be physically active. Although the model does not specifically describe adolescent girls' participation in physical activity, it provides a useful framework to describe factors that influence physical activity participation in various populations and settings.

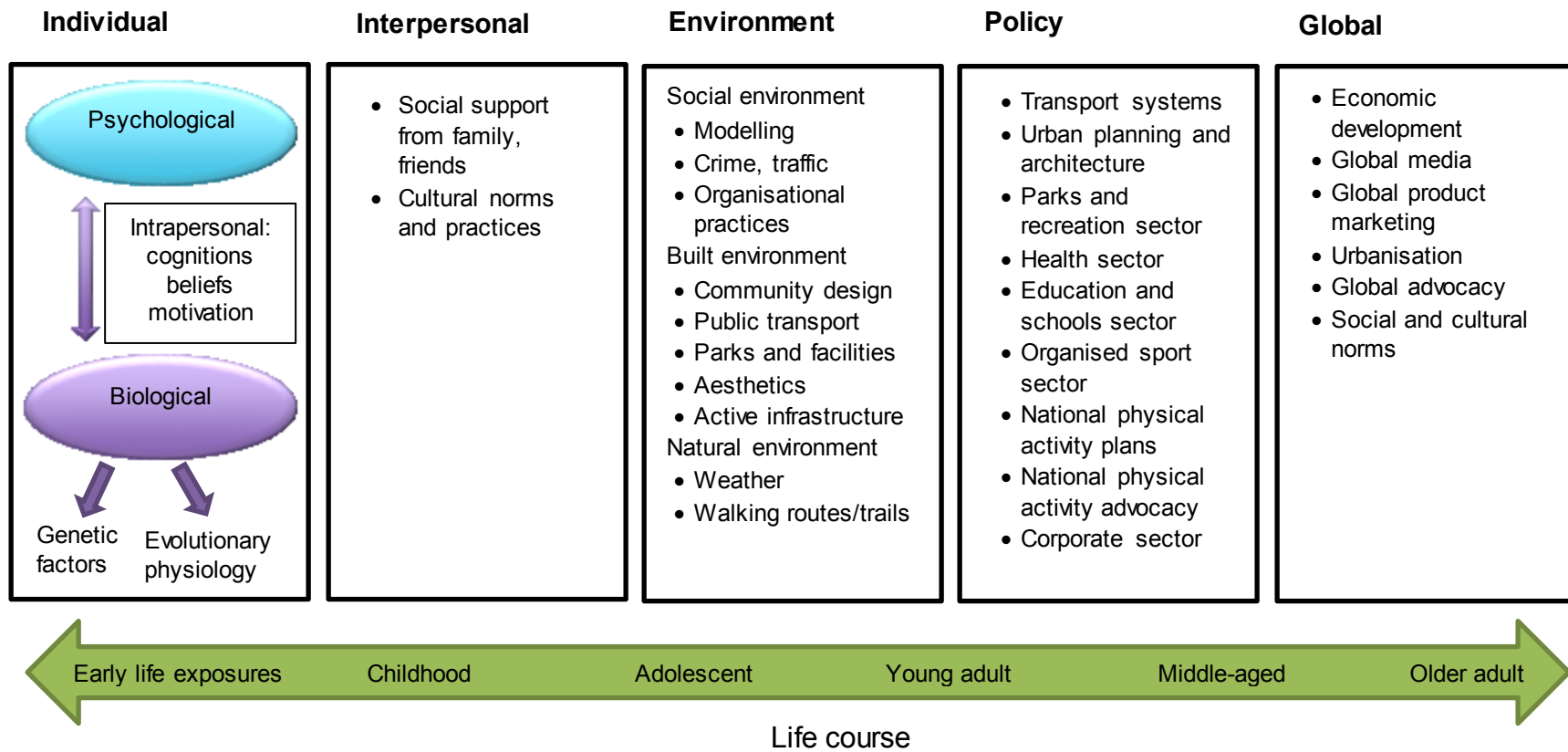


Figure 4 Ecological model of physical activity (Bauman et al., 2012)

Whilst ecological models are helpful for understanding influences on physical activity in all groups, in order to understand why adolescent girls are or are not physically active and effectively develop interventions, it is important to evaluate research specifically on adolescent girls. Due to the low levels of physical activity in youth populations, a growing body of evidence exploring correlates of physical activity in youth populations exists, and has subsequently been summarised by systematic reviews (e.g. Biddle, Atkin, Cavill, & Foster, 2011; Biddle, et al., 2005; Sallis, Prochaska, & Taylor, 2000). Consistent with a socio-ecological approach, correlates can be categorised into individual factors (e.g. age, ethnicity, psychological), interpersonal factors (e.g. social norms, social support) and environmental factors (e.g. active infrastructure, school facilities). As previously noted, policy factors (e.g. health, education, transport policies) and global factors (e.g. economic development, media) have been less widely researched, although they are thought to be important influencers of physical activity on a larger scale (Bauman, et al., 2012).

The Centre for Evidence-Based Medicine's evidence hierarchy identifies systematic reviews as stronger evidence than primary research (Howick et al., 2011). However, it should be noted that evidence hierarchies are limited because such ordering of study designs does not account for the suitability of different research designs to address the question or problem. Evidence hierarchies also favour randomised controlled trials over other study designs yet randomised controlled trials, like other study designs, have the potential to be poorly conducted. In these instances the results could be misleading. However, systematic reviews are thought to minimise bias associated with primary research by collating all relevant research to answer a pre-specified research question, thus relying on all relevant research rather than single studies (Higgins & Green, 2011). Therefore, the following sections will present findings from systematic reviews where available and will draw upon primary research where systematic reviews are not available.

Individual factors.

Individual factors include personal and demographic correlates and psychological correlates. Personal and demographic correlates of adolescent girls' physical activity behaviour include age, ethnicity, biological factors and socioeconomic status. Girls of a non-white ethnicity, girls with a lower socio-economic status and older adolescent girls have a greater risk of physical inactivity (Biddle, et al., 2005). Higher body mass indexes in girls (Biddle, et al., 2005; Fairclough, Hilland, & Stratton, 2012) and lower levels of educational achievement in adolescents of both genders (Rasberry, et al., 2011) have also been associated with lower physical activity levels.

Systematic reviews of quantitative and qualitative research demonstrate that a number of psychological constructs are associated with adolescent girls' physical activity. Psychological constructs can be separated into psychological factors associated with physical activity and psychological barriers to physical activity. The main psychological constructs associated with physical activity in adolescent girls include perceived competence (belief in abilities at performing physical activities) (Biddle, et al., 2005; Fairclough, et al., 2012; Standiford, 2013), self-efficacy (belief that one is able to be physically active) (Biddle, et al., 2005; Craggs, Corder, van Sluijs, & Griffin, 2011), physical self-concept (an awareness of one's skills and limitations) (Babic et al., 2014), and enjoyment of physical activity (Biddle, et al., 2005; Sallis, Prochaska, et al., 2000; Sallis, Prochaska, Taylor, Hill, & Geraci, 1999).

Adolescent girls have highlighted numerous psychological barriers to physical activity. Specifically, Standiford (2013) identified adolescent girls concerns for their appearance as one of the most frequently occurring themes in the synthesised qualitative studies. Adolescent girls regularly noted an unwillingness to participate in PE because they wanted to maintain their "feminine" appearance. Girls have also expressed concerns about their body image when performing physical activities in front of others (Standiford, 2013), which is supported by quantitative research (Biddle, et al., 2005). Standiford (2013) also identified three studies in which girls

noted that they felt sexually objectified by boys during PE classes, and one study where adolescents of both genders reported being bullied by classmates due to their bodies. This suggests that the PE environment may be a source of discomfort for some. More generally for children and adolescents, lack of time, lack of interest, and perceived effort have been identified as barriers to physical activity (Sallis, Prochaska, et al., 2000; The National Institute for Health and Care Excellence, 2007).

Environmental factors.

There is less research investigating the influence of environmental variables specifically on adolescent girls' physical activity, however, systematic reviews have summarised the evidence for both males and females combined (Davison & Lawson, 2006; Ferreira et al., 2007; Sallis, Prochaska, et al., 2000; Sterdt, Liersch, & Walter, 2013). These reviews identified school policies, access to green space and playgrounds, and availability of active infrastructure as positively associated with physical activity, and perceptions of crime and deprivation as negatively associated with physical activity in adolescents.

Interpersonal factors.

Interpersonal factors include social support and social influence for physical activity. Numerous studies have investigated social correlates of physical activity in children and young people and have been summarised by systematic reviews (Beets, et al., 2010; Biddle, et al., 2005; Edwardson & Gorely, 2010; Gustafson & Rhodes, 2006; Mendonça, et al., 2014; Pugliese & Tinsley, 2007; Yao & Rhodes, 2015). This research primarily includes different forms of support from family and friends to be physically active and modelling of physical activity. Modelling is considered a form of social influence and describes the physical activity levels of the provider (e.g. parent, friend) and their perceived value in physical activity. Modelling is proposed to influence physical activity by young people observing providers engage in physical activity and value physical activity and modifying their physical activity

levels in response to these observations. Modelling is typically measured in terms of associations between the physical activity levels of the provider and receiver of modelling (e.g. family member/friend/teacher and young person).

Most research has focused on parental influences on child and adolescent physical activity with Pugliese and Tinsley (2007), Edwardson and Gorely (2010) and Yao and Rhodes (2015) providing the most comprehensive reviews in this area.

Edwardson and Gorely (2010) assessed parental influences by types and intensities of physical activity and found that parent support is important for adolescent physical activity and different forms of support were associated with different types of physical activity (e.g. MVPA, total physical activity). Pugliese and Tinsley (2007) and Yao and Rhodes (2015) conducted the only meta-analyses in the area. They both identified significant associations between social support and child and adolescent physical activity ($r = .17$ and $r = .38$ respectively) and small but significant associations between parent modelling and child and adolescent physical activity ($r = .13$ and $r = .16$ respectively). Differences in effect size estimates between the two studies can in part be explained by the more recent meta-analysis by Yao and Rhodes (2015) including more studies than Pugliese and Tinsley (2007) ($n = 112$ and $n = 30$ respectively), and Yao and Rhodes (2015) adjusted for sample size and measurement error.

Friend influences on child and adolescent physical activity have been less comprehensively investigated although systematic reviews have been conducted (Fitzgerald, Fitzgerald, & Aherne, 2012; Maturo & Cunningham, 2013; Mendonça, et al., 2014; Sawka, McCormack, Nettel-Aguirre, Hawe, & Doyle-Baker, 2013). Whilst no meta-analyses have been performed for friend influences, systematic reviews have consistently identified positive associations between friend support and friend modelling on child and adolescent physical activity (Fitzgerald, et al., 2012; Maturo & Cunningham, 2013; Mendonça, et al., 2014; Sawka, et al., 2013). Qualitative research also suggests that social support is important for physical activity behaviour, as adolescent girls noted that support from friends and family made it easier for them to be physically active (Standiford, 2013).

Summary.

Ecological approaches to understanding physical activity behaviour are underpinned by the assumption that multiple sources of influence must be addressed in interventions to successfully change behaviour. These sources of influence can be categorised as individual, interpersonal, environmental, policy and global factors. This section provided an overview of the numerous factors associated with physical activity behaviour in adolescent girls including individual, interpersonal and environmental influences framed using an ecological approach.

Social influences on behaviour

Whilst an ecological approach to understanding physical activity suggests that multiple sources of influence must be addressed in interventions to successfully change behaviour, it is important to consider correlates of physical activity in depth to learn more about them. As previously outlined, social correlates of physical activity have been positively associated with adolescent girls' physical activity behaviour. Social correlates are also potentially modifiable and, therefore, understanding the role of social correlates on physical activity could inform intervention strategies aimed at increasing physical activity.

However, social correlates are often poorly defined or investigated together using an umbrella term such as 'social relationships' (Berkman & Glass, 2000). It is important to investigate social correlates separately because evidence suggests that they can influence health differently and independently of each other (Cohen, 2004; Cohen, Gottlieb, & Underwood, 2000; Lakely & Cohen, 2000). A better understanding of social relationships and the effect of different social correlates on health could inform more targeted interventions aimed at improving health behaviours. This section aims to outline and define these social correlates and provide a conceptual understanding of how social relationships may influence physical activity behaviour.

Social relationships and health

Research considering the influence of social relationships on health has expanded rapidly since the 1970s (Langford, Bowsher, Maloney, & Lillis, 1997), in part due to increasing recognition of the importance of social relationships for health. Social networks, social support, social interactions, and feelings of isolation have all independently predicted health outcomes (Cohen, 2004). A meta-analysis of 148 studies found that social relationships are predictive of all-cause mortality (Holt-Lunstad, Smith, & Layton, 2010). Specifically, the authors found that people with more social connections had a 50% increased likelihood of survival than those with few social connections. This trend was consistent across demographic factors, initial health status, cause of death and follow-up period.

Social networks.

People within our social networks have the capacity to influence our health and behaviour. A social network is a “specific set of linkages among a defined set of persons” (Mitchell, 1969, pg. 2). The concept of social networks originated from work carried out by Barnes (1954) and Bott (1957) to analyse social ties connected to residential areas and social class groups. Networks are typically defined in terms of the number of people in the network (network size) and by the number of people who know each other in the network (network structure). Networks vary depending on a number of factors including reciprocity of resources and support within a network, strength of relationships, formality of relationships, complexity of relationships and defining characteristics of a network (e.g. homogeneity of age, socioeconomic status) (Heaney & Israel, 2008).

Early research on social relationships and health involved social network analysis by quantitative sociologists. Network analysis investigates the number of members within a social network and the extent to which members within the network are connected to one another. It also explores the type of group structure, for example

workplace or neighbourhoods, and the homogeneity of individual members. This early research on social relationships and health consistently found that having little or no social ties predicted mortality from almost every cause of death (Berkman, 1995; Cohen, 1988; House, Umberson, & Landis, 1988). Research then began to shift from investigating the structural aspects of social networks towards investigating the specific pathways through which social networks may influence health.

Social networks provide a platform for social interactions. A person typically has to be connected to at least one social network (e.g. school, family, workplace) to form relationships that can influence health. Berkman and colleagues (2000) proposed a framework of how social networks influence health, which suggested that the extent, shape, and features of a social network provide opportunities for social interactions that can lead to changes in health outcomes. An overview of the general framework is firstly discussed and then applied to physical activity (see Figure 5). The framework highlights social influences (e.g. social norms, peer pressure), social engagement (e.g. interpersonal attachment/interaction), person-to-person contact (e.g. close personal contact, disease transmission), access to resources and material goods (e.g. jobs, housing) and social support (e.g. instrumental, financial support), as primary social interactions that can lead to changes in health outcomes. These pathways have the capacity to influence health positively or negatively.

Group norms are a form of social influence and refer to the shared beliefs of a group (Berkman, et al., 2000). These shared beliefs have been proposed to directly influence the health behaviours of those within a network (Berkman, et al., 2000). Within health behaviour research, peer norms and influence have been found to be both protective against and linked to increased risk of alcohol consumption amongst adolescents (Donovan, 2004) and they have been linked to young people starting and continuing to smoke (Kaplan, Napoles-Springer, Stewart, & Perez-Stable, 2001).

Social engagement involves spending time with others in a network and companionship, which Berkman and colleagues (2000) suggests provides “meaning

to an individual's life by virtue of enabling him or her to participate in it fully, to be obligated (in fact, often to be the provider of support) and to feel attached to one's community" (p. 849).

Person-to-person contact is being in close proximity to others within a network. In a health context, this can lead to both positive and negative health outcomes. For example, person-to-person contact can lead to transmission of disease such as human immunodeficiency virus (HIV).

Networks can also provide access to material goods such as housing and jobs, which also have the capacity to influence health. Provision of material goods from networks has not been well researched within a health context, however, there is consistent evidence to suggest that socioeconomic status is predictive of health in adolescents (Viner et al., 2012) so it is plausible that access to resources from networks could be linked to health outcomes.

Finally, there is a growing body of research that has investigated the effect of social support on health outcomes. Social support describes assistance and resources provided through interactions with others (Sheridan & Radmacher, 1992). In a meta-analysis, social support was found to be predictive of health outcomes independent of other social constructs (Holt-Lunstad, et al., 2010). Social support is discussed in more detail below.

It is important to note that these social interactions can have positive and negative effects on health outcomes. Heaney and Israel (2008) also suggest that social undermining, social comparison, negative interactions, influence, and control can negatively influence health outcomes.

Social networks in youth physical activity.

This research on how social networks influence health can also be applied to understand how networks can influence behaviour. Based on the framework by

Berkman and colleagues (2000) that was previously outlined, Figure 5 presents a conceptual model of how social networks may influence youth physical activity. Current research that has explored how networks influence youth physical activity was used to apply the model to youth physical activity. The conceptual model presents factors that may influence social networks and the opportunities social networks may provide to influence physical activity behaviour in children and adolescents. Most research in this area has focused on psychosocial mechanisms of how networks influence physical activity. Two main mechanisms of how social networks may influence physical activity have been proposed: through social influence and social support (see Figure 5). Within the model previously outlined by Berkman and colleagues (2000), social engagement was also considered important in influencing health. Whilst limited research focusing on social engagement in youth physical activity research has been conducted, it was included in the model as a potentially important factor that may influence access to social support and social influence.

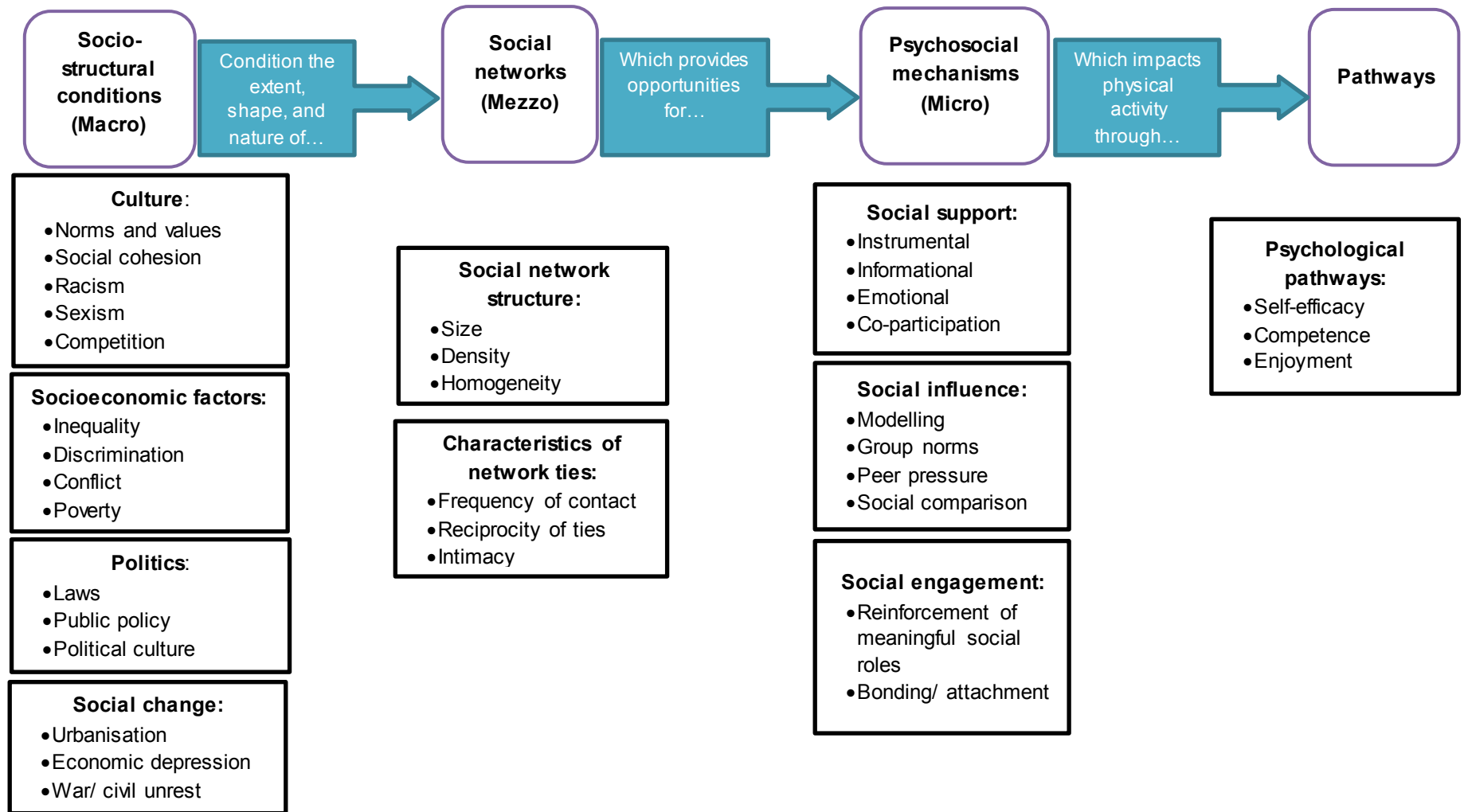


Figure 5 Conceptual model of socio-structural conditions, social networks and physical activity behaviour in children and adolescents (adapted from Berkman, Glass, Brissette, & Seeman, 2000)

Modelling of physical activity, group norms, peer pressure and social comparison are all forms of social influence within youth physical activity. Modelling of physical activity refers to the physical activity levels of a significant other such as a friend or family member and their perceived value in physical activity. Modelling is proposed to influence physical activity by young people observing significant others engage in physical activities and value physical activity and modifying their physical activity levels in response to these observations. Modelling is typically measured in terms of associations between the physical activity levels of the provider and receiver of modelling (e.g. associations between the physical activity levels of mothers and daughters). Systematic reviews have been conducted to synthesise this evidence with results suggesting that physical activity levels of friends (Macdonald-Wallis, Jago, & Sterne, 2012; Sawka, et al., 2013) and parents (Edwardson & Gorely, 2010; Pugliese & Tinsley, 2007; Yao & Rhodes, 2015) are associated with individual physical activity levels in children and adolescents, with meta-analyses finding small but significant associations between parent and child and adolescent physical activity (Pugliese & Tinsley, 2007; Yao & Rhodes, 2015). Some researchers have also considered network characteristics in relation to modelling of physical activity, including the influence of reciprocity of friendships (Schofield, Mummery, Schofield, & Hopkins, 2007) and closeness of friendships (Jago et al., 2011; Schofield, et al., 2007) on similarities in physical activity levels between individuals and those within their social networks.

Researchers have questioned whether these similarities in physical activity levels between friends in peer network analysis are because individuals 'seek out' others with similar levels of physical activity to them (the peer selection model), or whether an individuals' behaviour changes as a result of their friend's behaviour (the peer contagion model) (Sawka, et al., 2013). Whilst this has not been well researched, one longitudinal study identified in a review by Sawka and colleagues (2013) found that children modified their physical activity behaviour after developing friendships, supporting the peer contagion model. However, we also know that overweight children are more likely to be socially isolated (Schaefer & Simpkins, 2014; Strauss

& Pollack, 2003), suggesting that peer selection may occur when considering weight status of children. The formation of friendships and how these friendships influence young peoples' behaviour is likely to be complex and it is possible that both peer selection and peer contagion processes explain similarities in physical activity levels between friends.

Group norms and peer pressure are other forms of social influence within youth physical activity that have been less widely researched. Group norms are the shared attitudes about physical activity within a peer group (Sawka, et al., 2013). Group norms have not been widely investigated in the youth physical activity literature although some studies suggests there is a link between group norms and physical activity levels (Spencer, Rehman, & Kirk, 2015). Expanding on this, one study also found that group norms predicted physical activity independently from social support (Ball, Jeffery, Abbott, McNaughton, & Crawford, 2010). Peer pressure involves direct attempts to modify another persons behaviour (Sawka, et al., 2013). Evidence from a scoping review by Spencer, Rehman and Kirk (2015) suggests that group norms and peer pressure are closely linked. For example, their review identified qualitative evidence to suggest that social norms influenced physical activity behaviour on several levels. This ranged from pressure amongst girls to act and appear feminine, the shared norm that physical activity is a typically masculine behaviour with only certain activities such as gymnastics and dance perceived to be non-masculine, girls perceived unequal treatment by teachers due to gender norms, and they identified a shared belief that it is not "cool" for girls to participate in sport (Spencer, et al., 2015).

Finally, social support is another potential mechanism of how social networks might influence young peoples' physical activity behaviour. As previously outlined, social support has been consistently related to physical activity in children and adolescents (Edwardson & Gorely, 2010; Mendonça, et al., 2014; Pugliese & Tinsley, 2007; Yao & Rhodes, 2015). A fuller account of research on social support and physical activity is provided in the following section.

This section has outlined ways in which social networks might influence health and physical activity behaviour. Social networks have been suggested to influence physical activity behaviour through two pathways: social influence and provision of social support. Research considering these pathways could improve our understanding of the role of social relationships on adolescent girls' physical activity behaviour and inform intervention design.

Social support.

As previously outlined, numerous social constructs have been associated with physical activity in adolescent girls. However, in order to better understand these constructs it is important to consider each construct in-depth. Social support can be provided to individuals by others in their social networks (Cohen, 2004). As previously highlighted, a meta-analysis by Holt-Lunstad, Smith and Layton (2010) of social relationships and health found that having more social connections was associated with better health outcomes. However, when considering individual social constructs they found that social support is protective against certain diseases and significantly reduces the risk of all-cause mortality. Understanding the role of social support on adolescent girls' physical activity could inform more effective intervention design. The following sections present research that has considered the role of social support first in the broader health literature, then in adolescent girls' physical activity behaviour more specifically.

Defining social support – addressing inconsistencies within the literature.

Social support has various definitions within the wider literature. Broadly, social support has been defined as the assistance and resources provided through interactions with others (Cohen & Syme, 1985; Langford, et al., 1997; Sheridan & Radmacher, 1992). Social support can be provided by anyone within a person's social network. For adolescent girls, this could include family members, friends, teachers and coaches. Provision of support can vary by the provider of support (Berkman, et al., 2000). For example, closeness of relationships may have a role in determining how or if social support is provided.

There are also numerous types of support that can be provided. Types of support can be categorised as instrumental support, informational support or emotional support (House, 1981; Stroebe & Stroebe, 1996). Table 1 outlines the main types of support for physical activity. Instrumental support, or logistic support, refers to provision of equipment, transport or resources. For example, a parent buying their child a bicycle.

Informational support can involve providing feedback, advice or instruction. Emotional support most commonly refers to provision of encouragement. However, talking about physical activities, providing praise and watching young people perform physical activities are also considered to be forms of emotional support specific to physical activity. Some researchers also consider appraisal as a form of support, which involves providing information to help an individual evaluate themselves (House, 1981).

Within the physical activity literature, co-participation and modelling have also been considered forms of social support by some researchers (Davison, Cutting, & Birch, 2003; Dishman et al., 2002; Sallis, Grossman, Pinski, Patterson, & Nader, 1987). Co-participation involves doing physical activities with significant others, for example a mother and daughter walking together. Modelling, as previously outlined, is considered to be the physical activity levels and perceived value in physical activity of the provider (e.g. parent, friend). Modelling is proposed to influence physical activity by a person observing the provider engaging in physical activity and valuing physical activity and modifying their activity levels in response to these observations. Modelling is typically measured in terms of associations between physical activity levels of the provider and receiver of modelling (e.g. parent and child).

Whether modelling of physical activity should be considered a form of social support has been a topic of debate within the literature. Some researchers consider modelling to be a form of social support (e.g. Davison & Jago, 2009; Davison, Li, Baskin, Cox, & Affuso, 2011) whilst others consider it to be conceptually distinct (e.g. Beets, et al., 2010; Mendonça, et al., 2014). This difference in position seems, in part, related to a more general lack of consensus and explicitness about what social support means and how it is defined. Many researchers do not explicitly state why they consider or do not consider modelling to be a form of social support, or how they define social support. Beets, Cardinal and Alderman (2010) stated that social support is “conceptually different from social norms, modelling, social influence, and social networks”, however they did not expand on this. Within the health literature more

generally, modelling has been considered a form of social influence (Berkman, et al., 2000; Heaney & Israel, 2008). Heaney and Israel (2008) describe social support as resources provided by others that are “intended to be helpful”. Whilst providers may be active with the intention of setting a positive example to others (through modelling physical activity), by taking a self-determination theory approach, it may be more plausible that providers are *primarily* active because they value and enjoy physical activity (or are intrinsically motivated to be active), rather than simply to set a positive example for others (or through extrinsic forms of motivation) (Teixeira, Carraca, Markland, Silva, & Ryan, 2012) (see section on Theoretical Perspectives later in this chapter for a fuller account of self-determination theory). For this reason, modelling is not considered to be a form of social support in this thesis but a form of social influence (see Figure 5). Modelling and social support are recognised as two closely linked yet conceptually unique constructs.

Table 1 Types of social support for physical activity

Type of support	Sub-types of support/description
Emotional support	Providing child with encouragement for physical activities; encouraging child to be active; talking to child about physical activities; praise; watching child perform physical activities
Instrumental support (logistic support)	Financial support; providing transport to physical activities; providing equipment for child to be physically active (e.g. bicycle)
Informational support	Feedback on physical activities; providing instruction or advice to be physically active
Co-participation	Performing activities with child (e.g. going for walks together)

Within the wider literature, researchers’ definitions of social support are inconsistent. These definitions reflect researchers’ interpretations of social support as a construct. Some believe that social support is emotionally driven (e.g. Cobb, 1976; House, 1981; Schaefer, Coyne, & Lazarus, 1981). For example, Schaefer, Coyne and

Lazarus (1981) suggest that provision of equipment and advice insinuates caring rather than obligation. Alternatively, others place a greater emphasis on instrumental forms of support. For example, Sheridan and Radmacher (1992) defined social support as “the resources provided to us through our interactions with other people” (p. 156), which could be interpreted as provision of material goods.

Conceptualisations of social support also have considerable variations throughout the physical activity literature. For example, some definitions of social support encapsulate the various sub-categories of support outlined in Table 1 (e.g. co-participation, instrumental support, emotional support) (Yao & Rhodes, 2015). Whilst other researchers limit their conceptualisations to one or two forms of support, for example they might consider social support to involve only emotional forms of support (Bauer, Nelson, Boutelle, & Neumark-Sztainer, 2008), or do not provide specific definitions of social support (Eime, Harvey, Craike, Symons, & Payne, 2013; Kirby, Levin, & Inchley, 2011; Kuo, Young, Voorhees, & Haythornthwaite, 2007). This lack of consensus, and explicitness in many cases, is problematic because it influences how we measure and understand social support in quantitative studies and how we interpret social support qualitatively, making it difficult to compare findings. This has previously been identified as a problem in the field (Davison et al., 2013; Trost, McDonald, & Cohen, 2013).

To address this lack of consensus and explicitness in the literature it is necessary to clearly define what we consider to be social support. Therefore, taking into account the wider literature and the physical activity literature on how social support is conceptualised, for the purpose of this thesis, social support is defined as:

The interactions, resources, and assistance from providers to influence physical activity behaviour. Social support can be used to describe various ways in which the provider influences the physical activity behaviour of adolescent girls and may include various types of interaction and support.

This definition was created to reflect the multi-dimensional nature of social support, and in this, recognise that social support can come in many forms, including

instrumental, emotional and informational forms of support. This definition also acknowledges that various people can provide social support, each of which may influence physical activity differently. As previously highlighted, modelling is not considered to be a form of social support but a form of social influence. However, modelling and social support are recognised as two closely linked yet conceptually unique constructs.

This definition does not consider all forms of support to be emotionally driven, yet, there is likely to be a complex interaction between the providers' personal motivations for physical activity (e.g. how much value they place on physical activity, their enjoyment for physical activity), the environment within which the support is provided (including socio-cultural factors) and the relationship between the provider and the receiver of support. There is some evidence of this complex interaction in the literature. For example, a longitudinal study found that parents who encouraged their daughters to be active for weight loss (provider's motivation) found that girls reported reduced enjoyment for physical activity and heightened weight concerns (Davison & Deane, 2010).

Why focus on social support?

As previously highlighted, within the socio-ecological framework there are numerous factors that are associated with adolescent girls' physical activity including individual, interpersonal, environmental, policy and global factors. Following a socio-ecological approach, in order to successfully change physical activity behaviour it is important to target the multiple influences on behaviour (Sallis, et al., 2008). In order to do this successfully, we need to understand *how* to target these factors in physical activity interventions. Recent research has identified promising results for youth physical activity interventions targeting the social environment (Brown et al., 2016). Different interventions targeted different social-environmental aspects, for example role-modelling, social support and improving relationships, however it was not clear which of these approaches was most effective. Within the social environments literature, positive associations have been identified for both

role-modelling and social support on physical activity in youth (Yao & Rhodes, 2015), and evidence has also highlighted links between social norms and physical activity in youth (Draper, Grobler, Micklesfield, & Norris, 2015). Whilst it is likely that numerous aspects of the social environment are important for adolescent girls' physical activity, there is a need to develop an in-depth understanding of these different social environmental factors in order to inform physical activity interventions. It remains unclear how to increase perceptions of social support in youth physical activity interventions (Lubans, Foster, & Biddle, 2008; van Stralen et al., 2011). As social support is a potentially modifiable correlate of physical activity in adolescent girls, there is a need to better understand how social support influences behaviour and explore how social support can be successfully targeted in physical activity interventions. This thesis, therefore, focuses on the role of social support on physical activity in adolescent girls in order to gain a fuller understanding of the possible relationship to inform physical activity intervention design.

Associations between social support and physical activity.

As discussed earlier, there is evidence that social support is positively associated with physical activity in adolescents (e.g. Beets, et al., 2010; Biddle, et al., 2005; Edwardson & Gorely, 2010; Efrat, 2009; Mendonça, et al., 2014; Yao & Rhodes, 2015). However, there are a number of shortcomings of the research to date. Firstly, one limitation of the current evidence is the predominant focus on parental influences. The most robust evidence all focuses on parental influences (Edwardson & Gorely, 2010; Pugliese & Tinsley, 2007; Yao & Rhodes, 2015), with meta-analyses identifying significant positive associations between parent support and youth physical activity (Pugliese & Tinsley, 2007; Yao & Rhodes, 2015). No such analysis has been conducted for friend support or other provider variables, although narrative and semi-quantitative reviews have found that friend support seems to be positively associated with physical activity in adolescents (Efrat, 2009; Mendonça, et al., 2014). For teachers and sibling support, inconsistent associations on adolescents physical activity have been identified (Mendonça, et al., 2014).

Meta-analyses considering all providers and types of support would enable us to identify the relative importance of friends and other providers of support and make comparisons between providers and types of social support. Understanding the influence of support from different providers of social support may be particularly important when considering adolescent girls. Adolescence is a time period in which the nature of the relationship between adolescents and their parents transforms significantly (Smetana, Campione-Barr, & Metzger, 2006) and adolescents spend less time with their parents and more time with their friends (Larson, Richards, Moneta, Holmbeck, & Duckett, 1996). Friends may, therefore, be better positioned to influence physical activity during adolescence than family members.

Some types of support also seem to be more strongly associated with physical activity than others. For example, Yao and Rhodes (2015) found that encouragement and co-participation were most strongly associated with physical activity when compared with praise, watching and logistic support. However, to date, no such analysis on the influence of different types of support by providers other than parents has been considered. However, when types of friend support were considered narratively, a recent review found that encouragement and co-participation were most frequently associated with physical activity in adolescents (Mendonça, et al., 2014).

Finally, previous reviews have considered associations between social support and physical activity in children and adolescents more generally but none have focused specifically on adolescent girls. Yao and Rhodes (2015) and Pugliese and Tinsley (2007) considered gender but found no significant differences between boys and girls. However, these analyses only considered overall support and modelling and findings were only presented for children and adolescents combined. There is evidence to suggest that the relationship between social support and physical activity varies by age (Beets, et al., 2010) and gender (Salvy, De La Haye, Bowker, & Hermans, 2012), therefore, considering the relationship between social support and physical activity in adolescent girls separately may better inform intervention development.

Summary of social support research.

This section has reviewed the social support literature and highlighted that there is a lack of consensus and explicitness in the literature about how social support is defined. This was emphasised as a challenge, as it impacts how we measure and understand social support. Based on the literature, a definition of social support was presented to outline how social support is conceptualised for the purpose of this thesis. This section also presented evidence to suggest there is a small-to-moderate positive association between social support and physical activity in children and adolescents. However, research that has investigated associations between social support and physical activity in children and adolescents has predominantly focused on parental influences. There are no meta-analyses that have considered other providers of support (e.g. friends, teachers) in addition to parental influences. This type of analysis would allow for comparisons to be made between providers, which may be particularly important for adolescent girls during a life-phase when girls may be more susceptible to influences from their peers rather than their parents. Knowledge of the relative importance of different types and providers of social support for this population could inform more effective physical activity intervention design.

How social support influences physical activity

Within the physical activity literature, although there is a growing body of evidence that suggests social support is positively associated with physical activity, research examining *how* social support influences physical activity behaviour is limited. Improving our understanding of the mechanisms by which social support influences physical activity behaviour is necessary to both fully understand the relationship and also inform interventions aimed at increasing or maintaining physical activity.

Most research that has focused on these mechanisms suggests that social support influences physical activity through self-efficacy as a mediating variable. There are

two distinct types of self-efficacy that are considered in the literature: task self-efficacy and barrier (or self-regulatory) self-efficacy (McAuley & Mihalko, 1988). Task self-efficacy describes an individuals' confidence in their abilities to be physically active. Barrier self-efficacy describes an individuals' ability to overcome barriers to physical activity and regulate their behaviour. Peterson and colleagues (2013) found that parent instrumental support was indirectly associated with physical activity through barrier self-efficacy. Similar results were reported by Motl and colleagues (2007) and Trost and colleagues (2003) who both found that barrier self-efficacy mediated the relationship between social support and physical activity in adolescents. Wing, Bélanger, and Brunet (2016) also found that parent support was indirectly associated with physical activity through barrier self-efficacy and enjoyment as mediating variables. In particular, they found that tangible forms of support (e.g. instrumental support, companionship) were associated with physical activity through barrier self-efficacy and enjoyment and intangible forms of support (e.g. emotional support, informational support and role-modelling) were associated with physical activity through enjoyment. Shen and colleagues (in press) also found that parent support is associated with physical activity enjoyment. This suggests that social support could lead to increases in adolescents' enjoyment and confidence in their abilities to overcome barriers to physical activity, which may lead to increases in physical activity.

However, evidence from Wu and Pender (2002) found that whilst social support from friends had both a direct and indirect effect on adolescents' physical activity through barrier self-efficacy, there was a significant negative direct effect of family support on physical activity and no mediating effects of self-efficacy. Verloigne and colleagues (2014) also explored associations between social support and physical activity in adolescents. They found that internal barriers (e.g. lack of time, lack of interest and enjoyment for physical activity) significantly mediated associations between parent logistic support and physical activity. This suggests that parent logistic support may influence adolescents' physical activity both directly and indirectly through perceptions of internal barriers to physical activity. However, similar to the findings from Wu and Pender (2002), they found no evidence for a

mediating effect of barrier self-efficacy. Additional mechanisms have also been explored. In particular, Sabiston and Crocker (2008) found that best friends influenced adolescents' physical activity directly and indirectly through perceptions of competence and value. They also found that parents did not directly influence adolescents' physical activity although they found that parents had an indirect influence on activity through perceptions of competence and value. Sebire and colleagues (2014) also found that parent support was linked with other constructs associated with physical activity. They found that mother instrumental support was positively associated with girls' self-esteem, physical activity task self-efficacy and intentions to be physically active, whilst mother modelling of physical activity was associated with self-efficacy. Father modelling was positively associated with self-esteem and self-efficacy but there was no associations between father instrumental support and any of the measured psychosocial variables.

Davison and colleagues (2013) drew on this research as well as general parenting research as a means of developing physical activity parenting research and created an Integrated Model of Physical Activity Parenting (see Figure 6). The model suggests that socio-ecological factors interact to influence parental attributes and perceptions that determine physical activity parenting practices. These physical activity parenting practices (including forms of parental support) lead to physical activity behaviour and outcomes associated with child physical activity including enjoyment, motivation, perceived physical activity competence and physical activity self-efficacy. The model proposes that increases in enjoyment, motivation, perceived competence and self-efficacy will lead to increases in physical activity (see Figure 6). Whilst this model has not yet been tested it provides a useful theory-based and research-informed starting point for exploring social support for physical activity, and it is currently the only physical activity focused framework that has attempted to represent how social support influences physical activity behaviour in young people.

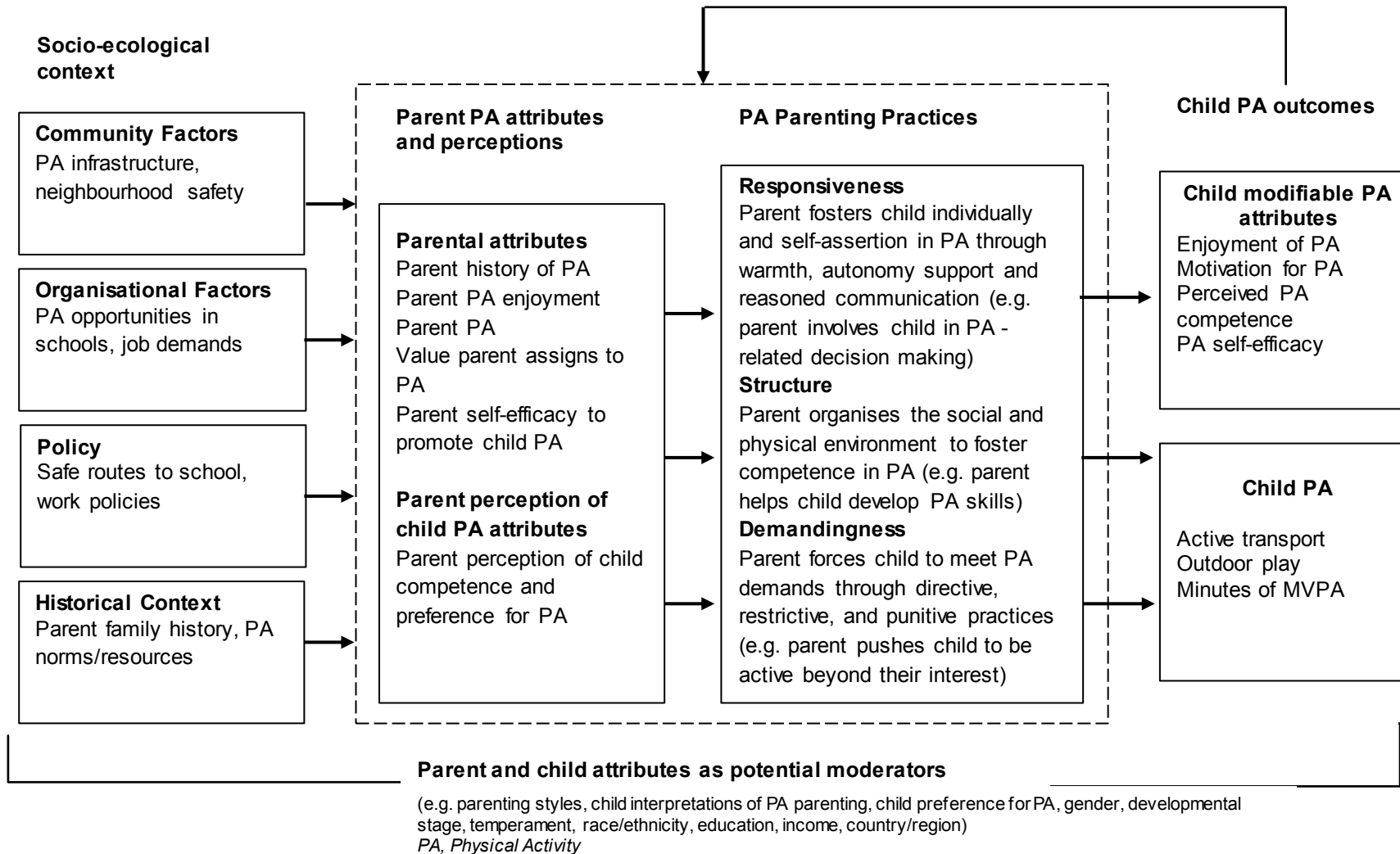


Figure 6 Integrated model of physical activity parenting

Theoretical perspectives.

In addition to studies that have explored how social support influences physical activity behaviour there are also psychological perspectives of behaviour change that may inform our understanding of the relationship between social support and physical activity. These theories are not examined in detail because they have not underpinned the empirical work of this thesis; however, they provide further explanation for how social support may influence physical activity behaviour. This section will outline some of the main theoretical approaches used in the physical activity literature with a social component and highlight the central role of the social component in understanding behaviour. This section aims to explore theoretical perspectives of how social support influences physical activity behaviour.

Self-Determination Theory.

One such theory that could inform our understanding of the relationship between social support and physical activity is Self-Determination Theory (SDT), a popular theory of motivation proposed by Deci and Ryan (1985; 1991). SDT is comprised of five sub-theories that attempt to explain motivation and behaviour that is based on differences in peoples' motivations to perform a behaviour, the context of these motivations and interpersonal perceptions (Hagger & Chatzisarantis, 2008).

The five sub-theories that make up SDT include: The Cognitive Evaluation Theory, the Organismic Integration Theory, the Causality Orientations Theory, the Goal Contents Theory and the Basic Psychological Needs Theory. Of particular relevance to understanding how social support might influence physical activity behaviour is the Basic Psychological Needs Theory, which suggests that there are three basic needs for psychological wellbeing including autonomy, competence, and relatedness. Autonomy is a persons' perceptions of their ability to regulate their actions, and competence is a persons' confidence in their ability to perform a particular behaviour. Relatedness, which is most relevant to understanding the relationship between social support and physical activity, refers to how connected an individual feels with others (Biddle, Mutrie, & Gorely, 2015). For example, perceptions of

relatedness are dependent on the social environment and could vary based on how supportive that environment is. High quality, supportive relationships could also contribute to perceptions of competence and autonomy, as well as contributing to perceptions of relatedness. SDT suggests that autonomous motivation is based on satisfying the three psychological needs and that these needs need to be met for positive psychological health.

The Organismic Integration Theory suggests there are several different types of motivation, which can be extrinsic or intrinsic. Extrinsic motivation refers to behaviours performed for outcomes not directly related to the activity. For example, performing physical activity for social approval or financial reasons. Extrinsic forms of motivation are not thought to be associated with long term behaviour, as when external motivations such as financial rewards or social approval are removed then behaviour would cease or decrease without any intrinsic motivation to perform the behaviour (Biddle, et al., 2015). There are four main types of extrinsic motivation: external, introjected, identified and integrated regulation, and extrinsic motivation has been proposed to lie along a continuum of self-determination. These types of motivation vary by autonomy with the more internalised extrinsic motivation being more autonomous (see Table 2). A person can also display amotivation, which is when they have no intention or motivation to perform a behaviour (Biddle, et al., 2015). Intrinsic motivation is linked to 'autonomy' (Deci & Ryan, 2002), meaning that performing a behaviour is self-directed and free from external pressures. Those who are intrinsically motivated may perform a behaviour for expected personal benefits such as enjoyment or a sense of accomplishment (Deci & Ryan, 1975). Unlike extrinsic motivation, intrinsic motivation is thought to be associated with long-term behaviour.

Table 2 Descriptions and examples of different forms of motivation

Type of motivation	Description	Example
Intrinsic motivation	Linked to 'autonomy' (Deci & Ryan, 2002). Meaning that performing a behaviour is self-directed and free from external pressures. Expected benefits of being physically active such as enjoyment or sense of achievement.	An adolescent girl choosing to attend a weekly gymnastics club because she enjoys it.
External regulation	Behavioural motivation through rewards or threats	A mother offers to buy her daughter a gift if she attends swimming lessons
Introjected regulation	Avoidance of guilt or for social approval	A girl walking to school in the mornings because she does not want to upset her parents by asking for a lift
Identified regulation	The behaviour is valued by the individual	A girl is aware of the health and social benefits of physical activity and this motivates her to be active.
Integrated regulation	Where performing an activity is regulated by personal goals or activities that contribute to defining an individual. Not intrinsic in that it is not motivated by enjoyment of behaviour.	Being physically active is important to a girl and who she is as a person and who she wants to be.
Amotivation	No intention or motivation to perform a behaviour	A girl is not physically active and has no intention to become active.

SDT has been tested as a theory to explain physical activity behaviour extensively, such that systematic reviews have synthesised the findings (Owen, Smith, Lubans, Ng, & Lonsdale, 2014; Teixeira, et al., 2012). Teixeira and colleagues (2012) conducted a meta-analysis of 66 studies to estimate SDT constructs for predicting

physical activity in adults. Each SDT motivation type was assessed as well as psychological needs satisfaction against its association with physical activity behaviour. Intrinsic motivation was most strongly associated with physical activity followed by identified and integrated regulation. Introjected regulation showed mixed results including positive associations, no associations and negative associations, and external and amotivation had no or negative associations with physical activity. The authors noted that limited research had examined associations between psychological needs theory and physical activity, but they found that of those that had, there was no association between relatedness and physical activity (Teixeira, et al., 2012). However, as psychological needs theory suggests that fulfilment of the basic psychological needs is needed for intrinsic motivation perhaps associations should have explored the relationship between relatedness and motivation rather than relatedness and physical activity.

Owen and colleagues (2014) conducted a similar meta-analysis to examine associations between each form of SDT motivation type with physical activity in children and adolescents. From 46 studies, they found that total self-determined motivation was positively associated with physical activity although the effect sizes were small. Intrinsic and identified regulation were most strongly associated with physical activity with moderate effect sizes. Similar to the findings from Teixeira and colleagues (2012), weak and negative associations were identified for introjected, external regulation and amotivation with physical activity behaviour (Owen, et al., 2014). Owen and colleagues (2014) did not, however, assess associations between basic psychological needs satisfaction, motivation and physical activity. This analysis was carried out by Sebire and colleagues (2013) in a study with 462 children. They found that needs satisfaction was related to intrinsic motivation, which was related to physical activity. However, this was mainly due to perceptions of autonomy, and relatedness was not significantly related. The authors attributed this to needs satisfaction sub-scales not being sensitive enough to distinguish between needs satisfaction constructs. Therefore, it remains unclear how important relatedness is for motivation and physical activity in children and adolescents.

In summary, principles of SDT suggest that motivation, particularly autonomous motivation, is linked with behaviour. SDT also suggests that quality autonomous motivation is dependent on satisfying the basic psychological needs including competence, autonomy and relatedness. Following the principles of SDT, social support could be linked with physical activity through motivation. However, whilst two systematic reviews identified that autonomous motivation was most strongly related to physical activity, only one review explored links between psychological needs satisfaction, motivation and physical activity and found no association between relatedness and physical activity.

Social Cognitive Theory.

Another theory that could inform our understanding of the relationship between social support and physical activity is Social Cognitive Theory (SCT). SCT suggests that our behaviours are a result of interactions between characteristics of the person, environmental influences and the behaviour (Bandura, 1986). Of these, there are three core elements of SCT that are linked with personal characteristics including: self-efficacy, outcome expectations and behavioural goals, and one environmental influence: socio-cultural factors. When considering how SCT might inform our understanding of the relationship between social support and physical activity, the role of environmental influences in the theory are of particular relevance.

Self-efficacy is a key construct in SCT and refers to a person's confidence in their ability to 'exercise control over one's health habits' (Bandura, 2004). Bandura proposed that mastery experiences (e.g. successfully practicing task), vicarious experience (e.g. modelling behaviour), verbal persuasion (e.g. encouragement), physiological states (e.g. heart rate) and emotional states (e.g. joy, frustration) contribute to self-efficacy beliefs. Therefore, significant others could influence self-efficacy beliefs through modelling physical activity and providing encouragement.

SCT suggests that self-efficacy influences behaviour through outcome expectations, socio-cultural factors and behavioural goals (see Figure 7). Outcome expectations

represents beliefs of the benefits or consequences of performing (or not performing) physical activity (Bandura, 2004). A key element of SCT is the idea that behaviours are a result of peoples' beliefs that their actions will lead to positive outcomes. Bandura proposed three classifications of outcome expectations: physical (e.g. bodily feelings), social (e.g. expected social approval or disapproval) and self-evaluative (e.g. how a person thinks they will feel about themselves after performing the behaviour).

Socio-cultural factors can serve to both promote and prevent physical activity behaviour. SCT suggests that socio-cultural factors influence physical activity behaviour through contributing to physical activity goals (or intentions to be physically active) and that socio-cultural factors mediate the relationship between self-efficacy and goals (see Figure 7). Therefore, according to SCT, social support could influence physical activity behaviour through influencing physical activity goals or intentions to be physically active.

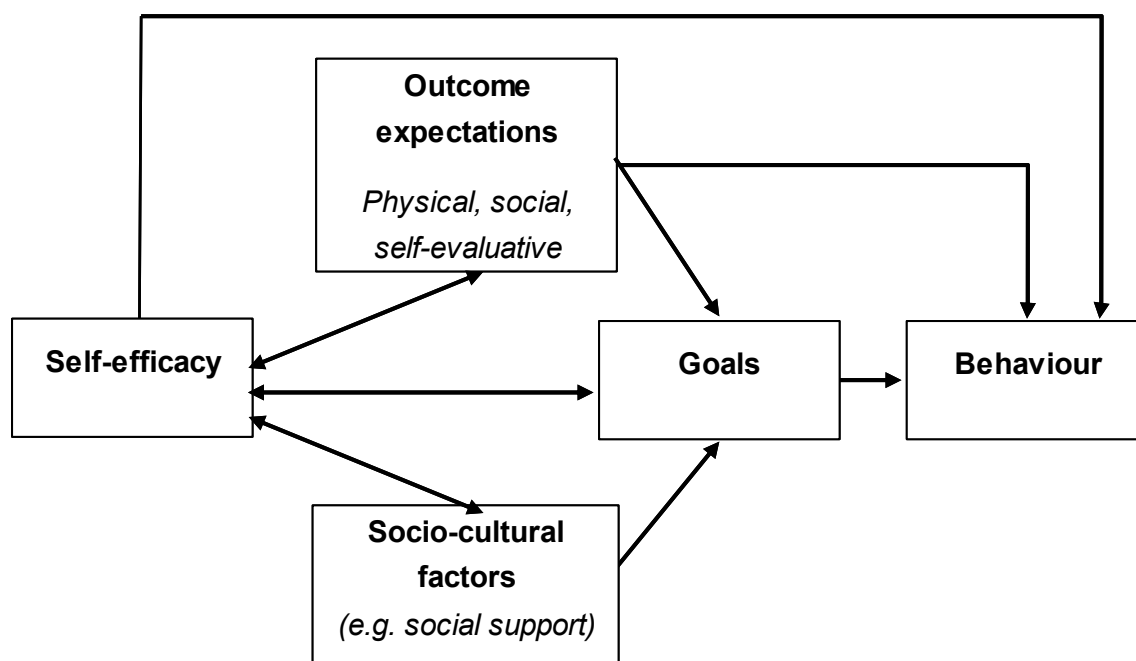


Figure 7 Social Cognitive Theory of physical activity behaviour (adapted from Bandura, 2004)

The application of SCT in explaining physical activity behaviour was investigated by Young and colleagues (2014) in a recent meta-analysis. They found that SCT explained 31% of the variance in physical activity behaviour, which the authors concluded is large enough to be considered a useful theory to explain physical activity behaviour. Similar results have been identified for adolescents. A meta-analysis by Plotnikoff and colleagues (2013) of 23 studies found that SCT explained 33% of the variance in physical activity behaviour and 48% of the variance for physical activity intentions in adolescents.

To summarise, there is evidence to suggest that SCT can be used to explain physical activity behaviour amongst young people. SCT suggests that behaviour is a result of interactions between characteristics of the person, the environment within which they live and the behaviour. In particular, socio-cultural factors such as social support are proposed to influence goals or intentions to be physically active, which, alongside outcome expectations, influences physical activity behaviour.

Other theoretical models with a social component.

Other theoretical models may also have a role in informing our understanding of the relationship between social support and physical activity. For example, the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) and the Theory of Planned Behaviour (TPB) (Ajzen, 1985, 1991) are two linked theories that suggest that behaviour is a result of intentions and that intentions are predicted by attitudes and subjective norms. The TPB is an extension of the TRA and suggests that perceived behavioural control is also a predictor of physical activity. The social component of the TRA and the TPB is that subjective norms predict intentions which predict behaviour. Subjective norms have been defined as an individuals' "perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991, p. 188). Beliefs that significant others have and motivation to comply with significant others will influence subjective norms. This proposed relationship between subjective norms, intentions and behaviour could be relevant when considering social influences on

physical activity behaviour. However, subjective norms are a form of social influence rather than social support, which potentially limits the ability of the TRA or the TPB to inform our understanding of the relationship between social support and physical activity.

The transtheoretical model (TTM), a stage-based approach to physical activity behaviour change, could also inform our understanding of the relationship between social support and physical activity. The TTM suggests that changing physical activity behaviour involves movement through five stages of change outlined below.

1. Pre-contemplation: Not currently physically active and no intention to increase physical activity levels.
2. Contemplation: Not currently physically active but thinking about increasing physical activity levels.
3. Preparation: Some physical activity with the intention and preparing to be more physically active.
4. Action: Physically active for less than 6 months.
5. Maintenance: Physically active for more than 6 months.

Within the TTM, ten processes of change are proposed to understand how people shift between stages of physical activity behaviour. Social support is considered to be a process of change. Following the principles of SDT, social support may help individuals to progress and move between stages of physical activity participation from pre-contemplation to maintenance.

Summary of how social support might influence physical activity.

To summarise, research on how social support influences physical activity is in its infancy but the available research suggests that social support may have an indirect

association with physical activity through other variables. Most research has adopted a cross-sectional quantitative approach with findings suggesting that social support could influence physical activity through self-efficacy. Some evidence also suggests that enjoyment, perceived barriers to physical activity, value and competence may mediate associations between social support and physical activity. Theoretical perspectives to physical activity behaviour may also inform our understanding of the relationship between social support and physical activity. In particular, SDT and SCT propose potential pathways through which social support may have an influence on constructs related to physical activity behaviour. However, no prior research has comprehensively investigated how social support influences physical activity behaviour in adolescent girls. A better understanding of the mechanisms through which social support influences behaviour could inform more effective physical activity intervention design, therefore, furthering our knowledge in this area could enhance both social support for physical activity research and intervention design.

Social support interventions

Research on social relationships has informed the design and implementation of interventions aimed at increasing physical activity in adolescent girls. In particular, some interventions have attempted to increase young peoples' perceptions of social support through specific behaviour change strategies. Strategies for increasing social support have targeted young peoples' peers, families and teachers, and have aimed to increase provision of positive feedback and encouragement (Dunton, Schneider, & Cooper, 2007; Eather, Morgan, & Lubans, 2013), promoted positive communication and teamwork (Dunton, et al., 2007), provided young people with guidelines on how they can get more support from their friends (Lubans & Sylva, 2009), and organised sessions outside the researcher-led session to be completed with friends (Lubans & Sylva, 2009). Intervention strategies have also attempted to directly engage families to increase provision of support for young people (Haerens et al., 2008; Taymoori, Lubans, & 2008) although poor parent engagement was identified as problematic in one of these interventions (Haerens, et al., 2008) and has been identified as an issue in parenting programs more generally (Mytton, Ingram, Manns, & Thomas, 2014).

However, the effectiveness of these intervention strategies is unclear. A systematic review by O'Connor, Jago, and Baranowski (2009) synthesised 35 physical activity interventions for young people that included features involving parents. They concluded that it is unclear how best to engage families in physical activity interventions aimed at young people due to the quality and design of previous interventions, which aligns with findings from other reviews (Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007; Van Lippevelde et al., 2012; van Sluijs, Kriemler, & McMinn, 2011). Similarly, systematic reviews that have investigated mediators of physical activity interventions have not found evidence for social support as a mediator of interventions for young people (Lubans, et al., 2008; van Stralen, et al., 2011), however, this seems to be because interventions have not been effective at increasing social support (van Stralen, et al., 2011).

More recently, Brown and colleagues (2016) conducted a systematic review, meta-analysis and realist synthesis to assess the effectiveness of family based interventions to increase physical activity in children. Forty-seven studies were included, of which, a small positive effect for family based interventions was identified (ES: .29, 95% CI 0.14-0.45). The realist synthesis identified consistent support for modifying the psychosocial environment. In particular, the realist synthesis provided evidence for interventions that focused on improving quality of relationships, which seemed to coincide with or result in enhanced social support, and using the child as the "agent of change". For example, in one intervention identified in the review the children role-modelled physical activity behaviour and encouraged their fathers to be physically active resulting in significant changes to the physical activity levels of both the father and the child. The findings from this review suggest that there is promise for family based support strategies in physical activity interventions when these strategies are appropriately targeted.

No reviews to our knowledge have directly assessed evidence on peer support components of physical activity interventions. However, of interventions that have utilised friend support components two reported no intervention effects on perceived

support from friends (Dunton, et al, 2007; Eather, et al., 2013). One intervention significantly increased perceptions of friend support in girls but these changes were not associated with changes in physical activity (Lubans & Sylva, 2009). These mixed findings suggest that the research on positive associations between social support and physical activity has not been well translated into physical activity interventions. A better understanding of how social support influences behaviour may inform more effective social support intervention strategies aimed at increasing physical activity in young people.

In summary, the effectiveness of social support strategies in physical activity interventions is not well understood. This could in part be attributed to the lack of understanding of the mechanisms through which social support influences physical activity. A better understanding of how social support influences behaviour might inform more effective social support intervention strategies, and hence, lead to more effective physical activity interventions for adolescent girls.

Gaps in the evidence and thesis aims

This review has identified positive associations between social support and physical activity in adolescent girls, however, two key gaps are evident in the literature. Firstly, it is not well understood how different providers of social support influence physical activity behaviour in adolescent girls. The most comprehensive evidence to-date has focused only on parent support. Only one review has focused on all providers and types of support and this is limited to having a semi-quantitative approach, therefore, the relative importance (e.g. strength of associations) of different types and providers of support could not be determined. Considering all types and providers of social support would improve our understanding of the relative importance of different types and providers of social support for adolescent girls.

Secondly, the evidence on positive associations between social support and physical activity in adolescent girls has not been well translated into physical activity

intervention strategies. Few interventions have utilised social support strategies in physical activity interventions aimed at adolescents, and of these, even less have analysed the effectiveness of social support strategies at changing behaviour (e.g. through mediation analysis). Current interventions that have included social support strategies have had limited effectiveness and are not well developed. There are two key issues: there is a lack of understanding of how social support influences physical activity behaviour, and therefore, how to effectively increase perceptions of social support in interventions; and interventions that do employ social support strategies fail to test the effectiveness of these social support strategies on mediating behaviour change.

This thesis aimed to address these gaps in the evidence in three ways. Firstly, a systematic review and meta-analysis was conducted to understand if different types and providers of social support influence physical activity behaviour in adolescent girls and to compare the relative importance of different types and providers of social support. Secondly, an analysis of a school-based physical activity intervention for adolescent girls was carried out. Baseline associations between social support and physical activity were assessed, testing for any mediating effects of self-efficacy. The effectiveness of the intervention was also assessed and social support and self-efficacy were tested as potential mediators of the effectiveness of the intervention. Thirdly, a school-based study qualitatively explored how social support influences physical activity in active adolescent girls.

Research questions and thesis structure

To address these aims, this thesis addressed the following research questions:

1. Is there a relationship between social support and physical activity in adolescent girls?
2. If so, does the relationship differ by provider and type of social support?
3. Does social support mediate the effectiveness of a physical activity intervention for adolescent girls?

4. How does social support influence physical activity behaviour in adolescent girls?

These research questions are addressed in three separate studies that make up this thesis. Research questions 1 and 2 are addressed in a systematic review that synthesised and meta-analysed studies that reported associations between social support and physical activity in adolescent girls. Study 2 addressed all 4 research questions and involved a mediation analysis of the effect of social support on physical activity in adolescent girls at baseline and as part of a physical activity intervention for adolescent girls. Study 3 qualitatively addressed research question 4 comprehensively by exploring adolescent girls' perceptions of how social support influences their physical activity behaviour. The study titles are detailed below.

Study 1

The role of social support on physical activity behaviour in adolescent girls: A systematic review and meta-analysis.

Study 2

The effectiveness of Health 4 U on increasing physical activity in adolescent girls: An analysis of social support as a mediator of physical activity behaviour change

Study 3

A grounded theory of adolescent girls' perceptions of how social support influences their physical activity behaviour.

Chapter 3: The role of social support on physical activity behaviour in adolescent girls: A systematic review and meta-analysis

Introduction

Interventions have been developed that aim to promote physical activity in adolescent girls, although these have had limited effect (Camacho-Miñano, et al., 2011; Pearson, et al., 2015; The National Institute for Health and Care Excellence, 2008). Recent evidence suggests that there are gender differences in correlates of physical activity in adolescents (Telford, Telford, Olive, Cochrane, & Davey, 2016). Therefore, understanding the correlates and determinants of physical activity specifically in adolescent girls is essential to inform the development of current and future interventions for this population (Sallis, Owen, et al., 2000).

A growing body of evidence focusing on correlates and determinants of physical activity in adolescent girls exists, and subsequently, research has been summarised by systematic reviews (Biddle, Atkin, et al., 2011; Biddle, et al., 2005; Sallis, Prochaska, et al., 2000; Standiford, 2013). Consistent with a socio-ecological approach (Sallis, et al., 2006), these reviews have identified categories of physical activity correlates including personal, psychological, environmental and social correlates. Social support in particular has consistently emerged as positively related to physical activity in adolescent girls. Social support describes resources provided from interactions with significant others that can influence behaviour (Langford, et al., 1997; Sheridan & Radmacher, 1992). These resources can be emotional (e.g. encouragement, praise), instrumental (e.g. equipment, financial), or informational support (e.g. advice, instruction) and they can be provided by various individuals (providers) within one's social network (e.g. friends, family, teachers) (Heaney & Israel, 2008; Stroebe & Stroebe, 1996). Within the physical activity literature, modelling (e.g. associations between activity levels of provider and child) and co-

participation (e.g. performing physical activities together) have also been considered forms of social support (Davison, 2010).

Numerous studies have focused on social support for physical activity in children and adolescents and these have also been systematically reviewed (Beets, et al., 2010; Edwardson & Gorely, 2010; Fitzgerald, et al., 2012; Gustafson & Rhodes, 2006; Maturo & Cunningham, 2013; Mendonça, et al., 2014; Pugliese & Tinsley, 2007; Sallis, Prochaska, et al., 2000; Yao & Rhodes, 2015). Most of these reviews have focused on parental influences with results suggesting significant positive associations between parent support and child and adolescent physical activity (Beets, et al., 2010; Edwardson & Gorely, 2010; Gustafson & Rhodes, 2006; Mendonça, et al., 2014; Pugliese & Tinsley, 2007; Yao & Rhodes, 2015). Despite the lower prevalence of physical activity in adolescent girls, none of these reviews focused specifically on this group. Only two reviews considered gender and they found no significant differences between boys and girls, however, analyses only considered overall support (Pugliese & Tinsley, 2007; Yao & Rhodes, 2015) and modelling (Yao & Rhodes, 2015) and were presented for both children and adolescents. There is some evidence to suggest the relationship between social support and physical activity might vary by age (Beets, et al., 2010) and gender (Salvy, et al., 2012), therefore, considering these variables separately may better inform physical activity intervention development for adolescent girls.

Pugliese and Tinsley (2007) and, later, Yao and Rhodes (2015) conducted the two meta-analyses in the area. They both identified small to medium significant associations between parent support and youth physical activity ($r = .17$ and $r = .38$ respectively) and small but significant associations between parent modelling and youth physical activity ($r = .13$ and $r = .16$ respectively). Neither meta-analysis considered all providers of social support. Findings from narrative and semi-quantitative reviews suggest that friend support also seems to be related to child and adolescent physical activity (Fitzgerald, et al., 2012; Maturo & Cunningham, 2013; Mendonça, et al., 2014) though they cannot inform us how meaningful the effect size is, or test for significant findings (Field, 2005).

Some types of support also seem to be more strongly associated with physical activity than others. Yao and Rhodes (2015) found that parental encouragement and co-participation were most strongly related to youth physical activity compared with praise, watching and logistic support. To date, no such analysis on the influence of different types of support by providers other than parents has been considered. A recent narrative review found that friend encouragement and co-participation were most frequently associated with physical activity in adolescents (Mendonça, et al., 2014) perhaps suggesting that different types of social support may influence physical activity differently.

Yao and Rhodes (2015) also considered how other variables moderated the effect sizes of the relationship. Specifically, they reported that for total parent support type of physical activity measure (e.g. objective/subjective) moderated the size of the effect with subjective tools showing larger effects. Study quality, geographical location and age were also assessed but did not significantly moderate effect sizes. It is also possible that other factors not investigated could have influenced reported effect sizes. For example, there is some evidence to suggest that associations may vary according to type of physical activity (e.g. MVPA, active travel) (Edwardson & Gorely, 2010). Measurement of social support may also moderate effect sizes, as inconsistent methods of measuring social support and the use of non-validated scales has previously been highlighted as problematic in the literature (Davison, et al., 2013).

To date, the only available evidence that has considered all providers and all types of social support on physical activity in young people adopted a semi-quantitative and narrative approach (Mendonça, et al., 2014). Whilst the findings from this review suggested that support from both parents and friends is positively associated with physical activity in adolescents, no comparison in effects sizes between providers and types of support was possible. Performing meta-analysis would allow us to compare effect sizes and establish if some types and providers of support are more strongly associated with physical activity in adolescent girls than others. However,

unpicking the relationship between social support and physical activity is complex because the number of different sources and different types means that there are in fact a substantial number of possible relationships between these two variables.

Therefore, the first aim of this study was to comprehensively map the literature to demonstrate the numbers of associations reported for different combinations of types and providers of social support. Secondly, where there was enough available evidence, we aimed to perform meta-analyses on effect size data for different providers and types of social support for adolescent girls' physical activity. Finally, we aimed to carry out moderator analyses on effect sizes for age, geographical location, social support measurement bias (e.g. high risk, low risk), physical activity measure (objective or subjective) and type of physical activity (e.g. MVPA, sports).

Method

This study followed the procedures for systematic reviews and meta-analysis outlined in the PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009). A protocol for this review was prepared and registered with PROSPERO (Laird, Niven, Fawcner, McNamee, & Kelly, 2014).

Search strategy.

Literature published until January 2015 were synthesised and reviewed. The following electronic databases were searched to identify studies for inclusion: MEDLINE, PsychINFO, EMBASE, CABabstracts, Global Health, Allied and Complementary Medicine, SPORTDiscus, ERIC, CinAHL, Science Citation Index, Social Science Citation Index, the Cochrane library, Dissertations and Theses A&I and the International Bibliography of the Social Sciences. Additional articles were located using the reference lists of included articles and previously published reviews. Personal resources including the authors' own EndNote libraries and book chapters were consulted. Search terms included a combination of free text terms and subject headings relating to the target population, social support, and physical

activity (see Table 3). The search strategy was adapted for each database and searches were logged and recorded. Pilot searches were conducted to improve the sensitivity and specificity of the final search strategies.

Eligibility criteria.

Peer reviewed publications or doctoral theses published until January 2015 were included. Studies were eligible for inclusion if: (1) data for adolescent girls between the ages of 10 to 19 years, or a mean age within this range, were reported (based on the World Health Organisations (2014) definition of adolescence); (2) they included a measure of social support as an independent variable; (3) they included a measure of adolescent’s physical activity as a dependent variable; and (4) they reported an association between physical activity and social support. Studies were excluded if (1) they focused only on clinical or overweight populations; (2) only a health related fitness measure was reported; or (3) they were not published in English.

Table 3 Systematic review search terms

Target population	Social support	Physical activity
Adolescen* Young people Youth Girl* Female* Teen* School age*	Social support (Family or peer or friend* or school) adj2 (support or encourage* or help or assist*) (emotion* or instruction* or information* or psychosocial) adj2 (support or encourage* or help or assist*)	Sport* Physical activit* Physical fitness Exercis*

* Search term truncated

Screening.

Two reviewers independently screened search results against the inclusion and exclusion criteria. This was carried out in two stages. The initial stage involved screening titles and abstracts only, and full articles were located where titles and

abstracts were identified as meeting the inclusion criteria. Any disagreements were discussed and resolved during a meeting with a third reviewer.

Data extraction and risk of bias assessment.

Data from the included articles were extracted onto an electronic form, which was designed and piloted for this review. The extracted data included: general study information; participant characteristics; outcome characteristics for physical activity and social support; methods of analysis; and results. Included studies were assessed for risk of bias. The Critical Appraisal Skills Programme for cohort studies tool (CASP; www.casp-uk.net), an 8-item checklist used previously in the physical activity literature (Barnett, Guell, & Ogilvie, 2012), was used to guide risk of bias assessment. Four categories were identified that might pose a risk of bias to the type of studies likely to be included in the review, including: selection bias, physical activity measurement bias, social support measurement bias, and confounding variables. Each category within each study was then assigned as having a 'low', 'high' or 'unclear' risk of bias using a set of pre-determined assessment thresholds (see Table 4). The risk of bias assessment was not used to exclude or weight studies within the review. Data extraction and risk of bias assessment was completed by one author. To estimate accuracy, a second reviewer carried out data extraction and risk of bias assessment on a random 25% of the included studies. Kappa statistics showed good agreement between risk of bias assessment and data extraction of the results between the two reviewers ($K = .62$, 95% CI), following previously outlined guidelines for level of agreement (Altman, 1991). Therefore, the data extraction and risk of bias accuracy of one reviewer was deemed to be acceptable.

Table 4 Risk of bias assessment thresholds

8-item checklist	Criteria	Thresholds for criteria
<p>Did the study address a clearly focused issue?</p> <p>Did the authors use an appropriate method to answer their question?</p>	<p>Initial screening questions</p>	
<p>Was the cohort recruited in an acceptable way?</p> <p>Was the follow-up of the subjects complete enough?</p> <p>Was the follow-up of the subjects long enough?</p>	<p>Selection bias</p>	<p>Random sample, non-response <30% and loss of follow-up <50% = Low risk</p> <p>Non-random sample and/or nonresponse ≥ 30% = high risk</p>
<p>Was physical activity (outcome) accurately measured to minimise bias?</p>	<p>Physical activity measurement bias</p>	<p>Objective measure (e.g. accelerometer/pedometer) or validated questionnaire (e.g. author references validation study in-text or known validated scale) = low risk</p> <p>Custom questionnaire or single-item questionnaire = high risk</p>
<p>Was social support (exposure) accurately measured to minimise bias?</p>	<p>Social support measurement bias</p>	<p>Self-report previously validated questionnaire = low risk</p> <p>Custom questionnaire = high risk</p>
<p>Have the authors identified all important confounding factors?</p>	<p>Confounding variables</p>	<p>Adjusted for confounders (age, SES, ethnicity) through analysis, stratification, or study design = low risk</p> <p>Adjusted for some or none of the confounders = High risk</p>

Assessment checklist collapsed from the CASP Toolkit: http://media.wix.com/ugd/dded87_36c5c76519f7bf14731ed1985e8e9798.pdf

Effect size calculation.

Random effects meta-analyses were performed using Comprehensive Meta-Analysis Software Version 3.0 (Borenstein, Hedges, Higgins, & Rothstein, 2014) to estimate pooled associations between provider and types of social support and physical activity in adolescent girls. Adjusted (where available) and non-adjusted (if adjusted not reported) standardised effect sizes or odds ratios were entered into Comprehensive Meta-Analysis (e.g. bivariate correlations, standardised regression coefficients). In cases where standardised effect sizes were not available, p-values and sample sizes were entered into Comprehensive Meta-Analysis to back compute the effect size. Correlation coefficients were converted to the Fisher's z scale, and all analyses were performed using the transformed values before being converted back to correlations to present the results. Pearson's r was selected as the effect size metric to report the results and interpretation of the results were based on Cohen's criteria for small ($>.10$), moderate ($>.30$) and large ($>.50$) effect sizes (Cohen, 1992). Meta-analyses were performed for different types and providers of social support, providing at least 3 studies reported results on the combination of provider and type of support. Previous reviews informed the selection of five possible moderators of effect sizes (see Table 5) (Edwardson & Gorely, 2010; Yao & Rhodes, 2015). Effect sizes were assessed for these proposed moderators by meta-regression including: age, geographical location, social support measurement bias, physical activity measure (e.g. subjective or objective) and physical activity type (e.g. MVPA, sport) when at least six studies were included in the meta-analysis.

Table 5 Moderators tested in meta-regression

Moderator	Categories
Social support measurement bias	High risk; low risk; or unclear risk
Physical activity type	MVPA; total physical activity; sports; leisure time physical activity; or active travel
Physical activity measurement type	Objective or subjective
Geographical location	USA; Australia/New Zealand; Europe; Asia; South America; or Canada
Participant age	10-12 years; 13-15 years; or 16-19 years

Longitudinal studies.

Longitudinal studies were not included in the meta-analysis and were presented narratively. This was deemed the most appropriate way to represent the longitudinal data due to the varied analyses performed. For example, the predictive effect of baseline social support on future physical activity is not directly comparable to change in social support and physical activity over time. It was, therefore, deemed inappropriate to statistically pool these findings.

Results

A total of 6647 records were identified from electronic and manual searches, of which 84 met the inclusion criteria (see Figure 8). Of these, data from 73 studies were included in the meta-analysis and data from 16 longitudinal studies were included in the narrative synthesis. Six cross-sectional studies were not included in the meta-analysis because there were not enough data to perform a meta-analysis (Edwardson, Gorely, Pearson, & Atkin, 2013; Sharma et al., 2009; Shokrvash et al., 2013; Voorhees et al., 2005) or because data could not be meta-analysed (Bungum & Vincent, 1997; Davison, 2004). See Appendix A for a full list of included studies and

data extracted from the studies. Table 6 describes the basic characteristics of the included studies. Included studies were published between 1986 and 2014. The majority of studies were conducted in the USA (55%). Other studies were conducted in Europe (15%), Australia (12%), Asia (8%), Canada (7%), and South America (2%). Most studies were cross-sectional in design (81%) and measured physical activity subjectively (71%). Included studies were assessed for risk of bias (see Figure 9). As shown in the figure, most studies were of high risk of selection bias or did not report the relevant information on study selection. The majority of studies (75%) did not control for all the proposed confounding variables in the risk of bias assessment and just over half of the included studies used a validated tool to measure social support (see Figure 9).

Table 7 provides an overview of the associations reported by the included studies, representing the combinations of associations available including 21 different providers and 14 different types of social support for adolescent girls. Associations were predominantly reported for total social support by all providers, parents, family and friends on adolescent girls' physical activity. Associations were also commonly reported for modelling, particularly for parents, mothers, fathers and friends. Associations for other types of support such as emotional, instrumental or informational support were rarely reported and some providers of support were not well investigated such as teachers, coaches and siblings (see Table 7).

Figure 8 Systematic review search flow diagram

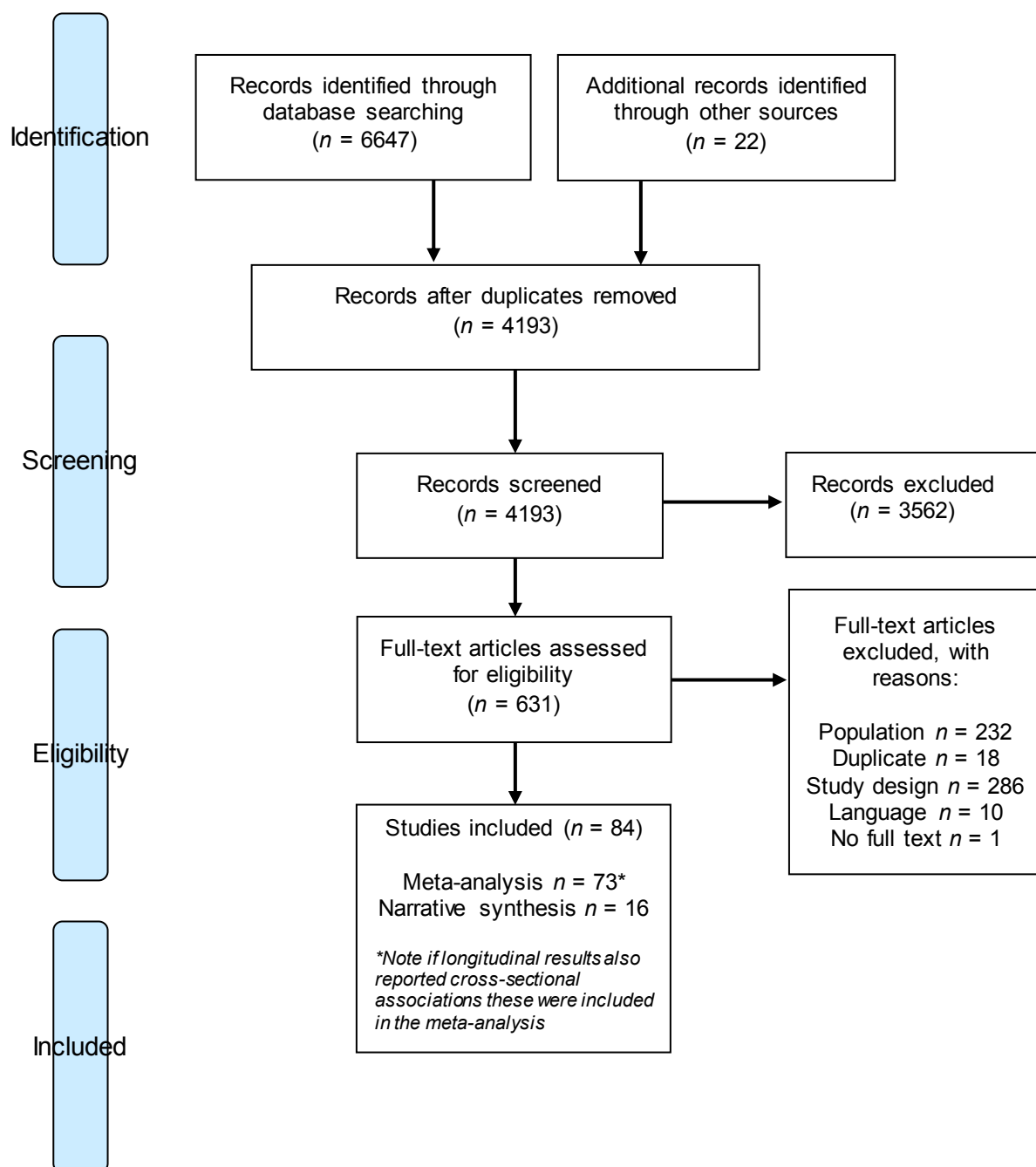


Table 6 Characteristics of included studies

Characteristic	Samples <i>n</i> (%)
Geographical Location	
Asia	7 (8%)
Australia	10 (12%)
Canada	6 (7%)
Europe	13 (15%)
South America	2 (2%)
United States	46 (55%)
Study Design	
Cross-sectional	68 (81%)
Longitudinal	16 (19%)
Physical Activity Measurement	
Self-report	60 (71%)
Objective	24 (29%)
Age	
10-12 years	29 (34%)
13-15 years	44 (52%)
16-19 years	9 (11%)
Not reported (but adolescents)	2 (2%)

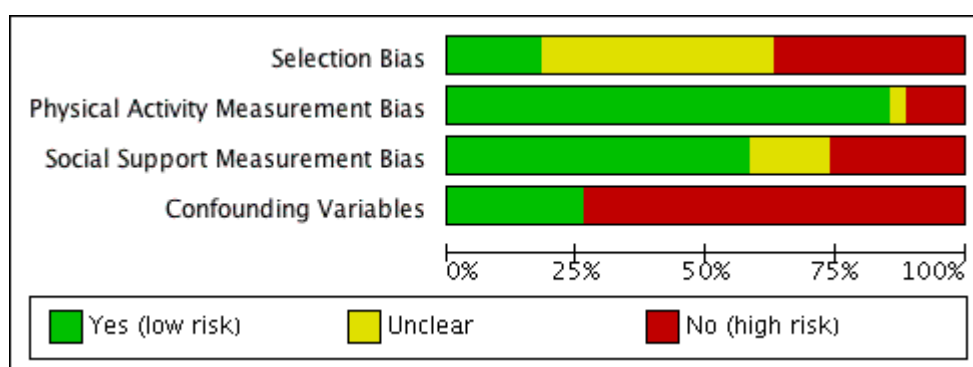


Figure 9 Risk of bias of included studies

Table 7 Number of social support associations with adolescent girls' physical activity reported by provider and type

Provider	Total support	Emotional support ^A					Instrumental support ^B				Modelling	Co-participation	Guiding	Informational
		Em	En	Pr	Ta	W	In	Tr	F	L				
All providers	12										1	1		
Parents	14		7		1		2	3	1		14	4	1	
Family	33	1	1	1			1					1		1
Mother	5		4			1	1				11			
Father	5		3				1				9	1		
Friend	35		1								10			
Teacher	6		1				1				1			
Sibling	2													
Brother											1			
Sister											1			
Best friend											1			
Boy peers	2		1								1			
Female peers	1		1								1			
Adult											1			
Coach	1										1			
Classmate											1			
Boy/girlfriend											1			
Primary caregiver											1			
First nominated friend											1			
Second nominated friend											1			
Third nominated friend											1			

^A Em: Emotional, En: Encouragement, Pr: Praise, Ta: Talking, W: Watching, ^B In: Instrumental, Tr: Transport, F: Financial, L: Logistic

Total social support.

Total social support refers to an overall measure of social support for physical activity. This could include various types of social support (e.g. emotional, instrumental) represented using a composite score. The relationships between different providers of total social support and physical activity in adolescent girls were estimated by random effects meta-analysis (see Table 8). Small but significant associations were identified for every available provider of social support except teachers on adolescent girls physical activity ($r = .14-.24$). However, there was considerable heterogeneity for most of the associations suggested by the significant Q-values and the high I^2 statistics.

Due to the high heterogeneity, moderator analyses were conducted to investigate if differences in effect sizes could be attributed to other variables. We performed a meta-regression to test for the five proposed moderators including: social support measurement bias, physical activity type, physical activity measure, geographical location and participant age (see Table 8). Further analysis did not find any of the proposed moderators to be significant for total support from all providers, parents or friends ($p > .05$). For family support, physical activity type was a significant moderator of the association between family support and physical activity.

Associations for sports participation ($r = .44$, 95% CI .19-.69) were significantly higher ($p < .01$) than MVPA ($r = .04$, 95% CI -.06-.14), total physical activity ($r = .10$, 95% CI -.01-.21), after school physical activity ($r = .03$, 95% CI -.16-.22), and active travel ($r = -.14$, 95% CI -.40-.12). There were not enough studies included in the mother, father or teacher support meta-analyses to perform moderator analysis.

Table 8 Associations from meta-analysis of all providers and sub-domains of providers of total social support with physical activity outcomes

	Effect size statistics					Heterogeneity statistics				Publi- cation bias
	<i>k</i>	<i>r</i>	SE	S ²	95% CI	Z	Q	τ ²	I ²	Fail safe N
All providers	12	.237	0.012	0.000	0.150, 0.321	5.21***	76.062***	0.017	85.54	555
Parents	14	.192	0.012	0.000	0.108, 0.273	4.50***	116.43***	0.020	88.83	513
Family	33	.136	0.009	0.000	0.081, 0.191	4.79***	420.96***	0.023	92.40	1815
Mother	3	.223	0.004	0.000	0.163, 0.280	7.20***	1.974	0.000	0.000	31
Father	3	.161	0.003	0.000	0.101, 0.219	5.25***	1.119	0.000	0.000	17
Friend	33	.135	0.004	0.000	0.096, 0.173	6.75***	180.23***	0.009	82.24	1738
Teacher	6	.062	0.015	0.000	-0.051, 0.174	1.08	102.55***	0.019	95.12	3

* $P < .05$, *** $P < .001$

k = number of studies; *r* = effect size; SE = standard error; S² = variance; 95% CI = 95% confidence interval; Z = test of null hypothesis; Q = total Q-value used to assess heterogeneity; τ² = between study variance; I² = the percentage of total variance across studies not attributed to sampling error; Fail safe N = the number of additional studies (in which the effect was zero) that would be needed to increase the meta-analysis P value to above 0.5.

Sub-domains of social support by provider.

1. Emotional support.

The most commonly reported form of emotional social support was encouragement, with only five other studies reporting additional types of emotional social support (talking $n = 1$, watching $n = 1$, praise $n = 1$, overall emotional support $n = 1$). Due to these low numbers for other forms of emotional support, and because different forms of emotional support may influence physical activity in different ways, we decided to perform analyses only on associations between encouragement and physical activity (see Table 9). Small but significant associations were identified for every provider of encouragement on adolescent girls physical activity ($r = .10-.21$). However, there was significant heterogeneity for most of the associations except for father encouragement. Due to the low sample sizes in the meta-analyses, moderator

analysis was only performed for parent encouragement and no significant moderators were identified ($p > .05$).

2. Instrumental support.

Studies that provided associations between instrumental support and physical activity were less common; with providers including parents, mothers and fathers (see Table 9). Studies were included in the instrumental support meta-analyses if they reported on relationships between general instrumental support, transport, financial, or logistic support for physical activity. These types of instrumental support were combined to form a composite instrumental support effect size, due to the low numbers of individual instrumental support associations reported. Significant associations were identified for parents and mother instrumental support on adolescent girls' physical activity ($r = .17-.21$), but father instrumental support was not significant ($r = .23$).

Due to the low sample sizes, moderator analysis was only performed for parent instrumental support. As only six studies were available, separate models had to be conducted for each proposed moderator. This identified age and geographical location as significant moderators of parent instrumental support. Studies conducted in the USA had larger effect sizes ($r = .20$, 95% CI .16-.24) than those conducted in Australia ($r = .09$, 95% CI .01-.18). Effect sizes were significantly higher ($p < .05$) for girls aged 13 to 15 years ($r = .20$, 95% CI .16-.25) compared with younger girls aged 10 to 12 years ($r = .09$, 95% CI .01-.18).

3. Modelling and co-participation.

The relationship between different providers of modelling and physical activity in adolescent girls were estimated (see Table 9). Small but significant associations were identified for parents, fathers, and friends on adolescent girls physical activity ($r = .13-.16$). No significant associations were found for modelling by mothers or family modelling on adolescent girls' physical activity. However, there was significant heterogeneity in all of the associations. Few studies investigated associations

between participating in physical activities with significant others and adolescent girls physical activity. There were only enough studies reporting associations for parents, therefore, the relationship between parent co-participation and physical activity in adolescent girls was estimated. Significant associations were not identified for parent co-participation on adolescent girls physical activity ($r = .03$).

Moderator analyses was performed for parent, mother, father, and friend modelling. No significant moderators were identified for parent, mother, or friend modelling ($p > .05$). The relationship between father and adolescent physical activity was moderated by how the girls' physical activity was measured ($p < .05$). To demonstrate this, subjective measures showed higher effect sizes ($r = .25$, 95% CI .04-.46) compared with objective measures ($r = -.03$, 95% CI -.28-.22). There were not enough studies included in the parent co-participation meta-analysis to perform moderator analysis.

Table 9 Associations from meta-analysis of all providers of sub-domains of support with physical activity outcomes

	Effect size statistics					Heterogeneity statistics			Publication bias	
	<i>k</i>	<i>r</i>	SE	S ²	95% CI	Z	Q	τ ²	I ²	Fail safe N
Encouragement										
Parents	7	.103	0.006	0.000	0.032, 0.173	2.841*	31.29***	0.007	80.824	108
Mother	5	.194	0.015	0.000	0.111, 0.275	4.512***	8.222	0.004	51.349	53
Father	3	.211	0.003	0.000	0.153, 0.266	7.075***	1.126	0.000	0.000	36
Instrumental support										
Parents	6	.169	0.002	0.000	0.131, 0.206	8.648***	5.545	0.000	9.822	107
Mother	4	.214	0.022	0.000	0.060, 0.359	2.703*	13.26*	0.019	77.37	26
Father	3	.234	0.050	0.002	-0.011, 0.452	1.875	12.827*	0.040	84.41	13
Modelling										
Parents	14	.130	0.011	0.000	0.049, 0.209	3.154*	105.788***	0.019	87.711	214
Mother	11	.079	0.012	0.000	-0.004, 0.160	1.874	104.625***	0.014	90.442	101
Father	9	.144	0.011	0.000	0.054, 0.232	3.128*	54.458***	0.014	85.310	131
Friends	10	.161	0.013	0.000	0.074, 0.245	3.615***	191.764***	0.017	95.307	505
Co-participation										
Parents	4	0.033	0.017	0.000	-0.102, 0.168	0.483	34.00	0.017	91.18	0

* $P < .05$, *** $P < .001$

k = number of studies; *r* = effect size; SE = standard error; S² = variance; 95% CI = 95% confidence interval; Z = test of null hypothesis; Q = total Q-value used to assess heterogeneity; τ² = between study variance; I² = the percentage of total variance across studies not attributed to sampling error; Fail safe N = the number of additional studies (in which the effect was zero) that would be needed to increase the meta-analysis P value to above 0.5

Publication bias.

Funnel plots were inspected for evidence of publication bias, which suggested possible publication bias for friend modelling and physical activity. Fail-safe N analysis was subsequently conducted. This found that 505 additional studies in which the effect was zero would be needed for the overall effect to be statistically insignificant. This suggests a possible skewed effect size. However, subsequent trim and fill analysis did not suggest it was necessary to trim studies from the analysis, therefore, the effect size remained the same. For other analyses, fail-safe N suggested that few additional studies (<150) were needed for the overall effect to be statistically insignificant in many of the meta-analyses performed. This suggests a possible skewed effect size although this could be linked to low sample sizes in the meta-analyses.

Longitudinal findings.

Longitudinal associations between social support and physical activity in adolescent girls were investigated in 16 studies (Bauer, et al., 2008; Bradley, McRitchie, Houts, Nader, & O'Brien, 2011; Crawford et al., 2010; Davison, Downs, & Birch, 2006; Dewar, Plotnikoff, & Morgan, 2013; DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Dishman, Dunn, Sallis, Vandenberg, & Pratt, 2010; Dishman, Saunders, Motl, Dowda, & Pate, 2009; Dowda, Dishman, Pfeiffer, & Pate, 2007; Duncan, Duncan, Strycker, & Chaumeton, 2007; Graham, Bauer, Friend, Barr-Anderson, & Nuemark-Sztainer, 2014; Kahn et al., 2008; Kirby, et al., 2011; Raudsepp & Viira, 2008; Reynolds et al., 1990; Zook, Saksvig, Wu, & Young, 2014). General providers of support were investigated by four studies. Dishman and colleagues (2009) found that change in social support was positively related to change in physical activity between 8th and 12th grade ($\beta = .21$) although another study found no significant direct path between social support and physical activity between 6th and 8th grade (Dishman, Dunn, et al., 2010). One study found that baseline support and modelling did not predict follow-up physical activity (Kahn, et al., 2008) and another study found that modelling by family and friends at 4 months

did not significantly predict physical activity after 16 months (Reynolds, et al., 1990).

Three studies investigated parent support longitudinally, two assessed how baseline support predicted follow-up physical activity (Davison, et al., 2006; Dewar, et al., 2013) and one used repeated cross-sectional design (Kirby, et al., 2011). Kirby, Levin and Inchley (2011) found that mother and father support were not significantly associated with physical activity at each measurement period (except mother support at S2) at multivariable level. One study found that parent support at 9 years predicted support at 11 years which in turn predicted physical activity at 11 years (Davison, et al., 2006) and another found that parent support at baseline weakly predicted physical activity after 12 months ($r = .08$) (Dewar, et al., 2013). Similarly, three studies investigated family support longitudinally (Dowda, et al., 2007; Graham, et al., 2014; Zook, et al., 2014). Two of these found that change in family support were associated with changes in MVPA (Dowda, et al., 2007; Graham, et al., 2014) and the other found that those with higher family support (OR 1.11, 95% CI: 1.02-1.20) were more likely to maintain physical activity after three years (Zook, et al., 2014).

Five studies investigated different types of social support provided by families and parents (Bauer, et al., 2008; Bradley, et al., 2011; Crawford, et al., 2010; DiLorenzo, et al., 1998; Graham, et al., 2014). Bauer and colleagues (2008) found that mother encouragement was associated with greater hours of MVPA after five years. They also found that mother modelling was not related to MVPA after five years but father modelling was related to MVPA among older females. Another study (DiLorenzo, et al., 1998) found that mother modelling was inversely related to girls' physical activity. Bradley and colleagues (2011) found that parent transport was related to changes in girls' MVPA between 9 and 15 years. They found no significant associations between parent encouragement, modelling or co-participation on changes in adolescent girls' physical activity between 9 and 15 years. Crawford and colleagues (2010) found father role modelling and parent co-participation to be positively associated with MVPA over five years. Finally, Graham and colleagues

(2014) found that change in parent modelling was associated with MVPA at follow up ($\beta = .29$).

Friend support variables were investigated in 5 studies, all of which found that friend support was positively associated with physical activity (Duncan, et al., 2007; Graham, et al., 2014; Kirby, et al., 2011; Raudsepp & Viira, 2008; Zook, et al., 2014). Duncan and colleagues (2007) found that girls with more physically active friends had less of a decline in physical activity from age 12 to 17 years. One study found that change in friend support ($\beta = .31$) and modelling ($\beta = .21$) was associated with MVPA at follow up (Graham, et al., 2014). Another study found that change in physical activity was significantly and directly related to change in friend support ($\beta = .51$) (Raudsepp & Viira, 2008). Kirby, Levin and Inchley (2011) used repeated cross-sectional design and found positive associations between friend support and child physical activity in all three measurement periods between primary school year seven (P7) and secondary school year four (S4). The final study found that those with higher social support from friends (OR 1.19, 95% CI: 1.04-1.35) and higher friend co-participation (OR 1.34, 95% CI: 1.13-1.59) were more likely to maintain physical activity after three years, and they found that friend modelling was not significantly related to maintenance of physical activity (OR 1.22, 95% CI: 0.78-1.89) (Zook, et al., 2014).

Discussion

Social support has been identified as a possible modifiable correlate of physical activity that can be used to inform interventions to enhance physical activity levels of adolescent girls. This study provided an overview of current evidence of the relationship between different providers and types of social support and adolescent girls' physical activity. This adds to previous systematic reviews by presenting the current evidence on all providers and types of support for adolescent girls' physical activity, which has not previously been done (see Table 7). We found 21 different providers and 14 different types of social support presented in the literature. Whilst this could mean that there are a substantial number of possible combinations of

providers and types of social support, the majority of the studies focused on total social support and modelling from parents, family and friends. There are a number of areas with limited or no research including informational support, watching and talking about physical activity, and social support from siblings. Whilst this may highlight areas where further research could be needed it also raises questions about whether it is feasible and informative to consider all these possible combinations of support. There may be a need to standardise and refine how social support is defined and measured to improve comparability between types of support and providers within the literature.

Total social support.

Small but significant associations were identified between total social support and adolescent girls' physical activity. Associations were similar in magnitude between family and friend total social support and the largest associations were for all providers of support and adolescent girls' physical activity ($r = .24$). This suggests that social support from both friends and family is associated with adolescent girls' physical activity, however, the small associations suggest that total social support explains only a small amount of the variance in adolescent girls' physical activity behaviour.

Our findings for parent social support both support and contest the findings from a recent meta-analysis by Yao and Rhodes (2015) who identified positive associations between parent support and physical activity in children and adolescents ($r = .38$). We identified more modest effect sizes than Yao and Rhodes (2015) for parent support on adolescent girls' physical activity ($r = .19$), which aligns more closely with a meta-analysis by Pugliese and Tinsley (2007) ($r = .17$). These differences could be attributed to several factors. Yao and Rhodes (2015) and Pugliese and Tinsley (2007) considered all children and adolescents, whereas we only synthesised associations reported for adolescent girls. It is possible that there are differences in observed effect sizes between older and younger children and boys and girls, although these were not identified as significant moderators in analyses by Yao and

Rhodes (2015). Furthermore, the higher observed effect sizes identified by Yao and Rhodes (2015) could partially be explained by their analysis procedures, as they corrected effect sizes for sampling and measurement error.

Our finding that effect sizes were similar in magnitude between parent and friend support variables on adolescent girls' physical activity was surprising because the nature of the relationship between children and their parents transforms significantly during adolescence (Smetana, et al., 2006). Adolescents spend less time with their parents and more time with their friends (Larson, et al., 1996). We anticipated that friends might be better positioned to influence adolescent girls' maintenance or drop out in physical activity, whilst parents may socialise children into physical activity at a younger age. No significant positive associations for teachers on adolescent girls' physical activity were identified. However, only six studies were included in the meta-analysis, thus limiting our understanding of the relationship between teacher social support and physical activity in adolescent girls. Similar findings were reported in a previous semi-quantitative review (Mendonça, et al., 2014). Teachers may, however, play a role in physical activity behaviour change when given the tools to do so as a randomised controlled trial found that teachers mediated the effectiveness of a physical activity intervention (Eather, et al., 2013).

We also found that physical activity type moderated effect sizes for total family support with significantly larger associations identified for sports participation compared with MVPA, total physical activity, after school physical activity and active travel. Consistent with previous research (Edwardson & Gorely, 2010), this suggests the relationship between social support and physical activity may vary by type of physical activity. Families may have a greater influence over organised domains of physical activity through provision of support but other influencing factors (e.g. friends or school infrastructure) may have a stronger role in predicting school-based physical activity or total physical activity. Given that girls have been found to take approximately 41-47% of steps during the school day (Tudor-Locke, McClain, Hart, Sisson, & Washington, 2009a) this is an important consideration for future research.

Sub-domains of social support.

In relation to the different types of social support, meta-analyses showed small but significant associations for encouragement, instrumental support and modelling. For parents, we identified similar effect sizes for encouragement ($r = .10$) and instrumental support ($r = .17$) and we found that co-participation was not significantly related to physical activity ($r = .03$). This does not support findings from Yao and Rhodes (2015) who found that encouragement and co-participation were most strongly related with physical activity. There were not enough studies to meta-analyse these types of support for friend support variables although Mendonça and colleagues (2014) found that friend encouragement and co-participation were most consistently associated with adolescents' physical activity. Future research may be needed to quantify the role of different types of friend support on adolescent girls' physical activity.

Longitudinal results.

The results of the longitudinal studies generally reflected cross-sectional findings. Change in support from families and friends was consistently related to changes in physical activity, suggesting that social support is a determinant of physical activity behaviour in adolescent girls. There were some differences in results observed when analyses used baseline social support to predict follow up physical activity, although, we would argue that these analyses are limited as they do not account for changes in social support that might occur within these time points that could influence follow-up physical activity. There was less longitudinal evidence for different types of social support (e.g. emotional support) nonetheless results reflected cross-sectional findings in that different types of support seemed to be less strongly associated with physical activity compared with total support.

Limitations.

The meta-analysis findings should be interpreted with caution for two reasons. Firstly, the analysis did not account for possible indirect effects of social support. The observed effect sizes suggest that social support only explains a small amount of variance in adolescent girls' physical activity, however, our analysis did not take account of possible indirect effects of social support on physical activity. Given that some research has found that self-efficacy (Motl, et al., 2007; Peterson, et al., 2013; Trost, et al., 2003) and competence and value (Sabiston & Crocker, 2008) mediates the relationship between social support and physical activity it is possible that social support indirectly influences physical activity through self-efficacy and other possible mediating constructs (e.g. enjoyment). Secondly, there was high heterogeneity between studies and some evidence of publication bias. The high heterogeneity statistics may in part be related to sampling error although it is likely that other variables moderated the size of the effects. Our moderator analysis showed that type of physical activity (e.g. sport, MVPA) predicted the effect size for total family support on adolescent girls' physical activity and the relationship between father and daughter physical activity was moderated by type of physical activity measures, with subjective measures demonstrating higher effect sizes than objective measures. There were no significant moderators identified for other meta-analyses performed. A previous meta-analysis by Yao and Rhodes (2015) carried out moderator analysis and similarly found that subjective measures demonstrated higher effect sizes but they did not test for type of physical activity.

After performing moderator analysis there was still high heterogeneity between studies so it is likely that other factors not investigated also moderated effect sizes. These high heterogeneity statistics may in part reflect methodological inconsistencies within the literature on associations between social support and physical activity in adolescent girls. For example, whilst we tried to account for type of physical activity (e.g. total physical activity, MVPA, sports participation) and how physical activity was measured (e.g. subjective or objective measures), alongside other potential moderators, we were not able to account for the vast range of tools used to measure physical activity (e.g. different subjective measures, accelerometers, see appendix

A). Whilst these tools all measure physical activity they are all inherently different with distinct purposes, therefore, it is possible this contributed to variances in the effect sizes and the high heterogeneity statistics. Similarly, social support was measured using various tools. The most commonly reported validated tools used included a scale originally developed for the Amherst Health and Activity Study and later validated (Dishman et al., 2010; Prochaska, Rodgers, & Sallis, 2002) and the Activity Support Scale (Davison, 2004). However, in many cases, these scales were modified for use or authors used non-validated, custom scales to measure social support. This is problematic because this lack of consistency could lead to imprecise measurement, which has been previously recognised as a challenge in the literature (Davison, et al., 2013). This may also have contributed to variances in the effect sizes and the high levels of heterogeneity identified although our analysis did try to account for this. Furthermore, various analysis techniques were employed across the included studies (e.g. correlations, regressions, growth curve models). Some of these analyses controlled for confounding variables (e.g. ethnicity, age) whilst others did not. This may also have contributed to variances in the effect sizes and high heterogeneity statistics. It was not possible to account for this within our analyses, which is a limitation to our findings.

Implications.

This review has highlighted several implications for future research. Firstly, measurement of social support is inconsistent. With a very high number of possible combinations of types and providers of support identified by this review there may be a need to standardise measurement so that more informative comparisons can be made. Secondly, although social support explained only a small amount of variance in adolescent girls' physical activity there may be some merit in exploring and testing intervention strategies aimed at increasing different types of social support from friends and families alongside other known determinants of physical activity in adolescent girls, consistent with a socio-ecological approach to physical activity behaviour change (Sallis, et al., 2006). Further research may be needed to better understand the role of teacher support on adolescent girls' physical activity.

Conclusion

Social support from friends, parents and families has a small but positive relationship with physical activity in adolescent girls and associations were generally similar in magnitude for different providers and types of social support. There was some evidence of publication bias and, in some cases, considerable heterogeneity so these findings should be interpreted with caution. This heterogeneity was not well explained by the proposed moderators, suggesting other factors influenced the effect sizes. This in part may be explained by methodological inconsistencies within the literature regarding measurement of social support and physical activity. However, there does seem to be a positive link between social support from families and friends on adolescent girls' physical activity. Further research could investigate the effectiveness of strategies aimed at increasing social support from friends and families on increasing physical activity in adolescent girls and further explore underresearched areas within adolescent girls social support research, such as the possible role of teacher support on physical activity in adolescent girls.

Chapter 4: The effectiveness of Health 4 U on increasing physical activity in adolescent girls: An analysis of social support as a mediator of physical activity behaviour change

Introduction

Regular physical activity has well-established benefits on the physical and psychological health of children and adolescents (Hallal, et al., 2006; Janssen & LeBlanc, 2010). Sustained physical activity throughout the lifespan reduces the risk of developing chronic lifestyle related diseases such as type II diabetes, coronary heart disease, and stroke (Thompson, et al., 2009; Warburton, et al., 2006). It is, therefore, cause for concern that physical activity levels decline as children move into adolescence. In Scotland in 2014, 83% of children aged 5 to 7 years were found to meet the recommended physical activity levels to achieve these benefits (Gill, 2015). At age 13 to 15 years, this declined to 60%. Girls in particular seem to be at a greater risk of physical inactivity than boys with just 51% of 13 to 15 year old girls reaching guidelines compared with 68% of boys in that age group (Gill, 2015). This is a consistent finding in the literature (Currie, et al., 2015; Hallal et al., 2012), consequently, physical activity interventions aimed at adolescent girls have been conducted although these have had limited effect (Camacho-Miñano, et al., 2011; Pearson, et al., 2015; The National Institute for Health and Care Excellence, 2008). Understanding the correlates and determinants of physical activity in adolescent girls is essential to inform the development of current and future interventions (Sallis, Owen, et al., 2000).

A growing body of research has examined correlates of physical activity in adolescent girls, such that systematic reviews have summarised the findings (Beets, et al., 2010; Biddle, Atkin, et al., 2011; Biddle, et al., 2005; Yao & Rhodes, 2015). Of these, social support has consistently emerged as an important correlate of physical activity in adolescent girls. The findings from the systematic review and meta-analysis presented in Chapter 3 suggest that there are small but significant

associations between social support from families and friends and adolescent girls' physical activity. However, no significant associations between teacher social support and adolescent girls' physical activity were identified. Support from teachers may, however, have a role in child physical activity as a recent group randomised controlled trial found that teacher support was linked to the effectiveness of a physical activity intervention for children (Eather, et al., 2013). Similar findings were reported in other meta-analyses that found significant positive associations between parent support and youth physical activity (Pugliese & Tinsley, 2007; Yao & Rhodes, 2015). Whilst these reviews are predominantly based on cross-sectional evidence, the longitudinal evidence identified in Chapter 3 and previous systematic reviews demonstrates similar relationships between social support and physical activity in young people (Mendonça, et al., 2014).

Social support interventions.

Some interventions aimed at increasing physical activity in young people have applied the findings of this social support research in behaviour change strategies. For example, Eather, Morgan and Lubans (2013) used behaviour change strategies as part of a physical activity intervention for young people that aimed to increase perceptions of social support from peers, families and teachers. This included provision of positive feedback and encouragement and included activities outside the researcher-led sessions designed to increase provision of social support. Peer support strategies, such as promoting positive communication, teamwork, and encouragement, were adopted by Dunton, Schneider and Cooper (2007); and in a physical activity intervention for adolescents, Lubans and Sylva (2009) provided participants with guidelines to help them increase support from friends. This involved sessions that participants had to complete with a friend outside the researcher-led intervention to increase perceptions of support. Intervention strategies have also attempted to directly engage families to increase provision of support for young people (Haerens, et al., 2008; Taymoori & Lubans, 2008) although poor parent engagement was identified as problematic in one of these interventions (Haerens, et al., 2008).

However, these intervention strategies have had limited success. A systematic review by O'Connor, Jago, and Baranowski (2009) synthesised physical activity interventions for young people that included features involving parents. They concluded that it is unclear how best to engage families in physical activity interventions aimed at young people due to the quality and design of previous interventions, which aligns with findings from other reviews (Salmon, et al., 2007; Van Lippevelde, et al., 2012; van Sluijs, et al., 2011). More recently, a systematic review by Brown and colleagues (2016) found small effects for the effectiveness of interventions with features involving families. Specifically, the authors identified consistent evidence in support of interventions that aimed to improve family relationships and increase social support. To our knowledge, no reviews have directly assessed evidence of peer support components of physical activity interventions. However, of interventions that have utilised peer support components two reported no intervention effects on perceived peer support (Dunton, et al., 2007; Eather, et al., 2013) and one significantly increased peer support in girls but changes in perceptions of support were not associated with changes in physical activity (Lubans & Sylva, 2009). These findings suggest there may be promise in social support intervention strategies but the current evidence is unclear on how these features can be successfully implemented.

One reason for this poor translation could be due to a lack of understanding of the ways in which social support influences physical activity behaviour. Improving our understanding of the mechanisms by which social support influences physical activity behaviour is necessary to inform intervention strategies aimed at increasing perceptions of social support. Most research that has focused on these mechanisms suggests that social support influences physical activity through self-efficacy as a mediating variable. For example, research by Peterson and colleagues (2013) found that parent instrumental support was indirectly associated with physical activity through barrier self-efficacy. Similar results were reported by Motl and colleagues (2007) and Trost and colleagues (2003) who both found that barrier self-efficacy mediated the relationship between social support and physical activity in adolescents.

In contrast, evidence from Wu and Pender (2002) found that whilst social support from friends had both a direct and an indirect relationship on adolescents' physical activity through self-efficacy, there was a significant negative direct effect of family support on physical activity and no mediating effects of self-efficacy. Verloigne and colleagues (2014) also explored associations between social support and physical activity in adolescents. They found that internal barriers significantly mediated associations between parent logistic support and physical activity and they found no evidence for a mediating effect of self-efficacy.

These studies provide some evidence that social support influences physical activity through self-efficacy as a mediating variable, however, the current evidence is inconsistent and further research is needed to understand this better. Considering this evidence, social support intervention strategies aimed at increasing self-efficacy, such as through provision of praise or encouragement, could be more effective than other approaches. This also links with SCT outlined in Chapter 2, in that interactions from the social environment can interact with self-efficacy to influence physical activity behaviour.

Social support as a mediator of physical activity interventions.

It is also important to understand the mechanisms of physical activity behaviour change to inform intervention design (Baranowski & Jago, 2005; Taymoori, et al., 2008). For example, we can explore the role of specific intervention components on the effectiveness of a physical activity intervention. Mediation analysis can enhance our understanding of physical activity interventions by allowing us to test components of interventions that have been effective at initiating behaviour change (Bauman, Sallis, Dzewaltowski, & Owen, 2002). For example, a physical activity intervention with features designed to increase perceptions of social support could lead to increases in social support, which leads to increases in physical activity. In this circumstance, social support would be described as a mediator of the intervention on physical activity behaviour (Hayes, 2009). Performing mediation analysis on physical activity interventions with social support behaviour change

components could improve understanding of the effectiveness of social support behaviour change strategies and contribute to our understanding of the relationship between social support and physical activity in adolescent girls. This could, in turn, facilitate more effective intervention design.

Despite this, few studies have investigated mediators of physical activity interventions in adolescent girls. A review by Lubans, et al. (2008) identified seven studies that investigated the mediators of physical activity interventions for children and adolescents. They found that self-efficacy was the most commonly assessed mediator in interventions and there was strong support for its role in mediating physical activity behaviour change. There was some evidence of support for other mediators although the authors noted that there was a lack of quality studies limiting their ability to draw conclusions.

Similar conclusions were identified in more recent reviews that called for more comprehensive investigations of physical activity mediators and determinants of change in physical activity in interventions for children and adolescents (Craggs, et al., 2011; van Stralen, et al., 2011). Salmon, Brown and Hume (2009) reviewed 19 studies and found that only one reported on social support. Whilst the intervention increased perceptions of social support, it did not report whether social support mediated changes in children's physical activity. Since then, Eather, Morgan and Lubans (2013) conducted a randomised controlled trial and found that social support from teachers mediated the effectiveness of a physical activity intervention for children. They also measured parent and friend support, but the intervention did not significantly increase these constructs. Quaresma and colleagues (2014) found that a physical activity intervention effectively increased physical activity through changes in parent and friend support. Social support led to increases in physical activity but also led to increases in intrinsic motivation, which in turn led to increases in physical activity. This suggests there is a need for mediation analysis in physical activity interventions in young people to better understand the effectiveness of social support behaviour change strategies in physical activity interventions and there may be

promise in social support as a mediator of physical activity interventions for young people.

Health 4 U.

Health 4 U is a multi-component school based health intervention for adolescent girls designed and delivered by Edinburgh Leisure in collaboration with Active Schools. Health 4 U encompasses common features of successful physical activity interventions for adolescent girls outlined by previous systematic reviews including: being school based (Camacho-Miñano, et al., 2011; Pearson, et al., 2015; The National Institute for Health and Care Excellence, 2008; van Sluijs, et al., 2007), multicomponent (Pearson, et al., 2015; van Sluijs, et al., 2007), and targeting only girls (Pearson, et al., 2015; The National Institute for Health and Care Excellence, 2008). Health 4 U is an eight-week intervention comprised of two weekly group sessions including a workshop educational session and a physical activity session. Table 10 outlines the topics covered by the weekly sessions and the accompanying behaviour change techniques, identified using the Behaviour Change Technique Taxonomy (Michie et al., 2013). Health 4 U was not designed with these behaviour change techniques in mind, however, an evaluation of the content of the intervention highlighted behaviour change techniques that could lead to increases in perceptions of social support and self-efficacy. Whilst the effectiveness of behaviour change techniques in physical activity interventions for adolescent girls are not well researched, some of these techniques have been successful in previous interventions for adolescent girls (Lubans et al., 2012; Taymoori, et al., 2008).

Health 4 U contains components and behaviour change techniques that could plausibly increase perceptions of social support and task and barrier self-efficacy. The coaches delivering the sessions were healthy, active females and were selected because they were considered to be positive role models for the girls. Coaches were expected to support and encourage participants to lead healthy lives, whilst also encouraging a supportive group environment during the intervention sessions. This involved specific interactive group tasks designed to enhance perceptions of peer

support within the intervention. The girls were also encouraged to participate in externally organised activities out-with the intervention with friends as a means of increasing exposure to positive social support. The intervention activities were designed with the aim of facilitating increased perceptions of social support amongst the girls as well as increasing their perceptions of self-efficacy because, as previously outlined, self-efficacy has been suggested to mediate associations between social support and physical activity in adolescents. It is, therefore, reasonable to assume that aspects of Health 4 U could facilitate increases in physical activity behaviour and perceptions of social support and self-efficacy.

This study had two main aims. First, we aimed to identify if social support from parents, teachers, and friends was positively associated with physical activity in a sample of Scottish adolescent girls; and if so, investigate if these associations were mediated by self-efficacy. Secondly, we aimed to investigate if Health 4 U was effective at increasing physical activity in adolescent girls, and investigate if social support or self-efficacy mediated the effectiveness of Health 4 U on adolescent girls' physical activity. We hypothesised that there would be baseline associations between all providers of social support and physical activity in adolescent girls, and self-efficacy would mediate these associations. We also hypothesised that Health 4 U would be effective at increasing physical activity and social support in adolescent girls, and that social support would mediate the effectiveness of the intervention.

Table 10 Health 4 U intervention components

Weekly sessions*	Content	Physical activity behaviour change techniques**
Week 1 – What is Health?	<ul style="list-style-type: none"> • Introduction to health and wellbeing and Health 4 U • Girls complete group activity where they draw around a group member on a sheet of paper and write healthy behaviours inside the drawing of the person – group discussion follows this activity • Complete goal setting task • Girls are directed to groups/opportunities available locally to support them to be physically active • Given free pass to use Edinburgh Leisure facilities 	1.1 Goal setting 12.5 Adding objects to the environment 5.1 Information about health consequences 3.2 Social support (practical)
Week 2 – Energy Balance	<ul style="list-style-type: none"> • Key guidelines for maintaining positive energy balance (physical activity guidelines, limiting screen time, eating balanced diet) • Reading food packaging (activity) • Energy balance (activity) – Performs various activities including steps, skipping and sitting, and estimate how long they would have to do that activity to burn off various different foods (e.g. pizza, banana) 	5.1 Information about health consequences 5.2 Salience of consequences 5.3 Information about social and environmental consequences 5.6 Information about emotional consequences
Week 3 – Sugars and Fats	<ul style="list-style-type: none"> • Activity – guess how much fat/sugar in different foods • Sugar activity – weigh out sugar content of high sugar day versus low sugar day and compare to daily intake guidelines • Discuss how a high sugar diet can make us feel and have a negative impact on our bodies 	
Week 4 – Truth about Diets	<ul style="list-style-type: none"> • Watch documentary (featuring celebrity) on the dangers of crash dieting, covering negative psychological and physical effects of severe calorie restriction and over exercising • Discuss how it is better to make small lifestyle changes and strive for healthy weight • Review goal setting from week 1 and modify or set new goal based on what they have learned over past 4 weeks 	9.1 Credible source 5.1 Information about health consequences 1.5 Review behaviour goals and/or 1.1 Goal setting
Week 5 – Women in the Media	<ul style="list-style-type: none"> • Introduce how images in the media are manipulated • Photoshopping activity – What is missing and spot the difference (before and after an image has been photoshopped) 	

	<ul style="list-style-type: none"> • Discuss different body shapes and how different body shapes are normal and the important thing is to maintain positive energy balance to be healthy 	
Week 6 – Self Esteem and Communication	<ul style="list-style-type: none"> • Hand outline activity – Girls draw around their hands and note positive qualities and strengths about themselves inside the hand • Discuss communication and how different styles of communication can make people feel • Body language role play • Confidence circle – highlight positive qualities about others in the group 	13.4 Valued self-identity
Week 7 – Positive Mental Health	<ul style="list-style-type: none"> • Discuss mental health and stress • Discuss how stress can influence different areas of our health • Activity – sources of stress and healthy ways to manage and avoid stress • Healthy behaviours including physical activity, diet, and rest discussed as ways to feel good long-term 	5.1 Information about health consequences 5.6 Information about emotional consequences
Week 8 – Moving Forward	<ul style="list-style-type: none"> • Recap on previous sessions • Issued Energise cards for discounted access to Edinburgh Leisure facilities • Issued with 2 free passes for Edinburgh Leisure facilities • Set health and wellbeing goals 	1.5 Review behaviour goals 1.1 Goal setting 12.5 Adding objects to the environment 3.2 Social support (practical) 3.1 Social support

*In addition to these sessions, weekly physical activity sessions were carried out based on the activities the girls wanted to do. Behaviour change techniques during physical activity group sessions: 4.1 Instruction on how to perform a behaviour; 6.1 Demonstration of the behaviour; 3.2 Social support (practical); 2.1 Monitoring of behaviour by others without feedback.

**Behaviour change techniques coded from the Behaviour Change Technique Taxonomy (Michie, et al., 2013)

Method

Participants.

Recruitment of schools.

Schools and participants were recruited between September and November 2013 (see Figure 10). Intervention schools were public high schools in Edinburgh that were scheduled to receive the 8-week intervention from January 2014 to March 2014. Scheduling Health 4 U was determined by schools availability and it was arranged between the schools and Edinburgh Leisure. Consequently, randomisation was not possible therefore a quasi-experimental design was adopted. Contact with the intervention schools was initiated through a gatekeeper, the Youth Development Officer at Edinburgh Leisure who was responsible for the delivery and management of Health 4 U. The researcher met with teachers at interested schools to explain the study procedures. Formal permission was requested in writing to the head teachers of participating intervention schools before recruitment of participants was initiated.

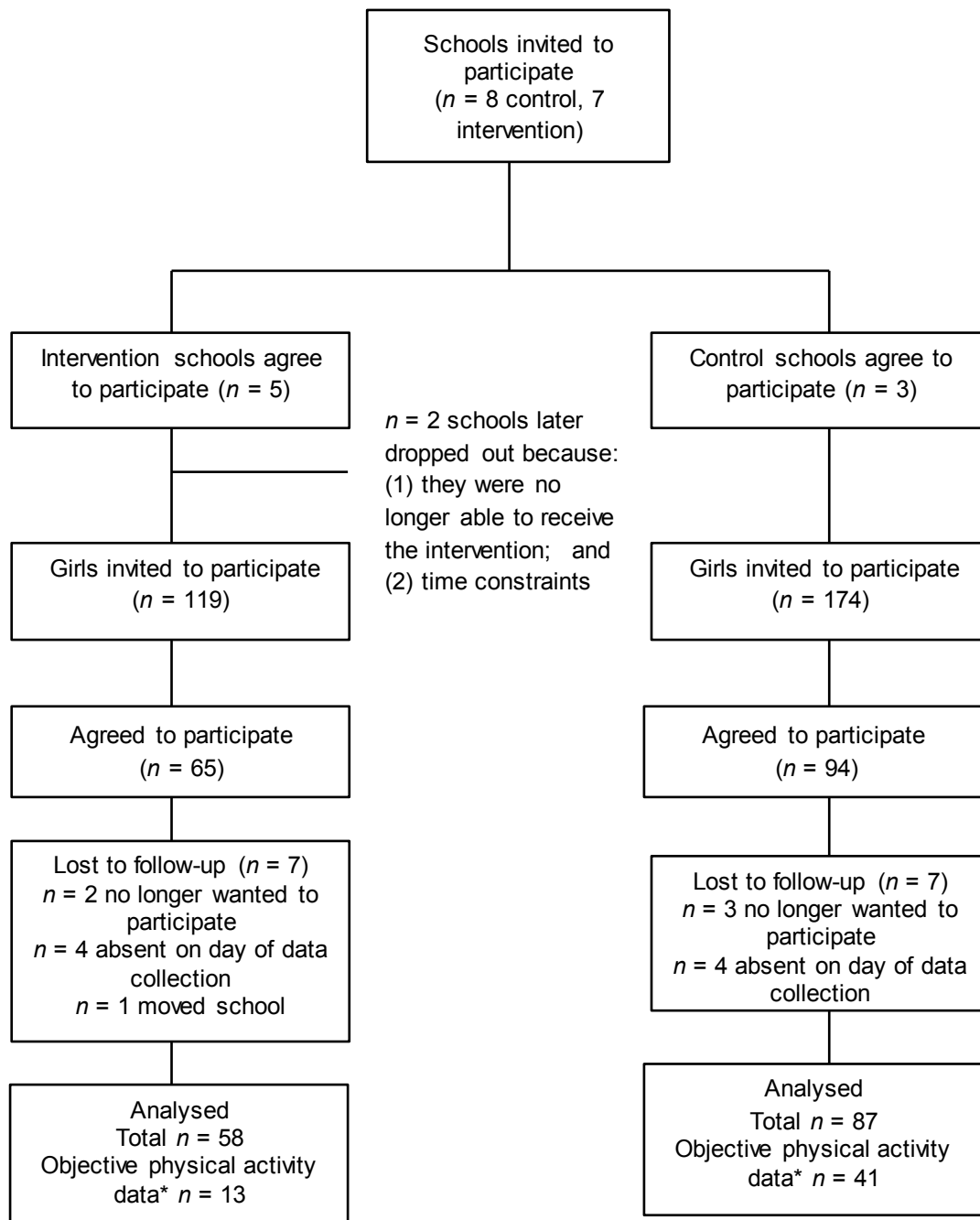
Schools that were not receiving Health 4 U in the 2013-14 academic year were considered eligible to act as comparison schools. We aimed to recruit schools with similar Scottish Index of Multiple Deprivation (SIMD) scores as the intervention schools in an attempt to have comparable baseline characteristics between the intervention and the control groups. The SIMD is a tool that ranks residential areas in Scotland for deprivation across indicators such as income and employment. It was challenging to recruit control schools with similar SIMD scores to the intervention schools because the majority of public high schools in Edinburgh were scheduled to receive Health 4 U during different terms in the academic year, and the few remaining schools not receiving Health 4 U were in less deprived areas than the intervention schools. In light of this, some control schools were approached in neighbouring districts. Control schools were recruited by initiating contact with either 'Active School' coordinators (school staff who aim to provide opportunities for young people to be more active), PE teachers, or head teachers. As before, a

written request for approval to conduct the research was sent to the head teachers before proceeding to recruitment of participants.

Recruitment of pupils.

G*Power (vs. 3.1.7) was used to calculate the required sample for overall steps as the primary outcome. Estimates of overall step averages and standard deviations from previously published literature were used (Schofield, Schofield, Hinckson, & Mummery, 2009). Calculations assumed equal numbers of participants in the intervention and control group. A power of 80% was applied with a 2-sided alpha of 0.05 to detect sample sizes and effect sizes for increases in overall daily steps by 1000 to 2000 steps. In order to detect a significant mediating effect of social support or self-efficacy, sample sizes for mediation analysis were also estimated based on previous research (Fritz & MacKinnon, 2007). Based on these calculations, and assuming a 20% participant dropout, we aimed to recruit 100 participants per group.

The research study was introduced to S3 girls (13-15 years) at participating intervention and control schools during October and November 2013 (see Figure 10). The primary researcher introduced herself to the girls, described the project, and provided the girls with information sheets and consent forms. Parents/guardians were required to opt-out if they did not wish their child to participate in the study by completing an opt-out form. Participants were given seven days to consider participating in the research project and they were encouraged to discuss the project with their parents or guardians. Full written consent was obtained from the participants. Participants were 144 adolescent girls (mean age = 14.28 ± 0.33 years) in S3 from six public high schools in the east of Scotland (see Figure 10). Participants predominately considered themselves British (85%). Three schools ($n = 58$) received the intervention from January 2014 to March 2014, and three schools ($n = 87$) acted as a control group during this period (see Figure 10).



*Based on participants with a minimum of 4 days pedometer data available both pre- and post- intervention

Figure 10 Health 4 U participant flow diagram

The Intervention.

Health 4 U was provided to S3 girls in 16 high schools throughout Edinburgh City Council during the academic year 2013-14. Program coaches received training to deliver the intervention involving a two-day workshop to learn the contents of the intervention, how to deliver the intervention, classroom management strategies, and practical physical activity sessions. Coaches who were new to delivering the intervention shadowed experienced coaches before delivering themselves and the project organiser observed coaches delivering the intervention and provided them with verbal feedback. Coaches were also encouraged to provide feedback on their experiences delivering each session to inform the content of Health 4 U.

Health 4 U was comprised of a weekly workshop session and a weekly physical activity session. Instructors were provided with resources to deliver the weekly sessions including eight detailed lesson plans for the weekly workshops. Topics are outlined in Table 10. The learning outcomes were designed to fit in with the Health and Wellbeing component of the Curriculum for Excellence (The Curriculum Review Group, 2004). The Curriculum for Excellence is the Scottish primary and secondary education curriculum, introduced to schools in 2010. Instructors worked with the girls to help them set goals during the intervention and goals moving forward at the end of the intervention. The physical activity sessions depended on the specialties of the instructor and the preferences of the girls. They included a mixture of activities that the girls would not normally receive as part of PE, for example Zumba or yoga. During the last workshop session the girls received a leaving pack that included two vouchers entitling them to use an Edinburgh Leisure facility for free (e.g. for a gym or swim) and an Edinburgh Leisure facilities discount card.

Measures.

Objective physical activity.

The NL-1000 (New Lifestyles, Inc., Lee's Summit, MO) is a piezoelectric pedometer that records steps and total time spent in different activity intensities. The data can be read from a digital screen and the device features a 7-day memory function.

Participants were issued with a tamper-evident security sealed pedometer and a belt. They were instructed to wear the device on the midline of their hip at all times for 7 days except during water based activities and whilst sleeping. To minimise lost data: (1) participants were asked to continue to wear their pedometer if they were off school on the day of collection, to account for the 7-day memory of the NL1000 pedometer, and the researcher collected the pedometer on their return; and (2) at the follow up stage of data collection, participants were entered into a prize draw to win a clothes shop voucher or a fitness membership with a local leisure provider if they successfully returned their pedometer, which was also aimed as an incentive to minimise equipment loss.

Questionnaire.

Participants responded to items measuring: (1) demographics, (2) subjective levels of physical activity, (3) task self-efficacy, (4) barrier self-efficacy, and (5) social support for physical activity. Scales demonstrated adequate internal reliability in this sample (see Table 11).

(1) Demographics.

Age and postcode were recorded in order to make comparisons between younger and older girls and those from different areas of social deprivation.

(2) Subjective physical activity.

Physical activity was measured subjectively using two tools: the Physical Activity Questionnaire for Adolescents (PAQ-A) (Kowalski, Crocker, & Donen, 2004); and a

single-item question used previously in the Health Behaviour in School-Aged Children (HBSC) Study (Currie, et al., 2012; Prochaska, Sallis, & Long, 2001). The single-item question enables us to identify the percentage of girls achieving the minimum physical activity guidelines, and for comparisons to be made with national physical activity data. The PAQ-A allows for different contexts of physical activity to be investigated as it contains sub-scales such as lunchtime and evening physical activity (see Table 11).

(3) Self-efficacy.

Task self-efficacy for physical activity was measured using a scale adapted from McAuley and Mihlko (1988). Participants responded on a 10-point likert scale on the extent to which they believe they can be physically active for 60 minutes per day each week. Barrier self-efficacy was measured using a previously developed and validated scale (Dishman, et al., 2002) for use amongst adolescent girls. Participants responded on a 5-point likert scale to eight items measuring the extent to which they feel they can overcome barriers to be physically active.

(4) Perceived social support.

Perceived social support was measured based on two scales used in the Amherst Health and Activity Study (Sallis, Taylor, Dowda, Freedson, & Pate, 2002) with slight adjustments. These included measuring mother and father support separately and measuring teacher support following the design of the parent and friend scales. Furthermore, one item was removed based on a validation study (Dishman, Hales, et al., 2010). The first scale measured perceived parent and teacher support for physical activity and asked how often male adult(s) and female adult(s) provide encouragement for physical activity, participated in a physical activity with the child, provided transportation for physical activity, watched the child participate in physical activity, or told the child physical activity is good for them, in a typical week. The second scale measures perceived friend/peer social support and asks how often friends encourage the child to participate in physical activity, how often the child

encourages friends to participate in physical activity, and how often friends participate in physical activity with the child (see Table 11).

Table 11 Health 4 U pre- and post- intervention questionnaire items

	Description of scale	No of items	Source and validation	α
PAQ-A	The PAQ-A comprises of an activity checklist (21 activities and space for participants to add two additional unlisted activities), and questions about context of physical activity conducted over last 7 days (including: physical activity during lunchtimes, PE, after-school, evenings, and weekends) Scale: 5-point Likert	36	Slight language adjustments were made to the previously developed scale (Kowalski, et al., 2004) to make it suitable for use in a Scottish context. Previously validated (Kowalski, Crocker, & Kowalski, 1997; Saint-Maurice, Welk, Beyler, Bartee, & Heelan, 2014), and a recent review identified the PAQ-A as a suitable tool to measure physical activity in young people (Biddle, Gorely, Pearson, & Bull, 2011)	.76
Single-item PAQ	Assesses how many days girls were active at a moderate to vigorous intensity on (1) the last 7 days, and (2) a typical 7 days Scale: 8-point Likert (0-7 days)	2 scales 1 item/ scale	Scale used in the Health Behaviour in School Aged Children Survey (Currie et al., 2011) originally developed and validated for use amongst adolescents by Prochaska and colleagues (2001).	N/A
Social support	Participants were asked to select how often each provider of social support (M: mother, F1: father, F2: friends, or T: teacher) provided them with social support during a typical week. 5-point Likert scale (never-every day)	4 scales M: 4 F1: 4 F2: 3 T: 4	Adapted scale previously created for the Amherst Health and Activity Study (Sallis, et al., 2002). Family and friends scales validated for 6 th and 8 th grade children (Dishman, Hales, et al., 2010). Teacher support scale used previously by Eather and colleagues, replicating the family support scale (Eather, et al., 2013).	M= .83 F1=.82 F2=.76 T= .81
Barrier self-efficacy	Asks participants to report their agreement for each item. <i>Example: I can be physically active during my free time on most days even if it's very hot or cold outside</i> 5-point Likert scale (1 disagree a lot – 5 agree a lot)	8	Previously developed and validated for use with adolescent girls (Dishman, Hales, et al., 2010; Dishman, et al., 2002; Motl et al., 2000).	.89
Task self-efficacy	Assesses the degree to which the participant believes they can be physically active for 60 minutes or more for different total days per week (1-2, 3-4, 5-6, and 7 days). 11-point Likert scale (0 No confidence at all – 10 Completely confident)	4	Modified from a previously developed scale by McAuley and Mihalko (McAuley & Mihalko, 1988).	.91

Procedure.

Ethical approval was received from the University of Edinburgh Ethics Committee and the National Health Service (NHS) Research Ethics Committee (12/WM/0418). All relevant local authorities provided permission for the research team to invite schools to participate and to conduct the research. Baseline data were collected between November and December 2013. Intervention schools ($n = 3$) received Health 4 U for 8 weeks from January 2014 while control schools ($n = 3$) continued with their standard PE during this time. Follow-up data were collected between March and April 2014, within the week following the end of the intervention. For the intervention schools follow-up data was collected in the last two weeks of term to coincide with the end of Health 4 U. It was not possible to collect all follow-up data at the same time due to availability of pedometers, therefore, the control group data were collected two weeks prior to the intervention group. At each data collection stage participants wore a pedometer for seven days to provide an objective measure of physical activity and completed a survey questionnaire to obtain subjective measures of physical activity and social and psychological indicators of physical activity. The questionnaires were completed either in a classroom (four schools) or in an assembly hall (two schools) during a normal school day. The researcher was available to answer any questions and check the completed questionnaires for missing data. Teachers were present during the data collection to help ensure participants completed the questionnaires in silence.

Analysis.

Data screening.

All data were input into SPSS (version 21). A random 10% sample of data were checked for human imputation errors. Data imputation errors were <5%, therefore it was deemed appropriate that any human imputation errors were low enough not to significantly modify the findings of the research. Frequencies for each variable were run in SPSS to ensure there were no scores greater than the possible scale and variables were checked for violations of statistical assumptions (e.g. normality). The pedometer data were then assessed for outliers. Pedometer values that were either

extremely low or extremely high were considered outliers. Rowe and colleagues (2004) previously proposed that step count values less than 1,000 steps and greater than 30,000 steps for children are outliers, and these values have subsequently been used in numerous pedometer evaluations with youth populations (Tudor-Locke, McClain, Hart, Sisson, & Washington, 2009b). Therefore, pedometer values less than 1000 steps or greater than 30,000 steps and their corresponding MVPA values were deleted. It is unclear from previous research whether it is necessary to include both weekday and weekend steps, or the minimum number of measurement days required, to obtain a reliable estimate of habitual physical activity using pedometers (Tudor-Locke, et al., 2009b). Tudor-Locke (2009b) synthesised previous pedometer measured physical activity studies in youth populations and reported unclear differences in intraclass correlations (ICCs) between three or four days of physical activity monitoring (ICC's ranging from .70 to .91). Based on this, pedometer values were recorded where a minimum of four days of physical activity monitoring was available to assess weekly physical activity. Weekday pedometer data were included for a separate analysis if a minimum of three days were available to maximise available data and weekend pedometer data were analysed separately where one or more days were available.

Analysis procedures.

Our first aim was to evaluate the relationship between social support and physical activity in adolescent girls and to assess if task self-efficacy or barrier self-efficacy mediated any relationships between social support and physical activity. We did this by performing mediation analysis. Mediation analysis can test whether a predictor variable influences an outcome variable via a third variable, the mediating variable (see Figure 11). Traditionally, mediation analyses have been performed using methods outlined by Baron and Kenny (1986) in their causal steps approach, or using the Sobel method (Sobel, 1982; Sobel, 1986). However these methods have limitations. The causal steps approach has been found to be low in power, therefore, less likely than other methods to detect a mediating effect (Fritz & MacKinnon, 2007). The causal steps approach also does not quantify the intervening effect of the

mediating variable; instead the existence of mediation is implicit based on the outcome of the hypothesis tests (Hayes, 2009). The Sobel test (Sobel, 1982; Sobel, 1986) quantifies the mediation effect although it has been criticised for assuming normality (Hayes, 2009).

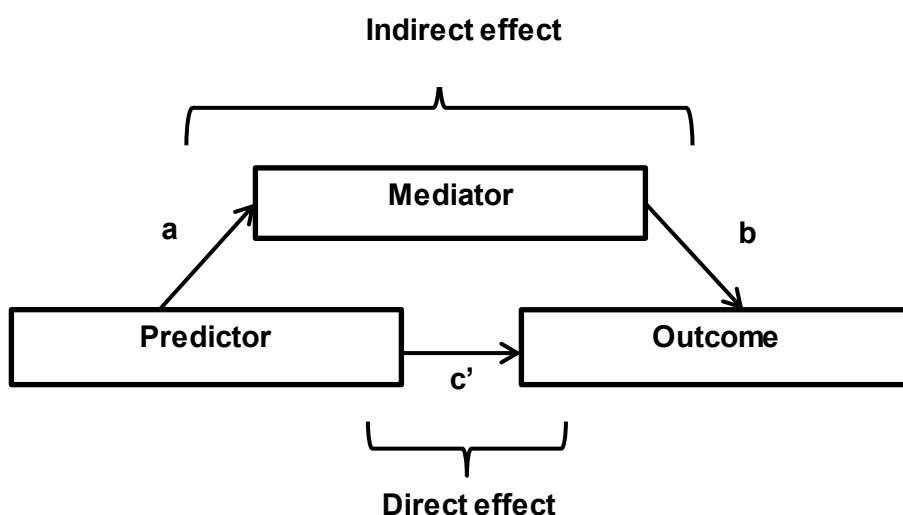


Figure 11 Basic mediation model

Bootstrapping is a statistical method of resampling. Bootstrap methods are becoming a more common approach to mediation analysis. Ordinary least squares regression was used to conduct a simple mediation analysis, utilising a macro for SPSS (SPSS Inc. Chicago, IL, 2010) developed by Hayes (2012) to perform the analysis. To assess the mediating effect of self-efficacy on the relationship between social support and physical activity: (1) The relationship between social support and physical activity was estimated by performing a regression of social support (total social support, teacher support, mother support, father support and friend support) on physical activity (based on PAQ-A scores); (2) Potential mediators (task self-efficacy or barrier self-efficacy) were regressed onto the social support variable; (3) physical activity was regressed onto social support and the mediators; and (4) bias-corrected bootstrap confidence intervals were created, based on 1000 bootstrapped samples. In order for mediation to have occurred, the confidence intervals must not include zero.

The macro developed by Hayes (2012) performs these steps in unison, allowing single and multiple mediation models to be performed.

Our second aim was to investigate the effectiveness of Health 4 U on increasing physical activity in adolescent girls, and to investigate if social support, task self-efficacy or barrier self-efficacy mediated the effectiveness of the intervention on adolescent girls' physical activity. To address this, repeated measures 2(group) X 2(time) ANOVAs were used to measure differences in changes in physical activity behaviour between the intervention and control groups from baseline to post-intervention using SPSS (SPSS Inc. Chicago, IL, 2010). This was conducted for each measure of physical activity: PAQ-A scores (including sub-scales of the PAQ-A), pedometer data and the single-item HBSC physical activity tool. This was also carried out for each hypothesised mediator of physical activity including social support (including provider sub-scales of social support), barrier self-efficacy, and task self-efficacy. Statistical significance was set at $p < .05$.

Mediation analysis was performed to assess whether changes in social support (including total social support, friend support, mother support, father support, teacher support, task self-efficacy, and barrier self-efficacy) mediated any changes in physical activity as a result of the intervention using single mediation models following ordinary least square regression procedures previously outlined. This mediation analysis involved the following steps: (1) The total intervention effect on physical activity was estimated by performing a regression of the condition (intervention or control group) on physical activity (based on PAQ-A scores); (2) Potential mediators were regressed onto the condition; (3) physical activity was regressed onto the condition and the mediators; and (4) bias-corrected bootstrap confidence intervals were created, based on 1000 bootstrapped samples.

Results

Results of data screening.

Frequencies for each variable were run in SPSS to ensure there were no scores greater than the possible scale, of which no scores greater than the possible scale were identified. Variables were then assessed for violations of statistical assumptions. For parametric tests, this includes 1) assessing data for normality; 2) data should be measured at least at interval level; 3) the variance between groups should be equal; and 4) we should be able to assume sphericity between the variables. All variables were visually inspected for normal distribution curves and assessed for skewness and kurtosis. All distribution curves appeared to be normally distributed except for baseline teacher support. When assessed for skewness and kurtosis, the majority of variables had skewness and kurtosis values less than twice their standard error and were, therefore, considered to be normally distributed (Coolican et al.). Baseline father social support, baseline teacher social support, post-intervention father social support and post-intervention mother social support values indicated a positive skewed distribution curve and baseline teacher support values indicated kurtosis. All data was measured at least at interval level. Coolican states that data should be interval level or continuous. All of the variables included were measured either at interval level using valid and reliable measures (PAQ-A, single item PAQ, social support scales, barrier self-efficacy, task self-efficacy), which Coolican et al. says is appropriate to conducting parametric ANOVAs using valid and reliable self-reported scale measures, or continuous data (steps, MVPA). Homogeneity of variance was tested using Levene's test. For most variables the Levene's test identified $p > 0.05$, therefore, the variance was considered to be roughly equal across groups for each variable. Baseline total social support, baseline mother social support and baseline and post-intervention teacher social support were all significant for homogeneity of variance, suggesting that the variance between groups in these variables was not roughly equal. Finally, sphericity between variables was tested using Mauchly's test of sphericity. For each variable $p > 0.05$, therefore the sphericity assumption was considered acceptable for each variable. Based on this,

the data for all variables except total social support, mother social support, teacher social support and father social support were considered suitable for parametric ANOVAs. The remaining variables were log transformed which is an appropriate transformation to perform on data with positive skew and unequal variances to make them suitable for parametric ANOVAs.

Aim 1: Investigate associations between parent, friend, and teacher social support on adolescent girls' physical activity and identify if any associations were mediated by self-efficacy.

Associations between different providers of social support and adolescent girls' physical activity were estimated. There were significant positive associations between all providers ($B = .197, p = .004$), father support ($B = .149, p = .004$), mother support ($B = .154, p = .001$) and friend support ($B = .133, p = .004$) on adolescent girls' physical activity (see Table 12). Teacher support was not associated with physical activity in adolescent girls ($B = -.034, p = .493$).

Associations between social support and physical activity were assessed for the mediating effects of task self-efficacy and barrier self-efficacy. In single mediation models we found evidence that barrier self-efficacy mediated associations between total support (CI: .076 to .240), father support (CI: .031 to .141), mother support (CI: .038 to .138) and friend support (CI: .050 to .173) on adolescent girls' physical activity (see Table 12). We also found evidence that task self-efficacy mediated associations between total support (CI: .031 to .141), father support (CI: .065 to .192), mother support (.044 to .129) and friend support (CI .039 to .131) on adolescent girls' physical activity, as demonstrated by the confidence intervals above (and not containing) zero (see Table 13).

Table 12 Model coefficients for the mediating effect of barrier self-efficacy on the relationship between social support and physical activity

	M (Barrier self-efficacy)			Y (Physical activity (PAQ-A))			Indirect effect*			
	Coefficient	SE	<i>p</i>	Coefficient	SE	<i>p</i>	Coefficient	SE	95% CI	
X (Total social support)	<i>a</i>	0.575	.104	<.001	<i>c'</i>	0.197	.067	.004		
		—	—	—	<i>b</i>	0.247	.050	<.001		
	<i>i₁</i>	1.770	.248	<.001	<i>i₂</i>	1.268	.169	<.001		
		$R^2 = 0.185$			$R^2 = 0.295$					
	$F(1, 135) = 30.74, p < .001$			$F(2, 134) = 28.06, p < .001$			0.142	.041	.076 to .240	
X (Father social support)	<i>a</i>	0.287	.090	.002	<i>c'</i>	0.149	.051	.004		
		—	—	—	<i>b</i>	0.264	.050	<.001		
	<i>i₁</i>	2.540	.202	<.001	<i>i₂</i>	1.359	.168	<.001		
		$R^2 = 0.078$			$R^2 = 0.293$					
	$F(1, 120) = 10.09, p = .002$			$F(2, 119) = 0.293, p < .001$			0.076	.027	.031 to .141	
X (Mother social support)	<i>a</i>	0.320	.072	<.001	<i>c'</i>	0.154	.045	.001		
		—	—	—	<i>b</i>	0.254	.050	<.001		
	<i>i₁</i>	2.331	.185	<.001	<i>i₂</i>	1.331	.159	<.001		
		$R^2 = 0.130$			$R^2 = 0.306$					
	$F(1, 131) = 19.52, p < .001$			$F(2, 130) = 28.65, p < .001$			0.081	.025	.038 to .138	
X (Friend social support)	<i>a</i>	0.367	.071	<.001	<i>c'</i>	0.133	.046	.004		
		—	—	—	<i>b</i>	0.258	.051	<.001		
	<i>i₁</i>	2.137	.197	<.001	<i>i₂</i>	1.340	.159	<.001		

		$R^2 = 0.169$			$R^2 = 0.298$					
		$F(1, 131) = 26.70, p < .001$			$F(2, 130) = 27.59, p < .001$			0.095	.023	.050 to .173
	<i>a</i>	0.162	.087	.065	<i>c'</i>	-0.034	.049	.493		
		—	—	—	<i>b</i>	0.325	.049	<.001		
X (Teacher social support)	<i>i</i> ₁	2.751	.199	<.001	<i>i</i> ₂	1.554	.174	<.001		
		$R^2 = 0.026$			$R^2 = 0.255$					
		$F(1, 131) = 3.466, p = .065$			$F(2, 130) = 22.28, p < .001$			0.053	.035	-.001 to .132

Note: X = independent variable, M = mediator variable, Y = dependent variable, *a* = Direct effect between X and M, *b* = Direct effect between M and Y, *c'* = Direct effect between X and Y, *i*₁ and *i*₂ = regression intercepts.

*Confidence intervals highlighted in bold represent significant mediation effects of M on the relationship between X and Y. A significant indirect effect occurs when confidence intervals do not contain and are above zero.

Table 13 Model coefficients for the mediating effect of task self-efficacy on the relationship between social support and physical activity

	M (Task self-efficacy)			Y (Physical activity (PAQ-A))			Indirect effect*			
	Coefficient	SE	<i>p</i>	Coefficient	SE	<i>p</i>	Coefficient	SE	95% CI	
X (Total social support)	<i>a</i>	1.886	.3159	<.001	<i>c'</i>	0.254	.069	<.001		
		—	—	—	<i>b</i>	0.0719	.0170	<.001		
	<i>i</i> ₁	2.1198	.7535	.006	<i>i</i> ₂	1.449	.1501	<.001		
		<i>R</i> ² = 0.215			<i>R</i> ² = 0.312					
	<i>F</i> (1, 130) = 35.64, <i>p</i> < .001			<i>F</i> (2, 129) = 29.27, <i>p</i> < .001			0.076	.027	.031 to .141	
X (Father social support)	<i>a</i>	1.280	.239	<.001	<i>c'</i>	0.110	.058	.057		
		—	—	—	<i>b</i>	0.095	.020	<.001		
	<i>i</i> ₁	3.864	.535	<.001	<i>i</i> ₂	1.650	.139	<.001		
		<i>R</i> ² = 0.198			<i>R</i> ² = 0.271					
	<i>F</i> (1, 116) = 28.69, <i>p</i> < .001			<i>F</i> (2, 115) = 21.36, <i>p</i> < .001			0.122	.032	.065 to .192	
X (Mother social support)	<i>a</i>	0.980	.220	<.001	<i>c'</i>	0.163	.045	.004		
		—	—	—	<i>b</i>	0.084	.017	<.001		
	<i>i</i> ₁	4.177	.565	<.001	<i>i</i> ₂	1.553	.128	<.001		
		<i>R</i> ² = 0.136			<i>R</i> ² = 0.325					
	<i>F</i> (1, 126) = 19.83, <i>p</i> < .001			<i>F</i> (2, 125) = 30.07, <i>p</i> < .001			0.083	.022	.044 to .129	
X (Friend social support)	<i>a</i>	1.011	.224	<.001	<i>c'</i>	0.172	.044	<.001		
		—	—	—	<i>b</i>	0.077	.016	<.001		
	<i>i</i> ₁	3.870	.618	<.001	<i>i</i> ₂	1.555	.131	<.001		

		$R^2 = 0.138$			$R^2 = 0.317$					
		$F(1, 127) = 20.42, p < .001$			$F(2, 126) = 29.19, p < .001$			0.078	.023	.039 to .131
	<i>a</i>	0.397	.274	.150	<i>c'</i>	-0.002	.050	.970		
		—	—	—	<i>b</i>	0.100	.016	<.001		
X (Teacher social support)	<i>i</i> ₁	5.663	.619	<.001	<i>i</i> ₂	1.852	.146	<.001		
		$R^2 = 0.016$			$R^2 = 0.236$					
		$F(1, 127) = 2.10, p = .150$			$F(2, 126) = 19.45, p < .001$			0.040	.029	-.025 to .092

Note: X = independent variable, M = mediator variable, Y = dependent variable, *a* = Direct effect between X and M, *b* = Direct effect between M and Y, *c'* = Direct effect between X and Y, *i*₁ and *i*₂ = regression intercepts.

*Confidence intervals highlighted in bold represent significant mediation effects of M on the relationship between X and Y. A significant indirect effect occurs when confidence intervals do not contain and are above zero.

Aim 2: Identify whether Health 4 U was effective at increasing physical activity behaviour and identify if the effectiveness of Health 4 U was mediated by social support or self-efficacy.

Baseline measures.

At baseline the intervention group had significantly lower physical activity than the control group when comparing PAQ-A scores (see Table 14) and steps (see Table 16). The intervention group also had significantly lower task self-efficacy and barrier self-efficacy and father and teacher social support than the control group (see Table 15). The single-item question used previously in the Health Behaviour in School-Aged Children Study identified 23% of girls in the intervention group and 18% of girls in the control group as reaching physical activity guidelines (see Table 14). When measured by the objective MVPA activity data 6% of girls overall (8% of girls in the intervention group, and 5% of girls in the control group) achieved the minimum daily MVPA guidelines for during the week. None of the girls in the intervention group and 3% of girls in the control group achieved the weekend MVPA guidelines (see Table 16). It should be noted that only a sub-set of the participants had sufficient pedometer data to be included in the analysis (see Table 16). This was due to failure to return pedometers on time, loss of devices, and failure to wear the pedometers for a sufficient number of measurement days.

Changes in physical activity from pre to post intervention.

The physical activity change scores identified that most physical activity variables decreased from baseline to post-intervention in the intervention group. In the intervention group, steps decreased by an average of 808 and 958 for weekdays and weekend days respectively, and MVPA time decreased by an average of .26 and .17 minutes for weekdays and weekend days respectively (see Table 16). The intervention group also reported no change in physical activity levels in the PAQ-A, but a decrease of 1 day per week of reaching at least 60 minutes of MVPA measured by the single-item PAQ. In the control group, weekday steps increased by an average of 1143 and weekend day steps decreased by 661 (see Table 16). For MVPA, the

control group increased their weekday MVPA by 3.79 minutes on average and decreased their weekend day MVPA by an average of 3.05 minutes (see Table 16). The control group reported no change in physical activity levels in the PAQ-A and no change to the number of days the participant achieved physical activity guidelines (See Table 14).

No significant group by time interactions were found for PAQ-A assessed or single-item PAQ assessed physical activity. To investigate whether particular domains of physical activity were influenced by the intervention, domain-specific scales within the PAQ-A were examined in isolation. A statistically significant group by time interaction was identified when comparing the ‘evening’ subscale in the PAQ-A ($F(1,126) = 5.907, p < .05$, partial eta squared = .045). There were no significant group by time interactions identified by examining other scales within the PAQ-A in isolation including PE time, lunch time, post school, and weekend days, $p > .05$.

There was a significant group by time interaction for weekday steps, $F(1, 57) = 4.156, p < .05$, partial eta squared = .068. No significant interactions were identified for weekend day steps or for MVPA time. There were no significant group by time interactions identified for any of the hypothesised mediators, including: total social support, father social support, mother social support, friend social support, teacher social support, task self-efficacy, or barrier self-efficacy (see Table 15).

Paired t tests were carried out to investigate the time effect within the group by time interaction effects on the ‘evening’ subscale in the PAQ-A and for weekday steps. From baseline to post-intervention, there was a significant increase for the ‘evening’ subscale in the PAQ-A for the intervention group ($t = 2.022, p = .049$) and a non-significant decrease for the control group ($t = -.872, p = .386$). From baseline to post-intervention, there was a significant decrease for weekday steps in the intervention group ($t = -2.214, p = .036$) and a significant increase for the control group ($t = 3.431, p = .001$).

The mediation analysis showed no mediating effects of total social support, mother, father, peer, teacher social support, barrier self-efficacy, or task self-efficacy on the effectiveness of the intervention.

Table 14 Baseline and post-intervention scores for subjective physical activity measures (mean \pm SD)

Variable	Range	Baseline		Post intervention		Change scores	
		INTERVENTION (n = 54)	CONTROL (n = 86)	INTERVENTION (n = 49)	CONTROL (n = 82)	INTERVENTION (n = 49)	CONTROL (n = 82)
PAQ-A							
Total PAQ-A score	0-5	2.31 \pm 0.52*	2.49 \pm 0.44	2.26 \pm 0.54	2.51 \pm 0.46	-0.035 \pm 0.14	-0.003 \pm 0.08
PE sub-scale	0-5	3.92 \pm 0.81	4.15 \pm 0.68	3.86 \pm 0.96	4.07 \pm 0.85	0.09 \pm 1.04	-0.09 \pm 0.91
Lunch sub-scale	0-5	1.47 \pm 0.50*	1.84 \pm 0.53	1.35 \pm 0.48	1.75 \pm 0.43	-0.15 \pm 0.42	-0.08 \pm 0.50
Post school sub-scale	0-5	2.13 \pm 1.19*	2.43 \pm 1.06	2.12 \pm 1.20	2.33 \pm 0.90	0.02 \pm 1.42	-0.10 \pm 0.87
Evenings sub-scale	0-5	2.10 \pm 1.10	2.69 \pm 0.99	2.47 \pm 1.19	2.56 \pm 1.01	0.45 \pm 1.52*	-0.10 \pm 1.02
Weekends sub-scale	0-5	2.10 \pm 1.11	2.28 \pm 1.01	2.31 \pm 0.92	2.27 \pm 0.89	0.21 \pm 1.35	0 \pm 0.99
Single-item PAQ	0-7	5 \pm 2	5 \pm 1	4 \pm 2	4 \pm 1	-1 \pm 2	0 \pm 1

*Significantly different from control $p < .05$

Table 15 Baseline and post-intervention scores for hypothesised mediators (mean \pm SD)

Variable	Range	Baseline		Post intervention		Change scores	
		INTERVENTION (n = 54)	CONTROL (n = 86)	INTERVENTION (n = 48)	CONTROL (n = 82)	INTERVENTION (n = 48)	CONTROL (n = 82)
Social support							
Total support	1-5	2.16 \pm 0.77	2.35 \pm 0.56	2.04 \pm 0.66	2.30 \pm 0.52	-0.08 \pm 0.43	-0.07 \pm 0.39
Mother support	1-5	2.22 \pm 1.00	2.49 \pm 0.87	1.96 \pm 0.92	2.27 \pm 0.82	-0.14 \pm 0.76	-0.22 \pm 0.61
Father support	1-5	1.77 \pm .81*	2.22 \pm 0.81	1.77 \pm 0.81	2.22 \pm 0.81	0 \pm 0	0 \pm 0
Friend support	1-5	2.45 \pm 1.03	2.72 \pm 0.86	2.36 \pm 0.84	2.71 \pm 0.85	0 \pm 0.96	-0.03 \pm 0.88
Teacher support	1-5	2.33 \pm 1.00*	2.02 \pm 0.68	1.96 \pm 0.76	1.97 \pm 0.52	-0.28 \pm 0.89	-0.06 \pm 0.77
Self-efficacy							
Task self-efficacy	0-10	5.48 \pm 2.74*	7.04 \pm 2.23	5.05 \pm 2.60	6.98 \pm 2.19	-0.40 \pm 2.74	0.02 \pm 2.09
Barrier self-efficacy	1-5	2.81 \pm 0.75*	3.27 \pm 0.85	2.74 \pm 0.75	3.17 \pm 0.76	-0.06 \pm 0.80	-0.13 \pm 0.66

*Significantly different from control $p < .05$

Table 16 Baseline and post-intervention objectively measured physical activity (mean/day \pm SD)

Variable	Range	Baseline		Post intervention		Change scores	
		INTERVENTION	CONTROL	INTERVENTION	CONTROL	INTERVENTION	CONTROL
Steps							
Total Steps ^A	1000-30000	9320 \pm 3178* (n = 29)	8018 \pm 2354 (n = 64)	7799 \pm 3807 (n = 21)	8844 \pm 2495 (n = 45)	-300 \pm 3793 (n = 13)	651 \pm 2550 (n = 41)
Weekday steps ^B	1000-30000	9900 \pm 3322* (n = 34)	8410 \pm 2303 (n = 63)	8011 \pm 4345 (n = 24)	9874 \pm 3279 (n = 47)	-808 \pm 1464* (n = 19)	1143 \pm 3040 (n = 40)
Weekend day steps ^B	1000-30000	4873 \pm 3779* (n = 22)	6646 \pm 3759 (n = 65)	5182 \pm 3335 (n = 14)	5615 \pm 2890 (n = 40)	-958 \pm 4882 (n = 7)	-661 \pm 3727 (n = 35)
MVPA (minutes)							
Total MVPA ^A	Unlimited	35.01 \pm 20.83 (n = 28)	33.02 \pm 13.16 (n = 65)	31.09 \pm 17.72 (n = 21)	39.06 \pm 14.28 (n = 45)	1.43 \pm 14.78 (n = 14)	4.72 \pm 13.98 (n = 42)
Weekday MVPA ^B	Unlimited	30 \pm 19.99 (n = 40)	30.80 \pm 15.43 (n = 76)	25.91 \pm 20.99 (n = 27)	35.58 \pm 20.74 (n = 57)	-0.26 \pm 23.66 (n = 30)	3.79 \pm 18.77 (n = 57)
Weekend day MVPA ^B	Unlimited	13.81 \pm 16.61* (n = 21)	24.15 \pm 17.92 (n = 65)	17.53 \pm 14.91 (n = 14)	19.59 \pm 15.09 (n = 40)	-0.17 \pm 13.33 (n = 7)	-3.05 \pm 19.93 (n = 35)

^A Based on a minimum of 4 days of available pedometer data

^B Steps and MVPA weekday data were reported when a minimum of 3 days of data were available; and weekend steps and MVPA data were reported when a minimum of one day was available

*Significantly different from control $p < .05$

Discussion

This study had two primary aims: to investigate associations between social support and physical activity in adolescent girls, including assessing whether task self-efficacy or barrier self-efficacy mediated any associations; and to investigate the effect of Health 4 U on adolescent girls' physical activity, including assessing whether any changes in physical activity were mediated by social support, task self-efficacy or barrier self-efficacy.

Baseline total social support, father support, mother support and friend support were significantly positively associated with physical activity in adolescent girls. Teacher support was not associated with adolescent girls' physical activity. This supports the findings from Chapter 3 and previous research (Mendonça, et al., 2014) that found significant positive associations between support from parents and friends but inconsistent or no associations between teacher support and physical activity in children and adolescents. When single mediation models were performed, task self-efficacy and barrier self-efficacy significantly mediated associations between total support, father support, mother support and friend support on adolescent girls' physical activity. Based on the cross-sectional analyses performed, there could be a link between social support, barrier and task self-efficacy and physical activity. This supports previous cross-sectional research that has explored self-efficacy as a mediator of the relationship between social support and physical activity (Motl, et al., 2007; Peterson, et al., 2013; Trost, et al., 2003). These findings are based on cross-sectional data and, therefore, do not demonstrate a cause-and-effect relationship. Analyses of these associations between two time points was not an aim due to the quasi-experimental nature of the study design although exploring these associations longitudinally may be an avenue for future research.

There were no significant differences between the intervention and control group for subjectively reported physical activity, measured using the PAQ-A and the single-item PAQ ($p > .05$). Although when examined in isolation, the intervention group significantly increased their evening physical activity assessed as a sub-scale within

the PAQ-A ($p < .05$). This suggests that Health 4 U could have encouraged the girls to do more physical activity at home in the evenings, although the effects were small (partial eta squared = .045). The intervention group decreased steps and MVPA from baseline to post-intervention, whilst the control group increased weekday steps ($p < .05$) but decreased their weekend day steps ($p > .05$).

This suggests that Health 4 U was not effective at increasing physical activity levels from pre- to post- intervention. Potential explanations for the intervention group decreasing physical activity might be explained by the timing of follow-up measurements in this group. The intervention group follow-up was taken in the last two weeks of term to coincide with the completion of Health 4 U, whereas the control schools were taken in the weeks leading up to this. As previously highlighted, this was due to a limited availability of pedometers. School activities during this period may have been subject to change, and it is a possibility that the intervention group did not receive normal PE during this period. Possible explanations for the control group increasing physical activity could be due to seasonal effects of physical activity. Baseline measurements were taken in November and December. Children have been found to be less active during the winter when weather conditions are poorer (Carson & Spence, 2010). The follow up measures were taken in March and April, when the weather would have been warmer and potentially more enabling of activity outdoors.

There were no significant differences in change from pre- to post- between the intervention and control group for any of the hypothesised mediators of physical activity (overall social support, mother support, father support, peer support, teacher support, task self-efficacy, and barrier self-efficacy) ($p > .05$). Again, this suggests that Health 4 U did not influence any of the hypothesised mediators of physical activity. A mediation analysis was performed and there were no mediating effects from any of the hypothesised variables.

Aspects of Health 4 U were designed to facilitate a supportive environment, from both coaches and those receiving the intervention. Coaches were expected to act as

positive role models for the girls and act to support and encourage participants to lead healthier lives, whilst also encouraging a supportive group environment within the classroom. Although Health 4 U did not increase perceptions of social support from teachers/coaches or from peers, this could be because there is currently very little evidence on how to effectively modify perceptions of social support in physical activity interventions (Eather, et al., 2013; van Stralen, et al., 2011). Health 4 U did not have an influence on perceptions of mother or father social support, although no specific features of the intervention were designed to engage parents. Originally, there were plans to involve parents at the end of Health 4 U by having an interactive workshop although this did not feature in the current sample due to poor uptake of parental involvement in previous Health 4 U groups. This aligns with other studies that have identified difficulties engaging parents in physical activity interventions (Haerens, et al., 2008). Further research is required to investigate more effective ways to increase perceptions of social support in physical activity interventions and to explore how best to engage parents in physical activity programs and interventions.

Although self-efficacy has been positively associated with physical activity, task self-efficacy or barrier self-efficacy were not mediating variables in the current study. Self-efficacy is one of the most commonly assessed constructs relating to physical activity behaviour in adolescent girls (Lubans, et al., 2008). We hypothesised that perceptions of task and barrier self-efficacy would be increased as a result of taking part in Health 4 U both directly and indirectly. Specific interactive tasks, physical activities, and positive feedback from coaches in the physical activity and workshop sessions, were hypothesised to influence feelings of self-efficacy, which may have led to increases in physical activity. Social support may contribute to self-efficacy through encouragement and modelling, as outlined as part of SCT in Chapter 2. It was thought that increasing perceptions of social support might in turn influence perceptions of self-efficacy indirectly; however, as previously noted the intervention did not increase perceptions of support, task self-efficacy or barrier self-efficacy.

Limitations.

Associations between social support and physical activity and the mediation models for these associations were based on cross-sectional data taken from the baseline data. These associations and mediation models are, therefore, not evidence of a cause-and-effect relationship. Longitudinal research is needed to determine causality. Additionally, other constructs that were not measured (e.g. enjoyment) may serve as mediators between the relationship between social support and physical activity in adolescent girls and could be explored in future research.

Randomisation was not possible because scheduling Health 4 U was out-with the researcher's control. Implementation of Health 4 U was managed and controlled by Edinburgh Leisure and it was not possible to conduct a process evaluation, therefore, the intervention may not have been delivered as it was intended. Similarly, implementation of the intervention may have varied between the intervention schools. Health 4 U was a multiple health behaviour intervention, which focused on aspects of healthy eating and mental health in addition to physical activity behaviour; therefore it is possible that the importance of physical activity was diluted by other health topics or that the importance of physical activity was not covered as intended by coaches delivering the intervention. Additionally, pedometers were used as an objective measure of physical activity in this sample but adherence to study protocols were poor and only a sub-set of the participants provided enough objective physical activity data to include. Reasons for exclusion of pedometer data were failure to return pedometers on time, loss of devices, and insufficient number of physical activity measurement data (e.g. not enough days of data). Finally, the objective measurements of physical activity for the intervention group were taken during the last two weeks of term as this coincided with the end of the intervention. It was not possible to measure the control group at the same time due to limited resources (particularly access to pedometers), therefore, the control group was measured in the weeks prior to this.

Conclusion

Evidence of significant positive associations between total support, father, mother and friend social support and adolescent girls' physical activity were identified. There was also some evidence that task self-efficacy and barrier self-efficacy might mediate the relationship between social support and physical activity. Further research could longitudinally explore the mediating effect of task and barrier self-efficacy on physical activity in adolescent girls. Other variables may also have a mediating role on the relationship between social support and physical activity (e.g. enjoyment, intentions) and these might be explored in future research. Health 4 U was not effective at increasing physical activity behaviour or perceptions of social support or task or barrier self-efficacy from pre- to post- intervention. None of the hypothesised variables mediated the effect of Health 4 U on physical activity in this study. This seems to be because Health 4 U was not successful at increasing perceptions of social support or barrier or task self-efficacy. This aligns with previous systematic reviews (Lubans, et al., 2008; van Stralen, et al., 2011) that found that physical activity interventions were not successful at increasing social support. This suggests a need to better understand how social support influences physical activity behaviour and modify or revise intervention strategies aimed at increasing perceptions of social support in physical activity interventions.

Chapter 5: A grounded theory of adolescent girls' perceptions of how social support influences their physical activity behaviour

Introduction

Physical inactivity is a leading risk factor for the development of non-communicable diseases, and consequently, is a major global public health concern (The World Health Organization, 2009). The health benefits of regular physical activity for young people are well-documented (Hallal, et al., 2006; Janssen & LeBlanc, 2010), yet an estimated 80.3% of adolescents aged 13 to 15 years fail to reach physical activity guidelines (Hallal, et al., 2012). Girls are consistently identified as less active than boys (Currie, et al., 2015; Hallal, et al., 2012) and have, therefore, been identified as a priority group for increasing physical activity levels (Bailey, et al., 2005; Cavill, et al., 2001). Interventions aimed at increasing physical activity in adolescent girls have had limited success (Pearson, et al., 2015). A better understanding of the correlates associated with physical activity in adolescent girls may inform more effective intervention design (Sallis, Owen, et al., 2000).

Systematic reviews have synthesised evidence on correlates associated with physical activity in adolescent girls (Biddle, Atkin, et al., 2011; Biddle, et al., 2005; Sallis, Prochaska, et al., 2000; Standiford, 2013). These reviews have identified personal and demographic, psychological, environmental and social correlates to be consistently associated with adolescent girls' physical activity behaviour. As outlined in the literature review in Chapter 2, several reviews have specifically considered the role of social influences, in particular social support, on physical activity in children and adolescents (Beets, et al., 2010; Edwardson & Gorely, 2010; Fitzgerald, et al., 2012; Gustafson & Rhodes, 2006; Maturo & Cunningham, 2013; Mendonça, et al., 2014; Pugliese & Tinsley, 2007; Salvy, et al., 2012; Yao & Rhodes, 2015). Social support describes resources provided from interactions with significant others (e.g. parents, friends) that can influence physical activity behaviour (Langford, et al.,

1997; Sheridan & Radmacher, 1992). These reviews have consistently found that social support from parents and friends is associated with physical activity in children and adolescents. Small but significant associations between social support from friends and family on adolescent girls' physical activity were identified in the systematic review presented in Chapter 3. The results of these reviews suggest that girls who are supported to be physically active are more likely to be active than girls with little or no support.

However, although research suggests there are positive associations between social support and physical activity, these findings have not been well translated into physical activity interventions. Typical social support intervention strategies include promoting positive communication, teamwork, engaging families in interventions and encouragement (Dunton, et al., 2007; Lubans & Sylva, 2009). These strategies have had limited success at increasing perceptions of support. Of three interventions that utilised friend support components, two reported no intervention effects on perceived support from friends (Dunton, et al., 2007; Eather, et al., 2013).

Interventions with features to involve families were synthesised by O'Connor, Jago and Baranowski (2009). They concluded that it is unclear how best to engage families in physical activity interventions due to the quality and design of previous interventions. This aligns with findings from other reviews (Salmon, et al., 2007; Van Lippevelde, et al., 2012; van Sluijs, et al., 2011). More recently, Brown and colleagues (2016) conducted a similar review and found small effects relative to the control condition on physical activity levels. The authors found consistent evidence for the effectiveness of interventions that focused on improving family relationships and increasing social support. These findings suggest there is growing evidence for family involvement but fewer studies focused on friend involvement in physical activity interventions.

A better understanding of how social support influences physical activity behaviour could inform intervention strategies aimed at involving families and friends in interventions. Limited research has investigated the mechanisms through which social support influences behaviour. Research that has investigated potential

mechanisms has mainly focused on the role of self-efficacy as a mediating variable between social support and physical activity (Motl, et al., 2007; Peterson, et al., 2013; Trost, et al., 2003; Wing, et al., 2016; Wu & Pender, 2002). In particular, this research found that social support was indirectly associated with physical activity through barrier self-efficacy (confidence in ones' abilities to overcome barriers to physical activity). This suggests that social support could lead to increases in adolescents' confidence in their abilities to overcome barriers to physical activity, which leads to increases in physical activity. However, there is also some evidence to suggest that other variables including internal barriers (e.g. lack of time, lack of interest and enjoyment for physical activity) (Verloigne, et al., 2014) and enjoyment (Shen, et al., in press; Wing, et al., 2016) might mediate the relationship between social support and physical activity. The cross-sectional findings in Chapter 4 suggest that both barrier self-efficacy and task self-efficacy may mediate associations between social support and physical activity in adolescent girls. A more detailed account of how social support might influence physical activity is outlined in Chapter 2 (see Figure 5). It is also possible that there are other pathways through which social support influences physical activity behaviour.

In order to unpick this complex relationship there is a need for qualitative research to explore the possible mechanisms through which social support influences physical activity behaviour. Current qualitative social support research mainly explored different forms of support provided to young people and who provides this support (Holt, Tamminen, Black, Sehn, & Wall, 2008; Jago et al., 2009; Weiss, Smith, & Theeboom, 1996; Wright, Wilson, Griffin, & Evans, 2010), rather than focus on how this support might influence behaviour. However, of this research, two studies provided some indication of how support may influence physical activity, although this was not an explicit aim of the studies. Weiss and colleagues (1996) explored young peoples' perspectives of friend support for sport participation. Individual interviews explored friendships within a sporting context and the ways in which friends support young people to be active. The authors found some support for friends to influence perceptions of self-esteem, enjoyment and performance in sports. Another study by Jago and colleagues (2009) also investigated the influence of

friends, specifically on initiation and maintenance in physical activities in young people. The authors conducted focus groups with young people and found that support from friends encouraged children to try new physical activities, and children perceived being physically active with friends as enjoyable. However, to our knowledge no qualitative papers have provided an in-depth analysis of how social support influences young peoples' experiences and participation in physical activity. Exploring young peoples' perceptions and experiences of how social support influences behaviour may better inform physical activity intervention strategies aimed at increasing perceptions of social support in young people.

Investigating girls' perspectives and experiences of support provided by significant others for physical activity behaviour could improve our understanding of how social support influences physical activity behaviour. Therefore, this study aimed to advance current research on the influence of social support on physical activity in adolescent girls by qualitatively investigating the mechanisms through which social support influences behaviour. In particular, this study aimed to: (1) explore the participants' perspectives about their physical activity levels, (2) identify the main sources and types of social support participants are receiving, (3) identify how participants perceive these sources and types of support influence their physical activity behaviour, and (4) develop an explanatory model of how social support influences physical activity in adolescent girls to inform intervention design.

Method

There are many different approaches that can be taken when analysing qualitative data, some of which are described as methodologies as they not only guide data analysis but also guide all other aspects including study design and data collection (Richie et al., 2014). This study closely followed a constructivist grounded theory approach (Charmaz, 2006, 2014) during all stages of the research process, from study design to data analysis. Grounded theory is a rigorous systematic approach to qualitative research, originally developed by Glaser and Strauss (1967). It is a complete methodology involving all stages of a research process from developing a

research question to theory formation. Other common approaches to qualitative research include phenomenology and discourse analysis. Grounded theory was applied in this study as it was felt to best address the research questions, aims of the study and study outputs compared with other approaches to qualitative research. Grounded theory aims to generate theory. In contrast, phenomenology aims to describe meaning of a phenomenon and discourse analysis aims to understand how language is used to shaped identities and experiences (Starks & Brown Trinidad, 2007). Generating theory grounded in adolescent girls' perceptions and experiences of how social support influences their physical activity was a key aim of this study. Secondly, the systematic, iterative approach of grounded theory was considered particularly important for understanding the research aims. In particular, the iterative process of data collection in grounded theory means that each interview and analysis can be explored further in subsequent interviews. In phenomenology and discourse analysis, the same interview guide is typically used for each participant and data collection and analysis is generally not an iterative process (Starks & Brown Trinidad, 2007). An iterative process of data collection and analysis was considered particularly important in this study, which aimed to understand a relatively underexplored area where new insights and knowledge could emerge from the data.

Since Glaser and Strauss' (1967) original grounded theory, several versions of grounded theory have been developed (e.g. Charmaz, 2006; Straus, 1987; Straus & Corbin, 1990; Straus & Corbin, 1998). Constructivist grounded theory is a form of grounded theory that, like other forms of grounded theory, is "inductive, comparative, emergent, and open-ended" (Charmaz, 2014, p.14). Unlike other versions of grounded theory, constructivist grounded theory is underpinned by the assumption that knowledge is co-created by participants and researchers and that there are multiple social realities (Charmaz, 2006, 2014). Whilst positivist and post-positivist epistemologies are based on the assumption that there is an objective truth, a constructivist approach aims to systematically represent the co-created interaction between participants and researchers. Constructivist grounded theory was considered the most appropriate form of grounded theory for this study for several reasons. Firstly, the primary researcher had prior knowledge of the subject area, having

completed a systematic review on the topic. Therefore, Glaser and Strauss' (1967) original grounded theory whereby the researcher conducts the study having limited prior knowledge of the subject area would not be appropriate in this instance. Instead, constructivist grounded theory recognises that most researchers will have prior knowledge but encourages them to enter the field with an "open mind not an empty head" and reflect on how their prior knowledge might influence their understanding of the data (Charmaz, 2014). Whilst Straus and Corbin's (1990, 1998) version of grounded theory also account for the researcher having prior knowledge in the research area, their analysis procedures are complex compared with Charmaz's (2014) more reflective and flexible approach. This reflective and flexible approach to analysis was viewed by the primary author as advantageous over Straus and Corbin's (1990, 1998) more complex approach, as it was felt that too prescriptive an analysis procedure may actually limit understanding of the data rather than enhance it.

Participants.

Participants included S3 adolescent girls aged 13 to 15 years from two schools in Edinburgh. Study procedures were described to potential participants and, after which, potential participants completed a single-item physical activity questionnaire to estimate their physical activity levels (Prochaska, et al., 2001). Written parental and participant consent was then obtained from those who volunteered to participate in the individual interviews and, from these, the most active participants were initially selected to be interviewed based on their self-reported physical activity levels.

Procedures.

The University of Edinburgh Moray House Research Ethics Committee and Edinburgh City Council approved the study procedures. Three schools were invited to participate, of which two agreed to take part. The study protocol was described to the teachers at participating schools and scheduling data collection was also arranged through the teachers.

Upon obtaining consent, participants were selected to take part in a 20 to 40 minute individual interview with the primary researcher. Interviews were conducted in a room with a window in school at a time agreed with teachers and participants. The initial sample involved selecting girls who were reaching or close to reaching physical activity guidelines, based on responses to the single-item physical activity questionnaire (Prochaska, et al., 2001). It was reasoned that girls who were reaching or close to reaching physical activity guidelines would be most likely to be receiving social support for physical activity. By targeting physically active girls we can explore if and how social support and significant others' play a role in their physical activity levels. S3 girls were expected to be more comfortable and capable of expressing their thoughts and experiences with the researcher compared with younger girls.

Theoretical sampling was carried out, whereby, the ongoing analysis informed subsequent collection of data. The sampling strategy was reviewed after the first three interviews were carried out. The initial theoretical sampling informed the development of the sampling strategy. Upon reviewing the sampling strategy it was decided not to select participants based on their responses to the single-item physical activity questionnaire because the questionnaire seemed to underestimate physical activity levels, based on comparisons with the girls' verbal descriptions of their activity levels during the individual interviews. It was, therefore, decided not to exclude participants based on the single-item physical activity questionnaire so it was eventually not used to make sampling decisions.

Instrument.

A semi-structured interview guide was developed containing questions designed to be non-leading with accompanying prompts and probes. Questions explored: (1) participants' physical activity participation, (2) the physical activity levels of significant others in their networks, (3) social support to be physically active provided by those within their networks, and (4) how the girls perceived support to

influence their physical activity behaviour (see Appendix M). Early questions were designed to act as icebreakers, to help ease the participants into the interview and make them feel more comfortable, which is a common approach when designing interview guides (Creswell, 2014). Before the interviews were conducted, a pilot interview was carried out to test the appropriateness of the interview schedule. Minor modifications were made to the interview schedule as a result of this to aid interpretation of questions. For example, some of the question wording was changed to improve participants' understanding. As data collection was ongoing, the interview schedule was adapted to follow-up on emerging themes and concepts.

Data analysis.

Interviews were audio-recorded using a digital voice recorder (Olympus VN-713PC, Toyko) then later transcribed verbatim. The interview transcripts were uploaded to NVivo10 software (QSR International Pty Ltd, vs. 10, 2012), where data were stored and analysed. Each interview was conducted, transcribed, and analysed before the next interview was carried out. This iterative process informed the sampling strategy, developments to the interview schedule, and the evolving themes that emerged from the data (see Figure 12).

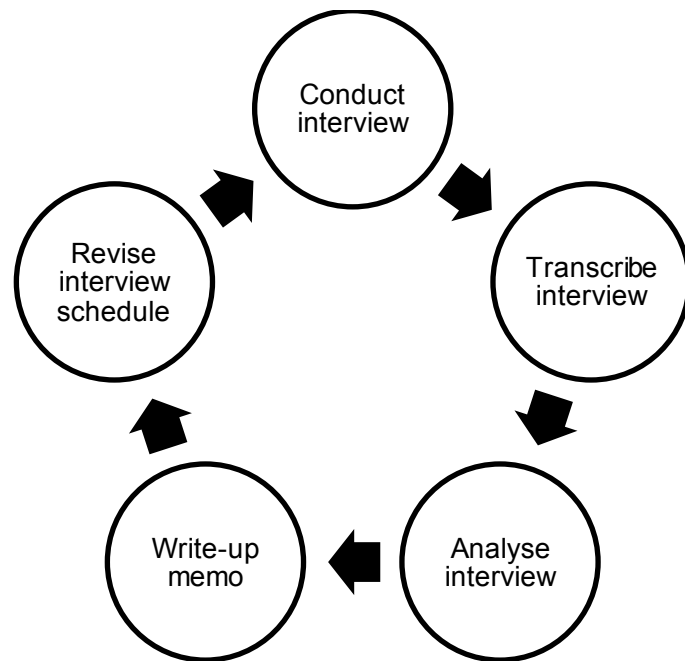


Figure 12 An iterative process of data collection and analysis – Based on processes outlined by Charmaz (2014)

Coding data.

Coding was carried out in two stages following procedures outlined by Charmaz (2014) and was facilitated using the ‘nodes’ function in NVivo10. Firstly, initial coding was carried out whereby the codes were closely linked to the data. This process enabled the primary researcher to develop a broad understanding of the data. As data collection and analysis continued, initial codes informed future data collection through modifications to the interview transcript and initial codes were refined as data collection continued. Secondly, the data were treated more analytically using focused coding. Focused coding refines the initial coding through highlighting important aspects of the analysis. This involved identifying patterns in the data and identifying initial codes that categorised the data. Some initial codes were grouped together and recoded.

Constant comparison methods (Glaser & Strauss, 1967) were used to make comparisons at all stages of analysis. Comparisons began when analysing the initial

interview by comparing data within the interview to identify similarities and differences. Data were then compared between interviews. As data collection and analysis progressed, codes and data from the final interviews were compared with codes and data from the early interviews to check that later interpretations of the data were relevant and applicable to early data and analysis.

Thoughts, ideas, and interpretations of the data were recorded through memo writing using NVivo10. Memo writing was carried out after each interview to reflect on the interview and the analysis. Memo writing helped develop ideas, assisted with the constant comparison process and it served as a key process that ultimately lead to the formation of the conceptual model used to represent the data. Memo writing was also used to reflect on the data collection process, such as identifying strengths and areas for improvement after conducting interviews to inform subsequent interviews (see Appendix Q for a memo example). A methodological journal was also used to promote additional reflexivity. Thoughts, ideas and conceptualisations of the data were noted and linkages were explored. The methodological journal also guided coding and the emerging conceptual model that represented the data.

Data collection continued until data saturation had been reached. Data saturation has been defined as a point in which gathering new data no longer leads to new theoretical conceptualisations or insights (Charmaz, 2006). Therefore, when no changes or additions to the conceptual model were made after analysis of new transcripts data collection stopped. Once all interviews had been coded, transcripts were re-read and coding was checked to ensure consistency of coding.

Development of the conceptual model.

The coding and memos were used to develop the conceptual model. These findings were compared with previous research to inform the final model, which is common in constructivist grounded theory and physical activity research (e.g. Holt & Dunn, 2004; Sabiston, McDonough, & Crocker, 2007). The researcher presented the final conceptual model to a sub-sample of the participants ($n = 6$). Each part of the

conceptual model was explained and discussed with the participants. This was to check the participants' understanding of the model and to establish whether it accurately represented their thoughts and experiences. Participants were given the opportunity to discuss and suggest modifications to the model. Participant names have been replaced with pseudonyms throughout.

Trustworthiness.

Within qualitative research, criteria for assessing the quality of studies are often termed as *trustworthiness* (Elo et al., 2014). Trustworthiness can be assessed at each phase of a research process, including data collection, interpretation, organisation, and reporting of results (Elo, et al., 2014). Within grounded theory, quality is achieved by immersing oneself and closely following grounded theory methodology. Weed (2009) suggests eight core elements that are necessary to meet quality conditions for grounded theory including: an iterative process; theoretical sampling; theoretical sensitivity; codes, memos and concepts; constant comparison; theoretical saturation; fit, work, relevance and modifiability; and substantive theory. This section has previously outlined how each of these criteria were met, except for fit, work, relevance and modifiability and substantive theory. Fit refers to how closely the theory represents the data and phenomenon of interest. Fit is ensured by constant comparison and theoretical saturation. A theory is thought to “work” if it provides an explanation for the problem of which it represents. The “relevance” of a theory is how closely a theory represents the people it is based on (e.g. adolescent girls), and “modifiability” means that a theory can be developed further. Substantive theory means that a grounded theory is specific to a particular area, and not universally applicable. It is thought that several substantive grounded theories can be joined to create a more generally applicable grounded theory. The reader is encouraged to make their own judgements on the quality of this grounded theory study and make assessments of its “fit, work, relevance, and modifiability”.

Results

Participant characteristics.

Participants were 18 girls in S3 aged between 13 and 15 years. Participants on average were reaching physical activity guidelines 5 days per week, estimated using the single-item PAQ. However, as previously noted, participants described being more active during the individual interviews than the single-item PAQ suggested. Participants discussed being involved in a range of physical activities including organised sports, active commuting, PE classes and leisure activities. The majority of girls ($n = 16$) were involved in at least one organised sport including hockey ($n = 7$), basketball ($n = 4$), football ($n = 5$), dancing ($n = 3$), taekwondo ($n = 1$), karate ($n = 2$) and tennis ($n = 1$). Six girls were involved in more than one organised sport. The majority of girls ($n = 16$) walked to and/or from school and all of the girls had chosen to do PE as an academic subject, and were doing PE 4 to 5 times per week. The two girls who were not involved in organised sports regularly walked or jogged for leisure and walked to and from school every day as well as taking part in PE.

Sources and types of support received.

Participants were well supported from those within their social networks to be physically active. Participants described receiving support from family, friends, teachers and coaches to be physically active in various forms including emotional, informational and instrumental support. All of the girls discussed receiving social support in some form to varying extents. Table 17 provides a full description and illustrative quotes to outline the various types of support that participants discussed receiving, and it demonstrates the number of participants who received each form of support and the number of times the type of support was mentioned.

As well as providing social support, it was evident that members of the girls' social networks engaged in the additional facilitating behaviour of modelling. Modelling was defined as the physical activity levels of the provider and their perceived value in physical activity. Modelling is proposed to influence physical activity by

adolescent girls observing providers engage in physical activity and value physical activity and modifying their physical activity levels in response to these observations. Modelling is considered to be conceptually unique from social support. All of the participants described receiving modelling to varying extents from at least one person within their networks. Some of the girls discussed having numerous friends and family members who modelled physical activity. Other girls had fewer network members who valued, were interested in and participated in physical activity.

Provision of social support seemed, in part, to be related to network members' modelling of physical activity. For example, girls discussed how parents who valued and had a personal interest in the physical activity their daughters were involved in talked to them about physical activity, provided instructional support or performed physical activities with them. In contrast, a lack of personal interest can limit the capacity of the provider to deliver support. When Lori was asked whether her parents talked to her about how she played after hockey matches she said:

Lori: "Not really, no. They don't, they never played hockey so I don't think they fully understand the rules or anything... I think if they understood the game a bit more, had a bit more experience in hockey then they could probably help me."

Table 17 Types of social support provided to participants

Type of support	Illustrative example	# of girls	# of references
Emotional support		17	100
Encouragement	“Well they think that I’m really good in my hockey and they think that I should stick it out and they think that it’s good that I’m keeping fit and it’s definitely something I should keep going with”	6	12
Talking about physical activity	“...like every time after a game you know we discuss it [<i>how they played during a sports match</i>] in the changing room or just sitting at the side”.	13	49
Praise	“If a friend acknowledges that you did do well or just something it will make you feel good”	14	27
Watching physical activity	“Well if it’s an important game or if it’s something that’s important to me then they’ll come and watch”.	8	12
Instrumental support		15	32
Financial support	“...they get me all the stuff that I need for it and they obviously pay for my training and stuff.”	15	18
Providing transport to physical activity	“They always take me to all of my club training and drive me to games”	4	9

Informational support		11	48
Feedback	“Yeah my dad’s very kind of, he likes to give feedback after the match kind of “you did this well”, “you need to do this more” and stuff and if I’ve ever, if I’m ever taking a friend home... my dad does the same to them as well”.	8	20
Instruction	“... if you’re like struggling with something at training or in a game like they’ll speak to you at a point where they can and like just explain like and try and help you and stuff.”	6	10
Co-participation	“...it makes it easier if they’re saying “aww do you wanna come like on a jog with me?” ‘cos then I have, I can go and do something with them. So it’s, at the same time it’s like social rather than just going out on my own and it yeah it just encourages me to get out the house”.	17	122
Negative support	“...if my friends having a party or something, going out somewhere, then I’d want to miss it [<i>hockey game</i>] but my dad’s just like “na you need to play” ‘cos I’m a first team member so I can’t let the team down... I think about it at the time and I’m like “well why, why are you not just letting me miss it?” but then like I understand why.”	7	20

Conceptual model.

The final conceptual model, presented in Figure 13, represents the ways in which participants perceived their social networks to influence their physical activity behaviour. The participants perceived their networks to primarily influence physical activity through two linked constructs: provision of social support and modelling. The conceptual model outlines the mechanisms by which these constructs might influence physical activity behaviour. The following sections describe each construct and pathways in more detail and provide illustrative quotes.

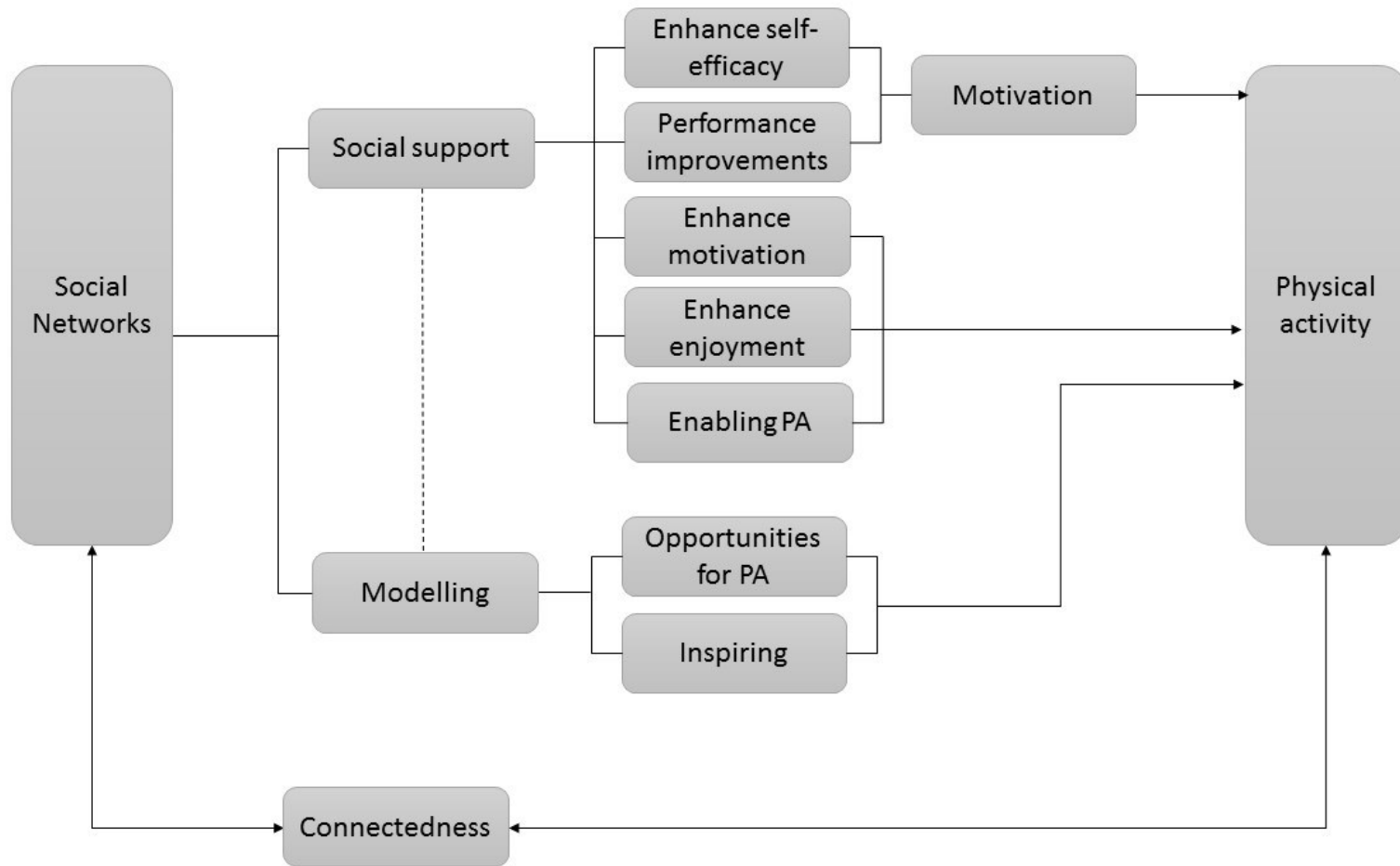


Figure 13 Conceptual model of how social networks influence adolescent girls' physical activity

Social support.

Social support was found to influence physical activity through five pathways: self-efficacy, motivation, enjoyment, performance improvements and through enabling physical activity. The following sections will describe these pathways in more detail.

Enhance self-efficacy.

Self-efficacy can be categorised as barrier self-efficacy or task self-efficacy. Barrier self-efficacy is a persons' confidence in their abilities to overcome barriers to physical activity and task self-efficacy is a persons' confidence in their abilities to be physically active. Provision of social support made girls feel more confident about their physical activity abilities and it helped them overcome barriers to physical activity, therefore, contributing to both task and barrier self-efficacy.

Enhance task self-efficacy.

Social support contributed to physical activity task self-efficacy, particularly through provision of feedback and praise for specific physical activities. The following quote emphasises how praise and positive feedback increased Maria's self-efficacy. The quote also highlights how self-efficacy can lead to sustained engagement in physical activities.

Maria: "... there's been a game I can think of where em the teacher that was watching kind of took me aside afterwards and spoke to me about my confidence on the pitch...

Researcher: Ok, so when the em teacher took you aside at the end of the game... what did she say to you?"

Maria: Em well she just reminded me that I had every right to be where I was and that I, I shouldn't be lacking in confidence... it made me feel a lot more confident about just turning up for the games and feeling that I mean, sometimes, feeling that your team might need you to do something and that made me feel really good so".

There was some indication that in order to feel more confident about their physical activity abilities the girls had to believe that the provider of support genuinely believed in their abilities. The following quote emphasises that social support can reinforce that the provider believes in the young persons' abilities, and thus, could lead to increases in self-efficacy:

Karen: "... well they obviously think that, if they're being this tough on me [*referring to the various ways her parents support her*] they obviously think that I have potential, so they know, well they have faith in me to be good at the sport so it pushes me on a wee bit more."

Self-efficacy for physical activity was also linked to motivation. As demonstrated below, physical activity self-efficacy resulting from social support contributed to participant's determination and motivation. This quote also emphasises how self-efficacy can lead to continued engagement in physical activities.

Stacey: "I like getting compliments about it because I don't really think I'm that good but like when I get compliments about it, it just makes my confidence grow a bit higher with it... I think right I'm good at this, I need to try harder to get even better at it so I'm trying even harder than I was before to achieve something better".

Enhance barrier self-efficacy.

The girls also discussed how social support also helped them to overcome barriers to being physically active. For example, one girl discussed how going for jogs by herself can make her feel self-conscious but having a friend with her made her feel more confident.

Rebecca: "...when you go out sometimes you feel a bit awkward being on your own, or I feel awkward being on my own in case like people are looking at me in a weird way but if you're with someone else you feel a bit more, em, confident"

In particular, several of the girls discussed how starting new physical activities can be challenging. When asked how she would feel about starting a new activity Annie said:

Annie: "I don't know if I would do that because I'd be quite like nervous and then be like scared that nobody's gonna like become friends with me and stuff 'cos I'm quite like nervous about that sort of stuff".

However, having a friend to go with helped overcome the challenges of starting a new physical activity. As demonstrated by Stacey below, having a friend to be physically active with can make girls feel more confident about starting a new activity.

Stacey: "... as you get older, like in this kind of phase, you'd want people there because you're quite insecure and stuff like that like if people are laughing in a group you'd think they were laughing at me because you're not doing it right or because you'll need more attention because you've just joined. When you're with friends you just laugh about it "oh I done that wrong, big deal!" but when you're by yourself you're more insecure".

Girls also discussed how encouragement can help them overcome feelings of lethargy. In particular, encouragement from family or friends when participants were feeling lazy or lethargic helped them to increase their effort level in training or encourage them to get out of the house and be physically active.

Stacey: "...if I'm in my room and they're like "come out" and I'm like "ugh, I can't be bothered!" and they'll be like "come on, just come out! You can laze about every day! ...Like I'll go out and I'll end up having a really good time like I'm glad that I've went out"

Performance improvements.

Participants linked specific forms of social support with performance improvements in physical activities, particularly in organised sports. Girls described how significant others identified areas where they could improve and provided them with advice or

instruction. To demonstrate this, Karen's parents identify areas that she can work on in training through watching her basketball matches:

Karen: "...well I've been playing basketball for four or five years now so yeah the more that I've done they've got quite a good knowledge of it now as well so and they can see more, they can see more than me of how well I do on the court than I can see of myself if that makes sense".

Researcher: "...so having someone watch you helps pick up faults or?"

Karen: "Yeah, pick up faults or if I didn't have the right attitude or I didn't, if I kept doing the same mistake over and over again or if I let someone steal the ball off me too many times and my head went down. Something like that. They can see all that more than I realise it so it does help. We know what I need to improve on or what I need to do for the next game".

Many of the girls talked about how they valued this support. In particular, girls discussed how personal feedback from parents or friends was beneficial by helping them to identify areas that they could improve on. One girl noted that feedback from coaches was normally less personal so also receiving feedback from her parents was particularly helpful to her.

The girls also linked co-participation to improvements in performance. For example, girls talked about how having friends to be physically active with presented opportunities for them to practice skills. For example, Sarah said she occasionally hired a basketball court with friends to practice. She noted how being physically active with friends helps her to improve her basketball:

Sarah: "...you can do lots of different stuff with a second person there whereas if you're on your own you can really only do ball handling stuff, you can only do shooting, whereas when you're with a person you can go one v one, you can go eh ball handling with a defender there, you can get passing in. It's generally better having that second person there."

Finally, a link was also evident between performance improvements and self-efficacy and motivation. Maria spoke about how noticing improvements in her performance was motivating.

Maria: "...when you see an improvement that's a really, really, a nice feeling to have... that's really motivating".

Enhance motivation.

Motivation was a key outcome of provision of social support. Girls discussed various ways in which support from friends, families, teachers and coaches motivated them in physical activities. Support motivated uptake or continued participation in physical activities, performance improvements and effort level. For example, girls discussed how having a shared interest in physical activities with friends was motivational.

Maria: "...we all do a lot of hockey training together and I suppose just talking about trainers and running leggings and things, it, it helps em and just, I sometimes think that if I didn't do the sport with them I would have a lot less in common with my friends so it kind of encourages you and motivates you".

In a PE setting, supportive teachers motivated increased effort during lessons through enthusiasm, providing encouragement, talking about physical activities, watching the girls during lessons and praising and providing feedback on physical activities. Rebecca discussed how teachers watching her during PE makes her want to put in more effort:

Rebecca: "I think it motivates me to like work harder 'cos especially like when you know they're watching so you're like "oh I need to try" so that like helps".

Similarly, support from friends, family or teachers motivated increased effort in physical activities outside of PE. For example, Karen talked about how support from her friends can motivate her to play better:

Karen: "...if I'm feeling like I can't really be bothered and I'm down at training they can try and bring me back up and be enthusiastic and stuff...it pushes me to play a bit better"

In addition, Maria discussed how she found support from her teachers to be motivating. She was very aware of how teachers went out of their way to support physical activities and this was a source of motivation for her.

Maria: "Just running it I mean they're not paid to do extra and it always amazes me that we have like hockey schedules and letters and trips organised and teachers can come to the school for 8 o'clock in the morning or come to the sports centre, like that always amazes me and I find that like a real drive because if they put so much effort into this, I mean they want to see a result but they're also doing it because they genuinely like love sport and hockey, rugby etcetera and that makes me want to try harder for them."

Participants described how encouragement and support more generally motivated them to perform to their best abilities. To demonstrate this, Karen discussed how a supportive team environment motivated her performance:

Karen: "Just em more determined to get better and, I don't know, just kinda like with my mum and dad, you know, coming and telling me what to do as well it just pushes me on em 'cos obviously there's Scotland stuff as well so them doing more exercise, we do more exercise together, we get better as a team and stuff".

Enhance enjoyment.

Friends, family, teachers and coaches were integral to making physical activity more enjoyable. Teachers and coaches showed enthusiasm during training or lessons, engaged in positive conversations about physical activities with the girls, went out of their way to organise additional physical activities, and helped to create a supportive

school environment for physical activity. The girls discussed how these positive, supportive behaviours from teachers and coaches contributed to their enjoyment of physical activities, through creating a positive environment in which to be active. Participants frequently talked about how teachers and coaches made physical activity fun.

Annie: "He's like, he's really good. I really like him. He's funny and he's, just like takes the mickey out of everybody. He's just really funny and he's a good coach... I think if you don't have a good coach then you're not as likely to listen and you're not exactly, you're not as likely to take it all in as somebody who has a bit of fun rather than just being boring and talking all the time".

Having friends or family to be physically active with also made activities more enjoyable and contributed to positive experiences in physical activity. Some of the girls talked about how walking to school was more enjoyable with friends than walking alone because they enjoyed having people to talk to. Not having friends to walk with was recognised as a barrier to walking to school by one girl.

Similarly, another girl discussed how going to an exercise class with a friend made it fun but she did not think she would go alone because they were the only young people who attended the class:

Margaret: "...with the classes at the gym, because it's like mostly adults, we're like the only kids. I don't think I'd really, I don't really want to go on my own... I think doing classes with a friend is more fun".

Girls also discussed enjoying physical activities with friends in their free time, such as playing a game of football after school or playing basketball over breaks and lunches. The girls identified these activities as things they did with friends for fun and a way to spend time with friends. Rose talked about how most days after school she plays football in the park with her friends:

Rose: “They just go out and we all play a big game [*offfootball*] ...Just to get out and have some fun.”

Finally, enjoyment was the most frequently mentioned reason for continuation of organised physical activities. Whilst it is likely that there are many contributing factors related to girls’ enjoyment of physical activity, having friends involved and a supportive environment in which to be active was a common reason why girls continued physical activities in this study.

Lori: “I like hockey because I play it with my friends and because I’ve played it for ages so I’m ok, I’m quite good at it”

Enabling physical activity.

One of the primary ways girls identified receiving support, particularly from their parents, was through logistic forms of support such as providing transport to physical activities or paying for sports club or gym memberships and kit. Although some of the girls mentioned that they contributed their own money to fund their activities or they walked or got the bus to training and did not rely on their parents for transportation, most of the girls relied on their parents for logistic support for physical activities. Several of the girls noted that they would not be able to do the activities they do without this support from their parents.

Diana: “...I get a lot of lifts but I don’t think if they couldn’t kind of give me lifts places and take me there then like I couldn’t do it all ‘cos it would be so much. I couldn’t get there in time for stuff so.”

Susan: “... ‘cos they pay for it like I wouldn’t be able to like pay for it...”

Modelling.

As previously described, modelling was viewed as conceptually distinct from social support in this study. However, modelling also appeared to be linked to participants’ physical activity behaviour and provision of social support. Modelling was found to

influence physical activity through two primary pathways: providing opportunities to be physically active and providing inspiration to be active.

Providing opportunities to be physically active.

Participants frequently discussed how their friends and family, or other network members, were the reason they first started organised physical activities or sports. Many girls discussed how their parents got them involved in physical activities at a young age or suggested physical activities for them to try. Girls also consistently talked about how having friends or family involved in physical activities presented opportunities for them to try it themselves.

Maria: "...my friend was doing it [*hockey*] and she said "oh you should come along" so I came along and then I liked it and I had other people who I was friendly with there, it was fun and exercise so I just continued to go."

Having friends or family members who were active themselves also presented opportunities for girls to participate in leisure activities (e.g. walking, recreational swimming) through network members inviting girls along to activities that they were doing. For example, one girl discussed how her parents enjoyed going for walks and it was something that they did together as a family:

Diana: "...my mum and dad quite like going out for walks and stuff and they like to go out for coffee and stuff as well so normally we do stuff like that as a family as well."

Inspiring girls to be active.

Having members of social networks model physical activities and perform well in organised physical activities inspired some of the girls to take up physical activities or motivated them to continue activities they were already involved with. Stacey discussed how her brother's success in boxing inspired her to be active.

Stacey: "...when my brother was winning like all his matches and stuff I started boxing because I saw like all his trophies and then the big smile and everyone being like "aw I'm so proud of you" and stuff."

Coaches were also a source of inspiration for some of the girls, particularly through their previous successes and through their knowledge and ability in physical activities. This inspired some of the girls to want to achieve similar levels for themselves.

Paula: "...sometimes we get to see them in like coach versus the seniors' games, it's to see them play the seniors, so it's good to see them play because like they're really good and it makes you think "oh I'd like to be able to play like that"."

Girls also discussed valuing their coaches' work ethic and performance achievements.

Paula: "...they do inspire you because they, they like worked really hard and they've, a lot of them have like, have done well with hockey in the past so a lot of them have a lot of knowledge about it and its good for them to show us like what they know".

Connectedness.

Participating in physical activity was also found to enhance social networks by strengthening current relationships and by adding to social networks. For example, many of the girls discussed making friends as a result of taking part in organised physical activities. Girls also discussed physical activities strengthening current relationships.

Maria: "My other grandparents... they like to have weekly sports roundup em and we always text on the Saturday and Sunday results and... everyone when I think about it, everyone seems to find out one way or another and everyone's just involved."

Stacey: "...my granda has such a big passion for football as well... that's our thing that we have in common."

Two girls also spoke about how having family members' interested and involved in physical activities contributed to their enjoyment in physical activities. When asked why basketball was her favourite sport, Sophie replied: "cos all my family do it... my mum plays it, my auntie plays it and some of my cousins play it as well."

Participating in physical activity also had a potentially negative impact in some cases on relationships and in participation in physical activities, suggesting that physical activity can have both a positive and negative impact on connectedness (see Figure 13). Where those within a social network did not have shared perceived value or interest in physical activities there were a few examples of girls noting that their friends sometimes were not understanding of their physical activity participation.

Kelly: "Sometimes if they're all going to the cinema or something and I've got training then they're like 'oh it's fine just miss it, it's fine, it's fine'... It sometimes makes me want to go but I know I would regret it 'cos I would rather be at hockey doing something productive".

Rebecca: "Sometimes if we're going to a certain place and we could walk and I'll be like 'oh let's walk!' and they're like 'oh no I don't wanna walk, let's get the bus'".

Similarly, in family situations girls noted that due to everyone being busy with various separate physical activities sometimes they were too busy to spend time together.

Discussion

This qualitative study explored adolescent girls' perceptions of how social support influences their physical activity behaviour. Although it has been considered important to engage families and friends in physical activity interventions there is limited research to guide effective intervention strategies to increase perceptions of

social support. This study serves as an exploratory study by identifying how social support influences physical activity behaviour in adolescent girls, represented in a conceptual model grounded in adolescent girls' perceptions and experiences. This conceptual model may be used to inform the development of more robust social support intervention strategies aimed at increasing physical activity amongst adolescent girls.

The first aim of this study was to explore participants' perspectives about their physical activity levels. From this, 89% of the participants (16 out of 18) discussed being involved in at least one organised sport. Although the girls were also involved in other activities, including active commuting, PE and leisure activities, sport was a key feature of most participants' weekly physical activity. Whilst girls who were involved in organised sport were not specifically targeted, rather physically active girls were targeted, it could be that the most active girls are involved in organised sports. This was also reflected in a systematic review by Biddle and colleagues (2005) who found a moderate to large association between adolescent girls' involvement in organised sports and physical activity levels. However, in this study, the recruited girls had all chosen to do PE as a curriculum subject. It is also plausible, therefore, that girls who chose to do PE are more likely to enjoy and participate in sport than girls who did not select PE as a curriculum subject. The results, therefore, may not be representative of girls' who are predominantly active through other means.

The second aim of the study was to identify the main sources and types of social support the participants were receiving. Participants discussed being supported by family members, friends, teachers and coaches to be physically active. Most frequently, this support was provided by friends and family. This is perhaps not surprising as family and friends probably have greater contact with young people, and hence, may be able to provide more support than teachers and coaches.

Support from teachers and coaches was generally limited to specific settings such as during training sessions or in PE. This could explain the findings from the systematic

review in Chapter 3 and the cross-sectional results in Chapter 4, as well as the results of a previous systematic review (Mendonça, et al., 2014), which found that social support from teachers and coaches is not significantly associated with overall physical activity in adolescent girls. Potential explanations for this could be that teachers and coaches can only or only support girls who are involved in organised sports and PE, such as the participants in this study, rather than girls who are not physically active or involved in organised sports. Another explanation is that the support teachers and coaches provide may only have an influence on specific domains of activity (e.g. PE, sports involvement) and not have an influence over total physical activity.

Similarly, participants also reported receiving different types of social support. The most frequently talked about forms of support were emotional support and co-participation. Negative forms of support were not frequently discussed, however, some participants discussed receiving negative forms of support such as negative controlling behaviours. The different forms of support mentioned were similar to those previously measured in the literature, coinciding with those identified in the systematic review in Chapter 3. Whilst participants in this study discussed mainly positive forms of support, it could be that less active girls perceive more negative support, such as encouragement or coercion to be active for weight loss. Parents encouragement of physical activity for weight loss has previously been found to negatively impact girls' enjoyment of physical activities (Davison & Deane, 2010), therefore, less active girls may perceive or receive different forms of support.

Thirdly, participants' perspectives about how significant others influenced their physical activity levels was explored. The findings from these discussions were used to develop a conceptual model grounded in participants' perspectives of how social support influences physical activity, which has not previously been investigated comprehensively in the literature. The girls' perceived social support and modelling to influence physical activity through various mechanisms, some of which are consistent with previous research. The girls' perceived social support to positively influence self-efficacy, motivation and enjoyment, lead to improvements in

performance and enabled the girls to be physically active. In addition, participants discussed how improvements in self-efficacy and performance also influenced their motivation, which was also linked to their physical activity behaviour.

Most research that has explored potential mechanisms of how social support influences behaviour amongst young people has suggested that barrier self-efficacy mediates the relationship between social support and physical activity (Motl, et al., 2007; Peterson, et al., 2013; Trost, et al., 2003). This suggests that social support influences perceptions of young peoples' confidence in their abilities to overcome barriers to physical activity, which has an influence on physical activity levels. The findings from this study support this mechanism, however it was also found that social support influenced girls' task self-efficacy, or confidence in their abilities to be physically active. No previous research that investigated potential mediating effects of social support through task self-efficacy on adolescents' physical activity behaviour was identified. Therefore, the finding that social support contributed to girls' self-efficacy for physical activity is consistent with and adds to previous research.

Expanding on this previous research, the findings also suggest that the increased self-efficacy from social support leads to increases in motivation to be physically active. This pathway suggests that the role of social support may be to enhance self-efficacy, which in turn could influence motivation for physical activity. Previous research has identified a link between social support and motivation. For example, a systematic review by Sheridan, Coffee and Lavalley (2014) found that social support from parents, friends and coaches was positively associated with young peoples' sport motivation. There is evidence of links between self-efficacy and motivation in the literature. Systematic reviews have consistently identified positive associations between self-efficacy and physical activity in adolescents (Biddle, et al., 2005; Craggs, et al., 2011; Van Der Horst, Paw, Twisk, & Van Mechelen, 2007). Prior research has also identified links between motivation and physical activity in young people (Owen, et al., 2014). The link between self-efficacy, motivation and physical activity also supports theoretical approaches to physical activity presented in Chapter

2. SDT, SCT, TPB, TRA and TTM all propose links between self-efficacy and physical activity, and the Basic Psychological Needs Theory in SDT in particular suggests there is a link between perceptions of competence, autonomous motivation and physical activity (see Chapter 2). Furthermore, principles set out by Bandura (1997) suggest that modelling (vicarious experience) and encouragement (or verbal persuasion) contribute to self-efficacy beliefs.

The girls also reported that social support contributed to their enjoyment of physical activities. This was enhanced through coaches and teachers creating positive environments in which to be physically active, and through participating in physical activities with friends. Girls discussed being active with friends during organised activities, leisure activities and as a fun way of spending time with friends and family. There is some evidence of this relationship in the literature. For example, a qualitative study by Jago and colleagues (2009) found that social support contributed to children's enjoyment of physical activity. In particular, when asked about why they enjoyed participating in physical activities, children talked about enjoying activities because of, and a way to spend time with, friends. There is also some quantitative evidence of a relationship between social support, enjoyment and physical activity. For example, Shen and colleagues (in press) found that perceived social support was associated with enjoyment of physical activity. Expanding on this, Wing, Bélanger, and Brunet (2016) found evidence that enjoyment mediates the relationship between social support and physical activity in adolescents. Specifically, they found that both tangible (e.g. instrumental support, companionship) and non-tangible (e.g. emotional support, informational support) forms of support to be associated with physical activity through enjoyment. Therefore, our findings add to the current literature that suggests there is a link between social support and adolescents' enjoyment of physical activities. This has implications for physical activity interventions. In particular, interventions should aim to involve friends and family in physical activities that they will enjoy doing together.

The findings also suggests that social support can contribute to performance improvements in physical activities, particularly in organised sports. For example,

significant others provided advice or instruction in physical activities and many of the girls discussed valuing and feeling as though this feedback lead to improvements in their performance. Girls also discussed valuing the opportunity to practice and develop skills with friends or family. There was also some suggestion that as a result of performance improvements, girls' self-efficacy and motivation for physical activity increased. These findings have some links with previous research. For example, a systematic review by Sheridan, Coffee and Lavalée found evidence to suggest that social support helps young athletes to feel more competent. They also identified links between motivation and achievement and motivation and continuation in youth sport (Sheridan, et al., 2014).

The participants' highlighted that instrumental forms of support enabled them to be physically active, for example through parents driving the girls to training practices, or paying for sports equipment and memberships. Some previous research has also found a relationship between instrumental support and physical activity. The meta-analysis in Chapter 3 identified small but significant associations between parent logistic support and physical activity in adolescent girls. Research has also found that instrumental support is associated with physical activity through enabling physical activity. For example, Peterson and colleagues (2013) found that barrier self-efficacy moderated the association between parent instrumental support and physical activity. This suggests that parent instrumental support can influence perceptions of young peoples' abilities to overcome barriers to physical activity, which is associated with physical activity. Whilst barrier self-efficacy is different from enabling physical activity (given resources to help be physically active), instrumental support may also help girls overcome logistic barriers to physical activity. In the current study, participants discussed how instrumental support helped enable them to be physically active, and it is likely that this had an influence on their perception of being able to overcome barriers.

It became evident that social support and modelling physical activity behaviour were two closely linked but distinct constructs. In particular, significant others' capacity and desire to provide support for physical activity in some cases seemed linked to the

social support they were able to provide. For example, network members with a personal interest and experience in physical activities were able to provide specific forms of support such as advice or instruction. Therefore, modelling was included in the conceptual model. The data suggests that modelling inspired the girls and presented opportunities for them to be physically active. Previous research has identified links between parent modelling (Yao & Rhodes, 2015) and children and adolescents physical activity levels. Furthermore, links between parent enjoyment of physical activity (Dowda et al., 2011) and perceived importance of child physical activity (Dowda, et al., 2011) and the levels of social support provided to children have been identified. Limited research focusing specifically on adolescent girls has explored how modelling influences physical activity behaviour, however, theoretical links between modelling and self-efficacy have previously been proposed. As previously highlighted, modelling (or vicarious experience) has been proposed to influence self-efficacy beliefs (Bandura, 1997) (see Chapter 2). This could refer to watching others perform a behaviour, and suggests a way in which modelling might influence physical activity behaviour although this was not supported by the findings of the current study. The findings that modelling can provide opportunities for girls to be active and inspire them to be active adds to previous research and could be a useful starting point for future research in this area.

Two potential mechanisms to explain friend modelling have previously been proposed: the peer contagion model (whereby young people are influenced by their friends' activity levels) and the peer selection model (whereby individuals seek out friends with activity levels similar to their own) (Sawka, et al., 2013). The current study found that modelling can inspire girls and present opportunities for them to be physically active, supporting the peer contagion model. However, girls may also seek out or become friends with those with activity levels similar to their own. This was also evident in our findings, as girls discussed making friends as a result of their involvement in physical activities. These findings have implications for future research and practice. In particular, if provision of social support is related to modelling of physical activity it may also be necessary to target the physical activity behaviour of family and friends when attempting to increase adolescent girls'

physical activity. Targeting family and friends' physical activity behaviour in interventions could enhance their capacity to provide support, whilst inspiring and offering opportunities for young people to also be physically active. There is some evidence of the effectiveness of this approach in the literature. A recent review by Brown and colleagues (2016) found evidence for family based interventions that used the child as the "agent of change" to model physical activity behaviour to their parents.

Finally, the girls suggested that participating in physical activity enhanced their connectedness. Girls made friendships as a result of taking part in organised physical activities, they strengthened relationships by having shared interests in physical activities and coaches and teachers were added to girls' networks as a result of their participation in activities. New network members as a result of friendships from taking part in organised sports offered participants access to additional social support. However, in some cases, connectedness was negatively affected as a result of participating in physical activities where involvement in activities limited time spent with friends or family outside of that activity. Therefore, there seemed to be a circular relationship between social support, physical activity and connectedness. Social support could help girls be more active and being more active could add members to their social networks who could provide additional social support. Equally, participating in physical activities could also weaken social connections where network members were not interested or engaged with the physical activity.

This qualitative study closely followed a constructivist grounded theory approach. Effective application of this systematic, rigorous approach to qualitative research is a strength to this study. Problems with effective application of grounded theory have previously been identified within sport and exercise (Holt & Tamminen, 2010; Weed, 2009, 2010). Another strength of the current study is the resulting conceptual model of how social networks might influence physical activity behaviour. No previous studies to our knowledge have provided a detailed account of how social support influences physical activity behaviour in adolescent girls. However, testing or validating the conceptual model was out with the scope of this study. Further

research is needed to explore further and test the model with adolescent girls and with other populations. A further limitation of the current study is that the participants were all active girls and the majority of the girls were involved in organised sports. This limits the generalisability of the results to inactive girls or girls who are not involved in sports, however, it may provide a helpful starting point for future research.

Implications

The findings from this study could be used as a starting point to inform intervention strategies aimed at increasing perceptions of social support, which have been previously been found not to be effective at increasing perceptions of support (van Stralen, et al., 2011). Interventions could focus on targeting wider social networks such as friends and family and focus on features that could lead to increases in modelling, social support and connectedness, and address the ways in which these constructs have been proposed to influence physical activity. Table 18 outlines the main findings from this chapter and suggests practical application of the conceptual model to physical activity interventions and programs.

Table 18 Practical application of conceptual model

Findings from conceptual model	Possible practical application
<p>Modelling</p> <ol style="list-style-type: none"> 1. Influences provision of social support 2. Provides opportunities to be active 3. Inspires physical activity 	<ul style="list-style-type: none"> • Target physical activity levels, perceptions, and values of network members [<i>influence provision of support, opportunities to be active</i>] • Focus on activities that can be done together that people can bond over [<i>influence provision of support, connectedness</i>]
<p>Support</p> <ol style="list-style-type: none"> 1. Enjoyment 2. Motivation 3. Self-efficacy (barrier and task self-efficacy) 4. Performance improvements 5. Enable physical activity 	<ul style="list-style-type: none"> • Activities should facilitate a shared enjoyment between target group members [<i>enjoyment</i>] • Group members should do activities together and help each other build skills [<i>self-efficacy, motivation</i>] • Group provides feedback to each other during activities such as praise or instruction [<i>performance improvements, self-efficacy, motivation</i>] • Help target group identify logistic ways to help each other and ways to overcome barriers [<i>barrier self-efficacy, enable physical activity</i>]
<p>Connectedness</p> <ol style="list-style-type: none"> 1. Strengthen current relationships through shared interests in activities 2. Meet new people through activities 	<ul style="list-style-type: none"> • Focus on activities that can be done together that could strengthen relationships [<i>strengthen relationship/shared interests</i>] • Provide activities that offer opportunities to meet new people [<i>Meet new people</i>]

Conclusion

Using a grounded theory approach, this study has comprehensively investigated how adolescent girls perceive social support to influence their physical activity behaviour. Using this data, a conceptual model grounded in the experiences of adolescent girls of how social support influences physical activity in this population was developed. This has not previously been done in the literature. The conceptual model demonstrates mechanisms through which social support might influence physical activity behaviour in adolescent girls and provides a framework for future research examining the role of social support in physical activity. The conceptual model could also be used to inform physical activity intervention design, specifically it could inform the development of features designed to increase perceptions of social support.

Chapter 6: Reflection

Introduction

This chapter provides a reflection on the thesis as a whole, considering how the researchers' decisions and definitions may have impacted on the findings. In particular, this chapter will discuss how the researchers' interpretation and definition of social support and modelling developed during the PhD process, and reflect on the methodological decisions made in the Health 4 U study.

Developing definitions of key constructs.

As understanding social support in the context of adolescent girls' physical activity is the main focus of this thesis, one of the first things I did when I started my PhD was to develop an understanding and definition of social support. This involved synthesising and appraising relevant social support and physical activity literature. Alongside this, I began planning for my systematic review (Chapter 3). After several months of appraising the literature, I developed a definition of social support which I felt represented my interpretation of social support whilst accounting for previous physical activity research. This was not as straightforward as I had originally thought it would be, as I quickly discovered numerous, and often conflicting, definitions of social support. However, I decided that a broad definition of social support that encompassed several sub-types of social support was most appropriate and I continued my work with this definition in mind. This decision meant that I originally included modelling (or the physical activity levels of the provider and their perceived value in physical activity) as a form of social support. As modelling was included in my early definition, I included modelling in my systematic review. As I progressed through my PhD and my studies and I began to read more widely, my interpretation of social support developed further. In particular, the social support literature in public health more generally shaped my interpretation of social support and modelling as two distinct constructs. I began to move away from the viewpoint that

modelling is a form of social support towards considering modelling as a unique construct and separate from social support.

Although my definitions of modelling and social support did not significantly change over the course of my PhD, my interpretation of how modelling and social support link together changed. I consider social support to be something that is *provided*. It is ways in which someone helps and supports another to active. I also began to understand modelling as something personal to the provider. Modelling is the providers' own physical activity levels, beliefs and values, and whilst parents or others could purposely be active with the intention of being an active role model (which links with the *providing* aspect of social support), this is difficult to distinguish. Evidence suggests that physically active people have high levels of intrinsic motivation (Teixeira, et al., 2012), suggesting that active people value and enjoy physical activity. Following a self-determination theory approach, extrinsic forms of motivation (e.g. to act as a positive role model) have been found to be a weaker form of motivation than intrinsic motivation (e.g. where being active is important to a person and something they enjoy) for continued involvement in physical activity. By adopting a self-determination theory approach, modelling is thought to be primarily driven by intrinsic forms of motivation (e.g. the parents/friends interest, value and enjoyment of physical activities) rather than being purposely *provided* with an aim of setting a positive example, although to set a positive example may partly why some people are active.

Towards the end of my PhD when I was conducting my final study, a grounded theory of how social support influences physical activity in adolescent girls (see Chapter 5), it became clear to me that whilst modelling and social support are unique constructs they are very closely linked. The girls involved in the study told me about how in some instances the support they received (or did not receive) was related to their friends or families interests (or lack thereof) in physical activity. To demonstrate this, one girl spoke about how her friends sometimes encourage her to skip hockey practices to spend time with them instead. Another girl spoke about how

her parents were not able to give her advice or instruction in her sport because they have a limited understanding and interest in it. In contrast, other girls spoke about how their parents have actively taken an interest in the sport they are involved with and because of this they have developed the knowledge and ability to provide feedback and advice. Similarly, several of the girls spoke about how having active family and friends presented opportunities for them to be active together such as going for family walks or going to classes together at the gym.

Therefore, although the main focus of this thesis was to understand social support in the context of adolescent girls' physical activity, modelling was also included in both the systematic review (Chapter 3) and the qualitative grounded theory study (Chapter 5). The inclusion of modelling was related to my changing definition of social support over the duration of the PhD and the recognition of the close link between modelling and social support through reading the literature and particularly through the findings of Chapter 5.

Friends, Family, and Health 4 U

When I began preliminary work to inform my systematic review (Chapter 3), part of this involved discussing my plans with stakeholders to get their feedback and advice on the focus of the review. This process directed me to a Youth Development Officer based in Edinburgh Leisure who designed and managed the Health 4 U program, an 8-week health intervention for adolescent girls. Based on discussions with the youth development officer, I learned more about Health 4 U and was presented with the opportunity to conduct part of my research on the Health 4 U intervention. We discussed the intervention topics, where the intervention was being delivered, and the possible development of Health 4 U.

My original plan for my thesis was to develop and test my own intervention, based on knowledge gained from my systematic review and qualitative study. However, when Health 4 U was presented as a potential opportunity I carefully considered

whether this would be an appropriate deviation from my original plan and what it would bring to my thesis.

To design and evaluate a robust physical activity intervention would be very time consuming. The Medical Research Council (MRC) framework for developing complex interventions outlines several stages that should be following when developing public health interventions (Anderson, 2008). Initial stages involve becoming familiar with the research area and developing a theoretical base for the intervention and/or logic model of how the intervention is proposed to influence behaviour. This could involve conducting a systematic review of interventions or consulting previous relevant reviews of interventions. In this thesis, it may have been appropriate to conduct a school or a family based social support intervention targeting physical activity. A systematic review to address this may have examined family based social support interventions aimed at increasing physical activity in youth. The next stage would be to use this knowledge to develop a new intervention, which could involve including strategies that have been effective in other interventions and developing new strategies. This planning stage should also involve consultation with the target population. If a family based intervention was the target, this might have involved carrying out focus groups with families to understand their preferences for a physical activity intervention. This stage might also involve engagement with a steering group of practitioners, policy makers, other academics and families who might be able to guide and inform the ongoing design and conduct of the intervention. When the intervention design is finalised, it would be piloted and evaluated.

Health 4 U had been planned in consultation with adolescent girls and piloted in schools. Pilot findings and feedback from girls' experiences of receiving Health 4 U and coaches' experiences of delivering the intervention were used to further develop Health 4 U before it was implemented again. Health 4 U had features designed to increase girls' perceptions of social support, which was of key importance for me. Most schools across Edinburgh were scheduled to receive Health 4 U during the

school year in which I would be doing my testing, which meant that there would be a potentially high sample size in which to evaluate the intervention and understand social support in the context of the intervention. Given that designing and evaluating an intervention was not the main focus of my thesis, rather my thesis aimed to understand social support in the context of adolescent girls' physical activity, having the opportunity to evaluate Health 4 U and understand social support in the context of a pre-piloted and pre-running intervention was considered more pragmatic than developing my own intervention.

Finally, there were also potential ethical implications of developing my own intervention rather than evaluate Health 4 U. If I had developed and piloted my own intervention it is likely that there would be a lack of continuation of the intervention on completion. In contrast, whilst Edinburgh Leisure received limited funding to deliver Health 4 U, a continuation plan was put in place to ensure sustainability of the program. Once Health 4 U had been established in schools, Edinburgh Leisure delivered Continued Professional Development (CPD) courses to PE teachers and other school staff and provided schools with the teaching modules, materials and class resources to deliver the intervention as part of the school curriculum. Since Health 4 U was designed to complement the Scottish Health and Wellbeing Curriculum, Health 4 U could be easily implemented into current teaching practice. Evaluating Health 4 U as part of my thesis, therefore, allowed me to contribute to the improvement and development of an ongoing intervention with clear plans for continuation rather than develop and test an intervention with limited prospect of continuation.

The decision to evaluate Health 4 U rather than develop my own intervention also had implications for the evaluation process. Evaluating Health 4 U gave me access to a larger sample size and enabled me to perform mediation analysis to investigate whether social support mediated the effectiveness of the intervention. It is unlikely that this would have been possible if I had developed my own intervention as mediation analysis requires larger sample sizes than would be possible if I were to

design and implement my own intervention as part of my thesis. It is likely, therefore, that the focus of the evaluation would have been more exploratory, investigating the feasibility of different social support intervention strategies and evaluating whether physical activity changed as a result of the intervention. This is an important and worthwhile avenue for further research and the literature would benefit from well-developed social support intervention strategies.

Despite the benefits of evaluating Health 4 U as part of my thesis, there were also limitations associated with this decision. Firstly, I had no or limited control over intervention features, content, delivery, or when the schools received the intervention. This lack of control had several implications for my research. Had I developed my own intervention it may have had different features and content to Health 4 U, particularly the features designed to increase social support as this would have been a key aspect of the intervention. If I had designed my own intervention, at the development stage particular attention would have likely been paid to social support features and how these could be effectively implemented. Similarly, I would have had more control over when the intervention was delivered and to whom and how it was delivered. This may have also reduced possible differences in content delivery between Health 4 U coaches.

Compliance with objective monitoring procedures in Health 4 U.

In addition to the definitions used and methodological decisions made over the course of my PhD, challenges specific to individual research projects may also have influenced the findings of the thesis as a whole and, hence, merit reflection. The most pertinent issue that arose related to compliance with objective monitoring procedures in the Health 4 U study. This section will outline the challenges I found with compliance with the use of pedometers in the Health 4 U study, how these challenges affected the analysis, and will offer strategies for how compliance with objective monitoring procedures might be improved in future studies with adolescent populations.

In the Health 4 U study, physical activity levels were a primary outcome measure. To understand whether physical activity levels changed as a result of taking part in Health 4 U, an 8-week health intervention for adolescent girls, physical activity levels were measured and compared before and after receiving Health 4 U. Participants were asked to wear a pedometer for 7 days before and after taking part in Health 4 U and they were asked to complete a questionnaire which assessed subjective physical activity levels (using the PAQ-A and a single item question used in the HBSC survey), self-efficacy and social support. I was aware of potential difficulties associated with compliance with objective monitoring procedures in youth populations through previous research and through speaking with other researchers with experience in this area, therefore, I developed strategies which I expected to help improve compliance. To help improve compliance and minimize lost data the following strategies were employed: (1) as we expected some poor compliance with the pedometers sample size calculations were adjusted for an estimated 20% drop-off (although this also took account of other reasons for participant drop-off, e.g. sickness); (2) participants who returned their pedometer on time were entered into a prize draw to win vouchers or a membership to a local leisure centre; (3) participants were asked to continue wearing the pedometer if they were off school on the day of data collection, this allowed for the pedometer to be collected on their return to school with limited missing data.; and (4) participants were provided with adjustable, elasticated belts that they could attach the pedometer to allow them to wear the pedometer with clothing without a waistband (e.g. a dress).

Despite these strategies, compliance with objective monitoring procedures was poor. Out of 159 girls who originally agreed to participate, usable pedometer data for both pre- and post- intervention was available for only 54 girls whereas subjective physical activity data at pre- and post- intervention was available for 145 girls. This poor compliance with pedometer wear had implications on the analysis procedures. The analysis plan was originally based on objective physical activity data but, due to the poor compliance, sample sizes were not met with the objective data. This meant

that subjective physical activity data (measured using the PAQ-A) were used for most of the analysis procedures. However, sample size calculations were originally based on objective physical activity data, rather than subjective physical activity data. Retrospective sample size calculations performed in G*Power for the PAQ-A subjective physical activity measure for increases in scores of 0.3-0.5 (equivalent to an approximate 10-20% increase) in the PAQ-A suggest that sample sizes obtained were adequate for detecting this change in physical activity levels. Required sample sizes were between 26 and 52 participants per group when taking accounting of 20% drop-off. However, as Health 4 U was delivered to girls in classes in different schools it is also possible of a clustering effect. Standard sample size calculations assume independent observations, therefore, sample size calculations may also need to be adjusted for clustering using the intra-cluster correlation co-efficient (ICC). In absence of pilot data, a generic estimate of an ICC can be used to adjust sample sizes (e.g. an ICC of 0.05) (van Breukelen & Candel, 2012). Clustering takes into account the number of clusters and the cluster size to estimate how many participants would be required to adequately power a study. Using the ICC, the sample size can be adjusted by the “design effect”. The design effect is equal to $1+(n-1)p$, where n is the mean cluster size and p is the ICC (Sedgwick, 2013). Using a mean cluster size of 20 for groups in Health 4 U, the design effect was 1.9, meaning that sample size calculations would need to be increased by a factor of 1.9. The above sample sizes of between 26 and 52 participants would be adjusted to approximately 51 to 99 participants per group when accounting for possible effects of clustering.

Compliance with objective monitoring procedures is a pertinent issue in physical activity measurement in youth populations. It is important that we understand how to collect the best possible physical activity data possible in order to draw meaningful conclusions about youth physical activity and health. In this study, several reasons for poor compliance with objective monitoring procedures were identified including: loss of equipment, sickness/absence on data collection days, and poor engagement/wear time.

The original strategies I had developed to aid compliance with objective monitoring procedures did not appear to be successful at addressing these reasons for poor compliance. However, reflecting on this process has allowed me to consider how compliance with objective monitoring procedures might be improved in future studies involving objective monitoring procedures. Based on my experience, I felt that the poor compliance in this study was related to three key reasons: (1) my limited contact time with teachers and pupils in each school; (2) the pupils and teachers limited involvement with data collection procedures; and (3) perceived lack of incentives for compliance with objective monitoring procedures.

Firstly, I felt that because I was collecting data in 6 schools, and sometimes in more than one class in each school, this meant that my contact time with teachers and pupils in each school was limited. I felt that this limited contact time had implications for the teachers and pupils' awareness and perceived interest/importance in the study. Had I been able to establish a stronger relationship with each school then I feel that pupils and teachers' engagement with the study may have been improved, although this may be more feasible when working with one or two schools or with greater available resources. Following on from this, my second point referred to the pupils and teachers' involvement with data collection procedures. I noticed improvements in compliance with study procedures in schools or classes where the teacher emphasized the importance of the study and procedures to the participants. Having a teacher who reminded the girls to wear and return pedometers seemed to result in higher numbers of girls who complied with study procedures compared with schools where the teachers seemed to be less engaged with the research and encouraging the girls to comply with study procedures. Based on this, I think that giving the pupils and teachers greater ownership over the study procedures and data collection could have led to improvements in compliance with the objective monitoring procedures. This may have involved giving teachers or groups of pupils the responsibility of issuing and collecting pedometers, taking records of data collection, and giving pupils and teachers more responsibility over recruitment procedures. Other potential mechanisms for improving compliance with objective monitoring procedures might have included daily check-ins/logging of

physical activity levels, although this might have been somewhat burdensome for the schools and would have had to be done in a way that meant that participants remained blinded to their daily step counts. Finally, perceived lack of incentives may have also been a reason for poor engagement with objective monitoring procedures. Whilst we offered participants who returned pedometers on-time the chance to enter a prize draw for vouchers or a gym membership, I felt that compliance to wearing the pedometer was not a key concern or priority for many of the girls. This may have been improved with incentives that were more attractive to the girls (e.g. provide them with vouchers rather than entering them into a prize draw), however, I think that the points raised earlier are likely to have a stronger influence over the girls perceived importance of wearing the pedometers (e.g. giving pupils and teachers more ownership over recruitment and data collection).

Similar strategies have been suggested by other researchers experienced in objective physical activity assessment in youth populations (Active Living Research, 2008). For example, making connections with participants, teachers and parents, highlighting the attractiveness of wearing the monitor, providing an instruction sheet, taking daily activity logs, repeating measurement period for non-compliant participants, use of reminder stickers, telephone reminders, and using incentives. It could also be worthwhile exploring teachers and pupils' perspectives on improving compliance prior to undertaking research involving objective monitoring procedures. Focus groups could identify pupils and teachers' context specific strategies for improving compliance with objective monitoring procedures.

Measurement of social support.

Within Health 4 U, measurement of social support also merits reflection. Social support was measured using a scale developed and validated by Sallis and colleagues (2002) which measures the frequency different types of social support are provided on a weekly basis from different providers. Whilst this tells us about the different forms of social support the girls received, there may be important aspects of social

support that are not captured. For example, it does not assess quality of support provided. Parents could encourage their child to be active on a daily basis but it is plausible that some ways of encouraging a child could be stronger or more meaningful to a child than others. To emphasise this, a parent saying to their child “you should be more active” might be a less meaningful way to encourage a child than “it would be great if you went for a walk today”. This level of detail is not picked up in the social support measures used in Health 4 U. Equally important, the scale does not take account of the type or types of support that girls desire or feel that they need. For example, girls may be encouraged by their parents to be active every day but it is possible that they might prefer to be praised for the activity they do. Different girls may also have different support needs, and this is not captured by the social support measures used.

These limitations to the social support measure used in Health 4 U could have had an influence on the strength of associations between social support and physical activity reported. In addition, if social support scales incorporated these aspects (relating to the quality of social support received and the social support desired by girls) then understanding on the influence of social support and physical activity could be enhanced and future physical activity interventions could be more targeted.

Process evaluation.

A process evaluation is a way of measuring if an intervention was delivered as intended and of understanding contextual factors related to intervention effectiveness (Bauman & Nutbeam, 2014). Process evaluation data can help inform us whether an ineffective intervention is related to implementation rather than intervention design, and they can provide information to inform improving and further implementing the intervention or other similar interventions (Bauman & Nutbeam, 2014). Process evaluations can measure intervention exposure, participation, fidelity (whether the intervention was delivered as intended), program satisfaction and usage (e.g. engagement with resources, usefulness of individual sessions), and contextual factors

that could be related to the intervention effectiveness (e.g. economic factors, community factors) (Bauman & Nutbeam, 2014).

Whilst process evaluations can provide key details to contextualize the effectiveness of an intervention, it was not possible to conduct a process evaluation as part of Health 4 U due to time and practical restraints. To be able to fully understand Health 4 U exposure, fidelity, program satisfaction, usage and contextual factors related to implementation and effectiveness of Health 4 U, multiple different types of data would have needed to be collected at each participating school. As I was the only person collecting data on Health 4 U, which involved data collection in six schools, it would not have been possible for me to collect and analyse the necessary data to form a thorough and meaningful process evaluation.

Had a process evaluation been possible as part of Health 4 U, this may have involved:

1. Classroom registers to collect information on intervention reach for each session
2. Weekly coach delivery logs whereby the coach self-reports whether the session was delivered as intended and note down any comments or feedback related to intervention delivery (dose)
3. Classroom observations to assess intervention fidelity and dose.
4. Focus groups or interviews could have explored program satisfaction and usage, for example participants' and coaches experiences of receiving/delivering Health 4 U, to understand why it was not effective.

Had it been possible to collect this process evaluation data, it may have helped to better understand why social support was not changed as a result of the Health 4 U intervention, therefore, a lack of process evaluation is a limitation to the Health 4 U chapter.

Summary

This chapter has reflected on how key definitions of social support and modelling developed over the course of this PhD. The reflection also focused on the decision to evaluate an existing intervention (Health 4 U) rather than develop my own, the challenges faced in Health 4 U with using pedometers to assess physical activity levels, measurement of social support in the Health 4 U study, and the limitations of not being able to conduct a process evaluation as part of Health 4 U.

Chapter 7: Conclusion

This thesis contributes to knowledge about how significant others, including parents, friends, teachers and coaches, can influence the physical activity levels of adolescent girls through providing social support to be physically active. This included an introduction to physical activity in young people, a review of the literature, and three separate studies that investigated the role of social support on physical activity in adolescent girls. This chapter summarises the main findings of the thesis, discusses potential implications of the findings for policy, practice and future research, and highlights the strengths and limitations of the research.

A review of the literature (Chapter 2) highlighted a large body of research focused on the topic of social support. A conceptual framework was proposed to synthesise this research and provide an understanding of how different social relationships might influence physical activity in adolescent girls. It was also evident that there were a number of gaps in the current literature. Firstly, no previous reviews focused specifically on adolescent girls. In addition, evidence that has investigated associations between social support and physical activity in young people has predominantly focused on parental influences. No meta-analyses were identified for all providers and types of social support, or for providers other than parents. This limits our understanding of the relative importance of different types and providers of social support on adolescent girls' physical activity. Secondly, it is not currently known whether social support intervention strategies can lead to increases in physical activity in adolescent girls. Lastly, limited evidence has explored how social support influences physical activity in adolescent girls. To address these gaps in the literature, the following research questions were addressed in this thesis: (1) Is there a relationship between social support and physical activity in adolescent girls? If so, does the relationship differ by provider and type of support? (2) Does social support mediate the effectiveness of a physical activity intervention for adolescent girls? (3) How does social support influence physical activity behaviour in adolescent girls?

Chapter 3 presented a systematic review and meta-analysis that contributed to the literature by providing a comprehensive map of the literature to demonstrate numbers of associations reported for different combinations of types and providers of social support on adolescent girls' physical activity. It was evident that there were a substantial number of possible combinations of types and providers of support highlighting the complexity of this area. Considering this, there may be a need to standardise and refine how social support is defined and measured to improve comparability between types and providers of social support within the literature.

The findings from the meta-analyses address the first research question and suggest that social support from friends and families is positively associated with physical activity in adolescent girls. Effect sizes were small but similar for different types and providers of social support, although social support from teachers was not significantly associated with physical activity in adolescent girls. These findings are also replicated in the cross-sectional data presented in Chapter 4 and highlight that social support has a small relationship with physical activity. This suggests that social support explains a small amount of the variance in physical activity behaviour in adolescent girls. This is perhaps not surprising given we know that many factors influence physical activity behaviour. The ecological model outlined in Chapter 2 suggests that physical activity levels are influenced by individual, interpersonal, environmental, policy and global factors (see Figure 4). An ecological approach suggests that numerous factors need to be addressed in order to successfully change physical activity behaviour. However, to inform efforts to increase physical activity behaviour it is important to investigate individual factors, such as social support, in-depth to learn more about them.

Given that we know that social support is related to physical activity behaviour in adolescent girls, the next aim of the thesis was to investigate if social support can mediate the effectiveness of a physical activity intervention for adolescent girls. It is important to understand if we can increase perceptions of social support in a physical activity intervention and measure if any increases in support lead to increases in physical activity. This analysis can inform interventions aimed at increasing physical

activity in adolescent girls. Chapter 4 investigated the effectiveness of Health 4 U, an 8-week physical activity intervention, on increasing physical activity and social support in adolescent girls. Social support was tested as a mediator of the effectiveness of the intervention. Health 4 U was not found to be effective at increasing social support or physical activity. Social support, therefore, did not mediate the effectiveness of the intervention as the intervention did not change perceptions of support. The findings of this study align with previous systematic reviews that have investigated mediators of physical activity behaviour change that suggest interventions have not been successful at increasing social support (Lubans, et al., 2008; van Stralen, et al., 2011). Therefore, whilst social support from friends and families has a positive relationship with physical activity in adolescent girls, it remains unclear if interventions aimed at increasing social support would lead to increases in social support and subsequently physical activity. This highlights a need to modify current intervention strategies or create new intervention strategies aimed at increasing social support, as current approaches are generally not effective.

One way to inform new intervention strategies aimed at increasing social support might be to better understand the relationship between social support and physical activity in adolescent girls, in particular, to understand how social support might influence physical activity behaviour. Therefore, the final aim of the thesis was to comprehensively explore how social support might influence physical activity behaviour. This was initially explored in Chapter 4, with findings suggesting that barrier and task self-efficacy may mediate associations between social support and physical activity. However, as the data were cross-sectional the links between the constructs are considered exploratory.

A more comprehensive account of how social support might influence physical activity in adolescent girls was provided in Chapter 5 using a grounded theory approach. Girls discussed the importance of several sources of support including friends, families, teachers and coaches in influencing their physical activity behaviour. The role of teachers as a source of social support was a new finding in

the literature, although this support may be limited to girls who are involved in organised sports or PE, such as the participants in Chapter 5.

Based on the girls' accounts a grounded theory of how social support influences physical activity in adolescent girls was developed. Specifically, the girls talked about how social support enhanced their self-efficacy, lead to improvements in their performance, enhanced their motivation, enhanced their enjoyment and enabled them to be physically active. Self-efficacy and performance improvements were also linked to enhanced motivation. This conceptual model expands on the meta-analyses findings that explored direct associations between social support and physical activity in adolescent girls, and highlights that there is likely also an indirect relationships between social support and physical activity. These findings also expand on the cross-sectional results in Chapter 4 that found a possible indirect relationship between social support and physical activity through barrier and task self-efficacy.

The emergent conceptual model also included modelling. Whilst modelling is not considered to be social support, rather a form of social influence, participants discussed how friends, family, teachers and coaches modelled physical activity, and modelling seemed to be linked but distinct to provision of social support. Some supportive behaviours, particularly providing advice or instruction, depended on the providers perceived interest, value and experience in physical activity or a particular sport. The girls discussed how modelling influenced physical activity by providing opportunities to be active and by inspiring them to be active. The link between modelling and physical activity is consistent with the findings from the systematic review (Chapter 3). Finally, the conceptual model highlighted the role of connectedness in adolescent girls' physical activity. Girls talked about how physical activities strengthened current relationships and added new people to social networks, for example by making friends through organised sports. Thus it is probable that there is a cyclical link between connectedness, receiving social support and participating in physical activity. For example, social support may lead to

physical activity and participating in some types of physical activity may lead to social support.

These findings from Chapter 5 highlight the complexity of the research area, and suggests there is a close link between social constructs, such as modelling, social support, and social relationships, as well as links with other factors related to physical activity, such as motivation, self-efficacy, and enjoyment.

To summarise, the main findings from the studies presented in this thesis suggest there are direct and indirect relationships between social support and physical activity in adolescent girls. There is evidence to suggest that social support influences adolescent girls' physical activity through enhancing their enjoyment, self-efficacy, motivation, performance and enabling them to be physically active. These findings support the role of social support in adolescent girls' physical activity and highlight a need to understand how to increase perceptions of social support in physical activity interventions.

Implications for research, policy and practice

The results of this thesis have highlighted a number of potential implications for research, policy and practice. Firstly, there may be a need to standardise or refine how social support is defined and measured. This was made evident in the systematic review in Chapter 3, which mapped out the previous literature that had reported associations between social support and physical activity in adolescent girls. Mapping out the literature identified 21 different providers (e.g. mothers, fathers, coaches or sisters) and 14 different types (e.g. co-participation, encouragement or praise) of support. There was a substantial number of possible combinations of types and providers of social support. Considering this, refining or standardising measurement of social support may result in improved comparability between studies. Standardising how social support is defined and measured could be achieved through several mechanisms, for example by setting up a working group committed to advancing measurement of social support. The working group could host expert

meetings in conjunction with a conference, carry out a DELPHI study, and collaboratively work to achieve agreement of how social support is defined and measured and publish findings. This may include limiting measurement of support to specific sub-types of support (e.g. emotional support, instrumental support) and providers of support (e.g. parents, friends). This would allow for comparisons to be made between studies. There are two scales that are most commonly used in the literature that have been validated for use with adolescent girls: the Activity Support Scale (Davison, 2004) and the Sallis scale (Sallis, et al., 2002). Both scales measure different types of support but also provide an overall level of social support and can be used with, or also address, different providers of support. Such a working group might build on these previous measures or agree on development of new measures that best represent how social support is defined.

The thesis findings also suggest that social support is likely to be important for the uptake and maintenance of physical activity in adolescent girls. However, as previously highlighted, intervention strategies aimed at increasing social support have not been effective. This highlights a need to revise or modify social support intervention strategies. The findings from this thesis, particularly the findings from Chapter 5, could be used to inform this process. In particular, Table 18 outlines the key findings from Chapter 5 and how these findings could be applied to intervention design, policies, or programs aimed at increasing adolescent girls' physical activity.

However, whilst the findings from this thesis can inform the development of social support intervention strategies, it is important to comprehensively develop and test intervention strategies aimed at increasing social support. This could involve developing strategies in consultation with adolescent girls and those connected with girls, such as parents, teachers or friends, and piloting and revising these developed strategies. Robust development of intervention strategies may be more effective at increasing girls' perceptions of social support, which would allow us to test whether any increases in social support leads to increases in physical activity behaviour. In addition, more recent research has employed more successful social support intervention strategies, therefore, drawing on these interventions may be a helpful

avenue for informing future social support intervention strategies (Eather, et al., 2013; Lloyd, Lubans, Plotnikoff, & Morgan, 2015). A more comprehensive understanding of social support and whether social support has a role in behaviour change may inform more successful physical activity intervention design aimed at adolescent girls. Advancing this area of research could help address the question of what works, for whom and under what circumstance.

Despite the limited evidence for the practical application of social support intervention strategies the findings of this thesis do suggest that social support is important, therefore, there would be merit in policies and programs that help adolescent girls to feel more supported to be physically active. This might be achieved through promoting an active lifestyle, such as through active transport, PE, organised sport or leisure activities, and having strategies in place to help young people be more active and feel supported to be active. For example, strategies aimed at increasing active travel to school could engage multiple people connected with adolescent girls. This could involve targeting parents to facilitate an environment in which girls can commute actively to school, or enable girls to commute actively. Provision of materials like bikes or appropriate footwear for walking, and helping girls plan active journeys could enable girls to be active. Parent support and encouragement of active travel may also positively contribute to girls' self-efficacy and motivation to commute actively. Furthermore, targeting friends to commute together and encourage each other could make active commuting more enjoyable for girls. These suggestions are based on the findings presented in Chapter 5 as strategies that could enhance enjoyment of active commuting, enable active commuting and motivate girls to be active.

There may also be value in targeting wider social networks in other approaches to increasing adolescent girls' physical activity. As identified in Chapter 5, capacity to provide support in some cases depended on the providers' perceived interest and experience in physical activity. This might give further support for whole-of-school or whole-of-community approaches to physical activity programs or interventions. Programs could focus on strengthening relationships between network members

through physical activities, facilitating enjoyment of physical activities through social support and being active with others, educating participants on how they can support each other to develop their physical activity skills and competence, and identifying mechanisms to enable participants to be active. More general suggestions based on the thesis findings, and Chapter 5 more specifically, are outlined in Table 18. However, as previously noted, there is a need to develop intervention strategies, in conjunction with girls' and those connected to them, and pilot these intervention strategies to understand their effectiveness.

Finally, it is important that policies and programs aimed at increasing physical activity in adolescent girls considers social support within an ecological approach to physical activity. There are many factors that are related to physical activity in adolescent girls and it is important that policies or programs recognise and address these multiple factors. For example, providing an intervention aimed at increasing physical activity with features designed to enhance participants' social support may not be effective if school policies, infrastructure and facilities are not conducive to physical activity.

Strengths and limitations of the thesis

The strengths and limitations of each study presented in this thesis have been previously outlined in individual chapters (see Chapters 3 to 5). However, there are several limitations to the thesis more generally that should be acknowledged. Firstly, whilst the focus on adolescent girls is considered to be a strength for informing knowledge on adolescent girls' physical activity, the results may not be generalisable to other populations such as boys or younger children. Secondly, the intervention tested in this thesis (Health 4 U) was externally designed and implemented. It is likely that features of the intervention and features designed to increase perceptions of social support may have been different if the intervention was designed for the purpose of understanding social support in this thesis.

There are also a number of strengths to this thesis. Firstly, as highlighted above, the focus on adolescent girls is a strength. Most previous social support research has focused on boys and girls combined yet we know that different factors are related to physical activity in boys and girls, therefore, understanding social support specifically for adolescent girls is important to inform interventions aimed at increasing physical activity in this population. Secondly, as identified in the literature review in Chapter 2, definitions and conceptualisations of social support have been wide ranging. A framework of how social networks might influence physical activity in adolescent girls was presented in Chapter 2 and definitions were provided to provide more clarity in this area. Thirdly, a multi-method approach to understanding social support in adolescent girls was adopted. Using this multi-method approach, different aspects of the thesis aims and research questions were explored in more detail than would have been possible if only one method was employed.

Conclusion

Social relationships are often considered to be important factors related to young peoples' physical activity levels. This thesis provides evidence to support the direct and indirect role of social support in adolescent girls' physical activity. The thesis also provides clarity for understanding and researching social relationships in physical activity and ideas for future empirical research and intervention design.

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Appendix A: Systematic review data extraction of included studies

Authors, country	Sample (number, age)	Design	Physical activity measure	Social support measure	Results	Effect size <i>r</i>
Anderssen and Wold (1992) Norway	N = 406, 13.3 ± 0.3 years	CS	Subjective – Leisure time physical activity (used in WHO cross-national surveys)	Does not reference scale source – looks like custom scale	Mother modelling $r = .14$	.14
					Father modelling $r = .14$	.14
					Best friend modelling $r = .31$	.31
					Mother encourage $r = .28$	.28
					Father encourage $r = .25$	.25
					Parent encourage $r = .22$	.22
					Friend encourage $r = .30$ (not enough studies for meta-analysis)	N/A
					Parent instrumental support $\beta = .19$	.19
					Total encouragement $\beta = .19$	.19
Baskin et al. (2013) USA	N = 62, 13.8 ± 1.4	CS	Objective – Accelerometers and activity log	Sallis scale (parent report)	Parent social support on child MVPA: Estimate 1.645, $p < .0001$	.474
Bauer, Nelson, Boutelle, and Neumark-Sztainer (2008) USA	N = 395, 12.8 ± 0.8 and 15.8 ± 0.6 years	Longitudinal	Subjective – modified version of the LTEQ	Does not reference scale source – looks like custom scale	Encouragement among younger females to be physically active from their mothers was associated with greater hours of MVPA five years later ($p < .01$ for trend). Adolescents perceptions of mother modelling	N/A

					was not related to MVPA after 5 years but father modelling was related to MVPA among older females.	
Bauer, Neumark-Sztainer, Fulkerson, Hannan, and Story (2011) USA	N = 253, 15.7 years	CS	Subjective – 3DPAR (MVPA)	Modelling - 3 item scale Godin and Shephard (1985) parent self-reported and Sallis scale for total support	Estimate/ <i>p</i> -value	
					Parent modelling 0.40, <i>p</i> = .047	.126
					Family support 0.28, <i>p</i> = .169	.087
Beets, Pitetti, and Forlaw (2007) USA	N = 259, 15.5 ± 1.2 years	CS	Subjective – HBSC tool and 2 others	Sallis scale	Peer support β = .42	.42
Beets, Vogel, Chapman, Pitetti, and Cardinal (2007) USA	N = 39, 10 ± 0.8 years	CS	Pedometer (7 days)	Modified Sallis and Activity Support scale (parent self-report)	Mother encourage β = .102	.102
					Mother watch β = .100 (only 1 – not enough for meta-analysis)	.100
					Mother co-participation β = -.073	-.073
Bradley, McRitchie, Houts, Nader, and O'Brien (2011) USA	N = 405, 9-15 years at baseline	CS and Longitudinal	Accelerometer (7 days)	Does not reference scale source. Modelling and social support – parent self-report.	Parent encouragement ES = .02	.02
					Parent modelling = .09	.09
					Parent co-participation = .05	.05
					Parent transport ES = .14	.14
Brown, Frankel, and Fennell (1989) Canada	N = 376, 13-19 years	CS	Subjective – Assessed participation in intramural activity, interschool sport and community sport (number of years participate in).	Adolescent report – encouragement, support and modelling	<i>r</i> = Intramural, interschool, community	
					Total encouragement <i>r</i> = .32, .34, .17 (mean = .276)	.276
					Total support <i>r</i> = .28, .28, .13 (mean = .23)	.23

			Unclear of specific differences so took an average of the three for effect size.		Father encouragement $r = .18, .24, .18$ (mean = .20)	.20
					Mother encouragement $r = .14, .19, .10$ (mean = .143)	.143
					Father support $\beta = .197, \beta = .209, r = .19$ (mean = .203)	.203
					Mother support $r = .20, .19, .15$ (mean = .18)	.18
					Father modelling $r = .10, .12, .15$ (mean = .123)	.123
					Mother modelling $r = .08, \beta = .116, \beta = .202$ (mean $\beta = .159$)	.159
					Male friend encouragement $\beta = .147, r = .20, .03$	Not enough studies for meta-analysis
					Female friend encouragement $r = .14, \beta = .158, r = .12$	
					Male friend support $r = .20, .21, .08$	
					Female friend support $r = .19, .22, .11$	
Bungum and Vincent (1997) USA	N = 852, 14-18 years	CS	Subjective – Standford Physical Activity Recall Questionnaire	Peer modelling, parent modelling, friend support, family support [derived from Sallis, 1987]	No significant associations for all participants (some significant when separated by ethnic group –non-significant associations not reported)	N/A

Burns, Murphy, and MacDonncha (2014) UK	N = 871, 15.28 ± 1.8 years	CS	Stages of change model (Marcus et al., 2003)	Sallis scale for friend social support	Friend support $\beta = .17$	.17
Canfield (2012) USA	N = 265, 13.2 years	CS	Subjective – modified from PAQ-A and Sallis Amherst study	Parental encouragement and modelling, unclear where derived from	Parent modelling $\beta = .201$	.201
					Parent encouragement $\beta = -.126$	-.126
Cheng, Mendonca, and de Farias (2014) Brazil	N = 1336, 16.4 ± 1.2 years	CS	Subjective (MVPA) – previously used, cites validation study	Previously used support scale – cites validation study. Unclear on modelling.	Friend modelling: $\beta = .07$	.07
					Father modelling: $\beta = -.01$	-.01
					Mother modelling: $\beta = .08$	.08
					Friend social support: $\beta = .20$	.20
					Parent social support: $\beta = .17$	.17
Crawford et al. (2010) Australia	N = 173, 10-12 years	Longitudinal	Accelerometer (8 days)	Parents for social support, siblings for co-participation [adapted from Sallis]	Parent co-participation $b = 1.73, p < .05, (0.45-3.02)$ and father role modelling $b = 0.39, p < .05, (0.01-0.76)$	
Crimi, Hensley, and Finn (2009) USA	N = 90, 13.14 ± 2.64 years	CS	PAQ-C and PAQ-A	CPAC	Parent role modelling $r = .23$	.23
					Parent support $r = .32$	.32
					Parent encouragement $r = .31$	.31
Davison (2004) USA	N = 92, 12.5 ± 0.8 years	CS	CPA scale, Activity checklist and the PA subscale of the Physical Self-Description questionnaire	ACT scale – adolescent report	The percentage of girls who were highly active was significantly higher when one parent provided a high level of support in contrast to no parents providing a high level of support (OR = 0.14, CI = 0.03-0.60).	
Davison, Downs, and Birch (2006) USA	N = 174, 9-11 years at baseline	Longitudinal	Activity checklist and CPA scale	ACT scale – parent report	Parent support at 11 significantly predicted PA at age 11. Parental support at age 11 mediated the association between perceived competence	

					at 9 years and PA at 11 years. No association was identified between parental support for girls at age 9 years and perceived competence at 11 years but parental support for girls at 9 years predicted support at 11 years which in turn predicted PA at 11 years.	
de Farias, Reis, and Hallal (2014) Brazil	N = 1653, 16.4 ± 1.19	CS	Subjective – cites validation study MVPA – meets vs does not meet guidelines	Unclear scale, adolescent self-report	Parent social support OR: 2.69 (2.13, 3.39) 95% CI	.104
					Friend social support OR: 2.65 (1.94, 3.61) 95% CI	.259
Deflandre, Lorant, Gavarry, and Falgairette (2001) France	N = 22, 17 ± 0.9 years	CS	Subjective – Weekly MVPA (also notes ‘physical and sports activity’ but used MVPA in analysis).	Does not reference scale source – looks like custom scale. Measures modelling, encouragement and total support.	Father modelling $r = .35$	.35
					Mother modelling $r = .21$	.21
					Sibling modelling $r = .27$	.27
					Friend modelling $r = -.22$	.22
					Total encouragement $r = .16$	.16
Parent support $r = .31$	.31					
Dewar, Plotnikoff, and Morgan (2013) Australia	N = 235, 13.2 ± 0.4 years	CS and longitudinal	Objective – accelerometer (MVPA)	Unclear – looks like custom scale	Parent support baseline PA $r = -.01$	-.01
					Parent support 12 month PA $r = .08$	
DiLorenzo, Stucky-Ropp, Vander Wal, and Gotham (1998) USA	N = 54, 11.2 ± 0.7 years	Longitudinal and CS	PAI	CPAC (measured child reported parent modelling, child reported total support, parent reported modelling)	CS Mother modelling $F(4,49) = 5.36, p = .02$ (inversely)	-.316
					CS Total support $F(4,49) = 2.33, p = .13$	.209
					Longitudinal results (extent to which phase 1 support variables predict PA at phase 2 – 3 years later: The only support variable	

					that entered into the model was mother modelling which was inversely related $F(5,36) = 2.81$, $p = .10$	
Dishman, Dunn, Sallis, Vandenberg, and Pratt (2010) USA	N = 971, 10-16 years	CS and Longitudinal	Accelerometers (7 days) Daily METs weighted minutes of MVPA	Sallis scale	CS association between social support and PA in 6 th grade $r = .12$	.12
					There was not a significant direct path between social support and PA ($\beta = -.05$, $SE = .08$, $p = .548$). The authors attributed this to the covariance of self-efficacy and perceived social support ($\beta = .54$, $SE = .04$, $p < .001$) <i>(Between 6th and 8th grade)</i>	
Dishman, Saunders, Motl, Dowda, and Pate (2009) USA	N = 195, 13.6 ± 0.6 years	CS and Longitudinal	3DPAR	Modified Social Provisions Scale (Cutrona & Russell, 1987)	CS association between social support and PA $\beta = .52$	.52
					Change in social support on change in physical activity $\beta = .21$	.21
Dollman and Lewis (2009) Australia	N = 827, 11.97 ± 1.41	CS	PAQ-A	CPAC and modelling self-reported by parents (Prochaska, 1997)	Parent support $\beta = .32$	.32
Dowda, Dishman, Pfeiffer, and Pate (2007) USA	N = 421, 13.6 ± 0.7 years	CS and Longitudinal	3DPAR	Sallis scale (2002)	Family support 8 th grade $r = .26$	.26
					Family support 9 th grade $r = .23$	.23
					Family support 12 th grade $r = .26$	.26
					Longitudinal findings: Models indicate that girls who had higher family support at 8 th	

					grade had higher total MET scores and change in PA is significantly correlates with change in family support.	
Duncan, Duncan, Strycker, and Chaumeton (2007) USA	N = 186, 12.05 ± 1.63 years	CS and Longitudinal	Pedometers (7 days) and two single item questions based on Youth Risk Behavior Survey	Parent reported modelling (single item question), parent and friend support (Sallis 2002) and friend modelling (participant reported)	CS Friend modelling	.26
					Girls with more physically active friends had less of a decline in PA from ages 12 to 17. There was also an effect of time 1 friend PA on the slope, such that girls with initially more active friends had a greater decline in PA from ages 12 to 17. The authors attributed this to a change score effect. E.g. simultaneous estimation of change in the variable would indicate a decline in this covariate over time.	
Edwardson, Gorely, Pearson, and Atkin (2013) UK	N = 142, 12-16 years	CS	Objective – accelerometer	Activity Support Scale	Total sibling support $r = .29$ (not enough studies to perform meta-analysis)	N/A
Eime, Harvey, Craike, Symons, and Payne (2013) Australia	N = 732, 13.6 ± 1.96 years	CS	Subjective – single item question on sports involvement (yes/no response)	Sallis scale (although not referenced)	Family support $\beta = .39, .54, .57$. Mean $\beta = .50$	.50
					Friend support $\beta = .07, .04, .09$. Mean $\beta = .067$	.067

Frenn et al. (2005) USA	N = 52, 12.75 years	CS	CAAL	Family, friend and classmate support (Garcia, 1995)	Total support $\beta = .566$	.566
Graham, Bauer, Friend, Barr-Anderson, and Nuemark-Sztainer (2014) USA	N = 356, 15.8 \pm 1.2 years	CS and Longitudinal	Subjective – 3DPAR (average daily 30 minute blocks spent in MVPA)	Previously validated scale – references New Moves study	CS Family support $\beta = .55$	.55
					CS Friend support $\beta = .41$	.41
					CS Teacher support $\beta = .48$	.48
					CS Parent modelling $\beta = .51$	.51
					CS Friend modelling $\beta = .56$	.56
					Change in family support on MVPA at follow up $\beta = .30$	.30
					Change in friend support on MVPA at follow up $\beta = .31$	.31
					Change in teacher support on MVPA at follow up $\beta = .01$	.01
					Change in parent modelling on MVPA at follow up $\beta = .29$	.29
Change in friend modelling on MVPA at follow up $\beta = .21$	.21					
Graham, Wall, Larson, and Neumark-Sztainer (2014) USA	N = 1486, 14.4 \pm 2 years	CS	Subjective – modified LTEQ (MVPA)	Seems to be a combination of previously used and custom scales	Parent modelling $\beta = .021$	.021
					Mother modelling $\beta = -.125$	-.125
					Father modelling $\beta = .216$	.216
					Parent co-participation on $\beta = -.118$	-.118
					Parent instrumental support $\beta = .205$	.205
					Family support $p = .727$	.009
					Friend support $p = .025$	.058
Male friend modelling $\beta = .330$ (not enough studies for meta-analysis)	.330					

					Female friend modelling $\beta = -.317$ (not enough studies for meta-analysis)	-.317
Gregson and Colley (1986) UK	N = 130, 15-16 years	CS	Self-reported number of hours per week playing sport	Asks about mother and father involvement in sport	Mother modelling $\beta = .084$	.084
					Father modelling $\beta = .139$	.139
He et al. (2013) Japan	N = 280, 13.44 \pm 0.93 years	CS	Subjective – unclear on scale or if validated (lunch-time and after school PA)	Assesses family and friend support, no validation information	Family support (<i>on after school PA</i>) $\beta = .13$	.13
					Friend support (<i>on after school PA</i>) $\beta = .16$	.16
Huang, Wong, and Salmon (2013) China	N = 146, 11.2 \pm 0.9 years	CS	Subjective – CLASS-C (MVPA)	Assesses family and friend support and parent role modelling, no validation information	B (95%CI) Friend support = 0.95 (0.35, 1.54), $p < .01$	.213
Jackson et al. (2013) UK	N = 244, 12.8 \pm 0.9 years	CS	Subjective – PAQ-A (total PA)	Sallis scale for parent total support	Parent support $\beta = .51$	.51
Jago et al. (2011) UK	N = 330, 10-11 years	CS	Accelerometers (≥ 3 days)	ACT scale Guiding support defined as ‘rules for PA’	Mother logistic support on MVPA coefficient 1.7 (-0.50-3.93) 95% CI, $p = .13$	.084
					Guiding support on MVPA coefficient 1.2 (0.04-2.36) 95% CI, $p = .04$ (not enough studies for meta-analysis)	
Jago et al. (2014) UK	N = 215, 10 years	CS	Objective – accelerometer for mean minutes of weekday MVPA and after school MVPA (5 days)	Revised parent ACTs	Coefficient (95% CI) p	
					Mother modelling 0.28 (-4.45, 5.01), $p = .903$	.008
					Mother logistic support 2.7 (-1.44, 6.83), $p = .188$	.090

					Father modelling -1.05 (-4.96, 2.85), $p = .579$	-.038
					Father logistic support 0.41 (-3.79, 4.60), $p = .841$	.014
Kahn et al. (2008) USA	N = 7237, 10-16 years at baseline	CS and Longitudinal	Subjective – assessed time spent during past year in 18 PA's to estimate total PA	Mother modelling (self- reported by mothers). Unclear where scale derived from.	Mother modelling $\beta = .130$ for cross-sectional associations at baseline ($n = 7237$)	.130
					Evaluated whether baseline support modelling predicted follow-up PA. None of the variables significantly predicted follow-up PA – results not reported.	
Kelly et al. (2010) USA	N = 1180, 6 th grade	CS	Accelerometer (6 days)	Sallis scale for family and friend support	Family support Hispanic MVPA ($n = 185$) $b = 0.008$, $p = .418$	.06
					Friend support Hispanic MVPA ($n = 185$) $b = 0.027$, $p = .061$	.138
					Family support black MVPA (n $= 289$), $r = .07$	.07
					Friend support black MVPA (n $= 289$), $b = 0.026$, $p = .006$	.161
					Family support white MVPA (n $= 706$), $b = -0.001$, $p = .879$	.006
					Friend support white MVPA (n $= 706$), $b = 0.020$, $p = .010$	.097
Keresztes, Piko, Pluhar, and Page (2008) Hungary	N = 247, 12.2 \pm 1.2 years	CS	Subjective – Leisure Time PA	Modelling scale based on other studies self-reported by child	Parent modelling OR 2.72 (1.15-6.44) 95% CI	.266
					Sibling modelling OR 2.22 (1.24-3.97), 95% CI	.215
					Classmates modelling OR 2.83 (1.58-5.05), 95% CI	N/A

					(not enough studies for meta-analysis)	
					Friend modelling OR 2.48 (1.44-4.36), 95% CI	.243
					Boy/girlfriends PA OR 1.78 (1.15-3.30), 95% CI (not enough studies for meta-analysis)	N/A
Kirby, Levin, and Inchley (2011) UK	N = 328, P7 at baseline	Longitudinal	PAQ-C	Sallis scale	Friend support P7 OR 1.31 (0.68, 2.53), 95% CI	.074
					Friend support S2 OR 1.51 (0.78, 2.90), 95% CI	.113
					Friend support S4 OR 2.86 (1.55, 5.27), 95% CI	.278
					Father support P7 OR 1.58 (0.82, 3.07), 95% CI	.125
					Father support S2 OR 1.11 (0.53, 2.34), 95% CI	.029
					Father support S4 OR 1.48 (0.72, 3.03), 95% CI	.107
					Mother support P7 OR 1.80 (0.83, 3.93), 95% CI	.16
					Mother support S2 OR 1.70 (1.11, 2.61)	.145
					Mother support S4 OR 1.39 (0.54, 3.58)	.09
Kitzman-Ulrich, Wilson, Van Horn, and Lawman (2010) USA	N = 375, 11.4 ± 0.7 years	CS	Accelerometers (7 days)	Social Support for Exercise Scales (Sallis, 1987) - adolescent self-report	Family support $r = -.03$	-.03
					Friend support $r = .07$	.07

Krishnamoorthy (2002) USA	N = 101, 13 ± 1 years	CS	Accelerometers (7 days) and 7DPAR Used accelerometer data	Social Support for Exercise Scales (Sallis, 1987) and 7DPAR for modelling	Primary caregiver modelling $r = .13$ (not enough studies for meta-analysis)	.13
					Family support $r = .05$ (7DPAR)/ $r = -.20$ (accelerometer)	-.20
					Friend support $r = .03$ (7DPAR)/ $r = -.03$ (accelerometer)	-.03
Kuo, Young, Voorhees, and Haythornthwaite (2007) USA	N = 221, 13-15 years	CS	7DPAR	Sallis scale and family involvement in PA's scale	Family support significantly predicted PA at multivariate $p = .03$ (associated with A in bivariate $r = .18$)	.146
					Family modelling at multivariate $p = .04$, ($r = .17$ for bivariate)	.138
Kurc and Leatherdale (2009) Canada	N = 11,017, 14-19 years	CS	Self-report minutes of moderate and VPA in last 7 days: kilocalories per kg of body weight/day. Categorised into low active and active.	Parent support. No information on where scale derived from – seems to be custom scale. Categorised into low support or socially supported.	Low parent social support on low active OR 0.71 (0.58, 0.89)	.09
Lee, Loprinzi, and Trost (2010) Singapore	N = 895, 14.4 ± 1.1 years	CS	3DPAR	Sallis scale	Parent support $\beta = .129$	.129
Leggett, Irwin, Griffith, Xue, and Fradette (2012)	N = 15736, grade 9-12	CS	Subjective - Based on SHAPES to assess how	Child reported parent encouragement and how many of their closest	Parent encouragement active vs inactive OR 1.66 (1.50, 1.83), 95% CI	.138

Canada			much PA they did in the previous week	friends are physically active. No information on where scales derived from – seem to be custom.	3-5 active friends active vs inactive OR 2.14 (1.94, 2.36) 95% CI (modelling)	.205
Lenhart, Patterson, Brown, O'Brien, and Nelson (2014) USA	N = 168, 4 th /6 th /8 th grade	CS	Subjective – PAQ-C (Total PA)	The Social Support for Physical Activity Measure	Total support OR 9.03 (1.95, 41.75) 95% CI	.519
					Parent modelling OR 1.95 (0.98, 3.85) 95% CI	.181
Leslie, Kremer, Toumbourou, and Williams (2010) Australia	N = 1504, 11.4 ± 0.8 years	CS	Subjective – reported on how they usually travelled to and from school (active travel) As very similar measures used most modest results for each provider	Sallis scale (2002) for family and friend support	Odds of active travel to school with high family support OR 0.81 (0.58-1.13), 95% CI	-.058
					Odds of active travel from school with high family support OR 0.70 (0.50-0.99) 95% CI	-.098
					Odds of active travel to school with high friend support OR 1.27 (0.94-1.73) 95% CI	.066
					Odds of active travel from school with high friend support OR 1.36 (0.99-1.86) 95% CI	.085
Ling, Robbins, Resnicow, and Bakhoya (2014) USA	N = 509, 11.76 ± 0.76	CS	Objective – Accelerometer (7 days)	Total support – study aimed to validated scale	Total support on MVPA $r = .13$	.13
Lubans and Morgan (2009) Australia	N = 72, 14.2 ± 0.7 years	CS	Pedometer (4 school days) – mean steps/day	Sallis scale (friends)	Friend support $r = .260$	.260
McGuire, Hannan,		CS	LTEQ (Total PA)	Adolescent perceptions of parent encouragement,	Parent modelling partial $r = .06$, $p = .456$	.034

Neumark-Sztainer, Cossrow, and Story (2002) USA	N = 477, age not reported (adolescents)			parent self-reported PA and parent self-reported child encouragement (No information on where scales derived from – look like custom scales)	Parent reported encouragement partial $r = .15$, $p < .001$, $r = .152$) and adolescent reported parent encouragement partial $r = .15$, $p < .001$ ($r = .137$). Mean of constructs $r = .1445$	.1445
Morgan et al. (2003) USA	N = 99, 11.6 ± 0.6 years	CS	7DPAR	Teacher modelling, parent modelling, parent support and parent transport. Adapted from previously used scales.	Parent transport partial $r = .217$, $p < .05$	.198
Morrissey, Wenthe, Letuchy, Levy, and Janz (2012) USA	N = 144, 13 ± 0.26 years	CS	Accelerometer (up to 5 days)	Sallis scale	B, SE, p , partial r squared	
					Friend support on non-school MVPA $r = .12$	.12
					Family support on non-school MVPA B = 7.93, SE 2.41, $p = .001$, partial $r^2 = .081$	.271
					Family praise on non-school MVPA B = 5.80, SE 1.85, $p = .002$, partial $r^2 = .070$ (not enough studies for meta-analysis)	N/A
Motl, Dishman, Saunders, Dowda, and Pate (2007) USA	N = 1655, 17.7 ± 0.6 years	CS	3DPAR	Social provisions scale	Social support $\beta = .28$	.28
O'Loughlin, Paradis, Kishchuk,	N = 1141, 9-13 years	CS	7-day recall adapted from the self-reported weekly activity checklist (Sallis) to categorise into inactive,	Parent role modelling and support for PA – previously used scales by	Sports outside school Mother encourages sports OR 1.6 (1.2-2.6), 95% CI	.128

Barnett, and Renaud (1999) Canada			moderately active and frequently active. Sport team participation and participation in organised sports outside school.	author although unclear if validated.	Mother does sports OR 1.6 (1.1-2.1)	.128
Patnode et al. (2010) USA	N = 145, 15.3 ± 1.7 years	CS	Accelerometer (7 days) (MVPA)	No information on where scale derived from but looks like the Sallis scale for social support. Parent modelling self-reported by parents using IPAQ.	Parent support $r = .09$	.09
					Friend support $r = .13$	.13
					Parent modelling $r = .03$	.03
Pearson, Timperio, Salmon, Crawford, and Biddle (2009) Australia	N = 421, 11.2 ± 0.6 years	CS	Accelerometer (8 days)	No information on where scale derived from. Measures parents self-reported co-participation, transport and financial support.	Parent co-participation OR 1.36 (0.90-2.07) 95% CI	.084
					Parent transport OR 1.42 (0.98-2.07) 95% CI	.096
					Parent financial OR 1.56 (1.08-2.26) 95% CI	.122
Pis (2006) USA	N = 48, grades 5 and 6	CS	GLTEQ	Social Influences Scale	Total support $\beta = -.37$	-.37
Price et al. (2008) USA	N = 1000, aged 9-12 years	CS	Subjective – Weight bearing PA. Looks like custom scale.	Friend modelling scale, parent reported encouragement, parent reported modelling and parent co-participation scale (no information on where scales derived from – looks like custom scales).	Parent modelling $\beta = .03$	.03
					Parent talking $\beta = .06$ (not enough studies for meta-analysis)	.06
					Parent co-participation $\beta = .13$	.13
					Friend modelling $\beta = .09$	.09

Ramanathan and Crocker (2013) India	N = 69, 15.3 ± 1.1 years	CS	Subjective – PAQ-A (total PA)	Perceived parental attitudes scale (Welk, 2003)	Total parent support $\beta = .01$ (-.23, .28)	.01
Raudsepp and Viira (2000) Estonia	N = 191, 13.8 ± 0.5 years	CS	Subjective – 7 day PA recall (Sallis et al., 1985)	Parent and sibling modelling – 7 day PA recall (Sallis et al., 1985)	Brother modelling $\beta = .09$ (not enough (not enough studies for meta-analysis))	N/A
					Mother modelling $\beta = .12$	.12
					Sister modelling $\beta = .17$ (not enough studies for meta-analysis)	N/A
					Father modelling $\beta = .20$	.20
Raudsepp (2006) Estonia	N = 158, 13.8 years	CS	Subjective – 7 day PA recall (Sallis et al., 1985)	ACT - Parent reported	Father logistic $r = .32$	.32
					Father modelling $r = .35$	.35
					Mother logistic $r = .31$	.31
					Mother modelling $r = .33$	.33
Reynolds et al. (1990) USA	N = 355, 14 to 16 years	Longitudinal and CS	Self-reported total PA activity checklist (previously validated)	Modelling measured at 4 months post baseline (no information on where scales derived from – looks like customs scale.)	B, F, P-value (note that negative coefficient represents positive relationship in this analyses)	
					CS 4 month PA with modelling (all providers) -1.00, 12.04, $p = .0007$ (not enough studies for meta-analysis)	N/A
					4 month modelling with 16 month PA -0.34, 1.45, $p =$ not significant	
		CS and longitudinal	3DPAR	Friend social support (Duncan et al., 2005)	Friend support baseline with PA baseline $\beta = .25$	.25

Raudsepp and Viira (2008) Estonia	N = 193, 12.6 ± 0.5 years				Longitudinal findings: Change in PA was significantly and directly related to change in friend support $\beta = .51$	
Sallis, Prochaska, Taylor, Hill, and Geraci (1999) USA	N = 229 grades 4-6, N = 208 grades 7-9, N = 210 grades 10-12	CS	11-item scale to assess total PA	Social support scales developed	Family support grades 4-6 partial $r = .292$ ($p < .001$)	.216
					Family support grades 7-9 partial $r = .161$ ($p < .05$)	.136
					Family support grades 10-12 partial $r = .375$ ($p < .001$)	.225
Sallis, Taylor, Dowda, Freedson, and Pate (2002) USA	N = 99 in grades 4-6, N = 126 in grades 7-9, and N = 105 in grades 10-12	CS	Accelerometer (7 days)	Sallis scale for family and friend support, parent modelling	Friend support grade 4-6 $\beta = .16$	.16
					Family support grade 4-6 $\beta = .08$	.08
					Friend support grade 7-9 $\beta = .23$	.23
					Family support grade 7-9 $\beta = .02$	.02
					Friend support grade 10-12 $\beta = .01$	.01
					Family support grade 10-12 $\beta = .20$	.20
					Adult modelling grade 4-6 $r = .09$ (not enough studies for meta-analysis)	.09
					Adult modelling grade 7-9 $r = -.10$ (not enough studies for meta-analysis)	-.10
Adult modelling grade 10-12 $r = .004$	.004					

					(not enough studies for meta-analysis)	
Saunders, Motl, Dowda, Dishman, and Pate (2004) USA	N = 1797, 13.6 ± 0.6 years	CS	Subjective. MVPA measured using 3DPAR. Team sport involvement measured by 2-item scale.	Sallis scale	Family support for MPVA Y = .10	.10
Sawka et al. (2014) Canada	N = 535, 11 to 15 years	CS	Subjective – HBSC tool	Modelling – Linked nominated friends PA levels <i>Paper also measures and reports social support association but measure is not social support for PA so results not included</i>	Proportion of active close friends OR 1.14 (1.02-1.27)	.036
Schofield, Mummery, Schofield, and Hopkins (2007) Australia	N = 318, 16 ± 0.8 years	CS	Pedometers (4 days)	Step counts of (pedometer 4 days) three nominated friends	First nominated friend β = .41	.41
					Second nominated friend β = .16	.16
					Third nominated friend β = .12	.12
Shokrvash et al. (2013) Iran	N = 207, 12.93 ± 0.49	CS	Subjective – modified version of APARQ	Seems to be custom family support scale	Informational family support OR 1.10 (0.80-1.23) (not enough studies for meta-analysis)	N/A
					Emotional family support OR 1.02 (0.67-0.99) (not enough studies for meta-analysis)	N/A
					Instrumental family support OR 1.11 (1.02-1.24) (not enough studies for meta-analysis)	N/A

Shafer (2012) USA	N = 55, 18.7 ± 0.7 years	CS	7DPAR	Social Support for Exercise Scale (Sallis, 1987)	Friend support for moderate PA $r = -.056$; Friend support for hard PA $r = -.237$; Friend support for very hard PA $r =$.130; Friend support for total PA $\beta = -.037$ (used β value)	-.037
					Family support for moderate PA $r = .090$; Family support for hard PA $r = .133$; Family support for very hard PA $r =$.136; Family support for total PA $r = .094$. Mean $r = .120$	.120
Sharma et al. (2009) USA	N = 718, 11.6 ± 0.4 years	CS	Subjective – SAPAC for total physical activity and COPA for weight bearing PA	COPA for family and friend social support (co- participation and encouragement to be active)	Family encouragement mean mins/day PA $r = .19$ (not enough studies for meta- analysis)	N/A
					Family co-participation mean mins/day PA $r = .19$ (not enough studies for meta- analysis)	N/A
					Friend encouragement mean mins/day PA $r = .21$	N/A
					Friend co-participation mean mins/day PA $r = .24$	N/A
					Total support on LTPA $r = .26$	.26
		CS		Social support scale (Garcia et al., 1995)	Mother support $r = .26$	.26
					Father support $r = .14$	.14

Taymoori, Rhodes, and Berry (2010) Iran	N = 558, 14.43 ± 1.6 years		CAAL (minor modifications) for total PA (mins/week)		Sibling support $r = .10$ (not enough studies for meta-analysis)	N/A
					Friend support $r = .09$	.09
Thompson, Berry, and Hu (2013) USA	N = 39, 14.2 ± 1.6 years	CS	Modified version of the APARQ	FSS and SIS	Total family support $r = .167$	.167
					Total social support $r = .119$	.119
Ploeg et al. (2013) Canada	N = 717, 10.9 ± 0.4	CS	Pedometers (9 days)	ACTs	Parent encouragement B = 632 (108-1155), $p < .05$	.073
					Parent modelling B = 890 (67-1712), $p < .05$	.073
Voorhees et al. (2005) USA	Not reported	CS	PAQ-C	Asks several questions regarding co-participation and modelling.	Co-participation 6 th grade: Change in predicted PA 0.033 (0.009, 0.048), 95% CI, $p = .004$. (not enough data for meta-analysis)	N/A
					Co-participation 8 th grade: Change in predicted A 0.045 (0.022, 0.069), 95% CI, $p < .001$. (not enough data for meta-analysis)	N/A
Wenthe, Janz, and Levy (2009) USA	N = 103, 13 ± 0.3 years	CS	PAQ-A and accelerometers (up to 5 days)(total MVPA)	Sallis scale for family and friend support	Friend support on % MVPA $r = .16$	.16
					Family support (% MVPA) $\beta = .32$	.32

Williams (2010) USA	N = 96, 13-19 years	CS	GLTEQ	Social Influences Scale	Family support total PA (METS) $r = .238$	.238
					Friend support total PA (METS) $r = .261$	.261
					Total support PA (METS) $\beta = .144$	.144
Williams and Mummery (2011) Australia	N = 184, 15.1 \pm 1.2 years	CS	APARQ	Sallis scale (2002) with slight adaptations and modelling with single-item	Parent modelling OR 0.53 (0.22-1.27) 95% CI	-.172
					Parent support OR 5.36 (1.76-16.34), 95% CI	.42
Wilson and Dollman (2009) Australia	N = 113, 13.9 \pm 0.6 years	CS	3DPAR	No information on where scale derived from. Measures father, mother, best friend and teacher role modelling, co-participation, encouragement and instrumental support.	Anglo-Australian average daily METS father instrumental support $\beta = .38$	.38
					Vietnamese-Australian average daily METs father co-participation $\beta = -.23$ (not enough studies for meta-analysis)	N/A
					Vietnamese-Australian on average daily METs teacher instrumental support $\beta = .32$ (not enough studies for meta-analysis)	N/A

					Vietnamese-Australian on average daily METs mother co-participation $\beta = .43$; Vietnamese-Australian on MVPA mother co-participation $\beta = .40$; Anglo-Australian on VPA mother co-participation $\beta = -.34$. Mean $\beta = .163$	.163
					Anglo-Australian on MVPA mother encourage $\beta = .33$	.33
					Anglo-Australian on VPA teacher encourage $\beta = .31$ (not enough studies for meta-analysis)	N/A
					Anglo-Australian on VPA mother instrumental support $\beta = .43$	.43
Wu, Pender, and Noureddine (2003) Taiwan	N = 383, 13.5 \pm 0.7 years	CS	CAAL	Social support and modelling scales (Garcia et al, 1995)	Friend support $\beta = .26$	.26
					Parent support $\beta = -.08$	-.08
Young et al. (2014) USA	N = 4461, 6 th , 8 th , and 11 th grade	CS	Accelerometers (7 days)	Sallis scale and social network scale, custom scales for teacher and boy support	Parameter (SE), <i>p</i> value	
					6 th grade friend support 0.35 (0.13), <i>p</i> < .01	.065
					8 th grade friend support 0.19 (0.09), <i>p</i> = .04	.037

					8 th grade (2) friend support 0.32 (0.18), $p = .08$	.065
					11 th grade friend support 0.28(0.23), $p = .22$	.051
					6 th grade family support 0.03 (0.09) $p = .70$	.01
					8 th grade family support -0.01 (0.06), $p = .84$	-.004
					8 th grade (2) family support - 0.08 (0.11), $p = .08$	-.028
					11 th grade family support 0.07(0.13), $p = .61$	.021
					6 th grade teacher support - 0.2(0.14), $p = .16$	-.035
					8 th grade teacher support - 0.16(0.1), $p = .09$	-.031
					8 th grade (2) teacher support - 0.19(0.2), $p = .35$	-.035
					11 th grade teacher support - 0.11(0.24), $p = .65$	-.019
					6 th grade boy support - 0.15(0.10), $p = .14$	N/A

					(not enough studies for meta-analysis)	
					8 th grade boy support 0.02 (0.07), $p = .76$	N/A
					(not enough studies for meta-analysis)	
					8 th grade (2) boy support -0.13 (0.15), $p = .39$	N/A
					(not enough studies for meta-analysis)	
					11 th grade boy support 0.38 (0.19), $p = .04$	N/A
					(not enough studies for meta-analysis)	
					11 th grade friend modelling 0.45 (0.26), $p = .09$	.07
Zakarian, Hovell, Hofstetter, Sallis, and Keating (1994) USA	N = 815, 15.88 ± 1.17	CS	Subjective – single item question for VPA and activity checklist (for vigorous PA outside school)	Social support: Friend, family, teacher and coach. Modelling: Family, friend, teacher and coach. Unclear where scales derived from.	Family support $\beta = .14$	.14
					Coach support $\beta = .06$	N/A
					(not enough studies for meta-analysis)	
					Family modelling $\beta = .05$	.05

					Coach modelling $\beta = .04$ (not enough studies for meta-analysis)	N/A
					Friend support $\beta = -.03$	-.03
					Teacher modelling $\beta = -.03$ (not enough studies for meta-analysis)	N/A
					Teacher support $\beta = .01$	.01
					Friend modelling $\beta = .01$	.01
Zook, Saksvig, Wu, and Young (2014) USA	N = 589, 12.29 \pm 1.48 years	Longitudinal	Objective - Accelerometers (7 days)	Modified Sallis scale and social network instrument	OR (95%CI)	
					Friend support 1.19 (1.04-1.35)	.048
					Family support 1.11 (1.02-1.20)	.029
					Friend modelling 1.22 (0.78-1.89)	.055
					Friend co-participation 1.34 (1.13-1.59)	.080

Physical activity measures: CLASS-C The Children's Leisure Activities Study Survey Questionnaire – Chinese version; APARQ – Adolescent Physical Activity Recall Questionnaire; 3DPAR - 3-day physical activity recall questionnaire; 7DPAR – 7-day Physical Activity Recall Questionnaire; SOPLAY – System for Observing Play and Leisure Activity in Youth (objective observations); LTEQ – Leisure Time Exercise Questionnaire; CPA – The Children's Physical Activity scale; PAI – Physical Activity Interview; SAPAC – Self Administered Physical Activity Checklist; COPA – Calcium, Osteoporosis and Physical Activity Survey; CAAL – The Child/Adolescent Activity Log; GLTEQ – Godin's Leisure Time Exercise Questionnaire.

Social support measures: ACTs – Activity Support Scale; FSS – Family Support Scale (Felton et al, 2002); SIS – Social Influences Scale (Saunders et al., 1997); CPAC – The Children's Physical Activity Correlates questionnaire.

PA: Physical activity

Systematic review and meta-analysis reference list of included studies

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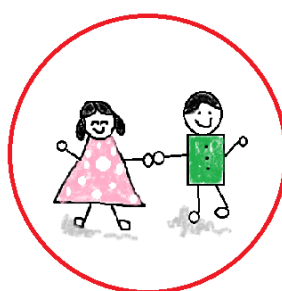
Appendix B: Friends, Family, and Health 4 U: Participant Information Letter (Chapter 4)



THE UNIVERSITY of EDINBURGH



Friends, Family, and Health 4 U



Participant Information Letter

Hello,

We are asking if you would join in a research project to find the answer to the question:

Do your friends and family influence your physical activity experiences and behaviour?

Before you decide if you want to join in, it's important to understand why the research is being done and what it will involve for you. So please consider this leaflet carefully. Talk to your family, friends, doctor or nurse if you want to.

Why are we doing this research?

Regular physical activity is important for health and we want to know if friends and family influence physical activity choices and experiences of a physical activity and health intervention (Health 4 U). If your school does not receive Health 4 U the information we collect from you will be compared to girls at schools who do receive

it. This project will measure how much physical activity you do and see if there is a link with how supported you feel to do physical activity by your friends and family and how confident you are about doing physical activity.

Why have I been invited to take part?

You have been invited to take part in this research because you are a 3rd year girl at a high school in or around Edinburgh.

Do I have to take part?

No. It is up to you. We will ask you for your consent and then ask if you would sign a form. We will give you a copy of this information sheet and your signed form to keep. You are free to stop taking part at any time during the research without giving a reason. There will be no negative consequences if you decide to stop.

What will I have to do if I want to take part?

You will be asked to wear a pedometer for 7 days (a small device which attaches to clothing and is worn on the hip which measures how many steps you walk each day). When you hand the pedometer back you will then be asked to fill out a short questionnaire which will take around 10 minutes. You will be asked to do this at three separate time points during the school year. The researcher will visit your PE class to give out the pedometers and the questionnaires will be completed during your normal PE class.

What do I do if I decide I want to take part?

If you would like to take part in the study please return the consent form to your PE class within the next week. You will need to sign a copy and you will be given one to keep for your information. A member of the research team will be there to collect your consent form. This will give you at least a week to decide if you would like to take part.

What are the potential benefits or risks of taking part?

The study may not directly help you but the information we get might help us to understand ways to help other young people be more physically active in the future.

If you decide to take part we will enter each girl who remembers to wear their pedometer every day and returns it into a prize draw to win a voucher. There will be one voucher available per class each time we ask you to wear a pedometer (up to 3 chances to win).

There are not many risks to taking part in this study but it might be that you feel uncomfortable or upset answering some questions in the questionnaire about friendships and family. You do not have to answer any questions if you do not wish to. If you tell us you are upset about something we might tell your guidance teacher if we think you might need someone to help you.

What if there is a problem?

If you do not feel happy about something related to this study please tell us or your parents immediately. If you tell us about you or anyone else being hurt we will have to tell your guidance teacher. They will then follow the usual procedures to help you.

Will anyone else know I'm doing this?

We will keep your information in confidence. This means we will only tell those who have a need or right to know, for example your parents or teachers. Wherever possible, we will only send out information that has your name and address removed.

What will happen with the information from this study?

All the answers and information collected will form part of a research study. We will share our findings of this study with other researchers and with Edinburgh Leisure and others involved with promoting physical activity to teenage girls. We will also provide your school with a summary of the results. We will make sure we do not use your actual name when we report your answers.

Who are we?

We are researchers at the University of Edinburgh. Yvonne Laird is the main researcher. She organised this research to find out more about girls like you and what you think about physical activity and how your friends and family might influence how active you are. We will also be comparing activity data between schools receiving a physical activity and health intervention (Health 4 U) and schools receiving normal PE lessons. The study has been funded by the Economic and Social Research Council (ESRC).

Before any research goes ahead it has to be checked by a Research Ethics Committee. They make sure that the research is fair. This project has been checked by the NHS Solihull Research Ethics Committee and the Moray House Research Ethics Committee at the University of Edinburgh.

If you want to find out more about the project contact Yvonne Laird on 0131 651 4111 or Yvonne.Laird@ed.ac.uk

If you would like to talk about this study with someone independent of the study please contact: Dr Simon Coleman on 0131 651 6653 or Simon.Coleman@ed.ac.uk

If you would like to make a complaint about the study please contact NHS Lothian:

NHS Lothian Complaints Team

2nd Floor, Waverly Gait

2-4 Waterloo Place

Edinburgh

EH1 3EG

Tel: 0131 465 5708

Thank you for taking the time to read this information sheet, please ask any questions if you need to

Appendix C: Friends, Family, and Health 4 U: Parent Information Letter (Chapter 4)



THE UNIVERSITY of EDINBURGH



Friends, Family, and Health 4 U

Parent Information Letter

Dear Parents/Caregivers,

Your child has been invited to take part in our research study being conducted by researchers at the University of Edinburgh. We would encourage you to read the following information letter in order to understand why the research is being done and what it would involve for your child. This information sheet will assist you in helping your child to decide whether or not she wants to take part.

What is the Friends, Family, and Health 4 U study?

Regular physical activity is important for health and we want to know if friends and family influence adolescent girls' physical activity choices. This project will measure how much physical activity the girls are doing and allow us to see if there is a link with how much support they feel they get from others to do physical activity. We will be comparing information collected from S3 girls involved in a physical activity intervention (Health 4 U) with girls receiving normal PE classes.

Why has my child been invited to take part in the study?

Your child has been invited to take part in the study because she is a 3rd year pupil at a high school in or around Edinburgh. She will either be receiving Health 4 U as part of PE or she will be receiving normal PE.

Does my child have to take part in the study?

No, taking part in the study is optional. If your child does agree to take part she can still change her mind at any time without having to give a reason and there will be no negative consequences for doing so.

What will my child have to do if she agrees to take part?

If your child agrees to take part they will be asked to wear a pedometer for 7 days (a small device which attaches to an item of clothing on the hip which records how many steps your daughter takes each day). When she hands the pedometer back she will then be asked to fill out a short questionnaire which will take around 10 minutes to complete. She will be asked to do this on up to three separate occasions during the school year. The researcher will visit your child's PE class to give out the pedometers and the questionnaires will be completed during your child's normal PE class.

What will happen with my child's data?

The questionnaires and pedometer data will be entered onto a password protected computer at the University of Edinburgh with your child's name and address removed so that they cannot be identified. The hard copies of the questionnaires will be stored in a locked filing cabinet at the University of Edinburgh for 5 years.

Will my child's responses and data to this research be kept confidential?

All the data collected as part of the research will be treated confidentially. The data collected will be made available for other researchers to use but any data which could identify your child will be removed. Any data reported will have your child's name and address removed so that they cannot be identified.

What are the potential benefits or risks of taking part?

The study may not directly help your child but the information we get might help us to understand ways to help other young people be more physically active in the future.

If your child decides to take part we will enter each girl who remembers to wear their pedometer every day and returns it into a prize draw to win (either a voucher for Edinburgh Leisure or a multiuse voucher - this will ideally be something which promotes health and PA and things which discourage it will be avoided) There will be one voucher available per class at each data collection point (up to 3 chances to win).

There are not many risks to taking part in this study but it might be that your child feels upset answering questions relating to friendships and family in the questionnaire. The risk of this is minimal and the questions are designed to be unobtrusive.

What if there is a problem?

It is very unlikely that your child will have a problem by taking part in this study. If you or your child would like to make a complaint about something to do with the study you can contact the research team directly (0131 651 4111 or email Yvonne.Laird@ed.ac.uk) or you can contact NHS Lothian Complaints Team (NHS Lothian Complaints Team, 2nd Floor, Waverly Gate, 2-4 Waterloo Place, Edinburgh, EH1 3EG, Tel: 0131 465 5708).

We may contact your child's guidance teacher if we feel your child needs additional support relating to the disclosure of personal issues.

If your child tells us that she or anyone else is being harmed we will in notify your child's guidance teacher who will take relevant action.

What will happen with the information from this study?

The results of this study will be published as part of Yvonne Laird's PhD thesis and in research journals. The findings will be communicated to Edinburgh Leisure and other physical activity practitioners and at scientific conferences. The data will be available for other researchers to use with any identifying data removed. We will also provide a summary of the results to the schools involved. All shared data will have any identifying data removed.

What does my child do now if she wants to take part?

If your child would like to take part and you are happy for them to do so they should read the "Participant Information Sheet" and sign the "Participant Consent Form" and bring all copies of the consent form to their next PE class. This should give you and your child at least a week to read and consider the information before giving consent. A member of the research team will arrange an appropriate time with the school to collect consent.

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

Unless you tell us otherwise, your daughter will take part in the study if she chooses to do so. If you would not like your child to take part in this study please complete and sign the attached "Parents/Guardians Consent Form" and ask your child to return it to her PE teacher **before 11th December 2013**. Alternatively, you can let us know by telephone (0131 651 4111) or by email (Yvonne.Laird@ed.ac.uk). If we do not hear from you by 11th December 2013 we will assume you are happy for your child to take part in the study if they choose to do so.

Who is organising and funding this research?

This study has been organised by Yvonne Laird, Ailsa Niven, and Samantha Fawkner, at the University of Edinburgh in partnership with Edinburgh Leisure.

Before any research goes ahead it has to be checked by a Research Ethics Committee. They make sure the research is fair. This project has been checked by the Solihull Research Ethics Committee and the Moray House Research Ethics Committee at the University of Edinburgh.

If you would like to find out more about the project please contact Yvonne Laird (Doctoral student) on 0131 651 4111 or Yvonne.Laird@ed.ac.uk.

If you would like to talk about this study with someone independent of the study please contact: Dr Simon Coleman on 0131 651 6653 or Simon.Coleman@ed.ac.uk

Appendix D: Friends, Family, and Health 4 U: Parent Consent Form (Chapter 4)



THE UNIVERSITY *of* EDINBURGH



Friends, Family, and Health 4 U

Parent Consent Form

Please only complete this form if you **DO NOT** want your child to take part in the study.

Alternatively, you can let us know by telephone (0131 651 4111) or email (Yvonne.Laird@ed.ac.uk) by **11th December 2013** if you do not want your child to take part.

Please make sure you return this form by **11th December 2013**. If we do not received this form from you we will assume you are happy for your child to take part in the study if they choose to do so.

Parents/guardians:

I wish to withdraw my child from the Friends, Family, and Health 4 U study

Pupil's name: _____

Name of school: _____

Parent/guardian's name: _____

Parent/guardian signature: _____

Date: _____

Appendix E: Friends, Family, and Health 4 U: Participant Consent Form (Chapter 4)



THE UNIVERSITY of EDINBURGH

Friends, Family, and Health 4 U

Participant Consent Form

Participant ID:

Please initial box

1. I confirm that I have read and understand the information sheet dated
(version.....) for the above study. I have had the opportunity to
consider the information, ask questions and have had these answered satisfactorily.
2. I understand that my participation is voluntary and that I am free to withdraw at any
time, without giving any reason and without any consequences.
3. I understand that the information recorded in the investigation will be made publically
available to other researchers to use but with any information that could identify me
removed and any information recorded in the investigation will remain confidential.
4. I understand that if child protection issues are disclosed then my
guidance teacher will be informed who will take necessary action.
5. I understand and agree that the data collected will be used for a research
thesis and will be published in scientific literature and presented at
scientific conferences.
6. I agree to a summary of the data collected being provided to my school
and I understand that I will not be identifiable from this data.
6. I agree to take part in the above study

Name of Participant

Date

Signature

Name of person taking consent

Date

Signature

When completed: 1 copy for participant; 1 copy for researcher.

**Appendix F: Friends, Family, and Health 4 U Questionnaire
(Chapter 4)**

Friends, Family, and Health 4 U: Questionnaire

Name:

School:

Date of birth:

Postcode:

Nationality:

PHYSICAL ACTIVITY IS ANY BODY MOVEMENT

Moderate physical activity is any activity that makes your heart beat faster and makes you get out of breath some of the time. You may also sweat a little. Physical activity can be done in sports, school activities, playing with friends or walking to school. Some examples of physical activity are running, walking quickly, cycling, dancing, skateboarding, swimming, football, gymnastics.

For the next two questions, add up all the time you spend in moderate physical activity each day.

Question 1. Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes (one hour) per day?

- | | | | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 0 days | 1 | 2 | 3 | 4 | 5 | 6 | 7 days |

Question 2. Over a typical or usual week, on how many days are you physically active for a total of at least 60 minutes (one hour) per day? Please tick the correct number of days.

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0 days	1	2	3	4	5	6	7 days

Question 3. 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"/>
Street hockey.....	<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"/>
Floor 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"/>
Ice skating.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cross-country skiing.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice hockey	<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"/>
_____.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 4. 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

Question 5. 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

Question 6. In the last 7 days, on how many days *immediately 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

Question 7. 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 times last week
- 5 times last week

Question 8. *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 last week
- 2 or 3 times last week
- 4 times last week
- 5 times last week

Question 9. 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.

- F. All or most of my free time was spent doing things that involve little physical effort
- G. 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)
- H. I often (3 – 4 times last week) did physical things in my free time
- I. I quite often (5 – 6 times last week) did physical things in my free time ..
- J. I very often (7 or more times last week) did physical things in my free time

Question 10. 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"/>

Question 11. 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? _____

Question 12.

	1 (disagree a lot)	2	3	4	5 (agree a lot)
I can be physically active during my free time on most days	1	2	3	4	5
I can ask my parent or other adult to do physically active things with me	1	2	3	4	5
I can be physically active during my free time on most days even if I could watch TV or play video games instead	1	2	3	4	5
I can be physically active during my free time on most days even if it is very hot or cold outside	1	2	3	4	5
I can ask my best friend to be physically active with me during my free time on most days	1	2	3	4	5
I can be physically active during my free time on most days even if I have to stay at home	1	2	3	4	5
I have the coordination I need to be physically active during my free time on most days	1	2	3	4	5
I can be physically active during my free time on most days no matter how busy my day is	1	2	3	4	5

Question 13. During a typical week how often has a **male** adult (e.g. your father/stepfather) in your house... (TICK ONE FOR EACH) *If not applicable then leave blank and move to question 14.*

	Never	Once	Sometimes	Almost every day	Every day
Done a physical activity or played sports with you?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provided transportation to a place where you can do physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Watched you participate in physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Told you that you are doing well in physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 14. During a typical week how often has a **female** adult (e.g. your mother/stepmother) in your house... (TICK ONE FOR EACH) *If not applicable leave blank and move to question 15.*

	Never	Once	Sometimes	Almost every day	Every day
Done a physical activity or played sports with you?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provided transportation to a place where you can do physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Watched you participate in physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Told you that you are doing well in physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 15. During a typical week, how often . . . (TICK ONE FOR EACH)

	Never	Once	Sometimes	Almost every day	Every day
Do your friends encourage you to do physical activities or play sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do your friends do physical activities or play sports with you?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do your friends tell you that you are doing well at physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 16. During a typical week how often has a **teacher** . . . (TICK ONE FOR EACH)

	Never	Once	Sometimes	Almost every day	Every day
Done a physical activity or played sports with you?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provided transportation to a place where you can do physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Watched you participate in physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Told you that you are doing well in physical activities or sports?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 17.

	No confidence at all				Somewhat confident				Completely confident			
	0	1	2	3	4	5	6	7	8	9	10	
1. I believe I can be physically active for a total of 60 minutes on 1 or 2 days of the week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
2. I believe I can be physically active for a total of 60 minutes on 3 or 4 days of the week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
3. I believe I can be physically active for a total of 60 minutes on 5 or 6 days of the week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
4. I believe I can be physically active for a total of 60 minutes on 7 days of the week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

Thank you for completing this questionnaire 😊

Appendix G: NHS Ethical Approval Health 4 U (Chapter 4)



Health Research Authority

NRES Committee West Midlands - Solihull

East Midlands REC Centre
The Old Chapel
Royal Standard Place
Nottingham
NG1 6FS

Telephone: 0115 8839435

14 October 2013

Miss Yvonne Laird
PhD student
University of Edinburgh
Room 2.32 St Leonards Land
Holyrood Road
Edinburgh
EH8 8AQ

Dear Miss Laird

Study title:	Health 4 U: Evaluation of the effectiveness of an 8-week health and physical activity intervention for adolescent girls on physical activity
REC reference:	13/WM/0418
Protocol number:	N/A
IRAS project ID:	132834

The Proportionate Review Sub-committee of the NRES Committee West Midlands - Solihull reviewed the above application on 09 October 2013.

We plan to publish your research summary wording for the above study on the NRES website, together with your contact details, unless you expressly withhold permission to do so. Publication will be no earlier than three months from the date of this favourable opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to withhold permission to publish, please contact the REC Manager, Wendy Rees NRESCommittee.WestMidlands-Solihull@nhs.net.

Ethical opinion

- The study involves asking females aged 14 – 15 years old to answer questionnaires regarding their normal physical exercise.
- There are information sheets for participants and parents.
- If parents do not want their child to take part they must write to opt out.
- The Participant Information Sheet stated that the study would start in

September 2013. This date needs to be updated to the correct date following ethical approval.

- The Committee noted that the name of the research ethics committee was incorrect and requested that this was updated .
- The Committee discussed the need for PALS to be listed and agreed this was not necessary. The Committee discussed whether girls of this age could get upset filling in the questionnaires and agreed that there were no particularly sensitive issues involved
- The Committee agreed this was suitable for proportionate review under Category 8

On behalf of the Committee, the sub-committee gave a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see “Conditions of the favourable opinion” below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission (“R&D approval”) should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at <http://www.rdforum.nhs.uk>.

Where a NHS organisation’s role in the study is limited to identifying and referring potential participants to research sites (“participant identification centre”), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations.

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the

current registration and publication trees).

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non clinical trials this is not currently mandatory.

If a sponsor wishes to contest the need for registration they should contact Catherine Blewett (catherineblewett@nhs.net), the HRA does not, however, expect exceptions to be made. Guidance on where to register is provided within IRAS.

The following changes are required in the Participant Information Sheet.

1. The date of the start of the study should be updated as it currently states a date that has already passed.
2. The name of the Research Ethics Committee should be updated to the 'Solihull' Research Ethics Committee.

You should notify the REC in writing once all conditions have been met (except for site approvals from host organisations) and provide copies of any revised documentation with updated version numbers. The REC will acknowledge receipt and provide a final list of the approved documentation for the study, which can be made available to host organisations to facilitate their permission for the study. Failure to provide the final versions to the REC may cause delay in obtaining permissions.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The documents reviewed and approved were:

<i>Document</i>	<i>Version</i>	<i>Date</i>
Evidence of insurance or indemnity		25 June 2013
Investigator CV	Dr Ailsa Niven	
Investigator CV	Samantha Fawkner	
Other: CV for Yvonne Laird		
Participant Consent Form	1.1	25 June 2013
Participant Consent Form: Parent Consent Form	1.1	25 June 2013
Participant Information Sheet	1.1	25 June 2013
Participant Information Sheet: Parent Information Letter	1.1	25 June 2013
Protocol	1.1	30 July 2013
Questionnaire	1.1	01 October 2013
REC application	132834/508273/1/666	02 October 2013

Membership of the Proportionate Review Sub-Committee

The members of the Sub-Committee who took part in the review are listed on the attached sheet.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document “After ethical review – guidance for researchers” gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website. information is available at National Research Ethics Service website > After Review

13/WM/0418	Please quote this number on all correspondence
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We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at <http://www.hra.nhs.uk/hra-training/>

With the Committee's best wishes for the success of this project.

Yours sincerely



Email: NRESCommittee.WestMidlands-Solihull@nhs.net

Enclosures: List of names and professions of members who took part in the review

“After ethical review – guidance for researchers”

Copy to:

Ms Marianne Laird

N/A. R&D contact not specified in database.

NRES Committee West Midlands - Solihull

Attendance at PRS Sub-Committee of the REC meeting on 09 October 2013

Committee Members:

<i>Name</i>	<i>Profession</i>	<i>Present</i>	<i>Notes</i>
Mrs Irene Linder	Assistant Manager, Local Authority - Retired	Yes	
Dr Rex J Polson	Consultant Physician - Chair	Yes	
Dr Timothy Priest	Consultant in Pain Management - Vice Chair	Yes	

Also in attendance:

<i>Name</i>	<i>Position (or reason for attending)</i>
Wendy Rees	REC Manager
Leni Robson	REC Assistant

24 October 2013

Miss Yvonne Laird
 University of Edinburgh
 Room 2.32 St Leonards Land
 Holyrood Road
 Edinburgh
 EH8 8AQ

Dear Miss Laird,

Study title:	Health 4 U: Evaluation of the effectiveness of an 8-week health and physical activity intervention for adolescent girls on physical activity
REC reference:	13/WM/0418
Protocol number:	N/A
IRAS project ID:	132834

Thank you for your letter of 2rs October 2013. I can confirm the REC has received the documents listed below and that these comply with the approval conditions detailed in our letter dated 14 October 2013

Documents received

The documents received were as follows:

<i>Document</i>	<i>Version</i>	<i>Date</i>
Covering Letter		23 October 2013
Participant Consent Form	1.2	16 October 2013
Participant Consent Form: Parent	1.2	16 October 2013
Participant Information Sheet: Parent	1.2	16 October 2013
Protocol	1.2	22 October 2013
Questionnaire	1.2	21 October 2013

Approved documents

The final list of approved documentation for the study is therefore as follows:

<i>Document</i>	<i>Version</i>	<i>Date</i>
Covering Letter		23 October 2013
Evidence of insurance or indemnity		25 June 2013
Investigator CV	Dr Ailsa Niven	
Investigator CV	Samantha Fawkner	
Other: CV for Yvonne Laird		
Participant Consent Form	1.2	16 October 2013
Participant Consent Form: Parent	1.2	16 October 2013
Participant Information Sheet	1.1	25 June 2013
Participant Information Sheet: Parent	1.2	16 October 2013
Protocol	1.2	22 October 2013
Questionnaire	1.2	21 October 2013
REC application	132834/508273/1/666	02 October 2013

You should ensure that the sponsor has a copy of the final documentation for the study. It is the sponsor's responsibility to ensure that the documentation is made available to R&D offices at all participating sites.

13/WM/0418	Please quote this number on all
correspondence	

Yours sincerely,



Rebecca Morledge
REC Assistant

E-mail: NRESCCommittee.WestMidlands-Solihull@nhs.net

Copy to: *Ms Marianne Laird*

Appendix H: Moray House Ethical Approval Health 4 U (Chapter 4)



Research & Knowledge Exchange
MORAY HOUSE SCHOOL of EDUCATION

Yvonne Laird
SPEHS
Room 2.32
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30 July 2013

Dear Yvonne

Friends, Family and Health 4 U

The School of Education Ethics Sub-Committee has now considered your request for ethical approval for the studies detailed in the your application.

This is to confirm that the Sub-Committee is happy to approve the application and that the research meets the School Ethics Level 2 criterion. This is defined as "covering novel procedures or the use of atypical participant groups – usually projects in which ethical issues might require more detailed consideration but were unlikely to prove problematic".

A standard condition of this ethical approval is that you are required to notify the Committee, of any significant proposed deviation from the original protocol. The Committee also needs to be notified if there are any unexpected results or events once the research is underway that raise questions about the safety of the research.

Yours sincerely

Dr S Bayne
Convener, School Ethics Sub-Committee

Appendix I: Friends, Family, and Physical Activity: Participant Information Letter (Chapter 5)



THE UNIVERSITY *of* EDINBURGH

The Physical Activity for Health Research Centre (PAHRC)

Friends, Family, and Physical Activity

Participant Information Letter

Hello,

We would like to invite you to take part in a project to find the answer to the question:

Do your friends and family influence your physical activity experiences and behaviour?

Before you decide if you want to join in, it's important that you understand why the research is being done and what it will involve for you. So please consider this leaflet carefully. Talk to your family, friends, or teachers if you want to.

Why are we doing this research?

Regular physical activity is important for health and we want to know if friends and family influence physical activity choices and experiences. This project will involve speaking to girls like you about how much physical activity you do and how your friends and family might influence this.

Why have I been invited to take part?

You have been invited to take part in this research because you are a 3rd year girl at a participating high school in Edinburgh.

Do I have to take part?

No. It is up to you. We will ask you if you would like to take part and then ask if you would sign a form to agree to take part. We will give you a copy of this information sheet and your signed form to keep. You are free to stop taking part at any time during the research without giving a reason. There will be no negative consequences if you decide to stop.

What will I have to do if I want to take part?

You will be asked to attend an interview with the researcher (Yvonne) for around 30 minutes, which will take place during a normal PE class. Yvonne will ask you about the sort of physical activities you do in a normal week and she will ask you about whether your friends or family influence your physical activity levels. The interview will be relaxed and informal and you can stop it at any time. The interview will be audio-recorded so that Yvonne can later type it up as a word document to have a record of what was said.

What are the potential benefits or risks of taking part?

The study may not directly help you but the information we get might help us to understand ways to help other young people be more physically active in the future.

There are not many risks to taking part in this study but it might be that you feel uncomfortable or upset answering some questions in the interview about friendships and family. You do not have to answer any questions if you do not wish to and you can stop the interview at any time. If you tell us you are upset about something we might tell your guidance teacher if we think you might need someone to help you.

What if there is a problem?

If you do not feel happy about something related to this study please tell us or your parents immediately. If you tell us about you or anyone else being hurt we will have to tell your guidance teacher. They will then follow the usual procedures to help you.

Will anyone else know I'm doing this?

We will keep your information in confidence. This means we will only tell those who have a need or right to know, for example your parents or teachers. Your classmates will know that you are taking part as the interviews will take place during PE.

What will happen with the answers I give?

If you don't mind we will record the interview with a voice recorder and later type up the recordings on a computer. After we have typed up the recordings, all the recordings of your voice will be deleted.

Your name won't appear on any written information. When we report the findings of our study we will use made-up names, so no one will know what you said. Only the researchers will know who said what and we will not share this information with your parents, teachers, or friends.

We will contact you after all the interviews are finished to check we understood what you said and meant if this is OK with you.

What will happen with the information from this study?

All the answers and information collected will form part of a research study. We will share our findings of this study with other researchers and others interested in adolescent girls' physical activity levels. We will also provide your school with a summary of the results. We will not use your actual name when we report your answers.

Who are we?

We are researchers at the University of Edinburgh. Yvonne Laird is the main researcher. She organised this research to find out more about girls like you and what you think about physical activity and how your friends and family might influence how active you are. The study has been funded by the Economic and Social Research Council (ESRC).

Before any research goes ahead it has to be checked by a Research Ethics Committee. They make sure that the research is fair. This project has been checked by the Moray House Research Ethics Committee at the University of Edinburgh.

If you want to find out more about the project contact Yvonne Laird on 0131 651 4111 or Yvonne.Laird@ed.ac.uk

If you would like to talk about this study with someone independent of the study please contact: Dr Simon Coleman on 0131 651 6653 or Simon.Coleman@ed.ac.uk

What do I do if I decide I want to take part?

If you would like to take part in the study please return the consent form (**and signed parental consent**) to your PE class as soon as possible. Yvonne will come to your PE class again to talk about the study again and to answer any questions. This will give you at least a week to decide if you would like to take part.

What if I do not want to take part?

If you do not want to take part in the study you do not need to do anything. You will only be invited to take part in an interview if you return the consent form and signed parental consent form.

Thank you for taking the time to read this information sheet, please ask any questions if you need to

Yvonne Laird

Appendix J: Friends, Family, and Health 4 U: Parent Information Letter (Chapter 5)



THE UNIVERSITY *of* EDINBURGH

Friends, Family, and Physical Activity

Parent Information Letter

Dear Parents/Caregivers,

Your child has been invited to take part in our research study being conducted by researchers at the University of Edinburgh. We would encourage you to read the following information letter in order to understand why the research is being done and what it would involve for your child. This information sheet will assist you in helping your child to decide whether or not she wants to take part.

What is the purpose of this research study?

Regular physical activity is important for health and we want to know if friends and family influence adolescent girls' physical activity choices. This project involves interviewing adolescent girls to talk about how much physical activity they do and about how much support they feel they get from others to do physical activity. The interviews will last around 30 minutes and will take place during one of your daughters' normal PE classes. The interviews will be recorded using a digital voice recorder so that the researcher can later type up the interviews.

Why has my child been invited to take part in the study?

Your child has been invited to take part in the study because she is a 3rd year pupil at a participating high school in Edinburgh. She has been identified as a pupil who regularly does physical activity.

Does my child have to take part in the study?

No, taking part in the study is optional. If your child does agree to take part she can still change her mind at any time without having to give a reason and there will be no negative consequences for doing so.

What does my child do now if she wants to take part?

If your child would like to take part and you are happy for them to do so they should read the “Participant Information Sheet” and sign the “Participant Consent Form” and bring all copies of the consent form to their next PE class. This should give you and your child at least a week to read and consider the information before giving consent. A member of the research team will arrange an appropriate time with the school to collect consent.

Will my child’s responses and data to this research be kept confidential?

All the data collected as part of the research will be treated confidentially. The audio recordings will be uploaded to a password protected computer then later deleted after they have been typed up as anonymous text. The data collected will be made available for other researchers to use but any data which could identify your child will be removed. Any data reported will have your child’s name removed so that she cannot be identified.

What are the potential benefits or risks of taking part?

The study may not directly help your child but the information we get might help us to understand ways to help other young people be more physically active in the future.

There are not many risks to taking part in this study but it might be that your child feels upset answering questions relating to friendships and family in the questionnaire. The risk of this is minimal and the questions are designed to be unobtrusive. Your child does not have to answer a question if they feel uncomfortable doing so, and they can stop the interview at any point.

What if there is a problem?

It is very unlikely that your child will have a problem by taking part in this study. If you or your child would like to make a complaint about something to do with the study you can contact the research team directly (0131 651 4127 or email Yvonne.Laird@ed.ac.uk).

We may contact your child’s guidance teacher if we feel your child needs additional support relating to the disclosure of personal issues. If your child tells us that she or anyone else is being harmed we will in notify your child’s guidance teacher who will take relevant action.

What will happen with the information from this study?

The results of this study will be published as part of Yvonne Laird's PhD thesis and in research journals. The findings will be communicated to researchers and physical activity practitioners and at scientific conferences. The data will be available for other researchers to use with any identifying data removed. We will also provide a summary of the results to the schools involved. All shared data will have any identifying data removed.

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

Your daughter will only take part in the study if you and your daughter sign a consent form for her to participate. If we do not receive consent from both you and your daughter then she will not be able to participate in the study. **You do not need to get in touch with us if you do not want your child to take part.**

Who is organising and funding this research?

This study has been organised by Yvonne Laird, Ailsa Niven, and Samantha Fawcner, at the University of Edinburgh. This research has been funded by a studentship provided by the Economic and Social Research Council (ESRC) for Yvonne Laird to conduct a PhD.

Before any research goes ahead it has to be checked by a Research Ethics Committee. They make sure the research is fair. This project has been checked by the Moray House Research Ethics Committee at the University of Edinburgh.

Thank you for reading this information letter. If you would like to find out more about the project or if you have any questions, please contact Yvonne Laird (Doctoral student) on 0131 651 4127 or Yvonne.Laird@ed.ac.uk.

If you would like to talk about this study with someone independent of the study please contact: Dr Simon Coleman on 0131 651 6653 or Simon.Coleman@ed.ac.uk

Kind regards,

Yvonne Laird

Appendix L: Friends, Family, and Physical Activity Questionnaire (Chapter 5)



THE UNIVERSITY of EDINBURGH

Friends, Family, and Physical Activity: Questionnaire

Name		Date of birth	
School		Class	

- We are trying to find out about your physical activity levels so that we can interview girls from a range of activity levels
- *Moderate* physical activity is any activity that makes your heart beat faster, makes you get out of breath some of the time, and maybe sweat a little bit
- Physical activity can be done in sports, school activities, playing with friends or walking to school
- Examples include: running, walking quickly, cycling, dancing, skateboarding, swimming football, gymnastics

For the next two questions, add up all the time you spend in *moderate* physical activity each day.

Question 1. Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes (one hour) per day?

 0 days 1 2 3 4 5 6 7 days

Question 2. Over a typical or usual week, on how many days are you physically active for a total of at least 60 minutes (one hour) per day? Please tick the correct number of days.

 0 days 1 2 3 4 5 6 7 days

Appendix M: Friends, Family, and Physical Activity interview schedule (Chapter 5)

Interview schedule

Thank you for agreeing to take part in this research study. Today I will be asking you about your physical activity levels and how your friends and family might influence these. By physical activity I mean any body movement that increases your heart rate and makes you feel a bit warmer. This could be an organised sport like swimming or it could be walking to school or PE.

There are no right or wrong answers to any of the questions I am going to ask you. Try to think carefully about your answers and aim to be as truthful as possible. You do not have to answer any questions that you are not comfortable answering and if you want to stop the interview or withdraw from the study you can do so at any time.

The interview will be recorded using a voice recorder so that I can have a record of everything that has been said. After the interview, I will type up the recording but I will remove your name so only the project team- will know who said what. Your name will not be on anything that is published.

1. What are your favourite physical activities or sports? [*Icebreaker*]
 - Why?
2. What physical activities do you do in a typical week? [*Icebreaker/PA level*]
 - Prompts: Active travel, organised sport, PE, walking
 - Probes: How do these activities make you feel? What is the best thing about these activities?
3. Can you tell me a bit about your family?
4. Can you tell me about the activities (PA or other) you do with your family in a typical week? [*Family co-participation*]
 - Prompts: Sedentary behaviour, sports, PA, other
 - Probes: How do you feel about these activities?
5. Describe the activity levels of others in your household. [*Family modelling*]
 - Prompts: Parents/siblings/frequency/types of activities
 - Probes: Does this influence your own PA level? How?
6. In what ways do others in your household help you to be physically active? [*Family support types*]

- Prompts: Who (mother, father, sibling), how (transport, emotional, instrumental), when
 - Probes: How does that make you feel? Can you give me examples? How does this help you?
7. In what ways does your family makes it easier for you to be physically active?
- Probes: Examples? Types of physical activities – sports, active transport, leisure
8. Describe any ways you feel your family prevents or discourages you from doing PA. [*Negative family support*]
- Prompts: Examples? Types of PAs – sports, active transport, leisure
 - Probes: How do you feel about that?
9. In what ways could your family help you to do more PA? [*Ways to increase perceptions of support*]
10. Thank you that has been great – now I'd like to find out a bit more about your friends and your physical activity. Can you tell me a bit about who your best friends are?
11. Describe the activities (PA or other) you do with your friends in a typical week. [*Friends co-participation*]
- Prompts: Sedentary behaviour, sports, PA, other
 - Probes: How do you feel about these activities?
12. Can you tell me about _____? How much physical activity does _____ do? [*Friend modelling*]
- Prompts: Best friend(s)/friends at school/other friends
 - Probes: Does this influence your own PA level? How?
13. In what ways do your friends help you be physically active? [*Friend support types*]
- Prompts: Who, how (transport, emotional, instrumental), when
 - Probes: How does that make you feel? Can you give me examples? How does this help you?
14. Do you think your friends make it easier for you to be physically active? [*How*]
- Probes: In what ways? Examples?
15. Describe any ways in which you feel your friends prevent or discourage you from doing PA. [*Negative friend support*]
- Prompts: Social activities
 - Probes: How does that make you feel? Does that influence your PA behaviour?

16. How could your friends help you to do more PA? [*Ways to increase perceptions of support*]
 - Prompts: Co-participation, talking about PA, watching
17. Is there anyone else you feel influences your physical activity levels?
 - Prompts: Teacher/coach/friends parent
18. Is there anything you feel we have not talked about but you would like to say?

Appendix N: Moray House Ethical Approval (Chapter 5)



Research & Knowledge Exchange
MORAY HOUSE SCHOOL of EDUCATION

The University of Edinburgh
Old Moray House
Holyrood Road
Edinburgh EH8 8AQ

Direct Dial 0131 651 4388

Switchboard 0131 650 1060

Email education@ed.ac.uk

<http://www.ed.ac.uk>

Yvonne Laird
SPEHS
Room 2.23
St Leonard's Land

28 January 2015

Dear Yvonne

A grounded theory of adolescents girls' experiences and perceptions of how significant other influence their physical activity behavior

The School of Education Ethics Sub-Committee has now considered your request for ethical approval for the studies detailed in the your application.

This is to confirm that the Sub-Committee is happy to approve the application and that the research meets the School Ethics Level 2 criterion. This is defined as "covering novel procedures or the use of atypical participant groups – usually projects in which ethical issues might require more detailed consideration but were unlikely to prove problematic".

A standard condition of this ethical approval is that you are required to notify the Committee, of any significant proposed deviation from the original protocol. The Committee also needs to be notified if there are any unexpected results or events once the research is underway that raise questions about the safety of the research.

Yours sincerely

Dr S Bayne
Convener, School Ethics Sub-Committee

DP

Appendix O: City of Edinburgh Council Approval (Chapter 5)

Yvonne Laird

Date 29 January 2015

Your ref

Our ref SCS/RW

Direct dial 0131 469 3137

Dear Yvonne,

I am writing in response to your application requesting permission to undertake research in The City of Edinburgh.

Your request has been considered, and I am pleased to inform you that you have been given permission in principle to undertake your research. I must stress that it is the policy of this Authority to leave the final decision about participation in research projects of this kind to Head Teachers and their staff, so that approval in principle does not oblige any particular establishment to take part.

I request that you forward a copy of your completed findings to me when they become available. In this case an electronic summary of your thesis would be preferred. Your work may be of interest to a number of staff in the Children and Families Department.

I would like to thank you for contacting the Children and Families Department about your work, and wish you every success in the completion of your project.

Yours sincerely

Ron Waddell

DSM and School Support Manager

Appendix P: Chapter 5 Example interview transcript

Researcher: Ok so just to start off, can you tell me what some of your physical activities or sports are?

PAR10: Em, hockey. Like I play hockey for the school and also for (club name 1). For (club name 1) I train on a Sunday morning and Tuesday evening so. Training is just kinda changing around at the moment for 'cos we're going into next year but and then normally matches on the Saturday mornings and on the Sunday normally sort of for (club name 1) and I also dance a lot. I like to dance. I do um like a ballet points class on Tuesday, Jazz class on Wednesday and I do em another ballet class and a tap class on Saturday after matches, and then, yeah. Mhmm.

Researcher: Ok, ok, so right so you're playing hockey is it, are your training three times a week and playing a game at the weekend.

PAR10: Yeah, two games at the weekend.

Researcher: Ok, and em when's hockey season? It's not all year round is it?

PAR10: No it's em winter so it's normally, it's normally roughly the time that we go back to school. Just after that until kind of Easter ish. Just after, just before Easter I think.

Researcher: So you're not playing matches just now?

PAR10: Eh not just now. We've had a couple of friendlies for (club name 1) for like the club em recently but that's been it. Not as much on at the moment, just like [*inaudible*], so.

Researcher: Ok and dancing, you're doing that four times a week? [*Yeah*] Four times a week, right ok. Em, and what got you, when did you start playing hockey?

PAR10: Em I started in primary 5 I think it was. I was em, it was with the Active Schools, the Friday afternoon Active Schools hockey training. I started doing that and then I joined (club name 2) em not (club name 2) (club name 3) I think later on that year 'cos I went to just try it out and then I really liked it so I joined the club and that was Tuesday night trainings and then I started some kind of under 12 matches on Sunday and tournaments and stuff, and I thought it'd be good to then...

Researcher: And then you...

PAR10: Yeah I joined a different club because they didn't have an under 16s team that wasn't playing. The under 16s team didn't play a lot em of matches it was just going straight up to ladies and I felt like from when I just turned 12 I had to go play with like full grown

ladies and I felt like it was quite a big step so I went to a different club that had an under 16s and an under 18s team.

Researcher: Ok, and em what about dancing? How did you get into dancing?

PAR10: Em I've been doing ballet since I was two. My mum started me in that when I was just young and then I really enjoyed that because I did it with friends and stuff as well and then I started tap and jazz when I was six and just kind of kept going with that at the same time as school and like my friends left, like a lot of them left because they just did it when they were younger, but I've kept going and started up a point class as well so.

Researcher: Ok, em, and what's kind of kept you involved with dancing so much, just 'cos you've enjoyed it?

PAR10: Yeah, yeah, I just really enjoy it and we do shows every year and the shows are just really good fun, and yeah.

Researcher: And do you compete then with dancing as well?

PAR10: Em no with dancing we don't compete but I do exams and grades and so I've got two. I've got a ballet and a tap exam in June, coming up in June, so it's kinda working my way up through the grades and stuff but I've not done any kind of competitive dance so.

Researcher: Ok, and is dancing something that you see yourself doing into the future as well?

PAR10: Em, I like to think of it as like an option. I'm not sure exactly what I want to do yet when I'm older but I think that like with the dance club I'm in they actually run like a course for once you leave school for full time students so I mean, I'm really into it at the moment and I think I'm like, 'cos I've been doing it since I was like so young, I've done quite well so I think yeah it's an option anyway so.

Researcher: Ok and what about for hockey as well, could you see yourself doing that?

PAR10: I'd like to em I don't know how hockey kind of works, if you go into it. It's like, I'm not sure if you can really do it as a career choices or whether it's more like a hobby as well as like doing like a university course or something like that but em yeah I'd like to kind of, I've had a couple of East of Scotland trials so that in S1 and 2 so yeah they were good, yeah.

Researcher: Ok, em and is there anything else, any other physical activities that you do in a normal week other than dancing and hockey?

PAR10: Em I go to the gym but that's, not really. I used to do athletics but I stopped that after I got like, because I was doing so much hockey and dancing and stuff.

Researcher: Ok so did you say you go to the gym every week?

PAR10: Yeah I do it every, I go every Friday. Em but normally sometimes if I've got like a spare day, like if I've not got anything on that day I'll sometimes go to the gym as well but its not really every single week.

Researcher: Ok and what sort of things will you do in the gym?

PAR10: Em normally I'll run on the treadmill for about 10 minutes and then I'll try and do some interval training on the bike and then I'll use the weight machines and do some, like do weights on them, and then sometimes I'll do some like floor exercises.

Researcher: Ok and how did you get started, like why did you start going to the gym?

PAR10: Em, I, think it was S1, I, when I moved, when I started high school in S1, um I moved house quite away from like my primary friends and then I got to know a lot of people that came from (primary school name) because I was from (town name) and they all went to the gym on a Friday afternoon down at (gym name 1) and so I asked my dad if I could join up there and I started there and then I was only using it once a week so my dad decided he'd cancel my membership there and I started up at (gym name 2) not that long ago.

Researcher: Ok so do you go with friends on a Friday still or do you just go...?

PAR10: Em yeah I normally, I mean there's not as many, like there's only me and one other that normally go on a Friday em but like sometimes if she's not, like if she's got like something on then I'll go on my own 'cos yeah.

Researcher: Em ok that's fine and you said you were doing athletics as well for a while?

PAR10: Yeah I did that kind of S2 time, S1/2 I think. I started that because I wanted to like, it was after the Olympics I think it was that I really like, I went to see the Olympics and I watched a couple of stuff, stuff on the TV as well, and I got quite like, I liked the look of it so I joined, I trialled for (club name 3) and then so I got in for there and I started off just doing kind of a bit of a mix of everything like running, jumps and stuff and then I kind of, I wanted to increase my speed for hockey as well so I mean it was quite good 'cos it helped me for both and then I ended up moving on to some throwing as well and did quite a bit of throwing, like it was the last thing I did. I did a lot of discus, shot-put and javelin and so, but then it got a bit busy because that was training on a Monday and Thursday so it just got all too, it got a bit much for me to do hockey and dancing and that. So and that stopped over the winter because throwing, it was too dangerous to do the throwing over the winter so I felt like after that it was during the winter it was quite a good like amount of stuff that I was doing out of school so I decided to just leave that.

Researcher: Yeah, em ok, and you're doing PE as well? [Yeah] So that's, you do extra PE? [Yeah] So is it four times week then that you're doing PE?

PAR10: Yeah, twice a week on a Monday, I've got double PE today so, so I've got it like this period and next period. Sorry last period and this period and em Wednesdays and Thursdays.

Researcher: Ok, and how do you get to school in the mornings? [*Eh, walk*] Walk, and how long does that take you?

PAR10: Em I try and leave my house about 8 o'clock but normally I'm in my house until about five past eight and I get to school about twenty five past or just before twenty past, just before the bell.

Researcher: Ok, right ok. So about twenty minutes? [*Yeah*] Each way, and you walk home as well I take it? [*Yeah*] Ok. Em, can you tell me a bit about your family, so who is in your family?

PAR10: Em my mum, my dad and I've got an eight year old sister as well so.

Researcher: Ok, [*Yeah*] and what sort of things do you do with your family in a normal week?

PAR10: Em I've done like, my dad likes to come to the gym with me quite a lot sometimes, and my mum, she's, like she does, she doesn't work on a Monday so on a Monday she goes to the gym and does like em kinda she does a few Zumba classes and she does like Latin fit classes and stuff like that 'cos she used to do dance when she was younger. She used to do sroc and ballroom dancing kinda thing so she likes all the Latin stuff like that so she does that and my dad just likes going to the gym because he had a heart operation a couple of years ago so he was kinda slowly getting back into like going to the gym because that em stopped him doing, he used to play football every week but then he couldn't do any contact sports after that so he's em, was just building it back up with the gym and stuff, so yeah.

Researcher: Ok, and does your little sister do anything?

PAR10: Yeah my sister, she's into dance as well. She does ballet, tap and jazz on a Saturday morning and she's really, she does hockey as well. She's at (club name 2) which was the first club I was at as well and she's enjoying that, she does that with her friends on a Tuesday night and she's also into her gymnastics a lot. She does that twice a week on a Thursday/Friday from four until six I think it is, so I think she's really into her gymnastics, yeah.

Researcher: Ok good em and, so what sort of, like what's a normal week for your family. Do you spend, like do you do things together other than physical activities? Do you have like dinners together or go out or?

PAR10: Yeah, well we normally have dinner together every night if we can but I think a Tuesday night is normally the night that we don't have dinner together because I've got dancing from quarter to five until quarter past six and then I've got hockey straight after that

and my sisters got hockey kind of in between there from six until seven so it's a lot, like everyone's kind of busy on Tuesday so normally we'll just kind of have our tea when we've got the time and a lot of the time it's not together but all the other days normally we have it together and Sundays I'm, if I've not got a hockey match on in the afternoon or if the match was earlier on normally we like to, like my mum and dad quite like going out for walks and stuff and they like to go out for coffee and stuff as well so normally we do stuff like that as a family as well.

Researcher: Ok, ok, em and you've already said that the, you know your mum and your dad and your sister are quite active themselves. Do you think that that has an influence on your activity levels or?

PAR10: Yeah I think so. I think my like my mum was obviously into dancing when she was younger and I think that's kind of got me into my dance a lot and my dad, he played a little bit of hockey when he was younger but he was quite into his football and so he's quite like, he's been quite encouraging about the hockey and my mums always loved the dance as well so it's kind of like they've been really like encouraging and they've got me into a lot of physical activity and stuff so. And there's a lot of things like with the athletics, I wasn't sure if I wanted to do it or not like, em when I got like I trialled for it and then when I got the place I wasn't sure whether I still wanted to do it or not and my dad was like "well try it out" and he kind of encouraged me to just give it a shot even if I wanted to quit afterwards then yeah, I could go for it so.

Researcher: Yeah, em and what are some of the ways that people, like your mum and your dad and your sister help you to be active or to be involved in the sports that you're doing?

PAR10: Em, like what do you mean by that?

Researcher: Em, so how do they support you to be in sports?

PAR10: Oh, so whenever I've got a hockey match they normally both of them will try and come to support me at matches em unless if it's on Saturday mornings then a lot of the time it clashes with my sisters dancing so they'll take it in turns on who'll come to the matches and with my shows for dancing as well em they're always there and also my grandparents come along and my auntie and some of my mums cousins like to come, it just depends who's... They like to come along and watch the shows 'cos they're good fun 'cos they've got, there's the full time students that train there for the college courses, they do it as well so.

Researcher: Oh ok so it's quite a big show? [*Yeah*] Ok. So you said that your, your family will normally come and try and watch most of your matches? [*Yeah*] Your hockey matches. Em, will they talk to you about how you've got on afterwards?

PAR10: Yeah my dad's very kind of, he likes to give feedback after the match kind of "you did this well", "you need to do this more" and stuff and if I've ever, if I'm ever taking a friend home, giving them a lift home or something, my dad does the same to them as well, he's kind of "oh you played well today but 'member just remember to do this!" so my

friends have kind of got used to if they are getting a lift home with me then we'll have kind of feedback from my dad, but yeah.

Researcher: And how do you feel about that? Is it a good thing?

PAR10: Yeah it's good. I find it like really helpful 'cos like as well as like a coach, a coach is good but they're, quite often they've got to give feedback to the whole team so it's quite hard for a coach to give, I mean at every single match every single person like feedback. I like personal feedback so I think my dad's quite helpful in that way, so he's quite kind of, it's kind of like a coach as well, but gives it quite personally to me as well so.

Researcher: Yeah, and I'm sure since you've been playing hockey for such a long time [yeah] him and your mum will know the game quite well?

PAR10: Yeah, yeah they know it well and my dad played a bit when he was at uni I think as well so he knows a wee bit about, he knew a wee bit about it before and like so they've picked up a lot since they've been watching and stuff.

Researcher: Ok, great, and em do they drive you to training?

PAR10: Yeah I get em, Tuesdays and Wednesdays I normally get the bus to dancing because I have to leave kind of straight, as soon as I get home from school I've got to pick up my stuff and go and they're normally still at work but Saturdays em normally one of them will give my sister a lift to dancing and one of them will give me a lift and Tuesdays after my dancing they'll pick me up from dancing and take me to hockey. Yeah I get a lot of lifts but I don't think if they couldn't kind of give me lifts places and take me there then like I couldn't do it all 'cos it would be so much. I couldn't get there in time for stuff so.

Researcher: Yeah, ok, and do you have pay memberships and things as well like will they? Do you have to pay for them?

PAR10: I, yeah, dance classes... I'm not sure how much they are but for each class I think you have to pay about £40 for the term, for however long the term is, but yeah per class and like each class you've got to pay for and then but there's not kind of like a membership fee on top of that it's just per class you're doing but there's also like if you do, I think it's three classes, you get 20% off or something the more classes you do. And for hockey as well like there's a membership fee or per term per season or whatever it is I think. I'm not sure what it is though but yeah.

Researcher: Ok, and so I'm guessing your parents?

PAR10: Yeah they pay for that but a lot of kind of, I contribute a lot of like money towards it as well 'cos like it's expensive so when my birthday money and Christmas money and stuff I get off family, like wider family, I'll put it towards kind of dancing and I've also got the South Africa tour coming up with the hockey so its school and its next summer um so kind of I'm contributing my money to that so it's, it's quite expensive as well so I'm putting a lot

of my money to that and a lot of my money to dancing as well and exams cost more money on top of the dance classes so paying for them as well.

Researcher: Ok [*Yeah*], em and can you think of any other ways your family help you with your sports or your dancing?

PAR10: Em, I'm not sure, I think, I dunno I just, quite a lot of encouraging and giving lifts and I dunno I just love sport and everything about it so.

Researcher: Yeah, would you say that it's something that your parents are quite supportive of and want you to be involved in?

PAR10: Yeah, yeah, and a lot of the time they say "oh I'm glad you're not just sitting about the house like not doing anything, I'm glad you're out and being active and kind of going to classes, going to clubs and stuff, rather than kind of." Like obviously they like me meeting up with my friends out of, outside of the clubs and stuff as well, but they're saying like it keeps you busy and its good to be involved in out of school stuff as well so.

Researcher: Yeah em and you know if they come and watch you at your dance shows and, or you know at hockey, or do they say you know things about how your performing, so do they say you're doing well or?

PAR10: Yeah I think like every year when my family come and watch my dancing they always go on about how much I've improved since last time and stuff and my dad when, like he likes to kind of say how, like my dad doesn't, he won't sugar coat things, he kind of gives it to me quite straight which is good because I'd rather be told what I need to improve on and stuff like, he's not harsh about it, like he gives me the good things and then also what I need to improve on a lot as well so like its quite.

Researcher: Ok, so is it different to how your mum will speak to you then?

PAR10: Yeah, my mum will sometimes like she 'cos for our shows we work for it for like months on our show dances so she wont normally see the kind of stage where it's all a bit rushed, it's more the finished stage, that's really the only time you can see it. Hockey my mums not as kind of, she's not as kind of tactical with all the hockey stuff as well so she doesn't give as much kind of stuff like that, as much kind of em [*feedback?*] ... feedback as my dad, yeah.

Researcher: Ok, em, is there any ways em that your family prevent or discourage you from activity or?

PAR10: No, not at all.

Researcher: Em, and is there any ways that they could help you do more? Or help you more with what you're doing?

PAR10: Yeah, I don't think so no to be honest. I think like they do, they help a lot I think, I don't think I'd have time in a week to do anything else even if they were to like try and like add another dance class or like take me to more hockey because they take me, everything that I like have or choose to do they'll make sure that I get there, like they will try and make sure. Like if they can't, if they're both, maybe if my dads away or my mums got my sister, like my auntie she'll help out as well if like if they can't get me somewhere like my mum will phone my auntie and be like "Are you free? Can you, you know, help out?", and stuff. She's quite, yeah.

Researcher: That's good. And em, it sounds like your parents help you a lot [*yeah*] but I'm guessing that you know ultimately it's, it's you that want to become involved in all these things?

PAR10: Yeah, yeah, I really like it and like yeah I just love hockey and dancing to be honest I think, yeah.

Researcher: Ok em that's great, I'll ask you a bit about your friends now so can you tell me em who some of your best friends are and if they're friends from school or hockey or?

PAR10: Yeah, em if I say, I've got like a group of four of us, we're kind of the closest. There's like me, (friend name 1), are you doing the other class as well or?

Researcher: I think it's just this one.

PAR10: There's a girl in the other half of the school em (friend name 1), (friend name 2) and (friend name 3) and the four of us we all play hockey together we're both at the school, in the school team, and at the club, and we're at the school together as well so. I'm closest with them 'cos I spend kind of most time with them. I've also got my friends at dancing and em I've kind of got three main best friends at dancing and then other ones that I'm still close with but they're, these three are in all my classes. It's (friend name 4), (friend name 5) and (friend name 6) and (friend name 6) lives in (name of town). It's quite hard to kind of em like meet up with her out with that time and kind of (friend name 5) lives just before (name of town) and (friend name 4) lives after (name of town) so they're yeah, like I can meet up with them but it takes quite a lot of... [*Planning?*] Yeah, planning and stuff if we're meeting up out with dancing.

Researcher: Ok em and so all your friends are involved in sports then? [*Yeah*] Yeah ok. So all, your closest friends at school are also in hockey? [*Mhmm, yeah*] Right ok, so I'm guessing they're all fairly active or as active as you are or?

PAR10: Yeah. I go to the gym with (friend name 1) who I play hockey with as well. She's the one I go to the gym on a Friday with, and, yeah.

Researcher: Ok, is em, is the aim of that to help with your hockey or just you know for fun?

PAR10: Em, a lot of, I mean yeah a bit of both to be honest. I mean I really enjoy going to the gym and it's kind of I want to get fitter and kind of build to be fitter for hockey as well so it's kind of for fun and for hockey as well.

Researcher: Ok and what sort of things em do you do with your friends in a normal week? Em, so you'll be playing...

PAR10: Yeah, a lot of hockey and stuff! But yeah sometimes on kind of Sunday afternoon is kind of the time that I've the most, is the day I have the most time, or sometimes a Friday afternoon after the gym like I know that like a lot of us like going up town, to a place up town, and we just go to each other's houses and stuff as well.

Researcher: Ok, and if you're at school together what kind of things would you do over breaks and lunches with your friends?

PAR10: Em at lunch sometimes we'll, normally walk to (name of café) which is quite close to the school and some people might buy their lunch some people like will have their lunch with them and sometimes we'll just stand outside and chat and then sometimes we'll go back and sit in the park and like occasionally and normally in the summer, well like we don't normally go in the winter at all, but in the summer occasionally we go down to (name of supermarket) em which is like a further walk but it means they've got more food there so, like a bigger range, so sometimes in the summer we'll go down and get some stuff from there so.

Researcher: Ok em and do you think that your friends have an influence over how active you are?

PAR10: Yeah I do. In S1 I was friends with, like when I first started school, I was quite friendly with people that weren't very active and I kind of moved away from them and became closer with like my best friends now who are a lot more active and I enjoy spending more time with them because they're, they've got like their personalities like quite like mine. They like the same things that I do so I mean I enjoy that more and like I dunno they are likely to have quite a good influence over me as well and it's also quite like kind of em like kind of competitive between us as well like everyone wants to be better and it's not kind of "oh I'm better than you" but it's kind of you know you wanna keep the same level and it's just that kind of, yeah.

Researcher: Yeah so you push each other on a little bit? [*Yeah*] And em how, what sort of ways do you friends help you, you know with your hockey or your dancing?

PAR10: ... For hockey if we're ever doing kind of activities or stuff like we all cheer each other on and stuff like that and like dancing its very kind of if we're trying like pirouettes or something if you do like a triple or whatever and that's like you're proud of that then everyone's like "wow, well done" and "that was really good!" and everyone kind of, you help each other. Like if you don't, if you're learning a dance and someone knows the dance

well and someone else isn't so sure on a part like it's always kind of, they will help you out as much as they can and, yeah.

Researcher: Ok, em and with hockey em would you talk to your friends about, you know, how you're playing or do you talk to your friends after matches and things like that?

PAR10: Yeah I mean a lot of the time kind of after a match if we're like, if sometimes we're walking home after a match as well, I get lifts home, but we kind of speak to each other about who we think played well as well as how we played and then we'll also talk about how we think we played as well so.

Researcher: Ok, and is that helpful for future matches as well?

PAR10: Yeah it is quite helpful, we, yeah. And at halftime and stuff we discuss like as a team how we worked together and what we need to improve on and stuff in the next half and yeah.

Researcher: Yeah ok. Is there any ways you think your friends discourage or prevent you from being active? [*No, not at all*] And is there ways that they could help you more with hockey or with dancing or with other things?

PAR10: I don't think so, I mean I think a lot of like, if we're talking about how we played and stuff at hockey it's the kind of feeling you don't want to be too modest, you want to be kind of big headed. If you're going "oh I played really well!" then sometimes people don't wanna be like that and also [*It's very British isn't it?*] Yeah! (laughs) They can be like sometimes for both hockey and dancing, I think it happens to everyone, but if someone's doing really well and someone's struggling more like it can they can get slightly jealous of the other person 'cos they're doing well and stuff but like yeah that's it really.

Researcher: Ok, em is there anyone else that you think influences your activity levels?

PAR10: Like teachers in school and stuff like (teacher name 1), I've got her for PE and she also, she's the senior coach so like I move up to senior next year em for hockey so it's kind of like she's quite encouraging about how like we play and I've heard from other people about, older than me who have got her as a coach, like how good a coach she is as well, as well as being a coach like a PE teacher as well, like she's a good PE teacher. And like my dance teachers and hockey coaches like out of school like they're really encouraging and yeah they're really helpful.

Researcher: Ok em so do you think em PE teachers, are they, do they influence your activity in PE as well out of PE?

PAR10: Yeah they well they like to kind of like motivate you in class as well and like there's a lot like they help you if there's something you're doing that you're not too sure on like other ones and so like yeah it's good.

Researcher: Ok, so how would they motivate you in class?

PAR10: Em like if there's like a hockey match or like the losing the team the teacher might cheer them on or kind of be like "oh well done, you're doing really well" and that like "keep going!" kind of like that if you're in a drill off or something.

Researcher: Yeah, ok and do they ask you about how you're getting on with sports or like things you do outside of school?

PAR10: Yeah em they speak to you kind of (teacher name 2)'s asked me a bit about my dancing and stuff and how hockey's going out of school as well, yeah.

Researcher: Ok and do other teachers ask as well or?

PAR10: Not so much, it's normally just the PE teachers. Other teachers, like our maths teacher sometimes speaks to us about how we're doing. Like if we've got, normally we'd have our matches at the weekend, he'd normally speak to like the rugby team like "how did rugby go?" and "how did hockey go?" and stuff, em but there's not much [*inaudible*]...

Researcher: Ok em that's fine, is there's anything else that we've not talked about but you think we should say?

PAR10: No I think that's it.

Researcher: Ok great.

Appendix Q: Example memo

Thoughts on the interview: I felt like this interview went smoothly and the participant was aware of many types of social support that she was receiving and was able to articulate how this influenced her behaviour and her sports involvement. Again, there were a few points where more open questions could have gotten fuller and more interesting responses however progress is definitely being made in this respect. I need to continue to think about follow up questions being open and encouraging the participant to be descriptive and provide examples. I also need to remember to take my time when asking questions and allow the participant sufficient time to answer the question.

Thoughts on the analysis: The participant noted several forms of social support that she was receiving. The participant explained that she started doing one of her sports because her brother started doing it and she noted that her reasons for continuing doing both of the sports she was doing was because she enjoyed them. She identified that her family are active and hold a certain importance for doing physical activities - her father was involved in sports when he was younger and it was something that was important to him. Now both her parents are still active, doing things like walking the dog regularly and going to classes and the gym. She also noted that her brother is very active and involved in three different sports.

She was able to articulate the different forms of social support that she was receiving from her parents unprompted including: driving her to training and competitions, financial support (club memberships and extra training), always coming to competitions, talking to her about her performance at competitions and how she could improve. She was also able to describe how this support affected her physical activity, noting that she felt like because her parents were so supportive it makes her feel like they believe she has potential and faith in her to be successful, and this pushes her on and gives her motivation and drive to perform better. When asked

further what sort of things her parents would say to her after competitions she talked about how her mum and dad provide helpful, constructive comments on her performance in the game and how she can use this to improve for the future and she noted that she finds this helpful as she is not able to visualise this herself and is not aware of where she needs to improve whilst she is playing. She is very aware that her parents are helping her a lot, and when asked what she thinks her parents think about her sports involvement, she says "I think that they're happy that I'm involved in sport and well I don't think that they'd be helping me this much if they didn't".

The participants' best friends were mostly her friends from the sports that she is involved in, many of who are also going to school with her. So most of her friends are very active as well and because her best friends are involved in her sport with her there are not the same competing demands for social activities other participants have discussed, although she did mention having other friends who were not particularly active. The participant was also able to articulate ways in which her friends helped her with her physical activity, through doing extra training with them, through pushing her to improve, and encouraging and motivating her when she is not feeling energetic. She noted that her friends involvement in these ways encouraged her to improve her performance, made her do more physical activity and train more, and make her feel more motivated. She also noted that like her parents, she would talk to friends about competitions and training and this was used as a way of improving her performance in the future. When asked if others influence her physical activity behaviour, she did not think anyone else really did. I prompted her to think about her coaches but she said she felt like her coaches tended to influence more the physical side of her sport (e.g. mastering moves/drills) rather than the psychological side (motivation, drive) which she had highlighted her friends and family were able to do through the support that they provided. She suggested that if her coach was a bit tougher on her team then this could help to improve their performance and suggested that having her coach able to influence the psychological side would be something that she wanted. *[Would having a coach that also influences the physical side of sport is also be likely to influence the psychological side – e.g. motivation, self-efficacy. This could have been followed up during the interview].*

The sports that she is involved with are clearly very important to her, she enjoys them, she enjoys the training and she has a real desire to continually improve her performance and become successful. She noted how when she first tried out basketball she "loved it" so she stuck with it and began improving and getting better. It is clearly a very important part of who she is and whilst she is very intrinsically motivated, she has a lot of support that helps her in terms of continued motivation to improve her performance, confidence and self-belief and logistic support that are all likely to be very important to her continued success and engagement in the sport.