

# **Development and feasibility testing of a buddy intervention to increase postnatal physical activity**

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This dissertation is submitted for the degree of Doctor of Philosophy

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# Development and feasibility testing of a buddy intervention to increase postnatal physical activity

Naomi Kate Ellis

## Abstract

Childbirth is a life event that negatively influences mothers' physical activity (PA) levels and is identified as a teachable moment for health behaviour change and therefore interventions to increase postnatal PA are required. This thesis broadly follows the first two steps in the Medical Research Council (MRC) intervention development guidance, combined with methods from the Behaviour Change Wheel (BCW).

The first study systematically reviewed the existing literature on the effectiveness of postnatal PA interventions. Eleven studies were included in the narrative review and eight in the meta-analysis. There was a small but significant increase in PA behaviour in the intervention group compared to the control group, but heterogeneity was high. A need for interventions with larger sample sizes, longer follow-up periods and objective PA measurements was identified.

Study two utilised a multi-methods design to explore the factors that influence postnatal PA according to the COM-B model of behaviour. Semi-structured interviews qualitatively explored participants' views on what factors influenced PA, and a questionnaire determined their relative importance. Qualitative findings indicated that all COM-B components influenced behaviour, and quantitative findings indicated that the most important factors that influenced behaviour were time, feeling tired, lack of available childcare, lack of advice from a healthcare professional, lack of motivation and development of a habit. The results are presented in a behavioural analysis for postnatal PA.

The next section of this thesis described the remaining steps of the BCW to identify intervention options, content and implementation options resulting in 'Buddy Up', an intervention that matches two new mothers as PA buddies to provide mutual support to increase PA. A buddy is an existing friend or another eligible participant. The intervention includes three PA counselling sessions based on Motivational Interviewing principles supplemented by a booklet. The final study explored the feasibility of delivering 'Buddy Up' utilising a single group pre-post study design. The study explored the feasibility of recruitment, data collection, intervention acceptability and preliminary efficacy data. 44 participants (existing friends (n=22); new match (n=22)) were recruited, and 21 participants

remained unmatched. Key recruitment challenges were engaging Children's Centres (CCs) with recruitment and matching participants. Participants engaged in PA with their buddy on 1.06 days (SD=1.76) in the past week and provided support by sending encouraging messages (85.7%), sharing PA ideas/information (71.4%) and doing PA together (60%). Findings from the post-intervention interviews suggest good acceptability of the intervention sessions, minimal usage of the booklet and varied views on the acceptability of the buddy element among participants. Preliminary effectiveness data is promising for objective (Baseline=697.68 counts per minute (cpm); Follow-up=765.05 cpm) and self-report PA (Baseline=1533.56 MET-min/week; Follow-up=1917.50 MET-min/week) and has a significant effect on self-efficacy to overcome some barriers to PA (when feeling depressed, when there is no one to be physically active with, during bad weather and when they have no money).

Collectively, this thesis describes the intervention development process and presents the first buddy intervention for postnatal physical activity. The feasibility study findings show promise that this is a fruitful research avenue, but the intervention's operational feasibility requires further refinement prior to recommending a large-scale efficacy trial.

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## Publications and conference proceedings

### Publications

Ellis, K., Pears, S., & Sutton, S. (2019). Behavioural analysis of postnatal physical activity in the UK according to the COM-B model: a multi-methods study. *BMJ open*, 9(8), e028682.

### Conference oral presentations

Ellis, K., Pears, S., & Sutton, S. Buddy Up: Feasibility and acceptability of a buddy physical activity intervention for postnatal women. *School of Primary Care Research Showcase*, 26<sup>th</sup> November, 2019.

Ellis, K., Pears, S., & Sutton, S. Feasibility of delivering a buddy intervention for health behaviour change. *School of Primary Care Annual Trainee event*. 9<sup>th</sup> September, 2019.

Ellis, K., Pears, S., & Sutton, S. What factors influence postnatal physical activity levels? *School of Primary Care Annual Trainee event*. 24<sup>th</sup> September, 2018.

Ellis, K., Pears, S., & Sutton, S. Postnatal physical activity: What influences new mothers to be active? *Murray Edwards Graduate Research Symposium*. 20<sup>th</sup> February 2018.

Ellis, K., Pears, S., & Sutton, S. Development and pilot evaluation of a postnatal physical activity intervention. *School of Primary Care Annual Trainee event*. 18<sup>th</sup> September 2017.

### Conference poster presentations

Ellis, K., Pears, S., & Sutton, S. Is it feasible to deliver a buddy intervention for postnatal physical activity? *School of Primary Care Research Showcase*, 13<sup>th</sup> November 2018.

### Journal articles in preparation

Ellis, K., Pears, S., & Sutton, S. Effectiveness of physical activity interventions on postnatal women's physical activity levels: A systematic review and meta-analysis. *BMC Women's Health*.

Ellis, K., Pears, S., & Sutton, S. Development and feasibility of a buddy intervention for postnatal physical activity intervention. *BMC Public Health*.

## List of abbreviations

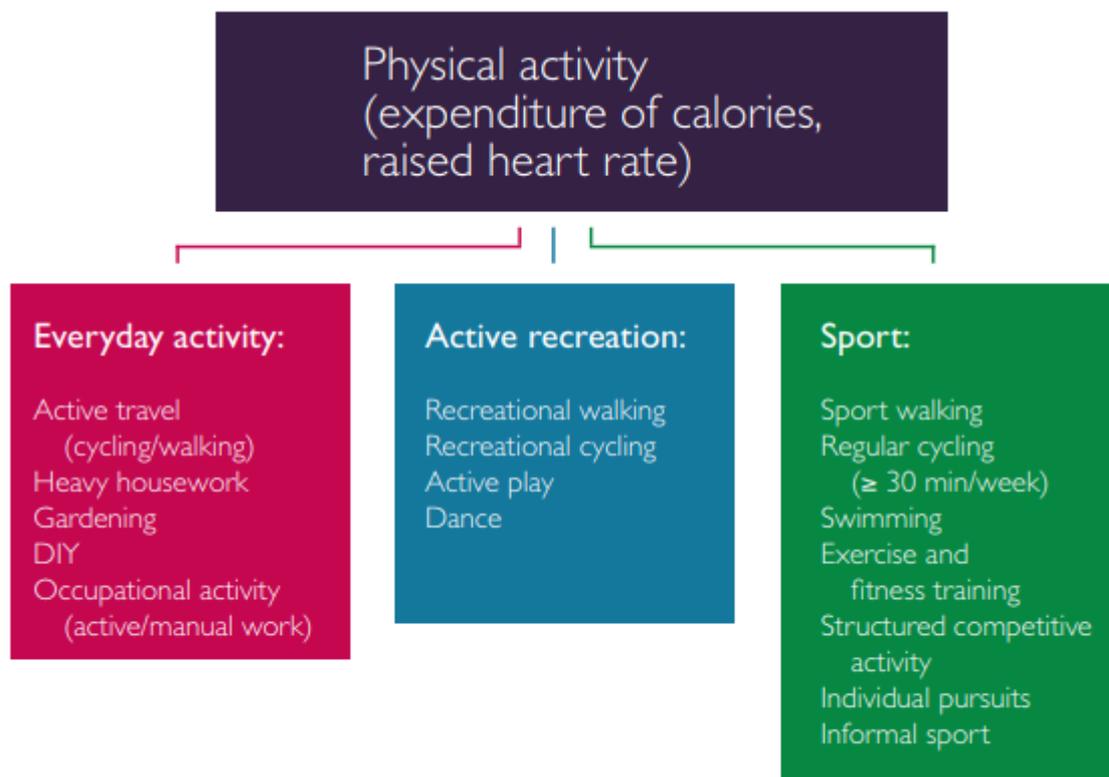
- BCTs** – Behaviour Change Techniques
- BCW** – Behaviour Change Wheel
- BMI** – Body Mass Index
- CC** – Children’s Centre
- CI** – Confidence Interval
- CPM** – Counts per minute
- GDM** – Gestational Diabetes Mellitus
- IPAQ-SF** – International Physical Activity Questionnaire – Short Form
- MI** – Motivational Interviewing
- MRC** – Medical Research Council
- MVPA** – Moderate to Vigorous Physical Activity
- NICE** – National Institute for Health and Care Excellence
- PA** – Physical activity
- PBC** – Perceived Behavioural Control
- PIS** – Participant Information Sheet
- PPI** – Patient and Public Involvement
- RCTs** – Randomized controlled trials
- RoB** – Risk of bias
- SCT** – Social Cognitive Theory
- SD** – Standard Deviation
- SMD** – Standardized Mean Difference
- SMS** – Short Message Service
- SS** – Social support
- TPB** – Theory of Planned Behaviour
- TTM** – Transtheoretical Model

# 1 Literature review

## 1.1 Physical activity

### 1.1.1 Definition

Physical activity (PA) is defined as any bodily movement produced by skeletal muscles resulting in energy expenditure (Caspersen, Powell et al. 1985). The definition of PA encompasses any form of movement that expends energy, and includes everyday activities, eg, housework, gardening, active travel or active recreation (Figure 1.1). PA is often categorised according to four domains: intensity, duration, frequency and mode. Intensity refers to the magnitude of effort required to perform activity. Duration is the amount of time spent in activity. Frequency is the number of sessions/bouts of PA within a given time period and mode refers to the type of activity.



**Figure 1.1 – Type of PA (Department for Health 2011 p9)**

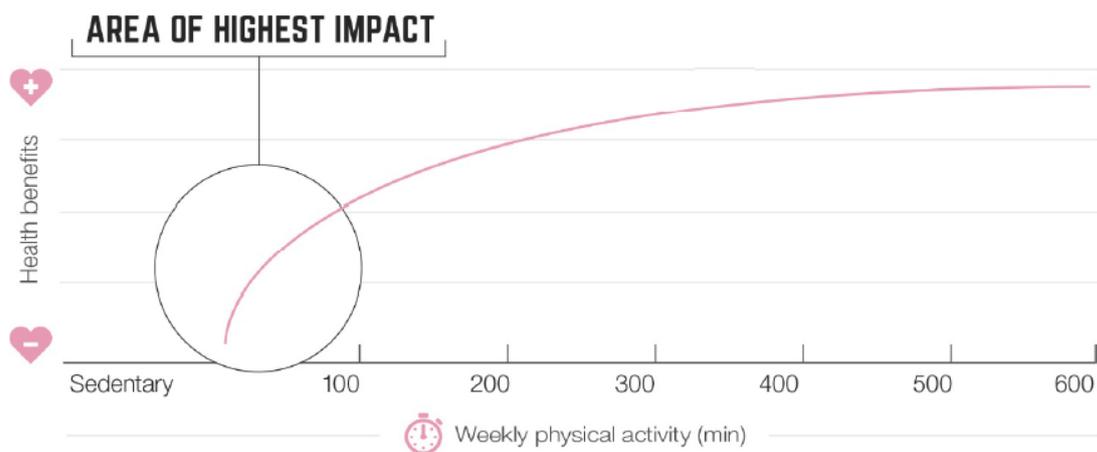
### 1.1.2 Physical activity guidelines

In 2019, the UK government updated existing PA guidelines, identifying the amount and type of PA required for optimal health (Department for Health 2019), drawing on evidence from large-scale scientific reviews by expert advisory working groups. They identified the importance of PA across the

life course and included PA guidelines targeting four key groups; early years, children and young people, adults (including disabled adults and women during and after pregnancy) and older adults.

### 1.1.2.1 Physical activity guidelines for adults (aged 19-64)

The guidelines in the UK represent the amount of activity needed to achieve substantial health benefits. Those who exceed the recommendations will achieve additional benefits and those who are inactive benefit from any PA even if they do not meet the threshold (Figure 1.2).



**Figure 1.2 – Dose response curve of PA benefits (Department for Health, 2019, p15)**

There are four key recommendations for adults in the UK: 1) aim to be active every day as any activity is better than none and more is better; 2) engage in activities that develop or maintain strength in major muscle groups on at least two days per week; 3) aim for 150 minutes of moderate intensity activity or 75 minutes of vigorous activity or even shorter durations of very vigorous PA, or a combination of all three intensities; 4) minimise the amount of time spent sedentary and where possible break long periods of inactivity with light PA.

### 1.1.3 Health outcomes of physical activity

Physical inactivity is the fourth leading cause of premature mortality worldwide (World Health Organization 2009). The first study identifying a link between PA and health was conducted in the 1950s. The study observed workers on London buses and found that the bus conductors, who spent their day actively walking along the bus, had a lower incidence of coronary heart disease compared to bus drivers whose occupation was largely sedentary (Morris, Heady et al. 1953). Since then, the field of PA for health has grown, and the cumulative evidence shows that PA reduces the risk of developing over 20 chronic diseases, including cardiovascular disease, type two diabetes and some types of cancer (Warburton, Nicol et al. 2006). In recent decades, research focusing on psychological

outcomes of PA have established its benefits for the prevention, management and treatment of mental illness (Biddle, Fox et al. 2003).

#### **1.1.4 Measuring physical activity**

Measuring PA accurately is important to identify PA levels and their relationship with health outcomes, identify inactive populations, determine the effectiveness of behaviour change interventions, set effective national guidelines and allocate research budgets (Prince, Adamo et al. 2008, Westerterp 2009, Warren, Ekelund et al. 2010, Ainsworth, Cahalin et al. 2015). There is no perfect measure of PA. Instead the choice of measurement methods involves a trade-off between accuracy, financial and feasibility implications (Laporte, Montoye et al. 1985). There are four key considerations when choosing a measurement method (Laporte, Montoye et al. 1985):

**a) Validity** - the extent to which a method measures what it is intended to measure, calculated by comparing two methods designed to measure the same outcome (Tudor-Locke, Williams et al. 2002, Warren, Ekelund et al. 2010).

**b) Reliability** – the extent to which the tool achieves the same results under the same circumstances when the assessment is repeated, often measured using test-retest reliability (Warren, Ekelund et al. 2010).

**c) Practicality** – practical methods are at an acceptable cost to researchers and participants in terms of time, finance and burden, often requiring a trade off with accuracy (Laporte, Montoye et al. 1985).

**d) Reactivity** – the degree to which an individual changes their behaviour when they are aware that they are being monitored and therefore their measured behaviour is not an accurate representation of their normal, real life behaviour, posing a threat to the internal validity of the study (Laporte, Montoye et al. 1985).

Field-based measurements collect PA data in normal free-living conditions and are discussed in the remainder of this section, grouped into self-report and direct measures.

##### *1.1.4.1 Self-report measures of physical activity*

Self-report measures of PA require participants to record their behaviour over a specific period and as such provide a record of their perception of their PA levels. Typically, self-report measures are self-administered using paper or digital instruments or researcher administered via face-to-face meetings or telephone calls. The validity and reliability of self-report measures varies between instruments and are key considerations when choosing which self-report instrument to use. The

strengths of self-report methods are their practicality due to low cost, ease of administration, low participant burden, high acceptability and ability to provide information on the context of PA (Melanson, Freedson et al. 1996, Warren, Ekelund et al. 2010, Ainsworth, Cahalin et al. 2015) which makes them suitable for large scale, population research (Melanson, Freedson et al. 1996). The limitations of self-report methods are their susceptibility to memory error (incorrect recall of behaviour, minimised by reducing the recall period) and reporting bias (incorrect reporting of behaviour, often due to social desirability over-reporting vigorous activity) (Sallis and Saelens 2000, Ainsworth, Cahalin et al. 2015). Two widely-used types of self-report PA measures are PA diaries and recall questionnaires:

**a) PA diaries** - They require participants to record their PA in real-time (Sylvia, Bernstein et al. 2014), collecting detailed information on PA domain, specific activities, body position, intensity and duration of PA (Ainsworth, Cahalin et al. 2015). This method is less susceptible to recall error and social desirability bias, but is subject to reactivity and has high participant burden (Sallis and Saelens 2000).

**b) Recall questionnaires** - Recall questionnaires require participants to think back over a specific period and recall PA participation. Dependent on the instrument, recall questionnaires record information in terms of intensity, duration and frequency of PA (Shephard 2003). Recall questionnaires show limited validity and reliability in comparison to laboratory methods of measuring PA (Shephard 2003). They are subject to recall bias due to the cognitive demand placed on participants to recall their PA, especially among participants with limited cognitive capacity, eg, older adults and children (Janz 2006) and in questionnaires with longer recall periods, eg, month, year or lifetime (Shephard 2003). Low intensity, moderate intensity and spontaneous intensity activity is underestimated when using recall questionnaires (Tudor-Locke, Williams et al. 2002, Shephard 2003). On the contrary, vigorous intensity activity is often overestimated due to social desirability bias, where participants over-report favourable behaviours. Cultural factors can influence questionnaire responses, and often questionnaires are validated among cultural groups to account for this (Shephard 2003).

Despite their limitations, recall questionnaires are a popular measurement method for research as they are acceptable to researchers and participants and can be applied in large populations with relative ease, low cost and minimal participant burden. Their key advantage is the contextual information they provide, and often they are used alongside direct measurement methods to provide contextual detail (Sallis and Saelens 2000).

Many questionnaires are available and choosing an appropriate recall measure requires careful consideration of the validity and reliability of each method, the cultural relevance and the participant burden.

#### 1.1.4.2 *Direct measurement methods*

Direct measures of PA measure energy expenditure (Riekert, Ockene et al. 2013) or actual movement (Dinger, Oman et al. 2004). They are considered more accurate compared to self-report measurements (Janz 2006, Prince, Adamo et al. 2008, Reilly, Penpraze et al. 2008); however, they are more expensive, time consuming and have a high participant burden. Direct measures are better able to detect low intensity activity and intermittent or routine PA, which may be missed with self-report measures (Janz 2006). Examples of direct measurement methods are doubly labelled water, heart rate monitors, pedometers and accelerometers:

**a) Doubly labelled water** – measures total energy expenditure in free-living conditions over a period of 1-4 weeks (Plasqui and Westerterp 2007, Westerterp 2009), requiring participants to drink a liquid substance containing labelled stable isotopes. The rate of elimination of the isotopes is used to calculate energy expenditure (Westerterp 2009). It is often used as the criterion measure of energy expenditure (Plasqui and Westerterp 2007, Hills, Mokhtar et al. 2014) but is not practical to use in large studies due to high cost and participant burden (Laporte, Montoye et al. 1985, Melanson, Freedson et al. 1996).

**b) Heart rate monitors** - Heart rate monitors measure participants' heart rate, a physiological indicator closely related to energy expenditure (Sylvia, Bernstein et al. 2014) and are a good option for measuring activities that cannot be captured by motion sensors, eg, cycling and swimming. They are limited due to their responsiveness to other stimuli, eg, medication, temperature, emotional state, age, sex and fitness (Warren, Ekelund et al. 2010, Ainsworth, Cahalin et al. 2015).

**c) Pedometers** - Pedometers measure ambulatory movement in a free-living environment and measure the steps accumulated through walking, jogging or running (Freedson and Miller 2000, Tudor-Locke, Williams et al. 2002). Pedometers provide accurate step count measurements but are less accurate measures of energy expenditure and distance (Butte, Ekelund et al. 2012). The accuracy is affected by body position (Ainsworth, Cahalin et al. 2015), BMI (Shephard 2003) and walking speed (Crouter, Schneider et al. 2003, Warren, Ekelund et al. 2010, Butte, Ekelund et al. 2012). Pedometers are useful for capturing low intensity incidental activity (Janz 2006) but are subject to reactivity bias. It is suggested that the best use of pedometers is as a motivational

tool in behavioural interventions (Freedson and Miller 2000, Warren, Ekelund et al. 2010, Hills, Mokhtar et al. 2014).

**d) Accelerometers** - Accelerometers measure the acceleration of the body and assume that acceleration is directly proportional to the muscular forces produced (Freedson and Miller 2000). They detect movement along axes to produce an output of activity counts (Warren, Ekelund et al. 2010). Accelerometers can be uniaxial, measuring movement along a vertical axis only, or triaxial, detecting movement on three axes (Plasqui and Westerterp 2007). Movement is detected at a set interval, known as an epoch, typically 5s, 10s, 15s, 30s or 60s. The measuring unit of PA using accelerometers is activity counts, normally expressed as counts per minute (CPM), which are commonly converted to meaningful measures of PA using energy expenditure prediction equations or intensity cut points.

Advantages of using accelerometers are that they capture incidental and low intensity activity, and are becoming increasingly feasible as advancing technology is enabling smaller, cheaper and less invasive devices (Ainsworth, Cahalin et al. 2015). Accelerometers are limited by their susceptibility to reactivity bias and underestimation of energy expenditure because they do not capture upper body movements (Lee, Shiroma et al. 2012), or when participants are carrying a load or walking on an incline (Freedson and Miller 2000, Warren, Ekelund et al. 2010).

When conducting research with accelerometers, there are several decisions to make about what model to use, the wear protocol (monitor placement and number of wear days) and data processing. Despite calls for best practice guidelines for data collection procedures and processing, there are currently none available. Therefore, researchers need to carefully consider each decision in terms of previous research and recommendations in the population under study.

### **1.1.5 Prevalence of physical activity**

Latest figures from a population level survey show that in England, 66% of men and 58% of women aged 16 and over meet the aerobic PA guidelines (NHS Digital 2017). The figures are derived from a self-report recall questionnaire for the past four weeks about PA in the home, walking, occupational activity and sport and exercise. Previous estimates from 2008 using accelerometer measures of PA suggest that only six percent of men and four percent of women met the national guidelines at that time of 30 minutes of PA on five days of the week (Health and Social Care Information Centre 2009).

Population level data identifies population subgroups that have lower PA levels including women, older adults, people from ethnic backgrounds and lower socioeconomic status, therefore an

important public health strategy is to target populations at risk of physical inactivity. For the remainder of this thesis, I have chosen to focus on postnatal women, defined as within twelve months of childbirth as they have been identified as a population sub-group with low PA levels.

## **1.2 Physical activity in postnatal women**

Females are consistently less active than males, starting as young as the under-fives (Bingham, Costa et al. 2016). Childbirth is a life event that negatively influences PA (Brown and Trost 2003) and has been described as a teachable moment for health behaviour change due to changing routines and enhanced motivation for health behaviour change (Phelan 2010). This section outlines the evidence relating to PA in the postnatal population.

### **1.2.1 Postnatal physical activity guidelines**

The latest PA guidelines issued by governments in the USA (Physical Activity Guidelines Advisory Committee Scientific Report 2018) and UK (Department for Health 2019) included specific guidelines for women following childbirth. Prior to this, guidelines for postnatal women were often embedded within pregnancy PA guidelines (Evenson, Mottola et al. 2014) and were criticised for being too brief and not providing specific, tangible targets for PA resulting in calls for clearer guidelines in terms of intensity, frequency and duration (Evenson, Mottola et al. 2014).

The US guidelines, released in 2018 recommend that, following an uncomplicated birth, mild PA in the form of walking, pelvic floor exercise and stretching can begin immediately, gradually increasing exercise levels to the recommended guidelines for adults, being careful not to introduce high impact activity too soon. Following a complicated birth or lower caesarean section, women should wait until a consultation with a health professional before resuming PA, usually the first 6-8 week check-up, and then resume PA gradually (Physical Activity Guidelines Advisory Committee Scientific Report 2018).

The UK government released guidelines in 2019 that acknowledged women's pre-pregnancy PA levels, recommending that the choice of activity reflects pre-pregnancy PA levels and intensities. Specifically vigorous intensity PA is not recommended for previously inactive women. Converse to previously published guidance, the latest UK guidelines do not split recommendations according to the type of birth, rather they recommend that after the 6-8 week check, dependent on how the mother feels, she can gradually resume more intense activities, suggesting building from moderate to vigorous intensity PA over a minimum period of three months. The guidelines are presented in an infographic in Figure 1.3.

# Physical activity for women after childbirth (birth to 12 months)



Figure 1.3 – Infographic displaying the UK Physical Activity Guidelines for Women following childbirth (Department for Health 2019, p38)

## **1.2.2 Health outcomes of postnatal physical activity**

As discussed briefly in Section 1.1, PA is beneficial for physical and mental health in the general population. The benefits discussed are applicable to postnatal women. However, there are some additional effects for postnatal women, discussed below.

### *1.2.2.1 Postnatal weight retention*

During pregnancy, women experience pregnancy related weight gain. Following birth there is an initial rapid period of loss followed by a plateau, and average weight remains higher than pre-pregnancy (Walker, Sterling et al. 2006). While the average postpartum weight retention is modest (0.5-3.0kg), there is high variability with ranges of -19.09 to 27.5kg reported in one study (Gore, Brown et al. 2003, Olson, Strawderman et al. 2003, Østbye, Peterson et al. 2012). Longitudinal data indicates that between 12-29% of women retain more than 5kg 24 months after childbirth (Oken, Taveras et al. 2007, Østbye, Peterson et al. 2012). Failure to lose weight during the postnatal period is a predictor of long-term obesity (Rooney and Schauburger 2002, Linné, Dye et al. 2004). At a ten-year follow-up, women who retained pregnancy weight six months after childbirth gained an average of 8.4kg above their pre-pregnancy weight during the ten-year follow-up period compared to 2.4kg weight gain for women who lost all pregnancy weight (Rooney and Schauburger 2002). Failure to lose gestational weight during the postnatal period can have a cumulative effect on subsequent pregnancies, and mothers are placed at greater risk of complications such as pre-eclampsia, gestational hypertension, gestational diabetes, caesarean delivery, stillbirth and large for gestational age birth (Villamor and Cnattingius 2006).

Observational studies utilising self-report measurements support the role of PA to reduce postnatal weight retention. A prospective cohort study of 597 women found that those who 'exercised often' were less likely to have major weight gain (>4.55kg) at one year postpartum compared to women who 'exercised less often' (Olson, Strawderman et al. 2003) (Odds ratio = 0.22; 95% CI: 0.09, 0.58). Kirkegaard, Stovring et al. (2015) found that those who engaged in >180 minutes of PA per week pre-pregnancy had significantly lower weight gain at 6 months, 18 months and seven years following childbirth.

Experimental studies on the effect of PA interventions on weight loss are mixed. Maturi, Afshary et al. (2011) trialled a tailored pedometer based intervention with inactive women to increase their PA gradually over a 12-week intervention. The intervention significantly increased PA levels and reduced anthropometric measurements (pre-intervention weight 66.8kg and post-intervention weight 64.7kg,  $p=0.001$ ). Bertz, Brekke et al. (2012) conducted a 12-week walking intervention (4x45 minutes/week at 60-70% of maximum heart rate). The intervention had no effect on waist

circumference, likely due to a lack of effect on total energy expenditure. A Cochrane review of diet and exercise for weight reduction following childbirth found two trials on PA where women who exercised did not lose significantly more weight than those in the control group (Adegboye and Linne 2013). Women who participated in seven diet and exercise interventions lost significantly more weight than those in the control group. The authors conclude that diet only or diet and PA interventions are effective for postnatal weight management, and recommend a combination of diet and PA due to the additional benefits of PA on cardiorespiratory fitness, fat loss and preservation of lean body mass (Davenport, Giroux et al. 2011, Adegboye and Linne 2013).

#### *1.2.2.2 Mental health*

The main body of evidence on the influence of PA on mental health in postnatal women assesses its impact on depressive symptoms. During the postnatal period, women are at a higher risk of developing postnatal depression, a condition affecting 16.1% of women during the first twelve months after childbirth (Woolhouse, Gartland et al. 2014). A recent review on the effect of PA interventions on postnatal depressive symptoms among the general postnatal population found a significant reduction in depressive symptoms in the intervention compared to the control group, suggesting that PA may be effective for the prevention of postnatal depressive symptoms (Pritchett, Daley et al. 2017). This finding is comparable with results from previous reviews (McCurdy, Boulé et al. 2017, Poyatos-León, García-Hermoso et al. 2017). The available evidence is unable to determine the optimal dose of PA for reducing depressive symptoms during the postnatal period (Physical Activity Guidelines Advisory Committee Scientific Report 2018). Some evidence suggests that the domain of PA may influence depressive symptoms with more favourable effects from participation in leisure time PA compared to work or household activities (Demissie, Siega-Riz et al. 2011, Teychenne and York 2013). A review of PA intervention type found no significant difference between the effect of exercise only and exercise with a co-intervention on depressive symptoms. Nor did the exercise content (group exercise or participants own choice) influence depressive symptoms (Pritchett, Daley et al. 2017).

There is little evidence to date on the influence of postnatal PA on other mental health outcomes.

#### *1.2.2.3 Cardiorespiratory fitness*

Cardiorespiratory fitness is the ability of the circulatory and respiratory system to supply the required fuel for sustained PA (Caspersen, Powell et al. 1985). One longitudinal study measured physical fitness in 124 women, 76 of whom became pregnant and provided measures of physical fitness at 6 and 27 weeks following childbirth. Their maximal oxygen consumption decreased between pregnancy and 6 weeks post-birth with some regains by 27 weeks; however, fitness levels

were still lower than pre-pregnancy. Despite changes in fitness, PA levels were unchanged likely due to the replacement of higher intensity pre-pregnancy PA with household activities and low intensity walking (Treuth, Butte et al. 2005). Baseline measurements of postnatal women for a pram walking intervention found all women to have fitness levels in the lowest ranked category (Armstrong and Edwards 2003).

Experimental studies demonstrate that PA participation increases cardiorespiratory fitness (Armstrong and Edwards 2003, O'Toole, Sawicki et al. 2003). Both interventions were 12-weeks long. In one study, participants attended pram walking sessions three times per week for 30 minutes for the first three weeks and 40 minutes thereafter (attendance rate = 66%). Post-intervention fitness, measured using an adapted graded treadmill test, was significantly higher among the intervention compared to the control group (Armstrong and Edwards 2003). In another study, cardiovascular fitness increased and maintained for twelve months following twelve weekly meetings compared to a control group. However, the study had a high dropout rate with only 23 of 40 participants (57.5%) remaining in the study at the one-year follow-up.

Research on the benefits to cardiovascular fitness is promising and are in line with those for the general population, which show that PA participation improves overall fitness (Manley 1996).

#### *1.2.2.4 Potential contraindications*

##### a) Breastfeeding

Early research questioned the influence of exercise on breastfeeding for breastmilk composition and volume and infant growth and development (Carey and Quinn 2001), raising concerns that exercise may increase lactic acid concentrations and affect infant acceptability (Clapp III and Little 1995, Daley, Thomas et al. 2012). However, this was following exposure to maximal exercise, an intensity that an average woman is unlikely to reach. Moreover, lactic acid concentrations return to normal levels within one hour of exercise (Carey and Quinn 2001). Moderate intensity activity has no effect on the lactic acid concentrations in breast milk (Quinn and Carey 1999, Carey and Quinn 2001), and subsequently no effect on infant acceptance (Wright, Quinn et al. 2002). The exposure to a supervised aerobic exercise programme consisting of 45 minutes per day, five days per week at 60-70% heart rate reserve found no impact on breast milk composition or volume (Dewey, Lovelady et al. 1994, Lovelady, Hunter et al. 2003).

A meta-analysis of four studies investigating the effect of maternal exercise on infant weight gain found no effect (Daley, Thomas et al. 2012). This included a study where overweight

women participated in an exercise and dietary restriction intervention for weight loss, with no adverse impact on infant growth (Lovelady, Garner et al. 2000).

While much of the available evidence for the effect of maternal exercise on lactation derives from small-scale trials, the results consistently indicate no adverse effect of exercise on breast milk composition, volume and infant growth, providing reassurance that it is safe and beneficial to engage in exercise during the postnatal period. A review of six national PA guidelines for postnatal women supported new mothers to engage in activities with no adverse effects (Evenson, Mottola et al. 2014).

#### 1.2.2.5 *Health outcomes in clinical populations*

##### a) Gestational diabetes mellitus (GDM)

GDM is a carbohydrate intolerance first recognised during pregnancy (Metzger, Coustan et al. 1998), with its prevalence ranging from 1.7% to 11.6% in countries with advanced economies (Schneider, Bock et al. 2012). Following birth, maternal glucose levels revert to pre-pregnancy levels, however individuals remain at high risk for developing type 2 diabetes in the next five to ten years (Metzger, Coustan et al. 1998, Kim, Newton et al. 2002, Bellamy, Casas et al. 2009). Therefore, women with previous GDM are at high risk of developing diabetes. In high-risk populations, PA reduces the risk of developing diabetes as evidenced in the Finnish Diabetes Prevention Programme where the intervention group received guidance to participate in regular PA, reduce their body weight and modify their diet. After 4.1 years, individuals who had the greatest increases in moderate to vigorous intensity leisure time PA were 63-65% less likely to develop diabetes, and the relationship remains significant after adjusting for dietary change and body weight. Current clinical practice guidelines refer women with previous gestational diabetes to weight loss or exercise programmes (National Institute for Health and Care Excellence 2012).

##### b) Postnatal depression

As discussed, PA during the postnatal period can reduce the risk of developing postnatal depression. Evidence is growing for PA as a treatment option for postnatal depression due to limited availability of traditional psychological therapies (Daley, MacArthur et al. 2007) and some women's reluctance to try pharmacological treatments in the postnatal period (Whitton, Warner et al. 1996). Trials of PA as a treatment for postnatal depression have a significant beneficial effect on depressive symptoms compared to the control condition (Daley, Blamey et

al. 2015) with the benefits most pronounced in women with greater depressive symptomology (Physical Activity Guidelines Advisory Committee Scientific Report 2018).

### **1.2.3 Prevalence of postnatal physical activity**

The transition to motherhood is a life event that negatively influences PA levels (Brown and Trost 2003, Bell and Lee 2005, Bellows-Riecken and Rhodes 2008, Engberg, Alen et al. 2012). Compared to women without children, women who have a child are more likely to be inactive. A four year follow-up study of 7281 women aged 18-23 years at baseline found that after adjustment, women who had their first child or a subsequent child during follow-up were more likely to be inactive compared to women who did not have a child (Brown and Trost 2003).

Several studies have measured the patterns of PA across the pregnancy and postnatal period. Some show a pattern of decreased PA during pregnancy, followed by a rebound during the postnatal period (Borodulin, Evenson et al. 2009, Cramp and Bray 2009, Evenson, Herring et al. 2012) or a further decrease during the postnatal period (Pereira, Rifas-Shiman et al. 2007, Coll, Domingues et al. 2016). Comparisons to pre-pregnancy PA levels are conflicting, and the measurement of pre-pregnancy PA levels is flawed by a long recall period and using the first measurement during pregnancy as a pre-pregnancy measure of PA. One study used objective measures during the pregnancy and postnatal periods and found that activity levels declined during pregnancy and remained low during the postnatal period. Analysis of the activity intensity found a decrease in sedentary behaviour and an increase in light activity, suggesting sedentary behaviour is displaced during this transition (Hesketh, Evenson et al. 2018)

Estimates for the number of women meeting the PA guidelines vary between studies. Pereira, Rifas-Shiman et al. (2007) found that 78.3% of postnatal women met the PA guidelines of 150 minutes per week of total activity. In contrast, an analysis of mothers with a child aged 0-4 years found that 65.6% were not meeting the minimum recommended PA guidelines (McIntyre, Peacock et al. 2012). An analysis of women during pregnancy, maternity leave and upon return to work found that 65% of women were classified as inactive upon their return to work (Grace, Williams et al. 2006).

The data above is reliant on self-report measures of PA, which are subject to over-reporting. Direct measures of PA using accelerometers during the postnatal period found that moderate to vigorous PA was 18 and 21 minutes per day at three and twelve months postpartum respectively. Evenson, Herring et al. (2012) compared these values to the National Health and Nutrition Examination Survey (NHANES) and found this was lower compared to women aged 20-29 and 30-39. Data on the prevalence of postnatal PA is largely from the USA, and studies in the UK are lacking.

There appears to be a marked shift in PA domains during the postnatal period (Treuth, Butte et al. 2005, Bellows-Riecken and Rhodes 2008, Koh, Miller et al. 2010). Leisure time/organised PA decreases during the postnatal period and is replaced by walking, care-giving, home and incidental activity (Treuth, Butte et al. 2005). Data from telephone interviews with women who had GDM in the past three years found that the prevalence of health-enhancing PA was 37.2%, a figure much lower than women in the general Australian population, despite higher walking time compared to the general population (Koh, Miller et al. 2010).

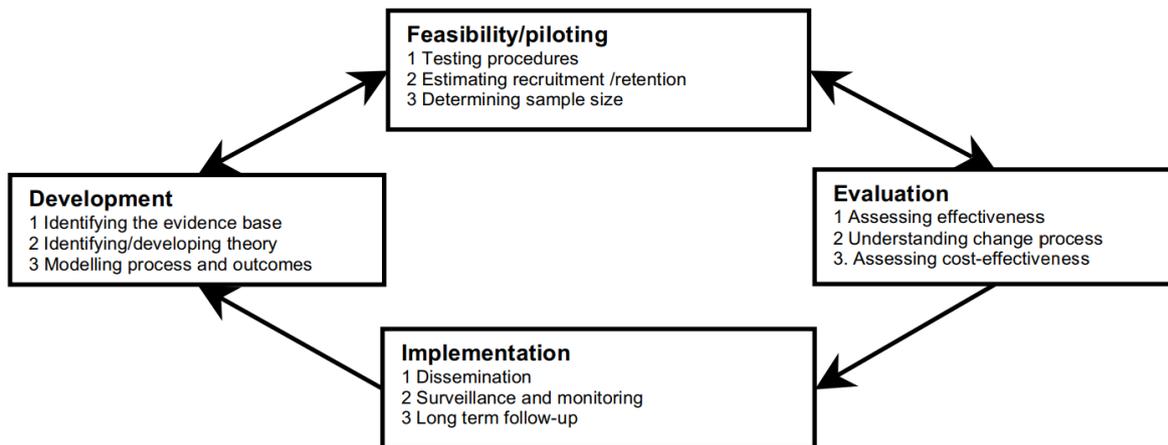
### **1.3 Intervention development**

#### **1.3.1 Intervention development models**

The literature reviewed thus far identifies the postnatal period as an opportune time for interventions to increase PA levels. Developing health behaviour interventions, defined as those that alter or affect the course of action taken by an individual relating to a health outcome, is a naturally complex process (Craig, Dieppe et al. 2008), and PA is a multi-component behaviour with multiple influencing factors. The complex nature of interventions and problems developing and evaluating them relate to the standardisation of intervention design and delivery, sensitivity to local features, the organisational and logistical difficulty of applying evaluation methods and the length of the causal chains linking intervention with outcome (Craig, Dieppe et al. 2008). Their complex nature demands a systematic approach to development to ensure the effective allocation of resources, to determine the mechanism for change and to enhance the likelihood of effectiveness. Below, I present models of intervention development used throughout this thesis.

##### *1.3.1.1 Medical Research Council guidance: Developing and evaluating complex interventions*

In 2008, the MRC published a framework of the intervention development cycle (Craig, Dieppe et al. 2008). The guidance places emphasis on the development stages and piloting the intervention and evaluation methods prior to a main efficacy trial. The guidance presents four key stages (Figure 1.4). These stages are cyclical, and users move between the stages as required by the research findings.



**Figure 1.4 - MRC guidance stages of intervention development (Craig, Dieppe et al. 2008 p8)**

a) Development

The increased focus on intervention development was a key feature of the updated guidance published in 2008. Taking a systematic and thorough approach to intervention development can create an intervention expected to have a worthwhile effect. The guidance proposes three key stages to development. First, identify the existing evidence, through a recently published or conducting an original systematic review. Second, identify or develop appropriate theory because theory-based interventions are likely to be more effective than atheoretical interventions (Michie, Abraham et al. 2009). Additionally, a theory will help understand the likely mechanisms or processes of change in an intervention.

b) Feasibility/piloting

The purpose of this stage is to test the intervention using a phased approach targeting the key uncertainties of the intervention. This stage identifies potential problems ahead of a larger trial and provides the opportunity to implement strategies that address these. The guidance proposes three key elements in this stage: the acceptability of procedures, the likely recruitment and retention rates of participants and a sample size calculation. Both qualitative and quantitative methods are encouraged in this stage and several studies may be required to refine the study design.

c) Evaluation

The third step of the guidance is a large-scale evaluation of intervention efficacy with three key aims: to assess effectiveness, understand the process and assess cost effectiveness. Assessing intervention effectiveness involves two key decisions: the study design and choice of outcomes

measured, usually a primary outcome and some secondary measures, guided by the intervention development work. The second aim of evaluation is to understand the processes. A process evaluation explores the reasons that a successful intervention is successful or an intervention fails. The components of a process evaluation can include fidelity and quality of implementation, clarify causal mechanisms and identify contextual factors associated with variation in outcomes. The third aim of an evaluation is to assess cost-effectiveness, which are useful for decision makers to justify the cost of implementing an intervention.

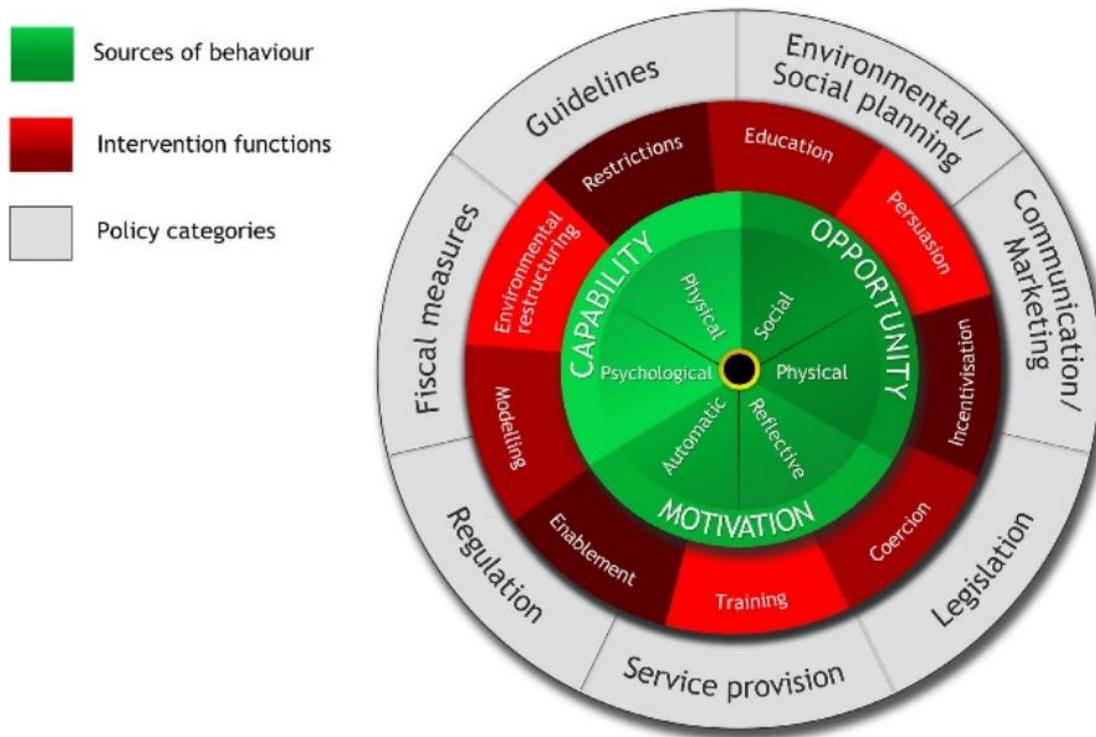
#### d) Implementation

Beyond publication, the guidance provides two additional steps to encourage the uptake of the results. The first is to get research into practice through active dissemination of the results in accessible and attractive formats. The second stage is surveillance; monitoring and long-term outcomes because there may be differences in outcomes in a long-term, widely disseminated intervention compared to the research trial.

##### *1.3.1.2 Behaviour Change Wheel*

The BCW is an intervention development method that is linked to a model of behaviour (Michie, Atkins et al. 2014). It was developed from a synthesis of nineteen frameworks of behaviour change and has three layers (Figure 1.5). The COM-B model (described in section 1.3.2.6) is the hub, which identifies the sources of behaviour to target in an intervention. Briefly, for a behaviour to occur, individuals must have the capability, opportunity and motivation.

The second layer presents intervention functions and the third layer presents potential policy options. The intervention functions and policy options present a wide choice so that developers can consider the potential of each option. Using these as a guide, intervention developers choose the appropriate intervention function and policy option using the APEASE Criteria. APEASE includes six criteria (affordability, practicability, effectiveness/cost-effectiveness, acceptability, side effects/safety and equity) against which each option is appraised and those meeting all APEASE criteria should be considered.



**Figure 1.5 – The Behaviour Change Wheel (Michie, Van Stralen et al. 2011 p1)**

The BCW has six steps (Table 1.1) to intervention development working through the three layers. Stage 1 culminates in a behavioural analysis, which identifies the factors that need to change to enable behaviour, categorised according to the COM-B components. During the second stage, the BCW links each behavioural component to the relevant intervention function and policy options for appraisal using the APEASE criteria resulting in the selection of intervention functions and/or policy options for the intervention. Stage three requires designers to identify appropriate BCTs for the chosen intervention functions or policy options. A BCT is an observable, replicable and irreducible component of an intervention designed to alter or redirect causal processes that regulate behaviour (Michie, Richardson et al. 2013). All BCTs are coded using a 93-item taxonomy to identify and report intervention content using a common language to enhance our ability to replicate and compare findings. The BCW identifies the BCTs used ‘more frequently’ and ‘less frequently’ for each intervention function and policy option. Intervention designers should consider the use of each BCT, using the APEASE criteria. The final stage of the BCW is to choose the intervention delivery method, using a taxonomy of delivery mode to consider the most appropriate delivery option.

**Table 1.1 – Description of each stage of the BCW**

<b>Stage</b>	<b>Step</b>	<b>Description</b>
1. Understanding the behaviour	1. Define the problem in behavioural terms	Specify the population and the behaviour, eg, what is the behaviour, where does the behaviour occur
	2. Select the target behaviour	Identify all behaviours that contribute to the problem and select the target behaviours of the intervention.
	3. Specify the target behaviour	Specify who needs to perform the behaviour, what they need to do differently, when will they do it, how often and with whom
	4. Identify what needs to change	What factors within individuals' capability, opportunity and motivation need to change to enable behaviour
2. Identify intervention options	5. Identify intervention functions	An intervention function is a broad category of means by which an intervention changes behaviour. Using results from the previous step identifying what needs to change, the BCW identifies the intervention functions that are likely to be effective for bringing about the changes. There are nine intervention functions. Intervention designers appraise each intervention function to choose those likely to be effective.
	6. Identify policy categories	For designers who have access to policy options, identify what policy options would support the delivery of the chosen intervention functions
3. Identify content and implementation options	7. Identify BCTs	Identify BCTs appropriate for the chosen intervention options from a list of 'most frequently' and 'less frequently' used, appraising each one
	8. Identify mode of delivery	Using a taxonomy of modes for delivering interventions, decide initially on a face-to-face or distance intervention.

The BCW is a relatively new intervention development model. It has been applied in promoting hearing aid use (Barker, Atkins et al. 2016), medication adherence (Jackson, Eliasson et al. 2014), increasing the frequency of very brief PA advice by healthcare professionals to cancer patients (Webb, Hall et al. 2016) and health coaching programme for low income Latina mothers with recent GDM (Handley, Harleman et al. 2015). One systematic review of PA interventions in postnatal women identified 'self-monitoring of behaviour' and 'goal setting' as the most common BCTs among efficacious interventions (Gilinsky, Dale et al. 2015). In a qualitative study of a postnatal weight management intervention, participants reported using 'self-monitoring of behaviour', 'prompts/cues' and 'social support (unspecified)' (Smith, Taylor et al. 2016).

### **1.3.2 Theories of health behaviour**

Intervention development requires the identification of appropriate theory. Theory and interventions have a reciprocal relationships where theories should guide intervention development (Prestwich, Webb et al. 2015), indeed the use of theory for intervention design is preferred as theory-based interventions are more effective than non-theory based interventions (Michie, Abraham et al. 2009). Interventions test the theoretical constructs and the findings are used to refine the theory, however the extent to which theory refinement occurs is limited (Prestwich, Webb et al. 2015). As outlined above, selecting an appropriate theory is important because they provide relevant techniques and intervention strategies that should be included in behaviour change interventions. Key health behaviour theories are outlined below.

#### *1.3.2.1 Theory of Planned Behaviour*

The TPB proposes that behavioural intentions and perceived behavioural control (PBC) determine behaviour. PBC represents an individual's perception of their ability to perform the behaviour and is included to account for factors outside of the individual's control. In the theory, intention is determined by attitude towards the behaviour, subjective norm and PBC. Attitude is a result of the individual's behavioural beliefs about the outcome of the behaviour, influenced by the evaluation of these outcomes. Strong beliefs that performing the behaviour will have a positive outcome will result in a positive attitude towards the behaviour. The opposite is true for negative beliefs. Subjective norms are influenced by normative beliefs and the beliefs of other important individuals (often approval or disapproval) and the extent to which the individual feels compelled to comply with others beliefs. PBC is influenced by control beliefs, the individual's perception of barriers to the behaviour and the power of each factor to facilitate or inhibit behaviour.

The TPB has been widely applied to PA behaviour, and findings show a large effect size for the relationship between intention and behaviour, attitude and intention, attitude and behaviour, PBC

and intention and PBC and behaviour (Hausenblas, Carron et al. 1997). A moderate effect size has been found between subjective norm and exercise intention (Hausenblas, Carron et al. 1997). In a prospective study following women through pregnancy and up to one year after childbirth, intention to exercise was a highly significant predictor of exercise at one year (Hinton and Olson 2001). McIntyre and Rhodes (2009) examined the differences in theoretical constructs between mothers of children aged 0-4 years who continued or discontinued with PA after birth. In the studies, perceptions of control based on time, fatigue, social support (SS) and childcare were the critical components that determined continued participation. In addition, the expected affect and social aspects of participation influenced behaviour. Attitude and subjective norm did not differ between continuers and non-continuers.

### *1.3.2.2 Social-Cognitive Theory*

The SCT (Bandura, Freeman et al. 1999) extends the original Social Learning Theory, which states that individuals learn behaviour via observation of others, which does not guarantee behaviour change. The SCT expands to propose that learning takes place from a continuous and dynamic interaction between personal cognitive factors, environmental factors and behavioural factors, also known as reciprocal determinism. The personal cognitive factors relate to an individual's ability to self-determine or self-regulate behaviour and to reflect on and analyse their experience and include self-efficacy and outcome expectations. Environmental factors refer to the physical and social opportunities that promote or prevent behaviour and include SS, barriers and opportunities, observational learning and normative beliefs. Behavioural factors refer to the action performed by the individual, eg, behavioural skills, intervention and reinforcement or punishment, and can either be health enhancing or health compromising (Glanz, Rimer et al. 2008). The factors outlined do not contribute equally to behaviour, rather behaviour is dependent on which factors have the strongest influence at any particular moment.

SCT has been applied to PA across the literature and accounts for 31% of the variance in PA (Young, Plotnikoff et al. 2014), although the majority of the literature focuses on self-efficacy and less on the other constructs of the SCT (Sutton 2001). Observational evidence among women followed from pregnancy to one year after childbirth (Hinton and Olson 2001) and an intervention with pre-school mothers (Miller, Trost et al. 2002) show that self-efficacy is a significant predictor of exercise frequency.

### *1.3.2.3 Transtheoretical model*

The TTM is a stage-based model originally applied to smoking behaviour (Prochaska and DiClemente 1982, Prochaska and DiClemente 1986, Prochaska, DiClemente et al. 1992). The model proposes five

key stages based on current or past behaviour and behavioural intention; Pre-contemplation - no intention of changing behaviour in the near future (usually six months); Contemplation - intending to take action to change behaviour during the next six months; Preparation - intend to take action soon, (within the next months); Action - have changed their behaviour within the past six months, but remain at high risk of relapse because the behaviour is relatively new; Maintenance -have changed their behaviour for at least six months. A sixth stage of termination exists, although not commonly used, for individuals who have no temptation and are sure they will not return to their old behaviour. Movement through the stages is cyclical and individuals move through the stages but often relapse to an earlier stage before they continue to move through the stages again. This may happen several times throughout an attempt to change behaviour. The constructs of the TTM are processes of change, decisional balance, self-efficacy and temptation. Ten processes of change describe the strategies adopted during the behaviour change process and they change according to the stage of behaviour. Decisional balance refers to the pros and cons of behaviour change and reflects individuals' positive or negative beliefs about performing the behaviour. Self-efficacy increases as an individual moves through the stages of change so that individuals in the later stages of change have higher levels of self-efficacy. Temptation indicates urges to engage with a behaviour in specific, often difficult situations, triggered by emotional distress, positive social situations and craving.

Fahrenwald and Sharma (2002) applied the TTM to low income mothers and observed a linear relationship between the stage of change and self-reported PA. Significant relationships were observed between stage of behaviour change and pros (sense of accomplishment, increased strength, stress relief and getting into shape after pregnancy), cons (fatigue, childcare and cold weather) and self-efficacy, concluding that interventions should utilise strategies to increase the perceived pros, decrease the perceived cons and increase self-efficacy.

#### *1.3.2.4 Health Action Process Approach*

The Health Action Process Approach is a two-stage model and proposes that an individual starts in the motivational phase, which culminates in a behavioural intention to adopt a health behaviour or cease a harmful behaviour. It is proposed that three components make up the intention; task self-efficacy, outcome expectations and risk perception. To bridge the gap between intention and behaviour, the model proposes a volitional phase, which involves self-regulatory skills and strategies (Gholami, Knoll et al. 2015). The model proposes four constructs during the volitional phase – coping self-efficacy, action planning, coping planning and recovery self-efficacy, all of which help individuals to plan, initiate, maintain behaviour and restart following a set-back (Sniehotta, Scholz et al. 2005).

In PA, three components of the volitional phase explained 69% of the variance in intention among cardiac rehabilitation patients (Sniehotta, Scholz et al. 2005). Coping self-efficacy and action planning were found to predict exercise behaviour (Sniehotta, Scholz et al. 2005). A meta-analysis of the social cognitive constructs of the health action process approach in the maintenance of regular PA found significant associations between all social-cognitive constructs of the model apart from risk perception and thus supports the model for its application to PA (Gholami, Knoll et al. 2015).

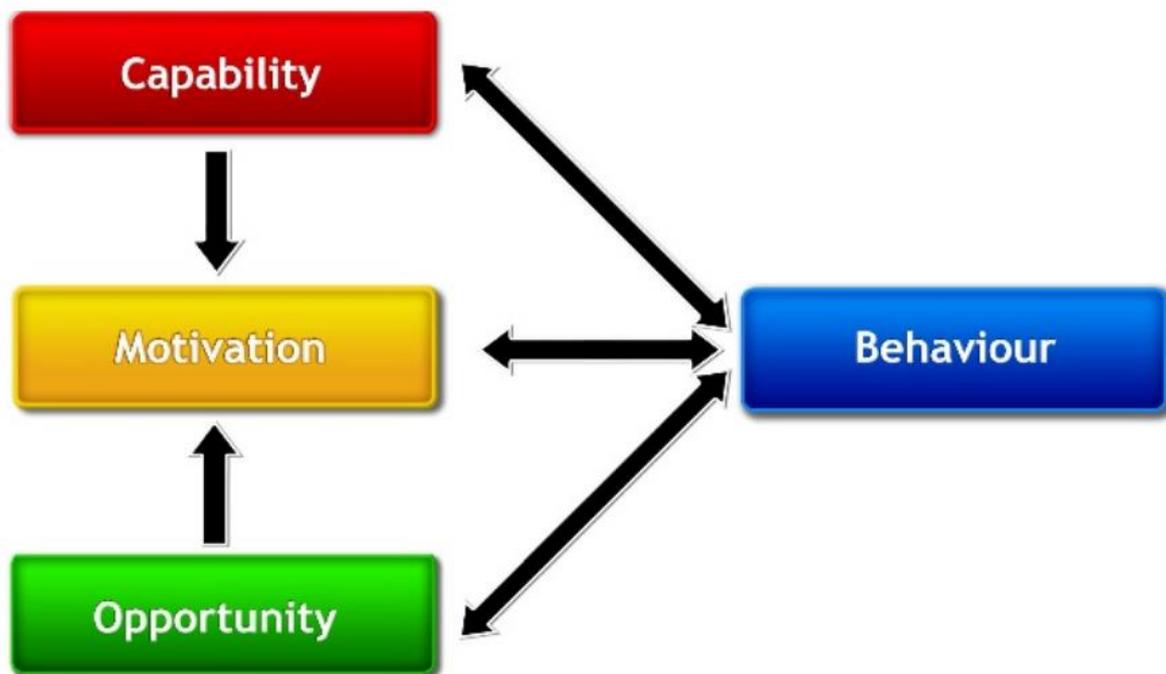
#### *1.3.2.5 The Health Belief Model*

The HBM proposes that an individual's health beliefs affect their behaviour. The constructs of the model have been used to determine whether individuals will take action to prevent, detect or control illness. The six key constructs are perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action and self-efficacy. The individual's perceptions of susceptibility and seriousness multiply to result in the perceived threat of disease. Benefits and barriers could be tangible or psychological (Glanz, Rimer et al. 2008), and cues to action are the least studied component of the model (Rosenstock 1974, Sutton 2001, Glanz, Rimer et al. 2008). A person is likely to engage in a health behaviour if they believe they are susceptible to the condition, which has potentially serious consequences, they believe the action will reduce the threat of the disease, and the perceived barriers to behaviour are outweighed by the perceived benefits and are not strong enough to prevent action (Glanz, Rimer et al. 2008). Sociodemographic factors are thought to moderate the relationship between health beliefs and health behaviour.

Evidence for the HBM provides support for the constructs albeit with small effects (Glanz, Rimer et al. 2008). In relation to PA, the theory accounted for 29% of the variance in adherence to coronary heart disease exercise. The perceived severity of coronary heart disease was associated with attendance at the sessions, but the perceived benefits of exercise had the opposite to expected relationship (Mirotznik, Feldman et al. 1995). Many of the HBM constructs have been associated with postnatal PA; however no studies have specifically explored the model.

#### *1.3.2.6 COM-B model*

The COM-B model forms the hub of the BCW (section 1.3.1.2). The model proposes that behaviour is a product of three interacting components; (C) Capability (O) Opportunity and (M) Motivation (Figure 1.6). All three components must be present for the behaviour to occur and the absence of one component will prevent behaviour.



**Figure 1.6 – Capability (C), Opportunity (O), Motivation (M) and Behaviour (B) model**

Capability refers to an individual’s physical and psychological capacity to engage in the behaviour, comprised of physical capability, having the physical strength or stamina to perform the behaviour and psychological capability, the knowledge or psychological skills, strength or stamina to engage in behaviour. Opportunity refers to environmental factors that influence behaviour and may be physical or social opportunities. Motivation refers to the cognitive processes that activate or inhibit behaviour and can be either reflective or automatic processes. The COM-B model is designed for use as part of an overarching framework for intervention development.

### **1.3.3 Application of intervention development guidance and theories of health behaviour in this thesis**

Due to the restricted timescales of this project, the remainder of this thesis focuses on the first two steps of the MRC guidance of intervention development and feasibility testing and concludes with recommendations for further research. Table 1.2 explains how the chapters presented in this thesis relate to existing intervention development guidance and theory.

**Table 1.2 – Thesis methods in relation to the intervention development guidance**

MRC Guidance	Thesis Chapters
<b>1. Intervention development</b>	
<i>1.1 Identifying the evidence base</i>	<b>Chapter 2:</b> Effectiveness of PA interventions in postnatal women: Systematic review and meta-analysis
<i>1.2 Identifying/developing appropriate theory</i>	<b>Chapter 3:</b> A multi-methods behavioural analysis of postnatal PA according to the COM-B model.
<i>1.3 Modelling process/outcomes</i>	<b>Chapter 4:</b> Intervention development using the BCW
<b>2. Assessing feasibility and piloting methods</b>	
	<b>Chapter 5:</b> Feasibility and acceptability trial of a buddy postnatal PA intervention: Methods
	<b>Chapter 6:</b> Feasibility and acceptability trial of a buddy postnatal PA intervention: Results

Chapter 2 systematically reviews the existing evidence on postnatal PA interventions. Chapter 3 identifies the COM-B model as an appropriate health behaviour model as part of the wider BCW intervention development method. Additionally, the COM-B model accounts for the multiple layers of influence on behaviour. Using the theory, the multi-methods study presented in Chapter 3 identifies the factors that influence behaviour as targets for the intervention. Chapter 4 follows the guidance to model process and outcomes of the intervention, for which I utilised the BCW due to the lack of information in the MRC guidance on how to progress through this stage. The BCW offers systematic guidance to understand what to target in the intervention and how to do this. This chapter follows BCW guidance to choose appropriate intervention functions, content and delivery method. Chapter 4 outlines this process and presents the resulting intervention.

The second stage of the MRC guidance relates to piloting of the intervention and evaluation and should address the key uncertainties of the intervention. Chapter 5 presents the methods for the feasibility study, and Chapter 6 presents the results of the feasibility study.

## **1.4 Chapter One summary**

Regular participation in PA is beneficial for the physical and mental health in the general population. Despite its benefits, the proportion of people who do not meet the government's guidelines of 150 minutes of moderate PA per week is high. Across all ages, women are less active than men and postnatal women are at high risk of physical inactivity. For postnatal women, PA is important to reduce gestational weight retention, thus reducing long-term obesity risk, reducing the risk of developing postnatal depression and improving cardiorespiratory fitness. It is recommended that postnatal women aim to achieve 150 minutes of PA per week, resuming when it is comfortable and safe to do so following a natural birth and waiting until health professional approval following a complicated birth or caesarean section. Due to the low PA levels among this population and its benefits, interventions to increase PA are recommended. The process of developing interventions is complex and demands a systematic approach. For the remainder of this thesis I will broadly follow the first stages of the MRC guidance for the development phase utilising the BCW and associated COM-B model as a theory-base for intervention development.

## **2 Effectiveness of physical activity interventions in postnatal women: A systematic review and meta-analysis**

### **2.1 Introduction**

As discussed in Chapter 1, the first stage of intervention development is assessing the existing literature. Systematic reviews in this area primarily focus on the effect of PA with or without dietary intervention on weight related outcomes (Bertz, Brekke et al. 2012, Choi, Fukuoka et al. 2013). A Cochrane review of diet and PA interventions on weight outcomes after childbirth found that the effect of PA interventions was not significant compared to usual care for weight loss (Adegboye and Linne 2013). However, few reviews examine the effect of interventions on PA behaviour, which is important to explore due to the additional benefits of PA beyond weight loss. To my knowledge, only one review examines the effect of PA interventions on PA behavioural outcomes (Gilinsky, Dale et al. 2015). The search was initially conducted in July 2013; since then a number of postnatal PA interventions have been published (Albright, Steffen et al. 2012, Gilinsky, Hughes et al. 2012, Lewis, Gjerdingen et al. 2014, Monteiro, Jancey et al. 2014). A narrative review of PA interventions in healthy postnatal populations found that six out of seven interventions targeting PA in healthy postnatal women were effective (Gilinsky, Hughes et al, 2012). The meta-analysis of all studies found a significant moderate effect size (SMD=0.53; 95% CI; 0.05, 1.01; p=0.03) on PA frequency but no significant effect on volume of PA or walking behaviour. However, it included weight management interventions and interventions in clinical populations, which were less successful than those targeting healthy inactive postnatal women. Therefore, the true effect size of PA interventions in healthy inactive postnatal women is unknown.

Further to determining 'if' PA interventions are effective, it is essential to understand 'why' they are effective. Identifying the 'active ingredients' of effective interventions enables researchers to replicate the intervention in new settings (Wood, Hardeman et al. 2015) and facilitates the translation of research into practice. However, in the literature, descriptions of intervention content are poor (Glasziou, Meats et al. 2008), and effectiveness is variable (Michie, Richardson et al. 2013), making it difficult to identify the intervention components responsible for changing behaviour. Davidson, Goldstein et al. (2003) propose seven intervention components that vary: (1) who delivers the intervention; (2) intervention recipients; (3) how often the intervention is delivered; (4) for how long the intervention is delivered; (5) format of intervention delivery; (6) intervention context; (7)

intervention content. While the first six are well reported, definitions and reporting of intervention content is inconsistent or incomplete, resulting in calls for consistency of reporting complex interventions (Michie, Fixsen et al. 2009). BCT coding is one method to report intervention content. Identifying BCTs present in interventions can determine if particular BCTs are associated with effective interventions to inform the choice of BCTs. Three BCTs, 'self-monitoring of behaviour', 'prompts/cues', and 'social support (unspecified)', have been used by obese postnatal women for weight loss (Smith, Taylor et al. 2016). Furthermore, a review of postnatal PA interventions (Gilinsky, Dale et al. 2015) identified nine BCTs that were applied in  $\geq 40\%$  of the interventions, accounting for 57% of the BCTs coded in the review. However, the frequency of use does not indicate their efficacy. In the wider literature, a study utilised a meta-regression approach to determine the BCTs associated with intervention efficacy (Michie, Abraham et al. 2009), important to design evidence-based interventions. Previous reviews have utilised behaviour specific versions of the BCT taxonomy (Michie, Ashford et al. 2011), but to date no reviews in postnatal women have utilised the most recent taxonomy.

### **2.1.1 Aims**

The systematic review, meta-analysis and meta-regression will complete an assessment of the existing literature, as recommended in stage one of the MRC guidance. The review aims to answer three questions:

1. What is the effectiveness of postnatal PA interventions?
2. What intervention characteristics are associated with effective interventions?
3. What BCTs are associated with effective interventions?

## **2.2 Methods**

I followed the Cochrane Handbook for systematic reviews to design the protocol (Green and Higgins 2005). The handbook provides guidance for researchers to conduct systematic reviews and make informed decisions about systematic review methods. I adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), when writing this chapter, a 27-item checklist (Appendix 2.1) to ensure transparent reporting of systematic reviews and meta-analysis in the published literature (Liberati, Altman et al. 2009).

### **2.2.1 Protocol registration**

I prospectively registered the review protocol with PROSPERO (registration number CRD42017053586), an international database of prospective systematic reviews created to avoid duplication and reduce the opportunity for reporting bias.

### **2.2.2 Information sources**

Studies were identified by searching electronic databases with no date restrictions. The search was conducted in MEDLINE via OVID (1946 to present), Embase via OVID (1974 to present), PsycINFO via EBSCOhost, Web of Science core collection (1990 to present), Scopus (1960 to present), Cochrane Central Register of Controlled Trials (CENTRAL) via Cochrane library and CINAHL via EBSCO Host (1981 to present). Reference lists of included studies were hand searched for additional studies.

### **2.2.3 Search**

I consulted a university librarian to assist designing the search strategy. The search terms were based on the PICO (Participants, Intervention, Comparison, Outcome) model and included synonyms based on 'postnatal, 'PA' and 'randomized controlled trials'. For example, synonyms for postnatal were 'new mums', 'postpartum' or 'perinatal', for PA were 'sport', 'walking', etc. I used the SIGN filter for RCTs to guide the search terms for RCTs. I used Boolean operators AND and OR to combine the search terms. Each search strategy was modified for the database (see Appendix 2.2 for MEDLINE search strategy).

### **2.2.4 Study selection**

#### *2.2.4.1 Eligibility criteria*

Eligibility criteria was based on the PICO model:

#### a) Participants

Included interventions were conducted on healthy women within twelve months of childbirth, with no restriction on BMI or PA levels. Interventions conducted in women with pre-existing medical conditions including back pain, urinary incontinence, GDM or postnatal depression were excluded.

#### b) Intervention

PA interventions were included, defined as an intervention aiming to increase PA. Interventions including dietary components or targeting weight loss or management were excluded.

#### c) Comparison

Studies were required to have a comparison condition including wait-list control, alternative intervention, no intervention, information provision or usual care comparison.

#### d) Outcome

Studies with a primary or secondary outcome of PA behaviour (objective or self-report) were included. Studies that included only measures of fitness, attitudes or beliefs to PA were not included in the review.

#### e) Study design

Randomised, quasi-randomised or cluster randomised controlled trials were included in the review.

Non-English language and non-peer reviewed articles were excluded from the review

#### 2.2.4.2 *Screening*

I conducted the database searches to identify a citation list, exported it to reference management software EndNote (V8) and removed duplicates. Two reviewers were involved at each stage to minimise bias and errors. I (Kate Ellis (KE)) screened all records at each stage and Sally Pears (SP) and Stephen Sutton (SS) each screened half of the records. We first screened the titles and abstracts against the eligibility criteria and retrieved the full text articles. The full text articles were screened according to the eligibility criteria and the reason for exclusion was noted. Multiple articles based on the same study were recorded and reported as one study. I compared the screening results of the reviewers at each stage to identify conflicting decisions. Inconsistencies were resolved by a discussion between the two reviewers in the first instance and outstanding conflicts resolved by involving the third reviewer. SP and SS acted as the third reviewer for the records they had not screened.

#### 2.2.5 **Data extraction**

I extracted the data into a standardised data extraction form developed for this systematic review and a second reviewer independently verified the forms. Data extracted from the studies were: publication details, study details, participant characteristics, intervention characteristics, self-report and objective PA outcome measures and other relevant information. I contacted corresponding authors of included articles for missing data. Where studies included three intervention groups, data was extracted for the intervention and the absolute control.

### 2.2.5.1 Assessment of risk of bias

A bias is defined as a systematic error and may lead to overestimation or underestimation of the truth and influence the internal validity of a study (Green and Higgins 2005). It is not possible to ascertain that a study introduced bias, rather we assess the risk of introducing bias to the study due to methodological flaws.

The Cochrane Collaboration Assessment of Risk of Bias (RoB) tool assesses possible sources of bias in RCTs across seven domains (Table 2.1). Two researchers (KE and SS or SP) independently assessed the RoB in included studies, following the processes outlined previously. We assessed RoB across each domain in every included study and assigned a rating of low, high or unclear risk of bias, using the guidelines for each source of bias outlined in the Cochrane Handbook.

**Table 2.1 – Cochrane Collaboration Assessment of RoB Tool**

Type of bias	RoB domain	Description
Selection bias	Random sequence generation	Differences between baseline characteristics of the groups, which should be prevented by randomization
	Allocation concealment	Implementation of a schedule of assigning participants randomly, by preventing intervention personnel knowing the upcoming group allocation
Performance bias	Blinding of participants and personnel	Difference in the care provided to both groups due to knowledge of their group allocation.
Detection bias	Blinding of outcome assessment	Difference between groups in how the outcomes are determined.
Attrition bias	Incomplete outcome data	Difference between groups in the rate of withdrawal from the study.
Reporting bias	Selective reporting	Bias occurring from selective outcome reporting
Other bias		Any other source of bias identified by the reviewers.

### 2.2.5.2 *BCT coding*

Coding BCTs included in interventions is an approach growing in popularity, which enables researchers to use a standardised approach to classify intervention content. It identifies intervention content in its simplest form, compares content and facilitates the replication of interventions. I completed an online training course to identify BCTs in intervention descriptions. The training included six sequential sessions, which focused on a subset of BCTs included in the taxonomy and a series of assessments and feedback. The evaluation of BCT training found that it improved trainees' competency in identifying BCTs among intervention descriptions. Trained coders can reliably code 80 of the 93 BCTs and identify 14 of the 15 BCTs present in published intervention descriptions. Moreover, reliability is maintained over one month (Michie, Johnston et al. 2014). SP and SS had previously undertaken face-to-face training on BCT coding.

### 2.2.5.3 *Coding behaviour change techniques*

Using the 93-item BCT taxonomy V1, we coded the BCTs in all intervention and control groups. Control group BCTs targeting PA behaviour only were coded. We coded the level of confidence that the technique was present:

- (i) definitely present (++): BCT is present beyond all reasonable doubt
- (ii) probably present (+): BCT is present in all probability
- (iii) absent.

Two researchers (KE and SP or SS) independently coded the BCTs as outlined in previous sections.

## 2.2.6 **Data analysis**

### 2.2.6.1 *Qualitative synthesis*

Study and intervention characteristics were compiled in a study characteristics, intervention characteristics and outcome measurement table. A narrative analysis summarised the key features of the studies and interventions.

### 2.2.6.2 *Quantitative synthesis*

Effect size, meta-analysis and subsequent statistical tests were performed in RevMan 5 (The Nordic Cochrane Centre 2014). The meta-regression was performed in Comprehensive Meta-Analysis (Borenstein 2013).

- a) Effect size calculation

Initially, I proposed calculating effect sizes at the final follow-up measure in each study to reflect the long-term effect, however only one study had a long follow-up period and as a result I used the post-intervention data collection measures to calculate effect size and 95% CI to maintain consistency between the studies.

Where more than one PA measure is provided, I used the following criteria to select the measurement: (1) if two measurement methods were used, I used objective measures as opposed to self-report measures (2) when more than one outcome was reported, I selected a continuous measure above a dichotomous outcome, and (3) when more than one continuous measure was available I used the measure that best reflects overall PA.

I used mean, SD and sample size to calculate the effect size. Where studies reported standard error or 95% CI, I manually calculated the SD. The chosen effect size was SMD and 95% CI to account for differences in the measurement scales between studies.

#### b) Meta-analysis

i) Pooled effect size: I calculated pooled effect size using a random effects model, in anticipation of high heterogeneity and presented it graphically in a forest plot. Cohen's effect size was used to categorise the pooled intervention effect sizes small ( $\sim 0.2$ ), moderate ( $\sim 0.5$ ) or large ( $\sim 0.8$ ).

ii) Heterogeneity: A Chi-Square test indicated the presence or absence of significant heterogeneity using a significance value of  $p < 0.05$ . I calculated  $I^2$  to estimate the proportion of variance due to a real difference between studies rather than random error, using the boundaries 25%, 50% and 75% to indicate low, moderate and high heterogeneity respectively (Higgins, Thompson et al. 2003).

iii) Publication bias: A funnel plot was used to visually assess publication bias. Publication bias occurs when decision to publish intervention research is influenced by its results, resulting in an increased chance of publishing significant results compared to null results. Funnel plots examine publication bias using a scatter plot of study effect size (horizontal axis) against a measure of the study's precision or size (vertical axis). In the absence of publication bias, the scatter plot should present a symmetrical, inverted funnel. If publication bias is present, it is likely that smaller studies with non-significant effects will not appear in the published literature resulting in a non-symmetrical plot.

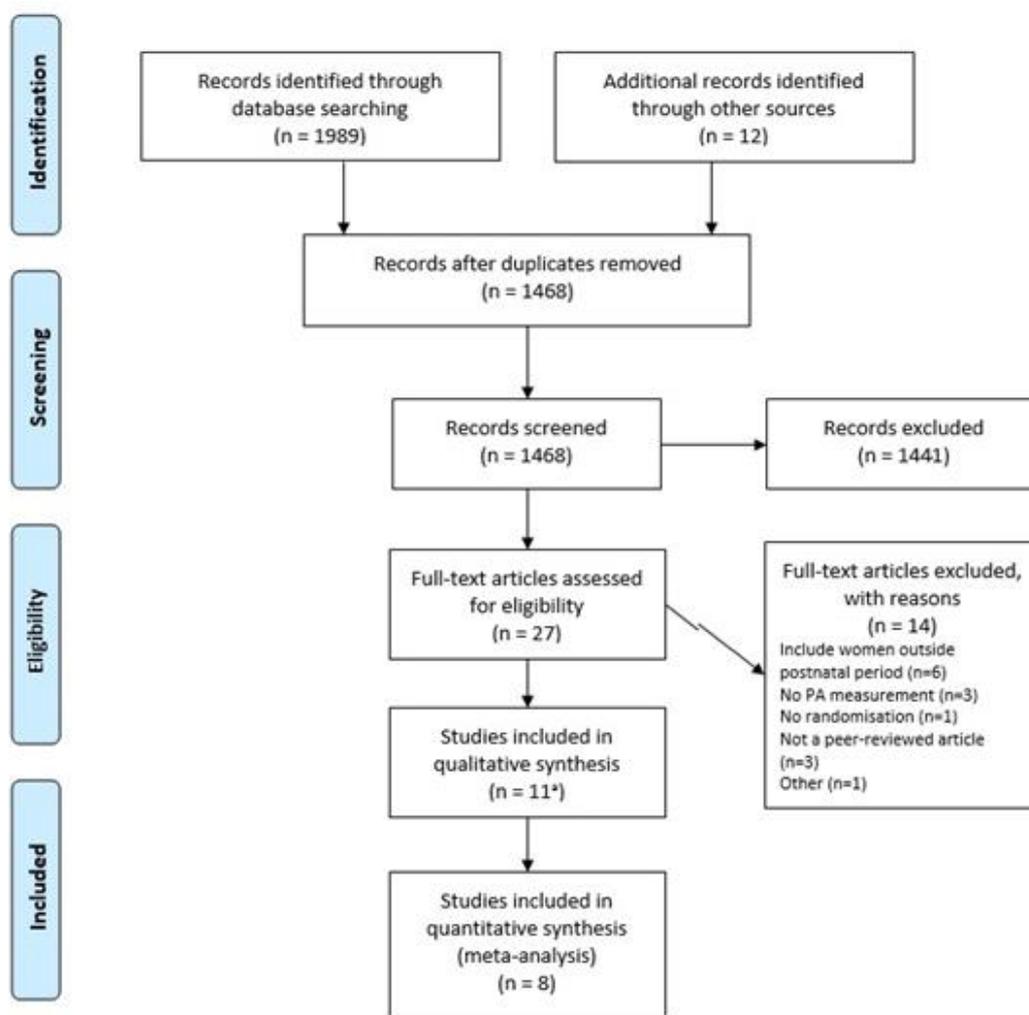
iv) Subgroup analysis: Subgroup analyses identify any difference in intervention effects between different study characteristics or participants and are often used as a method to explore heterogeneity. I pre-specified a subgroup analysis to assess the difference between interventions using self-report and objective measures, because participants are likely to overestimate PA levels when compared to objective measures.

c) Meta-regression

A random-effects meta-regression was used to identify intervention characteristics associated with intervention effectiveness. The pre-specified intervention characteristics included were: theory based (yes/no), BCTs (absent/present (BCTs classified as present were those coded (++) and were present in the intervention and absent in the control group), delivery provider, setting (home/community), duration (>8 weeks/<8 weeks) and delivery format (face-to-face/distance). Intervention components present in >30% of all studies were included. 30% is an asymmetrical value, therefore any characteristic present in >70% would be excluded.

## 2.3 Results

### 2.3.1 Search results



\*11 studies included in review. 13 full text articles describe 11 studies.

**Figure 2.1 – PRISMA Flow diagram**

Figure 2.1 presents the PRISMA diagram of the search and screening results. The database search yielded 1989 results (Medline=185; EMBASE=654; CENTRAL=220; Scopus=175; CINAHL=178; Web of Science=487; PsycINFO=90). Reference list searching of included studies identified an additional 11 records, and an additional 1 study was identified through talking to an author. 2001 citations were identified of which 533 were duplicates, resulting in 1468 titles and abstracts screened. We excluded 1441 articles based on the title and abstract and retrieved 27 full text articles. Following full text review, 14 articles were excluded. Thirteen articles were eligible to be included and two papers described the Madres para la Salud intervention (Keller, Ainsworth et al. 2014, Vega-López, Pignotti

et al. 2015) and the Moms in Motion intervention (Cramp and Brawley 2006, Cramp and Brawley 2009). Eleven studies were included in the narrative analysis and eight in the statistical analysis.

### **2.3.2 Study characteristics**

Table 2.2 presents a summary table of the study characteristics.

#### *2.3.2.1 Participants*

1221 participants were randomized to the intervention (n=611) and control (n=610) groups. Study participants mean age was 29.8 years (SD=5.64).

**Table 2.2 – Study characteristics of included studies**

<b>Author name; year; study name</b>	<b>Study design</b>	<b>Country</b>	<b>Participants (n)</b>	<b>Participants age (years); mean (SD)</b>	<b>Age of baby (weeks); mean (SD)</b>	<b>Eligibility criteria</b>
Albright; 2014; Hawaii Na Miki Miki	RCT	USA	311	31.9 (5.7)	22.2 (11.4)	18-45 years; infant aged 2-12 months, engage in <30 min MVPA per week; BMI 18.5-40; healthy
Ashrafinia; 2015	Cluster RCT	Iran	80	24.5 (3.6)	NA	18-35 years; primiparous; normal vaginal delivery; healthy with no history of physical or mental disease
Cramp; 2006	RCT	Canada	67	31.5 (5.1)	NA	6-52 weeks after childbirth; primarily sedentary; physician consent to be active; healthy; not currently pregnant
Fjeldsoe; 2010; MobileMums	RCT	Australia	88	30 (6)	NA	<12 months postpartum; had a mobile phone; less than 30 minutes of MVPA on 5 days per week; intention to increase PA in next three months; able to nominate a SS person
Keller; 2014; Madres Para La Salud	RCT	USA	139	28.3 (5.6)	NA	18-40 years; Habitually sedentary; Latina; 6 weeks to 6 months following childbirth;
Kernot; 2019;	RCT	Australia	81	31.1 (3.5)	28.63 (13.42)	Up to 12 months postpartum; current

Mums Step It Up						Facebook users; healthy, able to take part in PA, no planned pregnancy
LeCheminant; 2014	RCT	USA	60	26.4 (4.8)	15 (6.8)	6 weeks-8 months postpartum; >2.27kg above self-reported pre-pregnancy weight; no plans to become pregnant
Lewis; 2013; The Healthy Mom Trial	RCT	USA	130	31.54 (5.0)	5.9 (5.3)	<8 weeks following birth; personal or maternal history of depression; low active
Maturi; 2011	RCT	Iran	70	25.25 (4.2)	12.79 (5.4)	18-40 years; inactive or low active according to IPAQ; singleton pregnancy
Norman; 2010	RCT	Australia	161	29.70 (4.7)	7.65 (1.4)	All women on postnatal ward who speak and read English independently; Excluded with a diagnosis of psychiatric disorder
Tripette; 2014	RCT	Japan	34	32.45 (4.8)	28 (11.8)	3 months – 1 year following childbirth; natural delivery; no planned pregnancy; healthy; inactive

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### 2.3.2.2 *Outcome measures*

Seven studies measured PA objectively with five of those using accelerometers, one using a pedometer and one using a Nintendo Wii data saver. Two studies used objective measures only.

Nine studies collected self-report PA measures with four studies using self-report PA measurements as the primary measurement method and five studies using them alongside objective measurements. Studies used the 7-day PA recall questionnaire, Australian Women's Activity Survey, Stanford Brief Activity Survey, Active Australia Survey Instrument, IPAQ-SF, Standard Multidimensional fatigue inventory questionnaire and in one study the measurement tool was unclear. Table 2.3 presents a summary of outcome measures in the studies.

The most common outcome measure was MVPA-min/week or day, whereas others included reduced activity level, total steps/day, Stanford Brief Activity Survey score, formal PA min/weekend and total playing time.

**Table 2.3 – Study outcome measurements and results**

<b>Study author</b>	<b>Outcome measure: measurement tool (unit)</b>	<b>Results</b>
<b>Objective PA measures</b>		
Albright, 2014	<i>Objective</i> ; Accelerometer - New Lifestyles NL-2000, Inc (MVPA-min/week)	<i>Objective</i> : Non-significant ( $p=0.61$ ) effect of intervention on MVPA min/week.
Keller, 2014	<i>Objective</i> ; Pedometer - Omron HJ-720ITC (Total steps/day)	<i>Objective</i> : Significant group x time interaction for total steps/day ( $p<0.001$ ) between intervention group (6964) and control group (6425)
Kernot, 2019	Objective; Accelerometer – ActiGraph GT3X+ (MVPA-min/week)	Objective; Non-significant effect on MVPA min/week between intervention (189) and control (150) groups
LeCheminant, 2014	<i>Objective</i> ; Accelerometer – ActiGraph GT1M (MVPA-min/day)	<i>Objective</i> : No significant effect on MVPA ( $p=0.236$ ) between intervention (18) and control (16)
Lewis, 2013	<i>Objective</i> ; Accelerometer – ActiGraph (MVPA-min/week)	<i>Objective</i> : No significant effect ( $p=0.75$ ) of intervention on MVPA min/week between intervention (127.8) and control (122.2) groups.
Maturi, 2011	<i>Objective</i> ; Pedometer – Omron, HJ-152K-E (Steps/day)	<i>Objective</i> : No pedometer results available for control group.
Tripette, 2014	<i>Objective</i> ; Nintendo Wii Fit plus data saving system (Total playing time – minutes)	<i>Objective</i> : No objective results available for the control group.
<b>Self-report PA measures</b>		
Albright, 2014	<i>Self-report</i> ; Active Australia Survey Instrument (MVPA-min/week)	<i>Self-report</i> : Significant ( $p=0.027$ ) increase in MVPA min/week in intervention group (246 minutes) compared to control groups (156 minutes).
Ashrafinia, 2015	<i>Self-report</i> ; Standard Multidimensional Fatigue Inventory questionnaire (reduced activity)	<i>Self-report</i> : Significantly improved results ( $p<0.001$ ) for ‘reduced activity’ item on MFI-20 questionnaire

Cramp, 2006	<i>Self-report</i> ; 7 Day Physical Activity Recall Questionnaire (MVPA-min/week)	<i>Self-report</i> : Significant increase ( $p < 0.01$ ) in MVPA in the intervention group (400.38 min/week) compared to control (222.24 min/week).
Fjeldsoe, 2010	<i>Self-report</i> ; Australian Women's Activity Survey (MVPA-min/week)	<i>Self-report</i> : Non-significant effect ( $p = 0.082$ ) between the change in MVPA min/week between intervention (18.26) and control (16.36) groups at one week post intervention.
Keller, 2014	<i>Self-report</i> ; Stanford Brief Activity Survey (SBAS Score – 5 point scale)	<i>Self-report</i> : Significant group x time interaction for SBAS score ( $p < 0.001$ ) between intervention group (2.82) and control group (2.06).
Kernot, 2019	<i>Self-report</i> ; Active Australia Survey (MVPA-min/week)	<i>Self-report</i> ; Non-significant effect on MVPA min/week between intervention (451) and control (366) groups
Lewis, 2013	<i>Self-report</i> ; 7 Day Physical Activity Recall Questionnaire (MVPA-min/week)	<i>Self-report</i> : No significant effect ( $p = 0.34$ ) of intervention on MVPA min/week between intervention (129.8) and control (123.3)
Maturi, 2011	<i>Self-report</i> ; IPAQ-SF (MET-min/week)	<i>Self-report</i> : Significant difference in energy expenditure/week ( $p = 0.001$ ) between intervention group (4394) and control group (1651).
Norman, 2010	<i>Self-report</i> ; Questionnaire – based on American College of Sports Medicine and American Heart Foundation's Exercise Guidelines (Formal PA-min/week)	<i>Self-report</i> : No significant effect ( $p = 0.87$ ) on min/week of PA between the intervention (176) and control (155) groups.

### 2.3.2.3 Study design

Nine studies were RCTs with two groups, one was a three group RCT and one was a cluster RCT. Of the RCTs, one did not provide outcome data for the control group because data on the primary outcome measure, total time spent playing active video games, was only retrievable for the intervention group (Tripette, Murakami et al. 2014). It was assumed that the time spent playing active video games for the control group was zero.

#### 2.3.2.4 *Follow-up*

The average length of intervention follow-up was two weeks, however, when the one study with the longest follow-up period of four months is excluded (Kernot, Lewis et al. 2019), the average follow-up duration is 0.5 weeks. Eight studies did not include a follow-up period (Cramp and Brawley 2006, Maturi, Afshary et al. 2011, Albright, Steffen et al. 2014, Keller, Ainsworth et al. 2014, LeCheminant, Hinman et al. 2014, Tripette, Murakami et al. 2014, Ashrafinia, Mirmohammadali et al. 2015). One intervention had a one week follow-up period (Fjeldsoe, Miller et al. 2010), one had a four week follow-up (Norman, Sherburn et al. 2010) and one had a four month follow-up period (Kernot, Lewis et al. 2019).

### 2.3.3 **Assessment of risk of bias**

Figure 2.2 presents a RoB summary displaying each study's classification against the domains described earlier.

#### 2.3.3.1 *Selection bias*

##### a) Random sequence generation

Results for selection bias due to random sequence generation are mixed. Seven studies were at low risk of bias using prefix labels on their baseline surveys (Fjeldsoe, Miller et al. 2010), computer generated random numbers (Norman, Sherburn et al. 2010, Maturi, Afshary et al. 2011, Keller, Ainsworth et al. 2014, LeCheminant, Hinman et al. 2014, Kernot, Lewis et al. 2019), and a random number table (Lewis, Gjerdingen et al. 2014). The remaining four studies did not provide sufficient information to allow us to judge the risk (Cramp and Brawley 2006, Albright, Steffen et al. 2014, Tripette, Murakami et al. 2014, Ashrafinia, Mirmohammadali et al. 2015).

##### b) Allocation concealment

Four studies described processes deemed to ensure a low risk of bias including blinding after baseline assessments (LeCheminant, Hinman et al. 2014), and central allocation sealed opaque envelopes (Norman, Sherburn et al. 2010). Six studies were coded as unclear RoB. One study (Lewis, Gjerdingen et al. 2014), was deemed at high risk of selection bias due to block randomisation so that interventionists were aware of what intervention the participants were going to receive.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Albright, 2014			⊖	⊖	⊕		⊕
Ashrafinia, 2015			⊖	⊖			
Cramp, 2006			⊖	⊖	⊕		⊕
Fjeldsoe, 2010	⊕	⊕	⊖	⊖	⊕		⊕
Keller, 2014	⊕		⊖	⊖	⊖	⊖	⊕
Kernot, 2019	⊕		⊖	⊖	⊕	⊕	⊕
LeCheminant, 2012	⊕	⊕	⊖		⊕		⊕
Lewis, 2013	⊕	⊖	⊖	⊕			⊕
Maturi, 2011	⊕	⊕	⊖	⊖	⊖		⊕
Norman, 2010	⊕	⊕	⊖	⊖	⊕		⊕
Tripette, 2014			⊖	⊕	⊕		⊕

**Figure 2.2 – Risk of bias summary**

Green = low risk of bias; Red = high risk of bias; Blank = Unclear risk of bias

### c) Performance bias

The risk of performance bias arises from inadequate blinding of participants and personnel to their group allocation, which is very difficult in behavioural research due to noticeable differences in delivery between study groups. Intervention personnel are involved in delivering many behavioural interventions and subsequently are aware of participant's allocation to ensure they deliver the correct condition. Research participants will be aware which condition they receive as part of the intervention. Due to the difficulty to blind participants and personnel to behavioural interventions, all studies in this review were deemed at high risk of performance bias.

### d) Detection bias

Detection bias relates to blinding of outcome assessments. Only two studies were deemed at low risk of detection bias because the research assistant was blinded to the participant's treatment assignment and outcomes (Lewis, Gjerdingen et al. 2014, Tripette, Murakami et al. 2014). Self-report outcomes are subject to detection bias because the participants are the assessors and it is likely in behavioural assessments that they are aware of their group allocations, resulting in high risk of detection bias.

#### e) Attrition bias

Seven studies were coded as low risk of attrition bias and two as high risk of attrition bias. One study was coded high risk because the attrition rates were different in the intervention and control group and although missing values were imputed for the analysis, the imputation method is not described in the paper (Keller, Ainsworth et al. 2014). Maturi, Afshary et al. (2011) was deemed as high risk of attrition bias because no reasons were provided for withdrawal of participants from the study and the data was not analysed on an intention to treat basis. Two studies did not provide sufficient information about the presence of attrition bias (Lewis, Gjerdingen et al. 2014, Ashrafinia, Mirmohammadali et al. 2015).

#### f) Reporting bias

Nine studies were rated as unclear risk of reporting bias, relating to the bias arising from selecting the outcomes (usually positive) that are reported in the publication. Studies were rated as unclear risk of bias in the absence of a protocol paper to compare the reported outcomes against the outcomes collected. One study was deemed at high risk of reporting bias because the self-report PA measure reported in the trial outcome paper is different from the outcome measure in the protocol paper for the study (Keller, Ainsworth et al. 2014).

#### g) Other bias

Ten studies had low risk of other bias. One study did not provide sufficient information to determine the risk of bias because it is a cluster randomised trial (Ashrafinia, Mirmohammadali et al. 2015), which potentially introduces other sources of bias, for example, health care centres allocated to the intervention condition could recruit different women those allocated to the control. There is not sufficient information to determine the risk of bias.

**Table 2.4 – Intervention characteristics table**

<b>Author name; year</b>	<b>Study group (n)</b>	<b>Intervention and control descriptions</b>	<b>Intervention duration</b>	<b>Intervention setting</b>	<b>Provider</b>	<b>Theoretical base specified</b>	<b>BCTs present<sup>a</sup></b>
Albright; 2014;	154	Intervention: Culturally sensitive tailored telephone counselling and website plus pedometer. Counselling based on problem solving and to track and set goals based on total steps.	12 months	Home	Counsellor	Unclear	1.1 Goal setting (behaviour) (++) 1.2 Problem solving (+) 2.3 Self-monitoring of behaviour (++) 3.1 Social support (unspecified) (++) 8.7 Graded tasks (+) 12.5 Adding objects to the environment (++)
	157	Control: Standard website with standard PA information, resources and links to non-specific PA websites.					
Ashrafinia ; 2015	40	Intervention: Pilates-based intervention; four training sessions prior to delivery and given a video, training booklet and audio CD at home; progression on exercises that aid stretching, breathing and strengthening; exercise sessions recorded in a diary. Weekly phone calls and fortnightly visits by researchers to review diary and ensure correct implementation.	8 weeks	Home	Researcher	N/A	2.1 Monitoring of behaviour by others without feedback (++) 2.3 Self-monitoring of behaviour (++)* 4.1 Instruction on how to perform behaviour (++) 6.1 Demonstration of behaviour (++) 8.7 Graded tasks (++)
	40	Control: Training session on					

		postpartum care.						
Cramp; 2006	32	Intervention: Group mediated cognitive behavioural counselling plus standard exercise intervention; 4 weeks intense phase of community based exercise classes and group behavioural counselling focusing on self-regulatory skills; 4 weeks home-based exercise to implement home-based routines	8 weeks	Community + Home	Certified exercise instructors	SCT	1.1 Goal setting (behaviour) (++) 1.2 Problem solving (++) 2.1 Monitoring of behaviour by others without feedback (++)* 2.3 Self-monitoring of behaviour (++)* 3.1 Social support (unspecified) (++)* 3.2 Social support (practical) (+)* 4.1 Instruction on how to perform a behaviour (++)* 5.1 Information about health consequences (+)* 6.1 Demonstration of behaviour (++)* 8.1 Behavioural practice/rehearsal (++)* 8.6 Generalisation of the target behaviour (++)* 12.2 Restructuring the social environment (+)*	
	35	Control: Standard exercise intervention as described above without the group behavioural counselling						
Fjeldsoe; 2010;	45	Intervention: Face-to-face and telephone consultation with print based information; goal setting refrigerator magnet to aid planning and self-monitoring; tailored SMS and nomination of a SS person to help reach their goal	12 weeks	Home	Behavioural counsellor	SCT	1.1 Goal setting (behaviour) (++) 1.2 Problem solving (++) 1.4 Action planning (+) 1.5 Review behavioural goals (++) 2.1 Monitoring of behaviour by others without feedback (+) 2.3 Self-monitoring of behaviour (+)	

									3.1 Social support (unspecified) (+) 3.2 Social support (practical) (++) 3.3 Social support (emotional) (++) 5.1 Information about health consequences (+)* 5.3 Information about social and environmental consequences (+)* 5.6 Information about emotional consequences (+)* 10.7 Self-incentive (+) 10.9 Self-reward (+)
	43	Control: One face-to-face counselling session with print based PA information.							
Keller; 2014;	71	Intervention: SS intervention; group walking intervention led by trained leaders ( <i>Promotoras</i> ); pedometers; support sessions for the first 12 weeks targeting time management and goal setting; targets four types of SS – emotional, instrumental, appraisal and informational.	12 months	Community	Promotora (trained leader)	SS			1.1 Goal setting (behaviour) (++) 1.5 Review behaviour goals (+) 2.2 Feedback on behaviour (++) 2.3 Self-monitoring of behaviour (++) 3.1 Social support (unspecified) (+) 3.2 Social support (practical) (++) 3.3 Social support (emotional) (++) 5.1 Information about health consequences (++) 10.1 Material incentive (behaviour) (+)* 10.2 Material reward (behaviour) (++)* 12.5 Adding objects to the environment (++)*
	68	Control: Newsletters and weekly telephone calls on health and postpartum issues unrelated to PA.							
Kernot, 2019	41	Intervention: Team-based walking intervention delivered via Facebook	50 days	Home	Digital	TPB and Fun Theory			1.1 Goal setting (behaviour) (++)* 1.4 Action planning (++)*

		App. Nominated team captain recruits team members to reach a cumulative step goal. Participants log daily step counts using a pedometer, monitor progress, compare progress to other participants and communicate on message walls. App gives tips and has fun features.						2.2 Feedback on behaviour (+) 2.3 Self-monitoring of behaviour (++) 3.1 Social support (unspecified) (++) 5.1 Information about health consequences (++) 6.2 Social comparison (++) 7.1 Prompts/Cues (++) 10.3 Non-specific rewards (++) 10.4 Social reward (++) 10.6 Non-specific incentive (+)
	40	Control: Written information on PA guidelines						
LeCheminant, 2012	30	Intervention: Resistance training intervention with access to resistance training equipment. Progressive supervised resistance exercise programme for major muscle groups.	4 months	Community gym setting	Trained supervisor	NA		1.1 Goal setting (behaviour) (++) 1.4 Action planning (++) 2.1 Monitoring of behaviour by others without feedback (+) 2.3 Self-monitoring of behaviour (+)* 4.1 Instruction on how to perform a behaviour (+)* 6.1 Demonstration of the behaviour (+)* 8.1 Behavioural practice/rehearsal (+)* 8.7 Graded tasks (++)
	30	Control: Flexibility training involving stretching major muscles and recording progress on a record. Option of a weekly group stretching session.						
Lewis, 2013	66	Intervention: Telephone counselling intervention to set goals to increase PA to 30 minutes five days per week;	6 months	Home	Health Educator	SCT and TTM		1.1 Goal setting (behaviour) (++) 1.4 Action planning (++) 2.3 Self-monitoring of behaviour (++)

		Topics include goal setting and monitoring progress, making time for PA, SS, enjoyment of PA, increasing self-efficacy for PA and making PA a habit; Tips for increasing PA posted to participants						3.1 Social support (unspecified) (++) 8.7 Graded tasks (+) 12.5 Adding objects to the environment (++)
	64	Control: Telephone counselling session on stress reduction, nutrition and healthy sleep. Postal leaflets on general health/wellbeing topics.						
Maturi, 2011	35	Intervention: Pedometer-based intervention to increase steps per day by 500 per week until reaching 10,000. Baseline counselling session; weekly SMS; fortnightly telephone counselling	12 weeks	Home	Researcher	NA		1.1 Goal setting (behaviour) (++) 1.4 Action planning (++) 2.2 Feedback on behaviour (++) 2.3 Self-monitoring of behaviour (++) 3.1 Social support (unspecified) (+) 5.3 Information about social and environmental consequences (+) 8.7 Graded tasks (++) 12.5 Adding objects to the environment (++)
	35	Control: Limited information on control condition						
Norman, 2010	80	Intervention: Weekly group exercise sessions with baby involving cardiovascular and strength components adapted to individual needs; education sessions with health care professional; booklet with exercise examples and signpost to	8 weeks	Hospital	Physical therapist/healthcare professionals	N/A		4.1 Instruction on how to perform the behaviour (++) 6.1 Demonstration of the behaviour (++) 8.1 Behavioural practice/rehearsal (++)

		local facilities; afternoon tea for group at end of intervention.						
	81	Control: Weekly education material unrelated to PA.						
Tripette, 2014	17	Intervention: Active Video Gaming intervention using a Wii Fit console, Wii Fit Plus Game and accessories. Participants recommended to play 30 min/day.	40 days	Home	Digital	NA	1.1 Goal setting (behaviour) (++) 1.4 Action planning (++) 12.5 Adding objects to the environment (++)	
	17	Control: Asked not to change their lifestyle.						

<sup>a</sup> BCTs listed as ++ indicates the BCT is definitely present, those listed as + indicate the BCT is probably present.

\* BCT also present in study control condition

### 2.3.4 Intervention characteristics

Table 2.4 describes each study's intervention characteristics.

#### 2.3.4.1 Behaviour Change Techniques

The BCTs reported are the difference between the intervention and control group. The intervention that included the least BCTs had two (Cramp and Brawley 2006) and the most BCTs was eleven (Kernot, Lewis et al. 2019) with an average of 5.9 BCTs per intervention. No BCTs were coded in the BCT Taxonomy clusters of outcome, regulation, identity, scheduled consequences, self-belief and covert learning. Table 2.5 presents the number of interventions in the review that included each BCT.

**Table 2.5 – Number of interventions including each BCT**

Number of interventions included the BCTs	BCT
8	Goal setting (behaviour); Social support (Unspecified)
6	Self-monitoring of behaviour
5	Action planning; Graded tasks
4	Adding objects to the environment
3	Feedback on behaviour; monitoring of behaviour by others without feedback
2	Review behaviour goal(s); Social support (practical); social support (emotional); instruction on how to perform a behaviour; demonstration of behaviour; information about health consequences
1	Self-incentive; self-reward information about social consequences; social comparison; prompts/cues; non-specific rewards; social reward; non-specific incentive; behavioural practice/rehearsal

#### 2.3.4.2 Intervention duration

The average duration of interventions was 18.9 weeks, ranging from 40 days (Tripette, Murakami et al. 2014) to twelve months (Albright, Steffen et al. 2014).

#### 2.3.4.3 Theory base

Six studies were theory-based (SCT (n=3); TTM (n=1); SS Constructs (n=1); TPB (n=1); Fun Theory (n=1); Unclear (n=1). Two studies were based on a single theory, and three studies drew on

theoretical constructs from multiple theories. Although the remaining studies did not explicitly state they were theory-based, some targeted theoretical constructs.

Moms in Motion (Cramp and Brawley 2006), based on SCT, focused on improving self-regulatory skills (defined as self-generated thoughts, feelings and actions to attain goals) and outcome expectancies (defined as the likelihood of the outcome occurring as a result of participating in exercise over the next four weeks). Outcome expectancies were categorised into psychological outcome expectancies, eg, feeling energised, improved mood, enjoyment and sense of accomplishment, and intervention outcome expectancies, eg, likelihood of being independently active once the program was complete or making exercise a priority. The constructs were targeted in group mediated cognitive behavioural counselling sessions by brainstorming realistic expectations, self-monitoring PA, setting goals and scheduling activities, resulting in a significant increase in self-regulation and outcome expectancy measurements in the intervention group compared to the control group. Self-regulatory efficacy partially mediated the relationship between intervention and control conditions.

The MobileMums intervention (Fjeldsoe, Miller et al. 2010) used SMS to target five constructs of the SCT: self-efficacy, goal setting, outcome expectancy, SS and perceived environmental opportunity, which were phased throughout exercise adoption stages, eg, outcome expectancies targeted at the beginning of the intervention. SMS examples that targeted SCT theoretical constructs were; 'Lee, Free walking group 4 mums starts Monday 25th June at 9:30 in Apex Park near the lake. Prams welcome. Join the group' targeting perceived environmental opportunity or 'Lee. Make a deal with Susie 2 watch the kids while u do exercise and then return the favour' targeting SS.

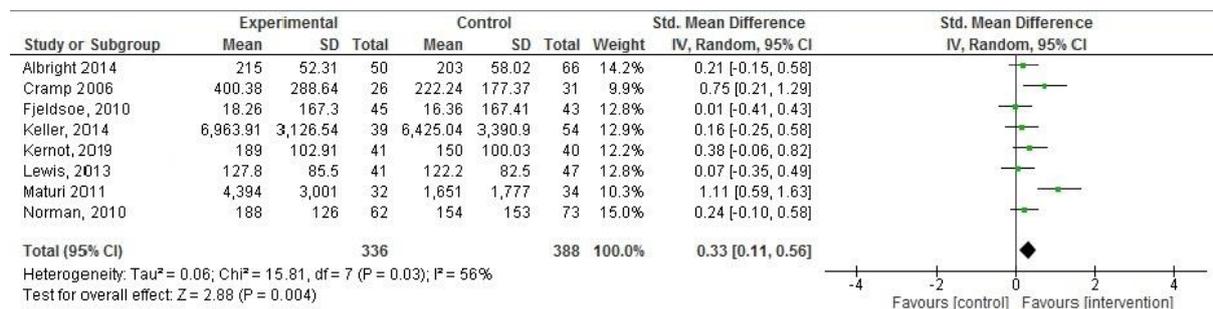
The Healthy Mom intervention targeted goal setting, SS and self-efficacy as SCT theoretical constructs. Albright, Steffen et al. (2014) stated that their intervention was theory-based and did not specify the theory; however, the intervention targeted theoretical constructs of barriers self-efficacy, enlisting support and navigating environmental factors, consistent with SCT.

### **2.3.5 Statistical analysis**

#### *2.3.5.1 Meta-analysis*

The random effects meta-analysis model included eight studies. Three were excluded from the quantitative synthesis because they did not use a comparable scale (Ashrafinia, Mirmohammadali et al. 2015) or a comparable intervention (LeCheminant, Hinman et al. 2014) and one did not report control group outcome measures (Tripette, Murakami et al. 2014). Figure 2.3 presents the forest

plot, which shows a small but significant effect of postnatal PA interventions on PA, SMD=0.33, 95% CI (0.11, 0.56), p=0.004.



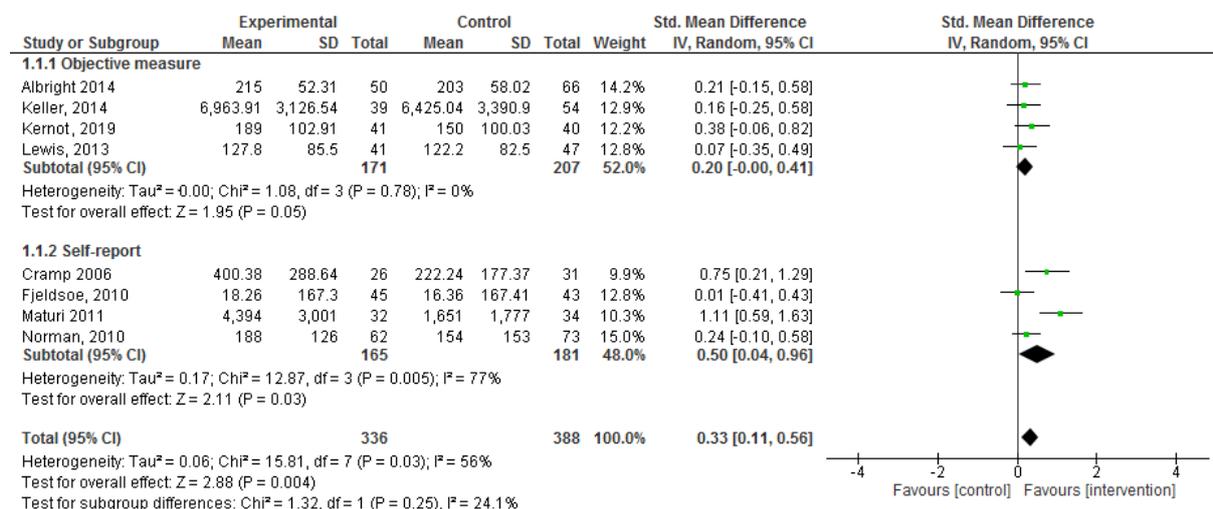
**Figure 2.3 – Forest plot of random effects meta-analysis for the effectiveness of postnatal PA interventions**

### 2.3.5.2 Heterogeneity

The Chi-square test demonstrates statistically significant heterogeneity between the studies ( $\chi^2_{[6]} = 15.81, p = 0.03$ ). The  $I^2$  test shows 56%, equivalent to a moderate degree of heterogeneity.

### 2.3.5.3 Subgroup analysis

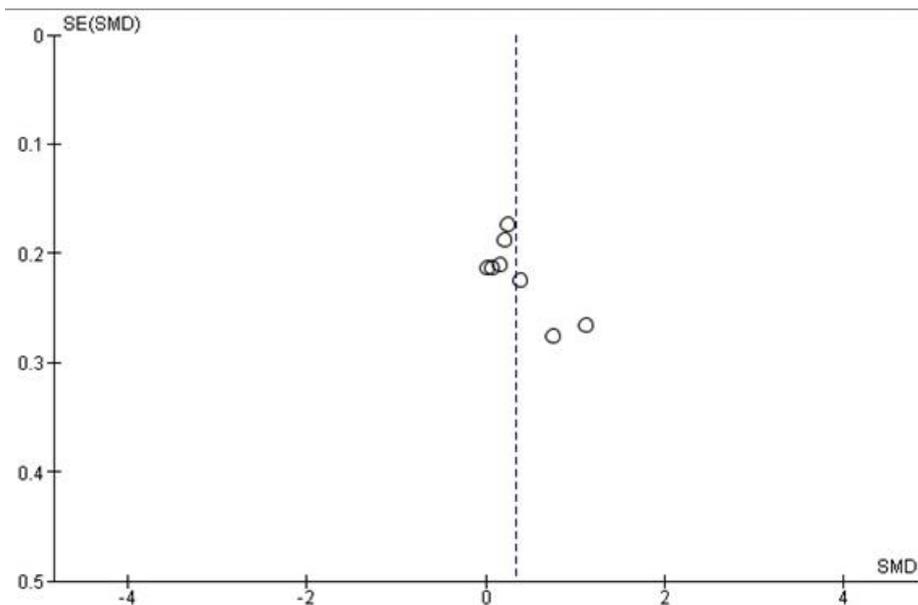
The subgroup analysis (Figure 2.4) comparing the effect size of studies using self-report and objective measurement methods found no statistical difference ( $\chi^2_{[1]} = 1.32, p = 0.25$ ), despite a smaller effect size in studies measured objectively (SMD=0.20, 95% CI (-0.00, 0.41)) compared to self-report measures (SMD=0.50, 95% CI (0.04, 0.96)).



**Figure 2.4 – Subgroup analysis comparing effect size of self-report and objectively measured PA**

### 2.3.5.4 Publication bias

The funnel plot assessing publication bias (Figure 2.5) is inconclusive. All studies have a similar level of precision and cluster on the same point on the vertical axis. Additionally, the effect size is similar resulting in a cluster on the horizontal axis, therefore all studies cluster around a central point.



**Figure 2.5 – Funnel plot assessing publication bias of the systematic review**

### 2.3.6 Meta-regression

#### 2.3.6.1 Univariate meta-regression

The sections below briefly describe the results of the meta-regression. Eight studies were included in the meta-regression.

##### a) Theory-base

Each study was classified as ‘yes’ or ‘no’ according to the interventions description of its theoretical base. Five studies (60%) (Cramp and Brawley 2006, Fjeldsoe, Miller et al. 2010, Keller, Ainsworth et al. 2014, Lewis, Gjerdingen et al. 2014, Kernot, Lewis et al. 2019) included in the meta-regression were theoretically based and three (38%) were not (Norman, Sherburn et al. 2010, Maturi, Afshary et al. 2011, Ashrafinia, Mirmohammadali et al. 2015). The univariate meta-regression model (Table 2.6) was not significant ( $Q=0.72$ ,  $df=1$ ,  $p=0.3951$ ), indicating that theory-based studies did not differ in efficacy compared to non-theory based studies.

**Table 2.6 - Theory-base – Meta-regression model**

Main results for Model 1, Random effects (MM), Z-Distribution, Std diff in means						
Covariate	Coefficient	Standard Error	95% Lower	95% Upper	Z-Value	2-sided P-value
Intercept	0.4684	0.1953	0.0855	0.8512	2.4	0.0165
Theory base	-0.213	0.2505	-0.7041	0.278	-0.85	0.3951

**Statistics for model 1**

**Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero**

Q = 0.72, df = 1, p = 0.3951

**Goodness of fit: Test that unexplained variance is zero**Tau<sup>2</sup> = 0.0717, Tau = 0.2678, I<sup>2</sup> = 60.29%, Q = 15.11, df = 6, p = 0.0194**Comparison of Model 1 with the null model****Total between-study variance (intercept only)**Tau<sup>2</sup> = 0.0612, Tau = 0.2474, I<sup>2</sup> = 57.00%, Q = 16.28, df = 7, p = 0.0227**Proportion of total between-study variance explained by Model 1**R<sup>2</sup> analog = 0.00 (computed value is -0.17)

## b) Setting

Studies were classified into ‘home-based’ (50%) or ‘community-based’ (50%). The univariate meta-regression model was not significant (Q=1.92, df=1, p=0.1662) suggesting that the study setting does not influence intervention effectiveness.

**Table 2.7 - Setting – Meta-regression model****Main results for Model 1, Random effects (MM), Z-Distribution, Std diff in means**

Covariate	Coefficient	Standard Error	95% Lower	95% Upper	Z-Value	2-sided P-value
Intercept	0.1445	0.1785	-0.2053	0.4944	0.81	0.4181
Setting: Home	0.3211	0.2319	-0.1334	0.7756	1.38	0.1662

**Statistics for model 1****Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero**

Q = 1.92, df = 1, p = 0.1662

Tau<sup>2</sup> = 0.0562, Tau = 0.2370, I<sup>2</sup> = 54.38%, Q = 13.15, df = 6, p = 0.0407**Comparison of Model 1 with the null model****Total between-study variance (intercept only)**Tau<sup>2</sup> = 0.0612, Tau = 0.2474, I<sup>2</sup> = 57.00%, Q = 16.28, df = 7, p = 0.0227**Proportion of total between-study variance explained by Model 1**R<sup>2</sup> analog = 0.08

## c) Delivery method

Intervention delivery was classified as ‘face-to-face’ or ‘distance’. Five studies primary delivery method was distance (Fjeldsoe, Miller et al. 2010, Maturi, Afshary et al. 2011, Albright, Steffen et al. 2014, Lewis, Gjerdingen et al. 2014, Kernot, Lewis et al. 2019) and three were face-to-face (Cramp and Brawley 2006, Norman, Sherburn et al. 2010, Keller, Ainsworth et al. 2014). The

meta-regression model did not find a significant effect of the delivery method on intervention efficacy ( $Q=0.01$ ,  $df=1$ ,  $p=0.9255$ ).

**Table 2.8 - Delivery method – Meta-regression model**

<b>Main results for Model 1, Random effects (MM), Z-Distribution, Std diff in means</b>						
<b>Covariate</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>95% Lower</b>	<b>95% Upper</b>	<b>Z-Value</b>	<b>2-sided P-value</b>
<b>Intercept</b>	0.3316	0.1607	0.0166	0.6466	2.06	0.0391
<b>Delivery: F2F</b>	0.0245	0.2618	-0.4886	0.5376	0.09	0.9255

---

**Statistics for model 1**

**Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero**  
 $Q = 0.01$ ,  $df = 1$ ,  $p = 0.9255$

**Goodness of fit: Test that unexplained variance is zero**  
 $Tau^2 = 0.0807$ ,  $Tau = 0.2841$ ,  $I^2 = 63.11\%$ ,  $Q = 16.26$ ,  $df = 6$ ,  $p = 0.0124$

---

**Comparison of Model 1 with the null model**

**Total between-study variance (intercept only)**  
 $Tau^2 = 0.0612$ ,  $Tau = 0.2474$ ,  $I^2 = 57.00\%$ ,  $Q = 16.28$ ,  $df = 7$ ,  $p = 0.0227$

**Proportion of total between-study variance explained by Model 1**  
 $R^2$  analog = 0.00 (computed value is -0.32)

---

d) Duration

Duration of interventions were classified by  $\leq 8$  weeks or  $> 8$  weeks. Six studies duration was  $\leq 8$  weeks (75%) and two was  $> 8$  weeks (25%). There were not  $> 30\%$  in the study characteristic of intervention duration to include in the meta-regression

e) BCTs

BCTs were classified as 'present' or 'absent' from each intervention. Five BCTs were present in a sufficient number of studies to be included in the analysis; 'action planning' (38%), 'problem solving' (38%) 'graded tasks' (38%), 'adding objects to the environment' (38%) and 'feedback on behaviour' (38%). Three BCTs could not be included in the review; (goal setting (behaviour), self-monitoring of behaviour and social support (unspecified)), because they were absent in less than 30%.

The univariate meta-regression showed that no BCTs had a significant effect on intervention efficacy; problem solving ( $Q=0.07$ ,  $df=1$ ,  $p=0.7878$ ) (Table 2.9), action planning ( $Q=0.01$ ,  $df=1$ ,  $p=0.9183$ ) (Table 2.10), graded tasks ( $Q=0.26$ ,  $df=1$ ,  $p=0.6106$ ) (Table 2.11), adding objects to the environment ( $Q=0.26$ ,  $df=1$ ,  $p=0.6106$ ) (Table 2,12) and feedback on behaviour ( $Q=1.39$ ,

df=1, p=0.2392) (Table 2.13). Therefore, the inclusion of the BCTs in an intervention would not have an effect on the interventions effectiveness.

**Table 2.9: BCT, Problem solving – Meta-regression model**

<b>Main results for Model 1, Random effects (MM), Z-Distribution, Std diff in means</b>							
<b>Covariate</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>95% Lower</b>	<b>95% Upper</b>	<b>Z-Value</b>	<b>2-sided P-value</b>	<b>VIF</b>
<b>Intercept</b>	0.3663	0.1583	0.0559	0.6766	2.31	0.0207	1.585
<b>BCT – Problem solving</b>	-0.0702	0.2607	-0.5811	0.4408	-0.27	0.7878	1
<b>Statistics for model 1</b>							
<b>Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero</b>							
Q = 0.07, df = 1, p = 0.7878							
<b>Goodness of fit: Test that unexplained variance is zero</b>							
Tau <sup>2</sup> = 0.0785, Tau = 0.2803, I <sup>2</sup> = 62.68%, Q = 16.08, df = 6, p = 0.0133							
<b>Comparison of Model 1 with the null model</b>							
<b>Total between-study variance (intercept only)</b>							
Tau <sup>2</sup> = 0.0612, Tau = 0.2474, I <sup>2</sup> = 57.00%, Q = 16.28, df = 7, p = 0.0227							
<b>Proportion of total between-study variance explained by Model 1</b>							
R <sup>2</sup> analog = 0.00 (computed value is -0.28)							

**Table 2.10: BCT, Action planning – Meta-regression model**

<b>Main results for Model 1, Random effects (MM), Z-Distribution, Std diff in means</b>						
<b>Covariate</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>95% Lower</b>	<b>95% Upper</b>	<b>Z-Value</b>	<b>2-sided P-value</b>
<b>Intercept</b>	0.3308	0.1578	0.0215	0.6401	2.1	0.0361
<b>BCT – Action planning</b>	0.0269	0.2625	-0.4876	0.5414	0.1	0.9183
<b>Statistics for model 1</b>						
<b>Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero</b>						
Q = 0.01, df = 1, p = 0.9183						
<b>Goodness of fit: Test that unexplained variance is zero</b>						
Tau <sup>2</sup> = 0.0792, Tau = 0.2814, I <sup>2</sup> = 63.14%, Q = 16.28, df = 6, p = 0.0123						
<b>Comparison of Model 1 with the null model</b>						
<b>Total between-study variance (intercept only)</b>						

$\tau^2 = 0.0612$ ,  $\tau = 0.2474$ ,  $I^2 = 57.00\%$ ,  $Q = 16.28$ ,  $df = 7$ ,  $p = 0.0227$

**Proportion of total between-study variance explained by Model 1**

$R^2$  analog = 0.00 (computed value is -0.29)

**Table 2.11 - BCT, Graded tasks – Meta-regression model**

Main results for Model 1, Random effects (MM), Z-Distribution, Std diff in means

Covariate	Coefficient	Standard Error	95% Lower	95% Upper	Z-Value	2-sided P-value
Intercept	0.291	0.1579	-0.0184	0.6004	1.84	0.0653
<b>BCT – Graded Tasks</b>	0.1317	0.2586	-0.3752	0.6386	0.51	0.6106

**Statistics for model 1**

**Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero**

$Q = 0.26$ ,  $df = 1$ ,  $p = 0.6106$

**Goodness of fit: Test that unexplained variance is zero**

$\tau^2 = 0.0771$ ,  $\tau = 0.2776$ ,  $I^2 = 62.23\%$ ,  $Q = 15.89$ ,  $df = 6$ ,  $p = 0.0144$

**Comparison of Model 1 with the null model**

**Total between-study variance (intercept only)**

$\tau^2 = 0.0612$ ,  $\tau = 0.2474$ ,  $I^2 = 57.00\%$ ,  $Q = 16.28$ ,  $df = 7$ ,  $p = 0.0227$

**Proportion of total between-study variance explained by Model 1**

$R^2$  analog = 0.00 (computed value is -0.26)

**Table 2.12 - BCT, Adding objects to the environment – Meta-regression model**

Main results for Model 1, Random effects (MM), Z-Distribution, Std diff in means

Covariate	Coefficient	Standard Error	95% Lower	95% Upper	Z-Value	2-sided P-value
Intercept	0.291	0.1579	-0.0184	0.6004	1.84	0.0653
<b>BCT – Adding objects</b>	0.1317	0.2586	-0.3752	0.6386	0.51	0.6106

**Statistics for model 1**

**Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero**

$Q = 0.26$ ,  $df = 1$ ,  $p = 0.6106$

**Goodness of fit: Test that unexplained variance is zero**

$\tau^2 = 0.0771$ ,  $\tau = 0.2776$ ,  $I^2 = 62.23\%$ ,  $Q = 15.89$ ,  $df = 6$ ,  $p = 0.0144$

**Comparison of Model 1 with the null model**

**Total between-study variance (intercept only)**

$\tau^2 = 0.0612$ ,  $\tau = 0.2474$ ,  $I^2 = 57.00\%$ ,  $Q = 16.28$ ,  $df = 7$ ,  $p = 0.0227$

**Proportion of total between-study variance explained by Model 1**

$R^2$  analog = 0.00 (computed value is -0.26)

**Table 2.13 - BCT, Feedback on behaviour – Meta-regression model**

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**Main results for Model 1, Random effects (MM), Z-Distribution, Std diff in means**

Covariate	Coefficient	Standard Error	95% Lower	95% Upper	Z-Value	2-sided P-value
Intercept	0.235	0.1434	-0.0461	1.64	1.64	0.1013
BCT – Adding objects	0.2835	0.2409	-0.1886	0.7556	1.18	0.2392

---

**Statistics for model 1**

**Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero**  
Q = 1.39, df = 1, p = 0.2392

**Goodness of fit: Test that unexplained variance is zero**  
Tau<sup>2</sup> = 0.0585, Tau = 0.2418, I<sup>2</sup> = 55.91%, Q = 13.61, df = 6, p = 0.0343

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**Comparison of Model 1 with the null model**

**Total between-study variance (intercept only)**  
Tau<sup>2</sup> = 0.0612, Tau = 0.2474, I<sup>2</sup> = 57.00%, Q = 16.28, df = 7, p = 0.0227

**Proportion of total between-study variance explained by Model 1**  
R<sup>2</sup> analog = 0.04

---

### 2.3.6.2 Multi-variate meta-regression

The multi-variate meta-regression model was not possible to run because of an insufficient number of studies for the number of covariates.

## 2.4 Discussion

### 2.4.1 What is the effectiveness of postnatal physical activity interventions?

The current review found that postnatal PA interventions have a small but significant effect on PA compared to the control condition. The pooled effect size of the current review is smaller than a previous review (Gilinsky, Dale et al. 2015) estimating the effect of postnatal PA behaviour (0.33 vs 0.53 respectively); however, the effect size in the previous review estimates the effect on PA frequency (days per week). Their estimate of intervention effect on PA volume was non-significant (SMD=0.15, p=0.16). A potential explanation for the significant result of our review is that it excluded studies with dietary components, which the authors suggested reduced the effect of the intervention on PA behaviour. A review assessed the effect of PA interventions on PA during pregnancy and found favourable intervention effects in eight out of the ten included studies (Currie, Sinclair et al. 2013). The current review may have overestimated the intervention effect due to the use of self-report measures and the lack of long-term follow-up measurements leading to uncertainty of their long-term effectiveness. Each of these will be discussed in detail below.

Four studies in the meta-analysis used self-report PA measurements, which have demonstrated an overestimation of PA compared to objective measurements (See Chapter 1). This is demonstrated in the subgroup analysis, which found a larger effect size of 0.50 for self-report measures compared to 0.20 for objective measurements, although non-significant. In the current study, comparability between self-report measures is difficult due to the use of different measurement instruments. Fjeldsoe, Marshall et al, (2009) developed a self-report PA tool for women with young children, measuring behaviour in relevant domains that are omitted by existing instruments, eg, housework and childcare activities, which account for a significant proportion of a mothers' day (Fjeldsoe, Marshall et al. 2009). Self-report measurements capture contextual detail on participants PA, however, due to their susceptibility to overestimation, there is a movement towards objective measurement.

The effect size may also be overestimated by the use of post-intervention measurements. Evidence demonstrates that the intervention effects reduce from immediately post-intervention to a follow-up measurement (Müller-Riemenschneider, Reinhold et al. 2008). In this review, only one study included a six-month post-randomisation measurement. The intervention group reduced MVPA from the post-intervention measurement to the follow up measurement (189 to 173 min/week respectively) compared to an increase over the same time period in the control group (150 to 160 min/week) (Kernot, Lewis et al. 2019), resulting in a reduction in the effect size at follow-up. The authors of two interventions included in this review are conducting larger RCTs including a follow-up measurement. The full MobileMums trial included a six-month follow-up measure and found that compared to baseline self-report PA measurements (80 minutes), the intervention had a significant effect on post-intervention PA (111 minutes), which declined to 85 minutes at the six-month follow-up measurement (Fjeldsoe, Miller et al. 2015). A protocol for a full trial of the Healthy Mom trial is utilising a three-month post intervention follow-up measurement (Lewis, Schuver et al. 2018). Future research should ensure that long-term follow-up measurements are included to determine the long-term efficacy of the interventions.

All studies included in this review were at a high risk of performance bias, which arises due to non-blinding of participants and personnel. Performance bias is present in many behavioural interventions, because it is impossible to blind participants and personnel to their group allocation and is heightened in research with large differences between intervention and control groups. There may be a lower risk of bias if there is an active control condition as was present in Moms in Motion study, where control group participants attended four weeks of group exercise classes. Similarly, a risk of detection bias arises when outcome data collection is not blinded, especially when using self-

report measurement because participants may be more likely to under- or over-report when they are aware of their group allocation (Kassavou and Sutton 2018). Several judgements were unclear because of a lack of clear reporting for intervention and data collection methodology. To enable accurate judgements, I would recommend in the future that research methods are reported with reference to the RoB tool to ensure sufficient detail to allow accurate judgements in systematic reviews.

The funnel plot to assess publication bias is inconclusive because there are a small number of studies of a similar precision. One possible explanation is the exclusion of non-peer reviewed studies, eg, grey materials or PhD theses. The More Active Mums in Stirling study is one thesis identified that could have been included. The study explored the effectiveness of a PA consultation followed by a ten-week pram-walking intervention. The study was conducted in a small sample size (n=65) and did not report a significant effect on objectively measured PA. Postnatal PA interventions included in this review are all of a small sample size, which limits the precision of our results. There are two studies with larger sample sizes of 263 (Fjeldsoe, Miller et al. 2015) and 450 underway (Lewis, Schuver et al. 2018), which will improve our ability to determine the efficacy of postnatal PA interventions.

#### **2.4.2 What intervention characteristics are associated with intervention effectiveness?**

The univariate meta-regression included in this review found no intervention components associated with intervention effectiveness. Contrary to existing evidence which suggests that theoretically based interventions are more effective than non-theory based interventions (Michie, Abraham et al. 2009), the meta-regression found that this component was not associated with intervention efficacy. A review of pregnancy PA interventions showed that only two interventions of the fourteen included were theory-based (Currie, Sinclair et al. 2013). Theory is important because theory driven interventions allow generalisability of the findings and provide an understanding of the mechanisms of behaviour (Foy, Francis et al. 2007). Theory-based interventions are more likely to address the psychological needs of the individual (Brown, Sinclair et al. 2012) and provide an insight into the reasons why they did/didn't work to inform future intervention design (Brug, Oenema et al. 2005). Research should focus on developing theoretically-based interventions to identify the successful aspects of interventions to inform future development and identify non-successful components to avoid replication and wastage of research resources. If future studies explored the effectiveness of theory-based interventions it would be possible to test for the effectiveness of specific theories, eg, SCT, or TPB, and their theoretical components in a meta-regression similar to that employed in this study.

Interventions in the systematic review were classified as delivered from a distance or face to face, however categorising the interventions into one of the two was difficult as many interventions included a mixture of both, thus lying on a continuum of intervention delivery. At one end, the Moms in Motion intervention could be classified as an entirely face-to-face intervention where participants attend several group exercise sessions delivered by a trained instructor and a series of group mediated behavioural counselling sessions delivered in person. Further along the continuum was an intervention which included an initial face-to-face counselling session, followed by SMS and telephone counselling sessions (Maturi, Afshary et al. 2011). Further again is the MobileMums intervention, mainly distance because participants received a telephone counselling session and SMS delivered throughout the twelve week intervention, yet the initial counselling sessions were delivered in-person, introducing a face-to-face component. In cases where the delivery methods were mixed, we chose the primary method of intervention delivery, which confounds the classifications in this review.

Within the categories of distance and face-to-face there are differing methods. To explain, distance interventions included in this review were delivered in two ways. Firstly using telephone counselling sessions, which involve human interaction with a behavioural counsellor, albeit not face-to-face. Secondly, some interventions used digital methods as the primary method of intervention delivery, using SMS, websites, social media apps. Digital interventions are growing in popularity for health behaviour interventions and have the potential to be effective, cost-effective, safe and scalable for health behaviour change (Murray, Hekler et al. 2016). A previous review of PA interventions in pregnancy found that interventions were more effective when they were delivered face to face (Currie, Sinclair et al. 2013). Qualitative interviews in this population have discovered that postnatal women are a group at risk of social isolation and social networks are highly important for engaging in PA (Saligheh, McNamara et al. 2016), and digital interventions have the potential to minimise human contact and exacerbate social isolation. One potential method to overcome this is to utilise social networking websites or apps to connect new mothers (Kernot, Lewis et al. 2019). In contrast, formative research to inform the development of Mobile Mums intervention found that new mothers would favour distance contact to maximise adherence because they would not need to prepare to leave the house to get to an appointment on time (Fjeldsoe, Miller et al. 2010).

As above, some interventions included in this review do not strictly fit into the home or community-based intervention groups for this intervention component, due to the multi-component nature of many interventions. For example, the first phase of one intervention was delivered in the community followed by a second home-based phase, which aimed to facilitate women to adopt

home-based exercise routines (Cramp and Brawley, 2008). Again, we classified interventions into categories based on their primary setting, however, the mixture of settings is likely to have confounded the analysis.

Using the arbitrary cut point of 30%, each intervention component must be present and absent in at least 30% of interventions, but due to the limited number of studies there was a limited combination of characteristics present for the characteristic to be included in the meta-regression. A greater number of studies would enable us to test intervention characteristics and increase our confidence in the results. This technique is yet to be conducted in the postnatal population. In the wider population, a meta-regression of BCTs included in PA and healthy eating interventions found that self-monitoring alongside one other technique from control theory were significantly associated with more effective interventions (Michie, Abraham et al. 2009).

The limited number of studies in this review resulted in statistical limitations when conducting a meta-regression of intervention components. There are several components, none of which were statistically associated with intervention effectiveness. PA behaviour is complex, and there are several factors influencing behaviour and as a result behaviour change interventions are also complex with several interacting components. Determining the effective intervention components is difficult in practice and utilising statistical methods is a method to overcome this and determine whether intervention components are effective, while accounting for the interaction between components.

### **2.4.3 What BCTs are associated with effective interventions**

The BCTs that I was able to include in the meta-regression analysis were action planning, graded tasks, adding objects to the environment, problem solving and feedback on behaviour, however, none of the BCTs assessed in the meta-regression were associated with intervention effectiveness. The effectiveness of three BCTs were not assessed in the meta-regression because they were absent in less than 30% of the interventions. While this review did not identify any BCTs associated with effective interventions, a previous review examined whether specific BCTs were more common in effective interventions (Gilinsky, Dale et al. 2015). Goal setting (behaviour) and prompt self-monitoring of behaviour were included in 100% of efficacious interventions compared to 73% and 45% of non-efficacious interventions respectively. Goal setting and planning were also identified as common BCTs in pregnancy PA interventions (Currie, Sinclair et al. 2013). Additionally, the NICE recommendations for evidence-based practice recommend a person-centred approach targeting individuals' needs, motivation and focus on agreeing goals (Currie, Sinclair et al. 2013). In contrast, provide information on the consequences of the behaviour in general, provide information on where

and when to perform the behaviour, provide instruction on how to perform the behaviour and barrier identification/problem solving were more likely to be included in non-efficacious interventions (Gilinsky, Dale et al. 2015). This suggests that the mere presence of BCTs in many of the interventions in the literature does not indicate effectiveness and further analysis is needed to assess which ones are associated with effectiveness.

Gilinsky, Dale et al. (2015) used the most up to date BCT taxonomy at the time of the review, however, an updated version has since been published and applied in the current review. The previous BCT taxonomy, targeting specifically dietary and PA interventions did not include SS as a BCT, which was one of the three most common BCTs in this review. The updated BCT version eliminated a BCT relating to provision of information on how, where and when to be active, which were identified in the previous review as one of the most common BCTs. The interventions in the current review utilised signposting women to local opportunities to be active including when and where activity opportunities are available. Using the current taxonomy to code intervention content potentially misses these BCTs.

The BCT taxonomy and its subsequent use to code BCTs is useful in PA research to code interventions into a common language, enabling comparability between intervention content and the analysis of intervention content to inform future research. While the BCT taxonomy and associated training to educate review authors to code BCTs is useful, the method is limited by intervention descriptions. Firstly, intervention descriptions may not provide sufficient detail to enable accurate BCT coding. For example, one intervention noted that participants received an education session delivered by a health professional with no additional detail on the content of the education session, potentially leading to the omission of some BCTs. Secondly, some intervention descriptions are not written clearly and the resulting BCT code requires the coder's interpretation. Two coders were used (KE and SP or SS) to account for individual interpretation, but there were situations where the two reviewers could not agree on a final coding. Thirdly, there is limited reporting on intervention fidelity, and we cannot be certain that the intervention and subsequent BCTs were delivered as intended to recipients. When describing interventions, it would be beneficial for authors to clarify the BCTs included in the intervention to enable transparent reporting on the intervention content.

Beyond reporting issues, a weakness of the BCT taxonomy is that some potentially important intervention content is not included. For example, a key aspect of the intervention delivered by Albright, Steffen et al. (2014) was culturally tailoring intervention materials. Further, Fjeldsoe, Miller et al. (2010) Mobile Mums study personalised SMS messages to include participants' names, local

activity opportunities and the names of their nominated SS person. Such personalisation and tailoring is a key component of the interventions that are omitted when coding using the BCT taxonomy.

#### **2.4.4 Strengths and weaknesses of the study**

A strength of this study was that it is the first to assess the impact of PA interventions (without a dietary component) on PA behaviour. A strength of this current review is coding BCTs in the intervention and control conditions. This enables us to determine the difference between the two conditions and therefore the BCTs contributing to the study effect size. It is especially important in behavioural interventions because the control conditions are variable. Some target general health, eg, stress, sleep or nutrition yielding a limited effect on PA behaviour while others target PA behaviour with varying intensity, eg, standard PA website (Albright, Steffen et al. 2014) or four weeks of group exercise sessions (Cramp and Brawley 2006). In each case, the degree to which the control condition influences participants PA behaviour varies and coding control group BCTs enables us to determine which BCTs contributed to the study effect size.

A small number of studies limits the review and these were moderately heterogeneous and we did not identify intervention characteristics responsible for the difference in study effect sizes. Additionally, the inclusion criteria of the review only included published materials, and studies that may be mentioned in the grey literature were omitted.

The findings from this systematic review could not be used as anticipated to inform the intervention development process as I was unable to identify intervention characteristics and BCTs associated with intervention effectiveness. It is clear that there is a need for long-term follow-up measurements and for clear descriptions of BCTs and study methodology to inform the assessment of RoB.

## **2.5 Chapter Two Summary**

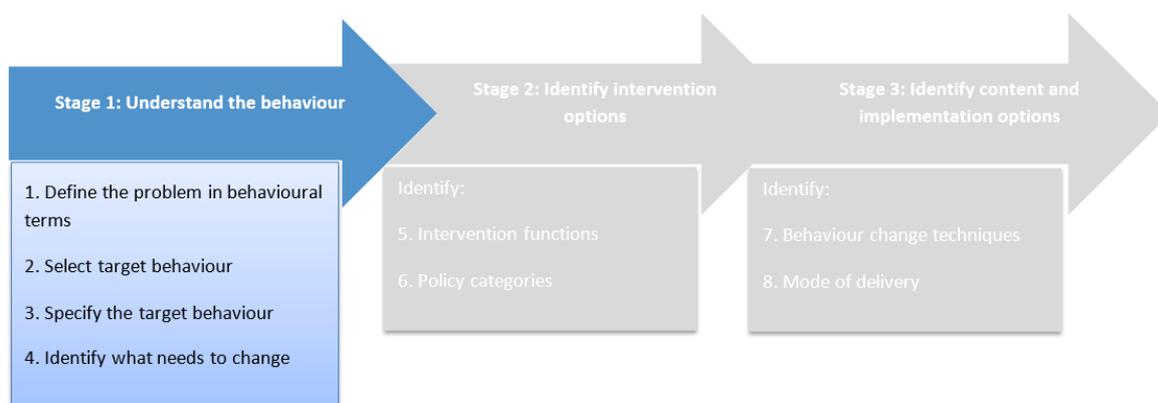
This chapter presents a review of the existing literature as the first stage of the intervention development process. Systematic reviews in this area have primarily focused on weight related outcomes or included dietary interventions to determine the effectiveness of postnatal PA interventions. This review aimed to determine the effectiveness of postnatal PA interventions and identify the intervention components and BCTs associated with intervention effectiveness. I searched seven databases using a systematic search strategy based on the terms 'postnatal', 'physical activity' and 'randomized controlled trials'. Studies were included if they were conducted in healthy postnatal women, targeted PA only, included a control group and measured PA. Two researchers screened the titles and abstracts of identified studies. I retrieved the full text of eligible

articles, and screened them according to the eligibility criteria. I extracted data including BCTs and assessed each study's RoB using the Cochrane Tool for RoB. I calculated a pooled effect size (SMD) using a random effects meta-analysis and conducted a meta-regression of intervention components to identify whether they were associated with intervention effectiveness. Eleven studies were eligible for the narrative review, and eight were included in the statistical analysis. The pooled effect size was small but statistically significant (SMD = 0.33, 95% CI (0.11, 0.56),  $p=0.004$ ) at the post-intervention measurement. No intervention components were significantly associated with intervention effectiveness in the random effects meta-regression. The review's strength is that it is the first to assess the effectiveness of PA only interventions in healthy postnatal women. While the results are promising, the study is limited by a small sample size thus making it difficult to identify intervention components associated with intervention effectiveness. In addition, the included studies lack long-term follow-up measurements and the long-term effect of postnatal PA intervention is unknown.

### 3 A behavioural analysis of postnatal physical activity: A multi-methods study

#### 3.1 Introduction

In the previous chapter, I completed the first two steps of the MRC guidance to identify existing literature and identify appropriate theory. The next stage requires modelling of process and outcomes, identifying what needs to change and how to change these outcomes. As discussed in Chapter 1, I am using the BCW to structure this process. Stage One of the BCW involves understanding the behaviour in a four stage process (Figure 3.1).



**Figure 3.1 – Stage 1 of the BCW for intervention development**

##### 3.1.1 Define the problem in behavioural terms

Defining the problem in behavioural terms means being specific about the target individual, group or population involved in the behaviour and the behaviour itself. Therefore, the behaviour I intend to change with this intervention is to increase PA levels to 150 minutes per week, working at an individual level of healthy postnatal women.

##### 3.1.2 Select the target behaviour

The authors of the BCW propose that other people and contexts influence the selected behaviour. Intervention designers should take into account all relevant behaviours performed by the target population. To increase postnatal PA levels to the recommended guidelines, the intervention will work with individuals to identify all of the candidate behaviours they can change.

### **3.1.3 Specify the target behaviour**

The selected behaviour must be specified in detail and context to allow a clear behavioural analysis. Behavioural specification needs to identify who needs to perform the behaviour, what the person needs to do differently to achieve the desired change, when will they do it, where will they do it, how often will they do it and with whom will they do it. An individual's context and preferences strongly influence PA levels. Providing an intervention that allows participants to engage in a PA they value at a suitable time and location is highly individualised. For example, an intervention providing childcare to enable mothers the time to engage in PA may be appropriate for one participant, but another may not feel comfortable to leave their child. Therefore, the specific behaviour, eg, walking older children to school instead of driving, will be determined by the individuals.

### **3.1.4 Identify what needs to change**

Step four of the BCW involves understanding the factors that influence behaviour. Factors can be non-modifiable, eg, sex, socioeconomic status or ethnic group or modifiable, eg, availability of childcare. Modifiable risk factors are of interest to intervention designers as they are amenable to change and are the targets of behaviour change interventions. The magnitude of change in these factors determines the success of the intervention (Hinton and Olson 2001). Determining which behavioural factors mediate changes in PA is key to enable the development of strategies that specifically address these mediators (Miller, Trost et al. 2002). The BCW method requires users to identify factors that influence individual capability, opportunity and motivation to engage in the target behaviour.

Using previous research to determine the predictors of inactivity following childbirth, a study followed a cohort of 1442 women throughout pregnancy and at six months following birth and found that postnatal weight retention, working long hours during the first trimester of pregnancy and a lack of childcare were predictors of inactivity (Pereira, Rifas-Shiman et al. 2007). Another factor identified in the literature is having other children at home (Cramp and Brawley 2009). Lower levels of PA have been associated with lower education levels, breastfeeding and minimal emotional support, whereas higher levels of PA are associated with low exercise self-efficacy, receiving advice about PA and warmer seasons (Vladutiu, Evenson et al. 2014).

Research exploring barriers and enablers to PA in this population limited participants to report one (Evenson, Aytur et al. 2009) or four (Cramp and Bray 2009) during early studies. They identified lack of time, childcare and tiredness as barriers and partner support and desire to feel better as enablers (Evenson, Moos et al. 2009). A comprehensive study of barriers and enablers to postnatal PA adopted a socioecological approach, which states that individual behaviour is influenced by

interpersonal, organisational and community level factors, thus factors influencing behaviour that are outside of the individuals control. The in-depth interviews identified the key barriers (fatigue, lack of motivation and confidence, time constraints, access to activities and poor public transport) and enablers (partner support) to postnatal PA (Saligheh, McNamara et al. 2016).

Experimental research to modify factors influencing postnatal PA has largely focused on constructs from psychological theories. Self-efficacy and SS are commonly associated with postnatal PA. Two of the studies identified in Chapter 2 targeted SS through walking groups (Keller, Ainsworth et al. 2014) and a nominated SS person to support behaviour change (Fjeldsoe, Miller et al. 2010), yet, it was not supported as a mediator of behaviour change. However, research supports SS as a mediator of PA in women with young children (Miller, Trost et al. 2002). There is no evidence to suggest whether the type of SS offered influences behaviour. Interventions targeting self-efficacy in women with young children found that meeting the PA guidelines was at least partly attributable to increased self-efficacy (Miller, Trost et al. 2002). Specifically with postnatal women, barrier self-efficacy is an important correlate (Cramp and Brawley 2009, Bauer, Pivarnik et al. 2014) and is a significant mediator for MVPA frequency (Fjeldsoe, Miller et al. 2013), likely due to the heightened barriers experienced during this period. Some evidence suggests that goal setting and self-regulatory skills may mediate increases in PA (Cramp and Brawley 2009, Fjeldsoe, Miller et al. 2013).

The existing research can inform the behavioural analysis by identifying barriers to behaviour and key psychological constructs to target in an intervention. However, only one study (Saligheh, McNamara et al. 2016) has extensively explored environmental factors that influence behaviour, and the authors state that they cannot be sure that they reached data saturation, therefore some important factors could have been omitted. In addition, no studies are from the UK, which may comprise different social structures and support, warranting further exploration.

### **3.1.5 Aims**

The study aims to:

- a) determine what factors influence postnatal PA
- b) identify the relative importance of the influencing factors
- c) develop a behavioural analysis of postnatal PA to inform the BCW intervention development process.

A multi-methods study was conducted consisting of qualitative (Section 3.2) and quantitative (Section 3.3) components.

The University of Cambridge Psychology Research Ethics Committee approved both studies (Qualitative - PRE2017.037; Quantitative - PRE2017.077). The research governance office arranged insurance and provided study sponsorship.

## **3.2 Qualitative study**

### **3.2.1 Methods**

#### *3.2.1.1 Participants*

##### a) Eligibility criteria:

Participants were included if they were within twelve months of childbirth, aged sixteen or over, lived with their youngest child and spoke sufficient English to participate in an interview. Participants were excluded if they were experiencing postnatal depressive symptoms or had a history of GDM.

##### b) Sample size:

I sampled to saturation, determined when no new codes emerged during the coding process.

#### *3.2.1.2 Recruitment*

The primary recruitment method for this study was contacting local authority Children's Centres (CCs) and mother and baby groups in Cambridgeshire and Hertfordshire. A longitudinal evaluation of CCs in England found that 85% of families use their service within the first year of birth (Maisey, Poole et al. 2015). I contacted staff via email, telephone or personal visits to arrange to visit sessions attended by a high number of postnatal women or for the settings to disseminate information. During session visits, I introduced the study and gave mothers the opportunity to ask questions. If participants expressed an interest, I followed the procedures outlined in section 3.2.1.3. I provided CCs with study flyers and text to display around the centres and distribute via communication channels, eg, newsletters, social media, websites or noticeboards.

#### *3.2.1.3 Procedure*

##### a) Eligibility screening

All participants who expressed interest in participating in the study completed an eligibility screening form. Ineligible participants were informed that they were unable to participate in the study.

##### b) Informed consent

All eligible participants completed a consent form, signing initials to indicate that they agreed with a series of statements and signed the form to provide consent to participate.

#### c) Interview arrangement

Eligible participants, who had completed a consent form, arranged an interview at a convenient time, date and location. Participants chose to complete a face-to-face interview (in an appropriate location, eg, home, libraries, coffee shop) or telephone interview.

### 3.2.1.4 Data collection

#### a) Demographic data

Participants completed a demographic questionnaire prior to the interview, collecting data on age, number of children, age of youngest child, employment status and education level.

#### b) Self-report physical activity

I collected PA data to understand the activity levels of participants. As discussed in Chapter 1, there are several considerations when choosing the PA measurement method. The burden of objective measures was too high for this study and self-report was deemed appropriate due to its feasibility and practicality.

Many recall questionnaires are limited to leisure time PA, however women with young children are likely to accumulate household and childcare related activity which are not likely to be captured in such questionnaires (Fjeldsoe, Marshall et al. 2009). Two questionnaires that assess a wide range of activity domains are the Australian Women's Activity Survey (AWAS) (Fjeldsoe, Marshall et al. 2009) and the International Physical Activity Questionnaire (IPAQ) (Craig, Marshall et al. 2003). The AWAS collects data on five PA domains (planned activities, employment, childcare, domestic responsibility and transport) representing the range of relevant activities applicable to women with young children. The AWAS has demonstrated good test-retest reliability (ICC=0.80 (0.65-0.89)) and acceptable criterion validity measured against the MTI accelerometer ( $r = 0.28$ ,  $p = 0.01$ ) (Fjeldsoe, Marshall et al. 2009). The IPAQ is a measure of adults' PA across four domains (transport, work, household and gardening tasks and leisure time). There are two versions a long form and a short form (SF), which show good test-retest reliability (Long form  $\rho = 0.81$  (95% CI 0.79-0.82); Short form  $\rho = 0.76$  (95% CI 0.72-0.77)). The SF asks about walking, moderate intensity and vigorous intensity activity and calculates scores for each intensity and a total score. The AWAS is an interviewer-administered questionnaire, and showed poor completion rates when self-administered. There are interviewer and self-

administered versions of both IPAQ questionnaires. Owing to the similar measures of reliability and validity among the instruments and that both instruments collect information across relevant PA domains, I chose to use the IPAQ-Short Form to collect PA measurements in this study for its convenience as a self-completion tool and low participant burden. The IPAQ-SF has been used as a suitable self-report measure in large-scale surveys (Rütten and Abu-Omar 2004). Participants completed the IPAQ-SF immediately following the interview, reporting PA for the seven days prior to the interview. When the interview was face-to-face, the IPAQ-SF was self-administered and when it was a telephone interview, the IPAQ-SF was interviewer administered.

### c) Qualitative data

Semi-structured interviews were conducted via telephone or in-person at a time, date and (if necessary) location to suit the participant. I met/contacted participants at the agreed time. Participants gave additional verbal consent to record the interview at the beginning of the interview, and I recorded the subsequent interview using a PIN-encrypted DSS Olympus Audio recorder, using an additional attachment for telephone interviews.

During the introduction to the interview, I gave participants a brief overview, reminded them that participation was voluntary and provided an opportunity for participants to ask questions. The semi-structured interviews followed a pre-prepared topic guide exploring participants' capability, opportunity and motivation to engage in PA, using prompt questions where necessary to elicit further information (Table 3.1). I wrote field notes during the interview to make note of contextual information and other points of interest that may be missed from the audio recording.

I used the Olympus DS-5000 voice recorder to record the interviews because it is encrypted which ensures security when collecting data in the field. At all other times, the recorder was stored in a locked cabinet in a locked room in the Institute of Public Health, Cambridge. Paper forms with personable identifiable data, including consent forms and eligibility screening forms were stored in a locked filing cabinet in a locked room in the Institute of Public Health. Electronic personal identifiable data was uploaded to the on the Clinical School Secure Data Hosting Service at the earliest opportunity. Once uploaded, access to the data was only accessible by the research team using a two-factor authentication (password and security fob). Anonymised transcripts and data, identified by the participant's unique ID number, was transferred to the secure University network servers.

**Table 3.1 – Pre-prepared interview topic guide questions**

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<b>Capability</b>	Have you been able to be active recently?  What makes it difficult for you to participate in PA?  What would make it easier for you to take part in more PA?
<b>Opportunity</b>	Think about the environment around you, how does this support you to be active?  Think about the environment around you, how does this make it difficult to be active?  Are there individuals or groups of people that support you to be active?  Are there individuals or groups of people that discourage you to be physically active?
<b>Motivation</b>	What do you think are the advantages of participating in PA?  What do you think are the disadvantages of participating in PA?  What would/does motivate you to be active?

---

### 3.2.1.5 Data analysis

#### a) Demographic data

Demographic data was input to SPSS, and I analysed demographic characteristics using descriptive statistics.

#### b) Self-report physical activity

IPAQ-SF data was processed according to the IPAQ processing and analysis guidelines (IPAQ Research Committee 2005), (Appendix 3.1) to enhance comparability between studies using this questionnaire. I calculated a continuous and categorical score for each participant. The continuous measure weighs each type of activity according to its energy requirements (METs) to provide a total MET score and a score for each intensity. The categorical score classifies participants into three levels of PA (low, moderate and high) based on the total volume and

frequency of PA to account for the emphasis on regular participation in PA outlined in PA recommendations.

### c) Qualitative data

Anonymised transcripts were imported to qualitative research software NVivo 11 to assist with data analysis. I chose Framework analysis because it is an appropriate approach when working with a pre-defined structure (the COM-B model) and when using a deductive approach allowing the inclusion of a priori concepts. Two reviewers were involved in the data analysis process. We followed a recommended seven step process for implementing framework analysis (Gale, Heath et al. 2013) detailed below:

i) Transcription: I transcribed interview audio recordings verbatim. I checked each transcript for errors by listening to the audio recording and reading the transcript simultaneously.

ii) Familiarisation with the interview: Both researchers listened to the audio recordings and read the transcripts and field notes to become familiar with the interviews.

iii) Coding: Both researchers independently coded three transcripts, line by line, applying codes to passages of text. We used a content coding approach, which analyses the informational content of the data. At this stage, we used open-coding to enable us to categorise the individual factors within the COM-B model components.

iv) Develop a working analytical framework: After independently coding the first three transcripts, we met to discuss the codes and link them to the COM-B components, resulting in an agreed set of codes that we applied to the subsequent five transcripts. We met to discuss our coding and adapt the analytical framework after coding each set of transcripts resulting in several iterations of the analytical framework. Upon coding the final transcript, we met to agree on the final analytical framework.

v) Applying the analytical framework: I re-coded all transcripts using the final analytical framework, verified by SP.

vi) Charting data into the framework matrix: I used the NVivo software to create a framework matrix; the resulting spreadsheet listed all codes in the columns and participants in the table rows. I summarised the data in each cell and retained the meaning and feeling of participants' words. We used the matrix to assess each code while maintaining the link with each participant's overall data.

vii) Interpreting the data: I interpreted the final framework matrix to understand the data and identified the key themes within each behavioural component.

### **3.2.2 Results**

23 participants expressed interest in the study and were screened for eligibility. Participants were ineligible because they were pregnant (n=1) or had a history of GDM (n=2) and four participants were uncontactable. Sixteen participants completed the semi-structured interviews (telephone (n=4); face-to-face (n=12)).

**Table 3.2 – Multi-methods participant demographic characteristics**

Characteristic	Interview (n = 16)		Questionnaire (n = 158)	
	N	%	n	%
<b>Age (years)</b>				
16-24	2	12.5	13	8.23
25-30	5	31.25	34	21.52
31-35	5	31.25	75	47.47
36-40	4	25	30	18.99
41-45	0	0	5	3.16
46+	0	0	1	0.63
<b>Age of youngest child (months)</b>				
0-3	1	6.25	36	22.78
4-6	8	50	52	32.91
7-9	5	31.25	50	31.65
10-12	2	12.5	20	12.66
<b>Number of children</b>				
1	14	87.5	102	64.56
2	2	12.5	47	29.74
3	0	0	6	3.80
4	0	0	1	0.63
5+	0	0	2	1.27
<b>Highest education</b>				
Some secondary school	0	0	2	1.27
GCSE	0	0	10	6.33
A level/equivalent	8	50	23	14.56
University/college degree	8	50	123	77.85
<b>Employment status</b>				
On maternity leave	12	75	122	77.21
Part time employment	2	12.5	10	6.33

Full time employment	0	0	12	7.59
Unemployed	2	12.5	14	8.86
<b>Marital status</b>				
Married	7	43.75	111	70.25
Cohabiting	9	56.25	39	24.68
Single	0	0	6	3.80
Separated	0	0	2	1.27
<b>PA levels</b>				
Low	2	12.5	31	19.6
Moderate	8	50	62	39.2
High	3	18.75	28	17.7
Excluded	3	18.75	37	23.4

Table 3.2 presents participants demographic characteristics. Three participants' PA data was invalid due to missing data or 'don't know/refused' response.

### 3.2.2.1 Capability

#### a) Psychological capability

Participants feel information poor because their sources of information do not meet their expectations or they have moved to a new area and are unfamiliar with the local environment. Participants' key sources of information are social media, CCs, online forums, word of mouth and pre-natal groups, with whom they had maintained contact. Of the few who did receive information from healthcare professionals, they did not perceive the information as useful.

*a lot of it is word of mouth through, sort of, baby groups and going and seeing other mums. Health visitors, children's centres, probably the main ones. And just the internet I guess and Facebook.*

*P022, Moderately active, 1 child, 7-9 months*

*When you see the doctor, the health visitors no one, none of them say 'are you exercising?'. Either are you eating/drinking, you don't get 'are you exercising?'*

*P396, Moderately active, 1 child, aged 4-6 months*

Participants felt they lacked information about two aspects;

1) PA opportunities suitable for postnatal women – participants desire information about local groups and facilities, but it is difficult to determine whether participants lack information about opportunities because they are not available.

*there isn't really or maybe it's not well advertised, but I couldn't find anything online,*

*P817, moderately active, 1 child, age 4-6 months*

2) examples of appropriate and safe activities to aid recovery – participants lacked knowledge of how to re-engage in PA safely immediately after birth. They would like step-by-step guides or examples of safe activities that reduce the need for planning.

*with the recovery and getting back to exercise now, it's all like I want to get there, or I want to get to the first week really ...[of the couch to 5K app]... but what's all the steps leading up to that?*

*P615, Invalid IPAQ Data, 2 children, age 0-3 months*

*when I do have the opportunity it's just like there's so many other things to do and my brain is just thinking, I'm not like trying to put a workout together, it just seems like it's going to take too much mental capacity.*

*P523, Invalid IPAQ Data, 1 child, 4-6 months*

#### b) Physical capability

Participants are physically capable of engaging in a variety of PA and report participating in postnatal activity classes, walking, YouTube videos, swimming with the babies and cycling. Many are modified to allow for the involvement or care of the baby or to aid postnatal recovery. Participants do not cite participating in traditional activities, eg, gym, spinning, but it is unclear whether this is due to reduced physical capability or other factors.

Some participants who had a Caesarean section or complicated birth report diminished physical capability during the early postnatal period, reducing their physical stamina and the distance they can walk. The Caesarean section limits specific movements when manoeuvring a pram, eg, lifting up a kerb or resisting downhill movement.

*It was actually far more tough than I realised, C-Section and getting back on your feet and going for walks. It took me ages actually.*

*P697, Highly active, 1 child, aged 4-6 months*

Some report difficulties to complete specific activities but they can remain active by engaging in alternative PA within their physical capability, eg substituting walking for cycling.

Other women believe they are physically capable of being active, which could be because they have managed their expectations.

*I didn't run as far but then that's because I knew I didn't have like the strength to run as far. I didn't have the breath. 'cause you need to work up to it.*

*P663, Moderately active, 1 child, 7-9 months*

### 3.2.2.2 Opportunity

#### a) Physical opportunity

The key factor influencing physical opportunity for PA is that there must be care in place for the baby through traditional childcare or activity opportunities that enable mothers to care for their baby. Both have influencing factors, which are discussed below.

Partners are the main source of traditional childcare, especially those who can provide care during the day, eg, shift workers, or working from home. Women whose partners can provide childcare in the evenings only are less likely to capitalise on this because of an interplay of other factors such as feeling too tired or not wanting to miss family time. Participants with access to evening childcare are able to participate in traditional activities, eg, gym-based exercise classes.

*I'd like to do swimming and things like that, but it is just needing to have her looked after when I do it really. That is the big, the big issue.*

*P554, Moderately active, 1 child, 4-6 months*

*my husband works from home so the main reason I can actually do anything is because if I want five minutes to do something, he can just watch the baby for five minutes*

*P697, Highly active, 1 child, 4-6 months*

Most participants do not feel comfortable with childcare provision by an external person to enable PA, because they do not feel comfortable leaving their child or cannot afford additional childcare to take part in PA.

*They always seem to be sort of somewhere else, which I wouldn't feel comfortable with, just leaving him in the care of somebody else, I don't know I just wouldn't feel comfortable with that*

*P817, Moderately active, 1 child, 4-6 months*

Activity opportunities that enable participants to care for their babies can be formal activities such as mother and baby fitness classes or informal activities such as walking in the community. Again, each opportunity is affected by a set of influencing factors.

The enabling aspects of formal activity opportunities are that mothers can take the baby and the instructor creates an environment where women feel comfortable to tend to the baby's needs during the class. Individuals have preferences on the type of activity, eg, Zumba, Pilates, Yoga, BuggyFit, but the most important factor is to create a baby-friendly culture in the class.

*if there was something to entertain him yeah like, half the hall, they're in, I don't know, doing something and then half the hall the adults are doing something but you can see them I think that would be absolutely fine*

*P396, Moderately active, 1 child, 4-6 months*

Other aspects to consider are the timing, location and cost of activities.

*So times conflicting, so when you first have the baby, obviously, you like, you try and do all the activities you can and I always found that all the activities always ended up on the same day, everything would be at the same time on the same day.*

*P697, highly active, 1 child, age 4-6 months*

*how much it would cost and how far away it is would make more of a difference to whether I was going to do it or not.*

*P663, Moderately active, 1 child, 7-9 months*

*you pay for sessions, most things you pay for like a block of classes and then the baby is sick for like, a couple of weeks or has really bad diarrhoea and you think 'I can't take him' and you end up missing stuff and everything's really expensive for stuff you don't do.*

*P697, Highly active, 1 child, 4-6 months*

Participants are more likely to walk or cycle in an accessible and pleasant environment. Good walking surfaces, safe, well-lit spaces and some greenspace are key aspects that participants value when being active outdoors. Access to facilities, eg, coffee shops or changing facilities provide a place for them to take a break, which is especially important when beginning to increase their PA levels. Bad weather has a negative impact on PA due to the preparation involved and unwillingness to expose the baby to the bad weather.

*for me going for walks it's the fact I have nice places to walk, safe places to walk and well lit places to walk.*

*P697, Highly active, 1 child, 4-6 months*

*weather. I didn't go out for a walk the other day because it was raining, and like the effort of having to go upstairs and find the rain covers and knowing how wet it would be and everything else I didn't bother, that was a big impact.*

*P615, Invalid IPAQ data, 2 children, 0-3 months*

Once care for the child is in place, the baby can be a barrier. A lack of routine in the early days leads to unpredictable feeding and sleeping times. Sometimes they do not sleep well leading to increased feelings of tiredness. As the babies grow older and can crawl/walk, it becomes more difficult to engage in PA while caring for them.

*I just feed on demand, I don't have a routine, it's difficult to know sometimes whether, say I go to this class, I may have to feed him during that time, um, and also sometimes he'll feed for five minutes, sometimes he'll feed for half an hour.*

*P523, Invalid IPAQ Data, 1 child, 4-6 months*

*She's just a nightmare. She wants to be doing what you're doing and um... I wouldn't be able to do anything at home. She's just on the go all the time. She tries to climb my legs, um, so anything like that where I've got to move my legs it wouldn't be possible, because she's up them.*

*P631, Low active, 1 child, 7-9 months*

Participants who breastfeed are reluctant to leave the baby, especially during the early postnatal period, because the baby requires a lot of feeding and they are reluctant to leave the baby. It is difficult to express enough milk to leave the babies or mothers prioritise the store of expressed milk for other activities. Feeding routines can be unpredictable, which makes it difficult to plan activities.

*I'm breastfeeding her, if she wakes up and she's hungry, he can't soothe her, it needs to be me.*

*P554, Moderately active, 1 child, 4-6 months*

## b) Social opportunity

Participants reported mixed views of SS from family and partners. Most cited positive support by engaging in activity themselves therefore creating an active culture, talking about participating in PA, identifying how she can engage in PA or engaging in PA together.

*when I'm saying. 'oh it's already so and so 'o clock and I haven't been for a run' and he's like you know, either 'why don't you go here, then or go then or then' giving me options. Yeah, just telling me I can do it I suppose when sometimes I think 'Oh, I can't do it,' and he's like 'no you can do it.'*

*P760, moderately active, 1 child, 4-6 months*

Other new mothers did not feel supported by their partners or family to be active. Some reported barriers to family and partner support for example family not living close by or not valuing PA.

*my partner could probably in the evening try and help a bit more so I could have more time to even if I just wanted to go for a jog or something. But he wouldn't do that because he would rather I was at home, getting on doing everything than him having to do it.*

*P817, Moderately active, 1 child, 4-6 months*

Being active in a group setting would provide a sense of accountability, as they would feel guilt if they let someone down by not turning up when planned. During PA, the group dynamics provide encouragement to persevere, which is absent in individual activities.

*If there was a group of people I'd be quite happy to meet up with them, because again it's a social thing. But if I was going on my own I'd do it probably once or twice and then think 'oh I can't be bothered now.'*

*P631, low active, 1 child, 7-9 months*

*everyone else sort of gets on with it as well and if you do sort of start to flag they sort of go "come on, you can do it. You've only got sort of this amount of time left" or it's like everyone's doing it so you don't feel like people are looking at you or you know you're not on your own.*

*P424, Highly active, 1 child, 10-12 months*

Specifically, engaging in activities with other new mothers was preferred because they are in similar life situations, understand the challenges associated with being a new mother and understand that post-pregnancy bodies will be different from pre-pregnancy. In addition, they can provide support and advice on other aspects of motherhood, eg, sleep.

*you're all looking a bit flabby and horrible and you don't care cause you're all in it together you know. If I was going to go and join some aerobics class I think I'd feel quite unfit by comparison but cause it's a postnatal class everyone's in the same boat.*

*P554, Moderately active, 1 child, 4-6 months*

Despite one new mother being reluctant to attend groups due to her shy nature, she welcomed the opportunity to talk to other new mothers about PA and to allow a relationship to develop organically to participate in PA.

*I'll just say, 'I do this' and then another mummy could say 'Well I do this' and you think 'well actually I could do that' and they can then sort of go away and say well*

*'yeah, I could do that too and you know you could probably sort of maybe even sort of chat to each other amongst yourselves and make friends that way and maybe then sort of say well 'why don't we start a jogging group'*

*P003, Invalid IPAQ data, 1 child, 10-12 months*

### 3.2.2.3 Motivation

#### a) Automatic motivation

One key motivation to engage in PA is that it is enjoyable and fun, which helps maintain behaviour.

*it's about having fun isn't it, as well as exercising. If I'm not having fun, I'm not going to carry on doing it.*

*P631, Low active, 1 child, 7-9 months*

Incorporating some social interaction into PA was a form of automatic motivation for participants, which may be indicative of the loneliness and isolation that some mothers can feel. The social interaction could be as small as having a conversation with another adult, but some aspire to form friendships.

*especially in the first couple of months, you do get, if you're not careful you get quite isolated. You're in the house, all of your focus is on the baby, you're having very few adult conversations during the day and you can go a little bit crazy if you're not careful, so yeah, getting out and just having normal conversations with people. Even like walking to the post office and back and saying hi to the person behind the till was important in those early weeks.*

*P554, Moderately active, 1 child, 4-6 months*

Linked with the need for social interaction is using PA as a way of 'getting out of the house'. Much of a mothers' day can be spent indoors and being physically active is a good way of ensuring that they spend some time 'out of the house'.

*being able to get outside, a lot of the time I'm you know in the fresh air, and just enjoying the outside.*

*P760, Moderately active, 1 child, 4-6 months*

#### b) Reflective motivation

Participants' evaluations of PA demonstrate an understanding of the physical and mental health outcomes of PA, which include *relieves tension, clearer head-space, energy levels, lifts my mood, feeling stronger, not getting as breathless, losing my baby weight.*

Unique to this population is the baby as a motivation including responsibility to be a positive role model, to ensure good health for the future and to feel refreshed to be a better parent.

*it helps them to see as they grow up that that's what you've got to do. You know, there's no sitting on computers all day*

*P003, Invalid IPAQ data, 1 child, 10-12 months*

*I'm 35, so I'm an older mum, and I want to make sure I'm fit and healthy to keep up with her.*

*P554, Moderately active, 1 child, 4-6 months*

*my family, um, have had heart attacks and heart problems from as young as thirty nine so I don't want to be somebody that's had the problems and her left without a mum because I've not kept myself healthy. Yeah she's my bab- main thing at the moment that I want to make sure that I'm good for her.*

*P631, Low active, 1 child, 7-9 months*

Negative evaluations of being physically active are parent-related. Some participants are reluctant to spend time away from the baby because they value family time and fear missing developmental milestones, especially when the babies are slightly older, eg, missing first steps or first words. Additionally, some participants cite 'mum guilt' as a reason for not leaving their babies or that they will be exhausted from being active and this will affect their parenting ability.

*he's doing all new things at the minute and he's learning things off of me, so I think I need to be around him at the minute.*

*P317, Moderately active, 1 child, 7-9 months*

*She usually wants me, you know [laugh] her dads great with her, but there comes a point where she just wants mum so I wouldn't be comfortable leaving her for an hour knowing that she might be upset for most of that hour. That's the main one.*

*P554, moderately active, 1 child, 4-6 months*

Beyond the negative beliefs above, participants display concern about becoming more tired or injuring themselves.

*even if I go for a long walk with him, after having only a few hours sleep each night I feel exhausted.*

*P396, Moderately active, 1 child, aged 4-6 months*

*I just feel like I need to be cautious because at the end of the day if I hurt myself the only person that's going to have to deal with that is me.*

*P697, highly active, 1 child, 4-6 months*

The overall evaluation of PA behaviour is positive from mothers, but when placed in a wider context there are other priorities competing against PA for mothers' limited time, money and energy, including housework, sleeping and caring for the family.

*at certain points, somethings gotta give and certain things need to get bumped off the checklist. So... yeah. Some days that has to you know, it has to be the working out.*

*P373, Low active, 1 child, 4-6 months*

*I've seen a couple of things in (place name) and they're really really expensive and I'm like, well I think I need that money for nappies and formula and stuff. I'd rather spend it on that than exercise.*

*P424, Highly active, 1 child, 10-12 months*

*I could do it if I didn't do some other stuff but then I just feel that's prob... that's more important. Because if that doesn't get done, then that's going to affect me more than if I don't exercise probably?*

*P817, Moderately active, 1 child, 4-6 months*

The value that mothers place on PA in comparison to competing priorities determines whether they engage in PA. Participants who prioritise PA engage in more PA compared to participants who place PA on a lower priority.

*because of me pushing my own exercise routine, my own goals, that my household is suffering and my husband is happy to pick up some of the slack for a while but I know that if that went on too long he would - that would become an issue for him.*

*P615, Invalid IPAQ data, 2 children, 0-3 months*

Some participants express a desire to get into a routine for PA because having a set routine places time aside to be active and means that they will be more likely to engage in the behaviour.

*having the exercise group meant that I had a routine that got me out of the house early on.*

*P554, Moderately active, 1 child, 4-6 months*

### **3.3 Quantitative study**

#### **3.3.1 Methods**

##### *3.3.1.1 Participants*

###### a) Eligibility criteria

Eligibility criteria were identical to the previous study, with the exception of sufficient English to participate in an interview (Section 3.2.1.1).

#### b) Sample size

Sample size was calculated by estimating the mean (4) and SD (2) of participant responses to the questionnaire statements (Section 3.3.1.4) to estimate the precision of the mean. We tested different sample sizes to determine one that was sufficiently narrow to ensure confidence in the results and to rank the statements in order of their relative importance. A sample size of 130 provided a mean precise to  $\pm 0.35$  deemed as an acceptable level of precision.

### 3.3.1.2 Recruitment

I used two methods to recruit participants to the study i) information dissemination by local authority CCs and mother and baby groups in Cambridgeshire and Hertfordshire ii) posting hyperlinks to the survey in online forums.

#### a) Mother and baby groups

I contacted staff at CCs and mother and baby groups in Cambridgeshire and Hertfordshire to disseminate information about the study by visiting settings or distributing research flyers. Where allowed, I visited the settings during mother and baby sessions, to provide information about the study and give mothers the opportunity to ask questions. Interested participants were given the opportunity to proceed via a paper questionnaire or electronic questionnaire. Alternatively, CCs distributed study information, which included the electronic hyperlink and my contact details via newsletters, social media, emails, posters etc.

#### b) Online forums

I identified online forums targeting postnatal women within Cambridgeshire and Hertfordshire and posted study information, contact details and a hyperlink to the questionnaire.

### 3.3.1.3 Procedure

#### a) Informed consent

Participants were given a Participant Information Sheet (PIS) outlining the purpose of the research, the research process including eligibility screening and the researcher's contact details. Participants provided informed consent using a condensed consent form, signing their

name to indicate agreement with the statement '*I have read and understood the participant information sheet and agree to take part in the study*'.

#### b) Eligibility screening

Following consent, participants completed an eligibility screening form. Ineligible participants were thanked for their interest, and eligible participants continued to complete the questionnaire.

#### c) Electronic questionnaires

The hyperlink included in the study advertisements directed participants to an online questionnaire hosted on the online survey platform Qualtrics, which included participant information, consent form and eligibility screening questionnaire using skip logic to branch ineligible participants out of the survey. The questionnaire prompted participants to complete unanswered questions before proceeding.

#### d) Paper questionnaires

Participants who opted to complete a paper questionnaire were provided with a PIS and consent form and completed an eligibility screening form, which was reviewed. Eligible participants were given a paper questionnaire to complete. At the end, participants could leave their contact details to be contacted about future research opportunities.

#### 3.3.1.4 Questionnaire development

The questionnaire was based on the Self-evaluation of behaviour questionnaire (Michie, Atkins et al. 2014), which presents a pre-specified list of statements about what it would take for participants to change behaviour relating to capability, opportunity and motivation, eg, I would have to know more about why it was important. Respondents tick all statements that apply and where possible provide a brief explanation. The original questionnaire was not appropriate for the current study, because the statements are generalised to all health behaviours and populations and it cannot determine the relative importance of each statement. Therefore, I used a four-step process to adapt the questionnaire, detailed in Table 3.3.

**Table 3.3 – Four step process to develop the questionnaire for the study**

Step	Description	Resulting changes
1. Tailor original questionnaire	Tailored the original questionnaire to target PA and postnatal mothers.	<p>Added an introduction and adapted statements.</p> <p>Removed space for participants to provide a brief explanation because this data was collected from the qualitative study.</p> <p>Inserted a ten-point scale from <i>'important'</i> to <i>'not important'</i> to allow participants to score the importance of the statements.</p>
2. Patient and Public Involvement (PPI) panel review	<p>Circulated the adapted questionnaire, study aims and COM-B model explanation to the Cambridge University Hospitals PPI panel* for review.</p> <p>Fifteen panel members responded and provided the following comments;</p> <ul style="list-style-type: none"> <li>- Questionnaire completion instructions were simple and clear</li> <li>- There was potential to modify statements to make them clearer and less clumsy</li> <li>- Questionnaire may be too long due to the repetitiveness of statements, and some of the language could be changed to be warmer and more empathetic</li> <li>- All potential influencing factors were addressed in the questionnaire</li> <li>- Questionnaire layout was busy and cluttered</li> </ul>	<p>Changed the language of the questionnaire.</p> <p>Removed some statements to reduce the length of the questionnaire.</p> <p>Reduced the scale to seven items and changed the wording to <i>'agree'</i> and <i>'disagree'</i>, which allowed the statements to be clearer.</p>

3. Pilot with target population	Three members of a mother and baby group completed the questionnaire under a think aloud protocol** and provided feedback	Comments included statements were clear and did not cause any difficulty.  IPAQ questions were difficult to estimate walking and sitting and they did not believe they were able to provide accurate estimates.  Added statements relating to childcare and receiving advice from healthcare professionals.
4. Refine according to qualitative study findings	Mapped the factors identified in the first two qualitative interviews against the questionnaire statements to identify additional factors that were absent.	Identified tiredness as an additional factor and was added to the questionnaire.

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\* panel consists of members of the public who provide feedback on research proposals, review documents and join focus groups about research studies conducted at Cambridge University Hospitals and University of Cambridge.

\*\* think aloud protocol – participants are asked to verbalise each thought that crosses their mind when completing the questionnaire (Jääskeläinen 2010)

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### 3.3.1.5 Data collection

The final questionnaire consisted of 22 statements, following the format ‘I would be more active if...’, (Table 3.4). Participants rated the extent they agreed with each statement on a scale of 1 (strongly disagree) to 7 (strongly agree). An open-ended question asked participants ‘Is there anything else that influences your PA levels?’. The questionnaire (Appendix 3.2) collected demographic data as in the qualitative study and physical activity data using the IPAQ-SF.

**Table 3.4 – Questionnaire statements**

<i>I would be more active if...</i>	
<b>Capability</b>	I had a better understanding of why physical activity is important I knew what to do I were physically stronger I learnt strategies such as setting goals I didn't give up so easily I had more stamina physically I had more stamina mentally
<b>Opportunity</b>	I had more time I had more money I felt less tired I had childcare I had the right kit, eg, clothes, trainers, pram It were easier to access facilities, eg, leisure centres, gyms, swimming pools There were suitable spaces to be active, eg, public parks, greenspaces, well lit/safe footpaths I were part of a group I were prompted to do so I had encouragement from those around me I was advised to do so by a healthcare professional
<b>Motivation</b>	I had more motivation I felt it would do me good I felt I could develop a habit I had a plan

<sup>a</sup> participants respond on a seven point scale: 1 (strongly disagree) 7 (Strongly agree)

### 3.3.1.6 *Data analysis*

Anonymised data was entered into IBM SPSS Statistics 25 for data analysis.

#### a) Descriptive statistics

I analysed the demographic data using descriptive statistics to calculate the frequency and percentage of categorical variables and mean and SD for the continuous variables.

I calculated mean, SD and 95% CI for each questionnaire statement, categorising the statements into disagree ( $<3.5$ ), neutral ( $3.5 < 4.5$ ) and agree ( $>4.5$ ) to aid interpretation of the findings.

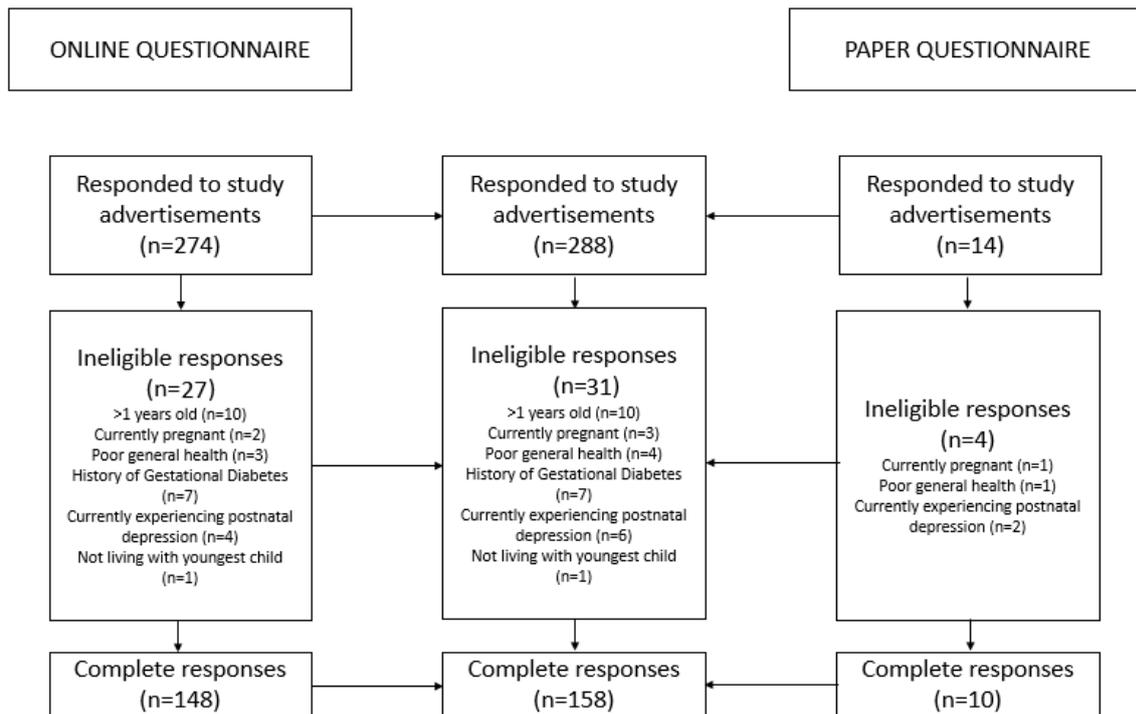
#### b) Open-ended question analysis

I used the final analytical framework, developed during the qualitative analysis, to code the open-ended question responses.

## **3.3.2 Results**

### 3.3.2.1 *Recruitment*

Figure 3.2 displays participant flow through the study. 288 participants responded to study advertisements, 99 did not complete the questionnaire and 31 were ineligible. 158 participants completed the survey. Of these, 148 were online and 10 were paper responses.



**Figure 3.2 – Participant flow through the quantitative study**

### 3.3.2.2 Participants

Table 3.2 displays participants' demographic characteristics. Table 3.5 presents the mean, SD and 95% CI of statement responses. The three statements with the highest rankings were if 'I had more time' (mean=6.06; SD=1.46), 'if I felt less tired', (mean=5.61; SD=1.65) and 'if I had childcare', (mean=5.52; SD=1.79), indicating these are the factors which have greatest influence on PA. The three statements with the lowest scores were 'if I had a better understanding of why it was important', (mean=2.34; SD=1.60) 'if I had the right kit', (mean=3.20; SD=1.87), 'if I was physically stronger', (mean=3.35; SD=1.90), suggesting these factors have the least influence on PA. When mean scores were categorised, participants agreed with seven statements, neutral for ten and disagreed with five statements.

**Table 3.5 – Questionnaire statement responses**

Questionnaire statement <sup>a</sup>	Mean (SD)	95% CI	Questionnaire response %							Categorisation <sup>b</sup>	
			1	2	3	4	5	6	7		
<i>I would be more active if...</i>											
Capability											
I had a better understanding of why it was important	2.34 (1.60)	2.09, 2.59	39.9	28.5	10.1	10.1	5.7	1.9	3.8		Disagree
I knew what to do	3.43 (1.94)	3.13, 3.73	22.2	17.7	13.3	12	19.6	7	8.2		Disagree
I were physically stronger	3.35 (1.90)	3.04, 3.66	21.5	20.3	12.7	15.2	16.5	5.7	8.2		Disagree
I learnt strategies, eg, goal setting	3.40 (1.81)	3.12, 3.68	19.0	17.7	18.4	13.9	17.7	7.0	6.3		Disagree
I didn't give up so easily	3.82 (2.01)	3.5, 4.14	17.1	16.5	10.8	13.9	20.3	8.2	13.3		Neutral
I had more stamina physically	3.85 (1.90)	3.55, 4.15	14.6	16.5	12.0	14.6	20.3	13.3	8.9		Neutral
I had more stamina mentally	3.85 (1.84)	3.56, 4.14	16.5	12.0	8.9	20.3	26.6	7.0	8.9		Neutral
Opportunity											
I had more time	6.06 (1.46)	5.83, 6.29	3.8	0.00	1.9	5.7	17.1	12.0	59.5		Agree
I had more money	4.17 (2.11)	3.84, 4.5	14.6	13.3	13.9	9.5	16.5	12.0	20.3		Neutral
I felt less tired	5.61 (1.65)	5.35, 5.87	3.8	2.5	5.7	10.1	15.2	19.6	43.0		Agree
I had childcare	5.52 (1.79)	5.25, 5.81	5.1	3.8	6.3	8.9	15.2	15.8	44.9		Agree
I had the right kit, eg, clothes, trainers, pram	3.20 (1.87)	2.91, 3.49	21.5	24.7	13.3	13.9	13.9	4.4	8.2		Disagree
it were easier to access facilities, eg, leisure centres, gyms, swimming pools	4.37 (1.99)	4.06, 4.68	10.1	14.6	7.0	18.4	16.5	13.9	19.6		Neutral
there were suitable spaces to be active, eg, public parks, greenspaces, well lit/safe footpaths	3.85 (1.94)	3.55, 4.15	15.8	15.2	10.8	17.1	19.6	10.1	11.4		Neutral
I were part of a group	4.66 (1.83)	4.37, 4.95	10.8	3.8	10.1	11.4	28.5	18.4	17.1		Agree

	I were prompted to do so	4.25 (1.80)	3.96, 4.52	9.5	12.0	10.1	19.0	22.2	16.5	10.8	Neutral
	I had encouragement from those around me	4.34 (1.81)	4.06, 4.62	8.2	10.1	12.7	21.5	17.7	15.2	14.6	Neutral
	I was advised to do so by a healthcare professional	4.54 (1.96)	4.23, 4.85	10.8	10.1	7.0	15.2	20.3	16.5	20.3	Agree
Motivation	I had more motivation	4.58 (1.87)	4.29, 4.87	8.9	7.0	12.0	17.7	17.1	18.4	19.0	Agree
	I felt it would do me good	3.68 (1.85)	3.39, 3.97	17.7	12.7	13.3	22.2	16.5	10.1	7.6	Neutral
	I felt I could develop a habit	4.65 (1.78)	4.37, 4.93	8.9	5.1	10.1	13.9	29.1	15.2	17.7	Agree
	I had a plan	4.49 (1.87)	4.2, 4.78	10.1	8.9	9.5	13.3	27.2	13.9	17.1	Neutral

a participants responded on a scale of 1 (strongly disagree) to 7 (strongly agree)

b mean response to statement categorised as agree  $\geq 4.5$ , neutral  $\geq 3.5 < 4.5$ , disagree  $< 3.5$ .

### 3.3.2.3 *Open-ended question analysis*

After coding the open-ended questions using the analytical framework from the qualitative analysis, most responses fitted with the coding of the analytical framework. Participants used the free space to re-emphasise the main factors that influenced PA or to provide additional explanations. Not all codes from the analytical framework were identified in the open-ended question analysis. I identified one additional code of low confidence, with participants citing low confidence to be active, which has occurred since childbirth, *'now I've lost some of the confidence that I had because I'm much less fit than I was and am daunted by the uphill struggle ahead to regain fitness'*. Table 3.6 describes participants' open-ended responses according to the COM-B model components.

**Table 3.6 – Description of participants’ responses to open-ended questionnaire**

<b>COM-B component</b>	<b>Description of open-ended response</b>
Physical capability	<p>Responses related to specific conditions that affected physical capability after birth, including, pelvic floor weakness, allowing time for diastasis recti to heal, lower back weaknesses and weakness following a C-Section. Three participants also cited general recovery after childbirth, which influenced their physical capability to be active.</p>
Psychological capability	<p>Only one participant cited a factor relating to psychological capability as an additional influencing factor. The participant cited a lack of available advice during the very early postpartum period (4 weeks) about gentle activities to strengthen muscles that would aid recovery from childbirth and adapt to the requirements of motherhood, for example, picking up and carrying the baby.</p>
Physical opportunity	<p>Participants’ responses relating to physical opportunity related to exercise classes, the weather, childcare, cost of activities, the baby, lack of time and tiredness, all of which were noted in the interview responses.</p> <p>Participants responded that the location, timing and access to activities that they can do with the babies were factors that influenced their PA. Timing of activities often clashes with naptime or they are in the evenings when participants do not want to engage in PA. Participants wanted options that enabled them to engage in PA with their babies; although there are some available, participants feel that there should be more.</p> <p>Participants cited the weather as an influencing factor with one participant explaining that being active is easier in the summer months as the winter is ‘cold, dark and miserable’. Again, participants worry about exposing their children to the cold weather.</p> <p>Childcare is a factor mentioned and lack of childcare limits opportunities for participants to be active. Participants report difficulties arranging childcare, or little time when their partners are available to provide childcare. Two participants cited that childcare is only available in one gym in Cambridge, but its memberships are unaffordable.</p> <p>Participants cite cost of group classes, gyms or childcare as a barrier to being active.</p> <p>Participants report the baby’s unpredictable routines and disrupted sleep make it difficult to commit to engaging to PA at a ‘fixed time’. Additionally, other children make it more difficult to be active due to added tiredness, even more limited time and additional costs of childcare with more children.</p>

Participants emphasise that lack of time is a key influencing factor, with one participant stating 'my levels of PA are directly linked to how much time I have'.

Feeling tired or getting more sleep at night is also cited by participants as an influencing factor.

Social opportunity Only one participant cited 'good support' as an additional factor that influenced PA levels.

Reflective motivation Participants' reflective motivations related to their outcome expectations of engaging in PA, which similar to our qualitative findings revolved around physical outcome expectations and those relating to the baby.

Physical outcome expectations were related to losing weight and one participant citing a good mood and positive mind set as a motivation to engage in PA.

Outcome expectations relating to the baby were both positive and negative. One participant cited that she wanted to be able to keep up with her older child and two others cited negative outcome expectations; one not wanting her baby to be out in the cold for too long and one citing that she is not able to let go and let someone else look after the baby.

Automatic motivation One participant cited that she did not enjoy being active and therefore this was a barrier to being active.

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## 3.4 Discussion

### 3.4.1 What factors influence postnatal PA?

Using interview data to map the factors associated with postnatal PA against the COM-B model of behaviour shows that all COM-B behavioural components influence PA. Some behavioural components include a greater number of influencing factors, notably opportunity contained the most influencing factors identified in the interviews. There is opportunity for PA when childcare options are available either through someone else looking after the baby or child-friendly activity opportunities. Requirements for child-friendly activity opportunities are that they are local, affordable, at appropriate times and appealing activities. The latter two inevitably vary between participants. Affordable solutions are necessary because many mothers are on maternity leave, and statutory maternity pay reduces throughout the postnatal period therefore reducing postnatal women's disposable income, especially when financial support from partners is limited. Suggestions

to improve affordability obviously include low priced classes, but also flexible payment plans, where mothers only pay for the sessions they attend. This presents difficulties for service providers, because instructing PA to any special population, eg, postnatal women, falls prevention or cardiac disease patients requires additional qualifications and specialist instructors have an additional associated cost. Social opportunities that facilitate PA are group PA opportunities, due to the enhanced accountability and sense of commitment. However, participants were tentative about attending groups with 'normal' people because they were fearful of judgement or did not feel ready to engage with 'higher intensity' or 'proper exercise'. In addition, such classes were perceived as less likely to be at a suitable time and do not offer childcare solutions. PA groups with other new mothers were attractive because they provided SS to engage in PA with people who are similar to them. Existing research on group PA demonstrates that participants will increase their involvement with the group if they perceive similarity with other group members (Beauchamp, Dunlop et al. 2012). Participating with other new mothers reduced the fear of judgement, especially related to body changes following childbirth and provides an opportunity to share experiences related to motherhood. One consideration under the opportunity component is the baby's behaviour, for example, many participants cite their babies climbing up their legs, crying during the activity or needing to be fed, highlighting that even if child-friendly activity opportunities are provided, the baby may be a barrier to engaging in PA.

Additionally, another consideration for opportunity is an environment conducive to PA for new mothers. Notably, to walk with a pram, pavements must be smooth and areas need to feel safe. Aesthetic environments also enhance their walking experience. Weather is an environmental consideration, because bad weather, eg, rain and cold is exacerbated because the babies are exposed to the weather.

Capability for postnatal physical activity can be bred from providing suitable opportunities. For example, providing child-friendly activities and ensuring they are well advertised via channels postnatal women commonly use would address women's concerns that they do not know about PA opportunities therefore enhancing psychological capability for behaviour. It was unclear from the interviews whether a lack of information about PA opportunities was a result of a lack of advertising or a lack of opportunities. Child-friendly opportunities can contribute to help new mothers' understanding of appropriate PA to aid recovery from childbirth, consequently reducing worries about participants' lack of confidence. Some participants report diminished physical capability following childbirth, especially following a complicated birth. However, it is clear that participants did not understand or know how to re-engage in PA safely, for example, how much walking is

appropriate or exercises to build strength. There is an understanding that their ability to engage in some specific activities is diminished, eg, lifting or driving. Despite this obvious physical capability deficit, it also indicates a deficit in psychological capability, that is, participants' knowledge of the type and amount of PA to engage in at the start. Indeed, a review conducted of the current PA guidelines in 2014 stated that they are often embedded in guidelines for PA during pregnancy and lack specificity and concluded that greater clarity in the guidelines would be useful to both practitioners and postnatal women (Evenson, Mottola et al. 2014). Provision of such advice may enable postnatal women to manage their expectations and gradually re-engage in PA safely.

A potential source for providing PA information is healthcare professionals, as recommended in the aforementioned review (Evenson, Mottola et al. 2014). Following childbirth, there are multiple contacts with a range of healthcare professionals – general practitioners, midwives and health visitors, all of whom are trusted sources of health information and lifestyle advice (Schofield, Croteau et al. 2005). The current questionnaire results show that participants (say they) would be more active if they were advised to do so by a healthcare professional. Evidence for the effectiveness of PA promotion in primary care shows a positive and statistically significant effect at twelve months in sedentary adults (Orrow, Kinmonth et al. 2012), but to date no studies have examined PA promotion by healthcare professionals in postnatal women. A study conducted in 1990 demonstrated that mothers were receptive to receiving lifestyle advice from their GP when it was relevant to the presenting condition and participants valued the right to accept or reject the advice (Stott and Pill 1990). Current clinical guidance from NICE advises healthcare professionals to address PA only for weight management purposes for overweight or obese patients (NICE 2010); however, the multiple contacts during the postnatal period provide opportune moments for professionals to provide PA advice and information to all postnatal women. Healthcare professionals have cited a lack of time during consultations, lack of knowledge or training on PA counselling and a lack of self-efficacy for patients' behaviour change as key barriers preventing them delivering PA advice in practice (Hébert, Caughy et al. 2012). Subsequently, training healthcare professionals to deliver brief interventions on health behaviour change is a growing avenue of research in the general population, which could be extended to the current population.

Automatic motivational factors were important to facilitate PA engagement, specifically enjoyment, an opportunity to get out of the house and a source of social interaction. There is potential to use these automatic motivations to frame communications, for example, advertising PA sessions as opportunities to socialise with other new mothers. Participants' reflective motivations were overwhelmingly positive towards PA, however, previous research has demonstrated that knowledge

of the health risks of physical inactivity, even when personalised by biological biomarkers, does not translate into behaviour change (Marteau, French et al. 2010). Unique to this population is the inclusion of maternal beliefs when evaluating PA outcomes. Positive beliefs include maintaining good health for their children's future and setting a good example. Positive maternal beliefs are counterbalanced by negative beliefs of missing time with the baby, missing new developmental milestones and negative impacts on parenting ability, eg, feeling exhausted or sustaining an injury. One potential method to increase motivation is to increase the positive maternal beliefs and reduce negative maternal beliefs. It should be noted that our methods may not have captured participants' automatic motivation towards behaviour because, by their nature, participants may not be aware that they are being influenced or motivated to be active by these motivations.

The analysis of the open-ended questionnaire question, which asked participants if any other factors influenced PA, did not reveal any additional factors beyond the qualitative interviews, suggesting that the interviews reached saturation.

The barriers identified in this research are similar to the general population (Troost, Owen et al. 2002), with the exception of childcare availability. However, contextual data collected in the interviews provides a unique angle from the target populations' perspective, showing that each factor has unique aspects for the postnatal population. To demonstrate, tiredness is exacerbated in the postnatal population due to disrupted sleep patterns, especially during the early postnatal period. Secondly, developing a habit is a desired outcome in many behaviour change interventions (Lally and Gardner 2013), however, the unpredictability of babies' routines makes this particularly difficult for new mothers. Thirdly, bad weather is associated with reduced PA (Tucker and Gilliland 2007), but an additional worry for participants is the exposure of their babies to cold and wet weather. This research identifies that despite the factors appearing similar to the general population, they are unique, strengthening the case for targeted interventions. Therefore transferring interventions from the general population to postnatal women would not be appropriate.

#### **3.4.2 What is the relative importance of the influences?**

Using the questionnaire results, the factors influencing postnatal PA can be ranked according to the extent to which participants agree. Factors relating to physical opportunity rank highest, specifically time, tiredness, childcare availability, followed by participating in a group (social opportunity) and being advised to do so by a healthcare professional (psychological capability/social opportunity), and motivational factors of developing habits and general motivation, all of which have been briefly discussed above. In addition, participants re-emphasised these factors when responding to the

open-ended question, which may suggest that they want to communicate which factors they believe are most important to them. Below, each factor is discussed in detail, using contextual detail from the qualitative interviews to explain.

Time is the highest ranking factor in this study, similar to existing literature in postnatal women (Saligheh, McNamara et al. 2016) and the general population (Sallis, Grossman et al. 1987). Our study discovered two potential reasons. Firstly, participants perceive PA as a time-consuming activity, with the time required to travel to the activity, participate and shower after the activity. Secondly, the priority placed on PA is an indicator of whether participants will prioritise their time for PA, therefore the perceived value of being active may determine the behaviour. Participants who value PA will prioritise being active when faced with competing behaviours or values, compared to participants who prioritise other behaviours (housework, sleep, cooking) or values (family time). Time was categorised under physical opportunity in line with previous studies that have used the COM-B model to categorise behavioural influences (Webb, Hall et al. 2016, Murtagh, Barnes et al. 2018). However, the qualitative component identified that its categorisation could be included as a motivational factor as it is a reflection of whether participants place sufficient value on PA to use their limited time.

Tiredness is a factor cited in older adults (Manaf 2013, Egerton, Chastin et al. 2015), pregnant women (Evenson, Moos et al. 2009) and clinical populations (Thomas, Alder et al. 2004) and as discussed above is exacerbated during the postnatal period. The feelings of tiredness mean that when participants have free time it is used for sleeping. Available evidence demonstrates that PA can reduce the feelings of tiredness and increase energy (Brown, Mishra et al. 2000). The interview data demonstrated that participants were aware of this, as they cited feeling energised and more motivated as key advantages of being active. Additionally, PA improves sleep quality during the postnatal period, but this did not take into account infants' disrupted sleep patterns (Vladutiu, Evenson et al. 2014).

Developing a habit of being active was another key influencing factor, and evidence demonstrates that developing active habits increases PA long term (Beeken, Leurent et al. 2017). During this life stage, participants are adapting to a new and unfamiliar routine, thus developing new habits. That said, habits, defined in the psychological literature as behavioural patterns performed automatically in response to a situation or 'cue' in which the behaviour has been performed repeatedly and consistently in the past (Verplanken and Aarts 1999, Wood and Neal 2009) are likely to be difficult to establish, because the babies' sleeping and feeding routines are highly unpredictable. As babies develop, their routines change which requires mothers to adapt. Therefore, repeating behaviours to

develop a habit is difficult during the postnatal period. Such unpredictability also makes planning PA difficult during this time.

The questionnaire responses scored five factors that did not influence PA levels: understanding why it was important, knowing what to do, being physically stronger, learning strategies such as goal setting and having the right kit. Understanding the benefits or risks associated with behaviour does not translate into behaviour (Marteau, Hollands et al. 2012) because much of human behaviour is driven by automatic processes, responding to environmental cues as opposed to conscious deliberation of the consequences of action. In pregnant women, educational interventions providing participants with information have demonstrated a significant effect, which researchers speculate is due to the heightened motivation for healthy behaviours during this period, which may help translate intention to behaviour (Currie, Sinclair et al. 2013). Despite this, interventions targeting individuals' reflective processes have demonstrated a sustained effect, but must go beyond information provision only and aim to enhance self-regulatory skills to change behaviour (Marteau, Hollands et al. 2012). Collectively the interview participants were aware of a range of benefits of being active on physical and mental health and outcomes for the baby, which suggests that participants are already aware and understand why PA is important. However, understanding of the importance of being active was varied, with one participant, when probed on the specific benefit for mental health said 'that's what they always tell you'. Some individuals may have a knowledge deficit and informing them of the benefits of being active may be part of a multi-component approach to increasing reflective motivation. Potential approaches in this population are developing participants' knowledge of the benefits of being active in line with automatic motivation as opposed to traditional health risk messages. Understanding and communicating the immediate benefits of being active that are in line with participants' automatic motivations of enjoyment and social interaction steps away from the traditional physical health risk messages and may be a strategy to explore in this population.

Learning strategies such as goal setting was not scored as an influencing factor, which appears to contradict the existing behaviour change intervention literature. The previous chapter identified goal setting as a commonly used BCT in postnatal PA interventions. Goal setting, alongside self-monitoring and feedback, is an active components of interventions to prevent gestational weight gain, and is effective in the wider population behaviour (Pearson 2012).

Increased physical strength was not an influencing factor, yet this statement may be applicable to a subset of participants following a Caesarean section or a complicated birth as evidenced in the qualitative study. In England, Caesarean births account for 27.8% of all births (NHS Digital 2017),

which could explain why the group average was classified as disagree for this statement, despite it being important among a small percentage of women who had a Caesarean section.

The factors discussed above are those that women consider to have the most and least influence on PA. Identifying the influencing factors at a population level can inform PA interventions targeting postnatal women. Examples of such interventions could be informational campaigns or service provision. While the factors outlined inform population level factors, they do not account for individual variation. Assessing the variation of scores, each statement was scored as a one and seven by at least one participant, thus reflecting variation in the factors influencing individual behaviour. Some subgroups of postnatal women may experience a unique set of factors that influence behaviour. For example, women who had a C-section or complicated birth report reduced physical capability. Future research should aim to identify the factors influencing subgroups, eg, primiparous vs multiparous women or single mothers, to develop interventions tailored to subgroups of postnatal women

It is unclear at present how the factors identified in the COM-B model interact to influence behaviour. The model identifies that all factors must be present in order to enable behaviour, however, the nature of the interaction between the behavioural factors is unclear. For example, informing participants of how to be active could reduce their feelings of physical incapability because they are able to engage in appropriate and safe PA.

### **3.4.3 Behavioural analysis of postnatal physical activity**

According to the authors of the COM-B model, intervention designers should use multiple data sources to identify the factors that influence behaviour (Michie, Van Stralen et al. 2011). The methods used in this study provide contextual data around the questionnaire statements, which provide behavioural insights that enable designers to understand the behaviour in detail. The authors also note that consistency between data sources provides confidence in the results (Michie, Van Stralen et al. 2011); however, the results presented in this chapter reveal inconsistencies. As discussed above, some factors influenced individuals' behaviour, eg, money, access to facilities, that were outside of the key factors identified in the questionnaire. This suggests that individual level behavioural interventions must be tailored according to the individual influencing factors. Using the results of the interviews, I have further refined the questionnaire statements to improve their applicability to the postnatal population. I mapped the final analytical framework from the qualitative analysis against the questionnaire statements to identify factors that were missing from the questionnaire, or the questionnaire statements that required modification or additional detail. Table 3.7 presents the questionnaire statements that I added and modified.

**Table 3.7 – Questionnaire statement development following qualitative data comparison**

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I would be more active if I had the right kit, eg, sports bra, bike seats <sup>a</sup>
I would be more active if child-friendly physical activity opportunities were available, eg, mother and baby exercise groups
I would be more active if local PA classes and facilities were advertised
I would be more active if parks/greenspaces were more accessible <sup>a</sup>
I would be more active if the weather was better
I would be more active if there were suitable walking routes, eg, safe, well lit, smooth paths/pavements <sup>a</sup>
I would be more active if I had someone else to be active with
I would be more active if I had another mum to be active with
I would be more active if it was enjoyable
I would be more active if I felt it would be good for my physical health <sup>a</sup>
I would be more active if I felt it would be good for my mental health <sup>a</sup>
I would be more active if I felt it would be good for my baby <sup>a</sup>

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<sup>a</sup> statements modified from previous statement

Combining the findings from the two data sources has informed the development of a behavioural analysis (Table 3.8), to continue the BCW intervention design process. The behavioural analysis provides details of all of the influencing factors, which were identified in the interviews and combines the two data sources. The behavioural analysis presented links to the overarching model of behaviour and provides a starting point to develop evidence-based postnatal PA interventions.

**Table 3.8 – Behavioural analysis of postnatal PA according to the COM-B model of behaviour**

COM-B component	Questionnaire statement.	Interview data	
	I would be more active if...		
Capability	<b>Physical</b> ...I had more physical stamina ...I were physically stronger	<b>Pain and tiredness;</b> Mothers, particularly those with complicated births, experienced pain and tiredness when walking during very early postnatal period.	
	<b>Psychological</b>  ...I knew what to do  ...I knew strategies such as goal setting ...I knew why it was important ...I had more mental stamina	<b>Knowledge of activity opportunities;</b> Don't know about local activity opportunities, don't know where to look to find out about them. Could be due to psychological capability, could be due to lack of opportunities.  <b>Knowing what to do;</b> Don't know when and how to re-engage in PA. Unsure what activities to do to regain strength and fitness.	
	<b>Physical</b>	<b>Baby;</b> Baby makes engaging in PA impractical by; demanding attention, eg, crying, disrupting PA attempts; sleeping and feeding routines are unpredictable – planning PA is difficult; walking long distances with baby in a sling can be uncomfortable.  <b>Weather;</b> Poor weather prevents outdoor activity and active travel	
	...if there were suitable spaces to be active	<b>Environment;</b> Environment unsuitable to engage in PA. Walking environment not suitable for prams, eg, uneven footpaths, traffic, feeling unsafe. Home environment may lack space/have too much baby equipment for home-based activity.	
	...if I had access to childcare	<b>Childcare;</b> often not available or expensive alongside activity opportunities. Mothers do not feel comfortable leaving baby in childcare at this early stage. Partners cannot provide childcare during the day due to work. Families have other commitments or live far away.	
	...if I felt less tired	<b>Tiredness;</b> Sleep deprivation leads to feeling too tired to engage in PA. Prefer to use spare time to sleep over PA, especially during early postnatal stage. Tiredness more pronounced during evening when partners are available to provide childcare.	
	...I had more time	<b>Time;</b> Not enough time in the day and PA does not feel achievable as it is perceived as a very time consuming activity.	
	...if I had access to facilities	<b>Child-friendly activity opportunities;</b> involve baby in PA/create an environment where mothers feel comfortable to tend to baby's needs (feeding, changing, soothing). Opportunities not available locally, are not on at appropriate times, are not activities that participants will enjoy.	
	Opportunity		

	...I had more money	<p><b>Cost;</b> Opportunities for new mothers are expensive or have block payment systems which mean that missed classes due to baby illness, doctors appointments, are chargeable leading to accumulating costs. Mothers have lower income while on maternity leave. The additional cost of childcare to engage in PA leads to added expense.</p> <p><b>Breastfeeding;</b> babies have unpredictable feeding routines – planning PA is difficult. Time spent feeding in early postnatal period is long and unpredictable. Expressing enough milk to leave the baby for PA is difficult when stores are being built up for other situations, eg, enabling partner to do night feeds.</p>
	If I had the right kit	
<b>Social</b>	...if I were part of a group	<p><b>Not motivated to engage in activity alone;</b> New mothers lack motivation to engage in activity on their own. Lack motivation to initiate activity bouts and complete intended activities.</p> <p><b>Participate with other new mothers:</b> Participants would prefer to engage in PA with other new mothers because they share their current life situation and can provide support to each other.</p>
	...if I received encouragement from those around me	<p><b>Lack of support from non-mum friends;</b> many new mothers moved to new areas and do not have friends in the areas. Some report losing contact with friends due to the change in circumstances. Meeting with friends and family often results in sedentary activities.</p>
	...I received advice from a healthcare professional ...I were prompted to do so	
<b>Reflective</b>		<p><b>Leaving baby;</b> Reluctant to spend time away from baby for fear of missing developmental milestones, feelings of guilt for leaving the baby when the person caring might not soothe it.</p> <p><b>Injury and tiredness;</b> belief that engaging in PA may lead to injury or tiredness. This was an afterthought by participants.</p> <p><b>Priorities;</b> housework and babies take priority when there are only ‘so many hours in a day’. PA is seen as a ‘nice to do’ not an essential thing.</p>
	...if I had a plan	
	...if I had more motivation	<p><b>Motivation;</b> lack of motivation to participate in activity. Generally ‘can’t be bothered’, lack of desire to engage in PA or laziness. Want to engage in activities that are enjoyable, provide social interaction and an opportunity to get out of the house.</p>
<b>Automatic motivation</b>	...if I could develop a habit	<p><b>Difficult to develop a habit:</b> Developing habits is difficult due to babies due to a lack of feeding and sleeping routines.</p>

#### **3.4.4 Strengths and limitations**

A strength of this research is the use of two data sources to identify the factors associated with postnatal PA. Using two data sources has enabled the identification of factors associated with postnatal PA across the target population and the interviews have identified the individual factors associated with postnatal PA. The use of the qualitative data added contextual information to the questionnaire statements to provide detailed information for intervention design. Additionally, the open-ended question in the questionnaire did not identify any additional factors, suggesting that our qualitative study collected data to saturation. The sample consisted of active and inactive women, which enabled a detailed exploration of the barriers from inactive participants' perspective and the enablers to PA from active participants' perspectives. For example, I was able to identify the specific aspects of existing child-friendly classes that enable and encourage participants to attend.

Using a four-stage development process for the questionnaire incorporated comments from members of the public and the target population to refine the questionnaire appearance, language and statements to be appropriate for the purpose of the research study. Involving participants in aspects of research design is different from participation, and involving members of the target population provides added insight to improve the relevance of the research based on their first-hand experience (National Institute for Health Research 2014). The questionnaire requires further refinement and once finalised its use as a screening tool to determine individual factors influencing behaviour should be explored. The sample sizes in this research study were sufficient. In the questionnaire, the sample size provided a precise group mean.

Using two researchers to code the qualitative data is a strength because qualitative analysis is influenced by researchers' characteristics and introduces different perspectives when analysing the data (Berends and Johnston 2005). Online recruitment to the questionnaire was a low cost method of recruitment, which enabled the study information to reach a large number of people at minimum cost and time. However, there are limitations, which include an inability to determine response rates and subsequently it is difficult to assess the characteristics of responders against non-responders and representativeness of the sample. Recruiting participants from CCs and online forums may predispose the sample to cite group activities and social interaction as a motivation. It is unclear whether mothers who are less inclined to attend group activities or prefer individual activities would also find group interaction as a key influencing factor. Further research should explore whether the findings on group activities and social interaction are similar from other recruitment methods. There was a high number of incomplete questionnaire responses, where participants had signed the

consent and screened for eligibility but did not complete all responses to the questionnaire statements; however, we cannot determine the reasons for incomplete responses.

### **3.5 Chapter Three Summary**

This chapter presents the results from a multi-methods study to explore what factors influence postnatal PA completing step four of the BCW. Semi-structured interviews (n=16) and questionnaires (n=158) were used to determine the factors and their relative importance for PA according to the COM-B model components. Participants were healthy postnatal women recruited from CCs and online forums. The qualitative interviews used a topic guide, were transcribed and analysed using Framework analysis. I identified that all six COM-B model components influence postnatal PA. The questionnaire presented 23 statements relating to factors that influence postnatal PA, and participants were asked to rank their agreement with each statement. The questionnaire statements were adapted from an existing questionnaire and refined using PPI consultation and pilot questionnaire. The factors that women rated as having the greatest influence were having more time, feeling less tired, access to childcare, were part of a group, were advised to do so by a healthcare professional, had more motivation and developing a habit.

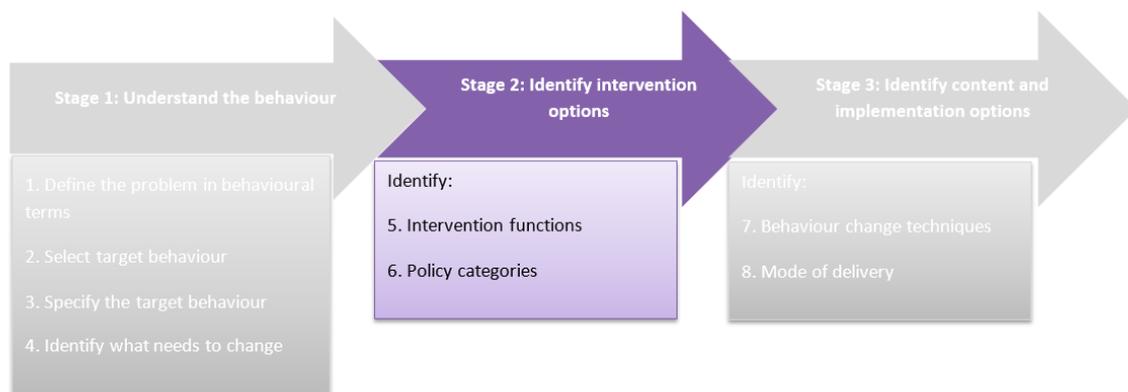
## 4 Intervention development

### 4.1 Introduction

The previous chapter presents a behavioural diagnosis (Table 3.8) of the factors influencing postnatal women’s capability, opportunity and motivation to engage in PA. This chapter describes in detail the subsequent steps in the BCW. After completing the BCW process, the findings will inform the development of an intervention strategy including the chosen intervention components. This chapter details how I used the results from the behavioural analysis throughout the subsequent BCW steps and describes the final intervention.

### 4.2 Stage 2: Identify intervention options

Identifying intervention options is broken into a further two steps; to identify intervention functions and policy categories (Figure 4.1).



**Figure 4.1 – Stage 2 of the BCW**

#### 4.2.1 Identify intervention functions

Intervention functions are broad categories of the means by which an intervention changes behaviour. There are nine intervention functions (Table 4.1). The BCW links each COM-B component to a set of intervention functions relevant for bringing about the desired change in behaviour, identified by a consensus exercise with a group of experts. For example, the BCW identifies the intervention functions of restriction, environmental restructuring, modelling and enablement as relevant for influencing change in social opportunity. Due to the applicability of the BCW to a range of target populations, behaviours and available resources, not all intervention functions are likely to be applicable or effective. The BCW uses the APEASE criteria, (see section 1.3.1.2) as a framework to

appraise the appropriateness of each intervention function. The behavioural analysis presented in Chapter 3 identified factors influencing all COM-B components, deeming all intervention functions potentially relevant for behaviour change. Therefore, I appraised each intervention function according to the APEASE criteria (Table 4.1) and selected education, persuasion, environmental restructuring, enablement and modelling as relevant. I excluded restriction and coercion because they are not practical or acceptable, training because it is not practical for this behaviour and incentivisation because it is not affordable within the constraints of this project. The behavioural analysis identified more than one influencing factor within each COM-B component, for example, psychological capability was influenced by lack of knowledge of the local opportunities and a lack of knowledge on when and how it is safe to re-engage in PA following birth. For each influencing factor, I identified the intervention functions that were most appropriate, presented in Table 4.1.

**Table 4.1 – Candidate intervention functions to consider**

<b>Intervention function</b>	<b>Definition</b>	<b>APEASE<sup>a</sup> judgement</b>
Education	Increasing knowledge or understanding	Yes
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Yes
Incentivisation	Creating expectation of reward	No – not affordable within the constraints of this project
Coercion	Creating expectation of punishment or cost	No – not practicable, acceptable
Training	Imparting skills	No – not practical for this behaviour
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in a competing behaviour)	No – not acceptable or practicable
Environmental restructuring	Change the physical or social context	Yes
Modelling	Providing an example for people to aspire to or to imitate	Yes
Enablement	Increasing means/reducing barriers to increase capability or opportunity	Yes

<sup>a</sup> APEASE Criteria; Affordability; practicability; effectiveness and cost effectiveness; acceptability; side effects and safety; equity.

#### **4.2.2 Identify policy categories**

The BCW identifies seven policy categories that represent the type of decisions made by authorities to support behaviour change (Table 4.2), which users appraise against the APEASE criteria. Each intervention function identified in the previous step is linked to policy categories to identify those likely to be effective and appropriate to support each intervention function.

**Table 4.2 – Policy categories to support behaviour change**

<b>Policy functions</b>	<b>Definition</b>
Communications/marketing	Using print, electronic, telephonic or broadcast media
Guidelines	Creating documents that recommend or mandate practice. This includes all changes to service provision.
Fiscal	Using the tax system to reduce or increase financial cost
Regulation	Establishing rules or principles of behaviour or practice
Legislation	Making or changing laws
Environmental/social planning	Designing or controlling the physical or social environment
Service provision	Delivering a service

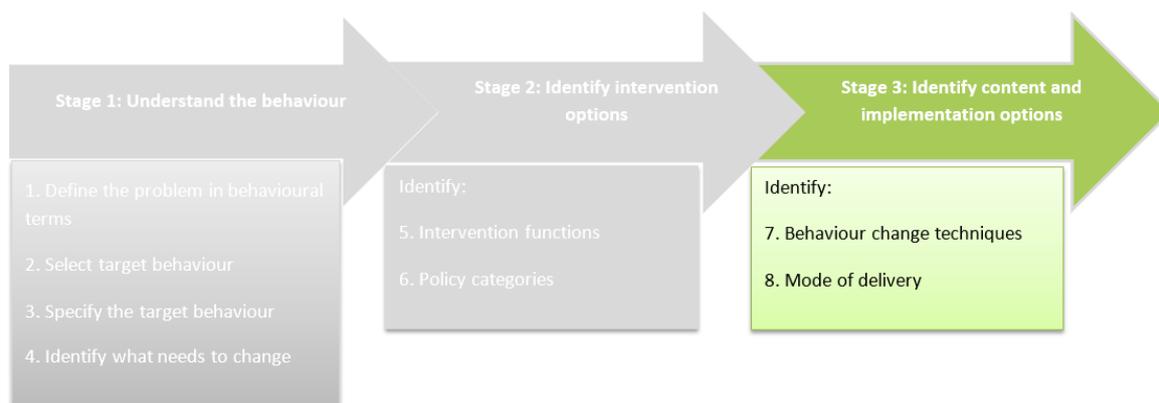
Policy categories are available to intervention designers with access to policy levers. There is no access to policy levers in this project or adequate resources to implement interventions targeting policy categories therefore this stage was not necessary for the current project.

### **4.3 Stage 3: Identify content and implementation options**

Stage three to identify intervention content and implementation options involves identifying the appropriate BCTs (content) and delivery mode (implementation option) to implement the chosen intervention (Figure 4.2).

#### **4.3.1 Identify behaviour change techniques**

Using methods similar to the previous steps, the BCW identifies BCTs that are appropriate for each intervention function. For each intervention, the most frequently and least frequently used BCTs are presented to guide users' choice to use as a starting point to identify BCTs likely to be effective. It is possible that an appropriate BCT is missing from the list, therefore I adopted a method utilised by Murtagh, Barnes et al. (2018) to review the 93 items in the BCT taxonomy to identify additional BCTs.



**Figure 4.2 – Stage 3 of the BCW**

The meta-regression presented in chapter 2 could not inform the selection of BCTs as it did not identify any BCTs associated with intervention effectiveness. Therefore, for each influencing factor and chosen intervention function(s) in the behavioural analysis, I chose the appropriate BCTs by assessing the list of most and least frequent BCTs and the 93-item taxonomy to identify any additional BCTs (Appendix 4.1). For example, one influencing factor was that new mothers are not motivated to engage in activity alone (social opportunity). I had previously identified persuasion, environmental restructuring or modelling as the relevant intervention functions and was able to identify 12 BCTs to address this. I repeated this process for each factor identified in the behavioural analysis resulting in 42 relevant BCTs.

### **4.3.2 Identify mode of delivery**

The BCW presents a taxonomy of modes for delivering interventions, and I used the APEASE criteria to appraise each mode. The first choice is a face-to-face or distance intervention, which was unclear from the systematic review. Results presented in Chapter 3 found that mothers value a commitment that enables them to get out of the house and/or participate in social interaction, supported by mothers' preference for face-to-face interviews as opposed to telephone interviews, leading to the choice of a face-to-face intervention. Other postnatal PA interventions utilised distance delivery modes because their formative research identified face-to-face contact as a barrier to intervention delivery (Fjeldsoe, Miller et al. 2010). When considering an individual or group based intervention, I chose a group intervention due the added accountability to attend and participate in the activity alongside an added sense of camaraderie, friendship and enjoyment from participating in PA with other mothers.

### **4.3.3 Developing an intervention strategy**

Contrary to the order of the BCW steps, I chose the mode of delivery prior to developing the intervention strategy, because the formative research pointed clearly to the use of a group-based face-to-face intervention, which narrowed the possibility when developing an intervention strategy. There is no exact science to operationalise BCTs to an intervention strategy and rather it requires a degree of creativity. To devise an intervention strategy, I met with another researcher with expertise in intervention design and brainstormed ideas on how to address each behavioural component using the candidate BCTs. During this process, we identified that some BCTs were not appropriate for the behavioural component and were no longer a consideration. Following the brainstorming session, I read the evidence base on the proposed intervention strategies and developed a coherent intervention strategy that encompassed the intervention strategies that had promising results in the literature. Table 4.3 presents the BCW process, from identifying the COM-B component, its associated intervention function and BCT(s) and the resulting intervention strategy. The final intervention, described in detail in section 4.4 included 10 BCTs and one new BCT for signposting, the provision of information on how, when and where to perform the behaviour.

We identified two strategies that underpin the intervention 1) a buddy based intervention 2) motivational interviewing (MI) principles, which will be described in detail below.

#### *4.3.3.1 Buddy interventions for health behaviour change*

I chose a buddy intervention to operationalise the BCT cluster SS. SS is an important construct in PA because the physical and social environment influences behaviour. An individual's social environment largely exists within families, communities and neighbourhoods (McNeill, Kreuter et al. 2006) and thus these factors are able to influence behaviour. In a supportive social environment, individuals are more likely to be active, and therefore utilising strategies to enhance social influence is a topic of research interest. One key category within a taxonomy on social influence on PA is SS and social networks (McNeill, Kreuter et al. 2006). SS interventions focus on changing behaviour by building, strengthening and maintaining social networks that are supportive of change (Neil Thomas, Macfarlane et al. 2012). There is strong evidence that SS, specifically buddy support, making behavioural contracts and walking groups can increase the time and frequency of PA participation (Kahn, Ramsey et al. 2002).

**Table 4.3 – Development of an intervention strategy**

COM-B component	Behavioural analysis	Intervention functions <sup>a</sup>	Behaviour change techniques <sup>a</sup>	Intervention strategies
Physical capability	<b>Pain and tiredness;</b> Mothers, particularly those with complicated births, experienced pain and tiredness when walking during very early postnatal period.	Enablement		Start intervention after participants have received GP permission at 6-8 week check-up.
Psychological capability	<b>Knowledge of activity opportunities;</b> Don't know about local activity opportunities, don't know where to look to find out about them. Could be due to psychological capability, could be due to lack of opportunities.	Education	Information on how to perform the behaviour**	<b>Session:</b> Explore existing knowledge of local opportunities and action plan to look up opportunities of local activities. <b>Booklet:</b> Signpost participants to – local activity opportunities, walking routes, credible websites, postnatal DVDs, YouTube videos.
	<b>Knowing what to do;</b> Don't know when and how to re-engage in PA. Unsure what activities to do to regain strength and fitness.	Education Enablement	Instruction on how to perform the behaviour** Goal setting (behaviour) Action planning Graded tasks*	<b>Session:</b> Inform of PA guidelines. Discuss activity preferences and strategies for engaging in those activities and action plan to look into how they can do those activities if there is not sufficient information. Discuss the activities presented in the booklet. Discuss goals and action plans for the following week, with guidance from researcher to make a plan on the activities they will engage in. <b>Booklet:</b> Introduction to PA guidelines on how to re-engage in PA following birth. Page introducing different types of activities and a signposting page to DVDs, YouTube videos, websites and links to lists of local activities. Write action plans in a planner section of the booklet
Physical opportunity	<b>Baby;</b> Baby makes engaging in PA impractical by; demanding attention, eg, crying, disrupting PA attempts; sleeping and feeding routines are unpredictable – planning PA is difficult; walking long distances with baby in a sling can be uncomfortable.	Enablement	Problem solving Action planning Information on how to perform the behaviour**	<b>Session:</b> Discuss and inform of activities that can be done with the baby or identify times when baby is quiet, eg, nap time to engage in alternative activity. Action plan activities at times that fit the babies schedule. Identify barriers to PA, (potentially the baby) and discuss solutions to overcome this <b>Booklet:</b> Signpost to activities that involve the baby. Write list of identified barriers and suggested solutions for overcoming these.

<b>Weather;</b> Poor weather prevents outdoor activity and active travel	Enablement	Problem solving Information on how to perform the behaviour**	<b>Session:</b> Discuss activity options that do not rely on weather. Identify barriers to PA, (potentially weather) and discuss solutions to overcome this <b>Booklet:</b> Signpost to activities that do not rely on the weather. Write list of identified barriers and suggested solutions for overcoming these.
<b>Environment;</b> Environment unsuitable to engage in PA. Walking environment not suitable for prams, eg, uneven footpaths, traffic, feeling unsafe. Home environment may lack space/have too much baby equipment for home-based activity.	Enablement	Instruction on how to perform behaviour**	<b>Session:</b> Identify environments that are suitable for PA. Buddy can provide with additional ideas/locations on where to be active. <b>Booklet:</b> Signpost to websites that identify walking routes or parks that are suitable for PA.
<b>Childcare;</b> often not available or expensive alongside activity opportunities. Mothers do not feel comfortable leaving baby in childcare at this early stage. Partners cannot provide childcare during the day due to work. Families have other commitments or live far away.	Enablement	Problem solving Instruction on how to perform the behaviour**	<b>Session:</b> Discuss the possibilities of activities with/without the option of childcare. Identify potential barriers (childcare plan falls through) and solutions to overcome this. <b>Booklet:</b> Signpost to activities that involve the baby when childcare is an issue and activities that do not need childcare for when childcare is available.
<b>Child-friendly activity opportunities;</b> involve baby in PA/create an environment where mothers feel comfortable to tend to baby's needs (feeding, changing, soothing). Opportunities not available locally, are not on at appropriate times, are not activities that participants will enjoy.	Enablement	Instruction on how to perform behaviour**	<b>Booklet:</b> identify local child-friendly activity opportunities
<b>Cost;</b> Opportunities for new mothers are expensive or have block payment systems which mean that missed classes due to baby illness, doctors appointments, are chargeable leading to accumulating costs. Mothers have lower income while on maternity leave. The additional cost of childcare to engage in PA leads to added expense.	Enablement	Instruction on how to perform behaviour**	<b>Session:</b> Discuss opportunities to engage in low cost or free activities <b>Booklet:</b> Signpost to activity options that are low cost or free

Social opportunity	<p><b>Not motivated to engage in activity alone;</b> New mothers lack motivation to engage in activity on their own. Lack motivation to initiate activity bouts and complete intended activities.</p>	<p>Environmental restructuring Modelling Enablement</p>	<p>Social support (unspecified) Social support (practical) Restructure social environment* Commitment*</p>	<p><b>Session:</b> Option to arrange to engage in PA with their buddy. Discuss how their buddy relationship will support PA and discuss their commitment to each other. <b>Booklet:</b> Write the commitments of how they will support each other.</p>
	<p><b>Lack of support from non-mum friends;</b> many new mothers moved to new areas and do not have friends in the areas. Some report losing contact with friends due to the change in circumstances. Meeting with friends and family often results in sedentary activities.</p>			
Reflective motivation	<p><b>Leaving baby;</b> Reluctant to spend time away from baby for fear of missing developmental milestones, feelings of guilt for leaving the baby when the person caring might not soothe it.</p>	<p>Enablement</p>	<p>Information about how to perform the behaviour**</p>	<p><b>Session:</b> Discuss preference for leaving baby or not leaving baby and discuss what activities are appropriate <b>Booklet:</b> Signpost to activities that involve the baby.</p>
	<p><b>Injury and tiredness;</b> belief that engaging in PA may lead to injury or tiredness. This was an afterthought by participants.</p>	<p>Education Persuasion</p>	<p>Information about health consequences Graded tasks**</p>	<p><b>Session:</b> Discuss benefits of engaging in PA for feelings of tiredness, improved sleep. Action plan graded tasks to increase the amount of PA gradually to minimise risks of injury and tiredness.</p>
	<p><b>Priorities;</b> housework and babies take priority when there are only 'so many hours in a day'. PA is seen as a 'nice to do' not an essential thing.</p>	<p>Education Persuasion</p>	<p>Information about social and environmental consequences Information about health consequences</p>	<p><b>Session:</b> Explore and strengthen motivations for PA to increase the value placed on PA by participants. Inform participants of PA guidelines and that PA can be completed in short bouts of 10 minutes. Discuss action plans for planning activities into the day. <b>Booklet:</b> List of reasons that PA is important and ask them to choose those that are applicable to them. Following the discussion, ask to write down the reasons why they want to</p>

**Tiredness;** Sleep deprivation leads to feeling too tired to engage in PA. Prefer to use spare time to sleep over PA, especially during early postnatal stage. Tiredness more pronounced during evening when partners are available to provide childcare.

Education  
Persuasion

Information about health consequences  
Problem solving\*\*

be active. Complete action plans that fit into their daily routines.

**Session:** Discuss benefits of PA for feelings of tiredness and improved sleep. Inform of PA guidelines that PA need not be vigorous or need to be done in long bouts of time. Identify barriers to PA, (potentially tiredness) and discuss solutions to overcome this

**Booklet:** PA guidelines. Write list of identified barriers and suggested solutions for overcoming these.

**Time;** Not enough time in the day and PA does not feel achievable as it is perceived as a very time consuming activity.

Education  
Persuasion

Information about social and environmental consequences  
Information about health consequences

**Session:** Explore and strengthen motivations for PA to increase the value placed on PA by participants. Inform participants of PA guidelines and that PA can be completed in short bouts of 10 minutes. Discuss action plans for planning activities into the day.

**Booklet:** Complete action plans that fit into their daily routines.

Automatic motivation

**Motivation;** lack of motivation to participate in activity. Generally ‘can’t be bothered’, lack of desire to engage in PA or laziness.

Persuasion  
Environmental restructuring  
Modelling

Information about health consequences  
Information about social and environmental consequences  
Commitment\*  
Social support (unspecified)\*\*  
Social support (practical)\*\*  
Social support (emotional)\*\*

**Sessions:** Discuss how the buddy will support/motivate them to be active. Set goals and action plans to gradually increase PA over the course of the intervention.

**Booklet:** Commit to support their buddy to be active. Write goals and action plans in the booklet and use the plans to self-monitor activity.

<sup>a</sup> deemed as appropriate according to the APEASE criteria

\* Less frequently used BCTs

\*\* Identified from additional searching of the BCT taxonomy

The behavioural analysis presented in Chapter 3 explored perceptions of social opportunities to engage in PA, which represented a lack of support from non-mum friends, lack of motivation to engage in PA alone and a desire to engage in PA with other new mothers to provide a sense of camaraderie. Existing interventions for postnatal PA have utilised SS through general encouragement to be active (Keller, Ainsworth et al. 2014) or nominating a SS person or participants nominating a SS person who also receives SMS messages detailing how they can encourage the participant to be active (Fjeldsoe, Miller et al. 2010).

Buddy interventions, defined as two people working together to help each other reach the desired goal, have been identified as a potential effective SS intervention (Brinson, Wallace-Bell et al. 2013). Buddies can be assigned through existing networks, other participants or programme staff (Hurdle 2001). The interpersonal relationship formed within a buddy partnership is proposed to influence behaviour by the provision of SS, establishing social norms that promote behaviour and information sharing (McNeill, Kreuter et al. 2006). Additionally, buddy intervention may be especially effective for women because theories of relationship indicate that at every developmental stage, girls and women's need for social relationships is a primary motivation that determines behaviour (Hurdle 2001).

Buddy systems have been implemented successfully in programmes to promote smoking cessation (May and West 2000) and breast self-examination (Mayer, Beach et al. 1991). The method has been used in PA research where a self-selected buddy attended MI training and supported the delivery of the intervention sessions. Participants in the buddy support group had greater increases in PA than the control group (Brinson, Wallace-Bell et al. 2013). In postnatal women, one pilot study utilised self-selected buddies from family or friends to support the participant to be active, which did not result in increased PA in the intervention group compared to the control group, although women with an active buddy were more likely to be active than those with an inactive buddy (Choi and Fukuoka 2018). A strength of self-selected buddies is the utilisation of social capital within existing social networks, however choosing a partner or friend may not be able to provide the social camaraderie, shared experience and mutual understanding that was identified in Chapter 3 as a motivation to be active with other new mothers. To date, no intervention has explored the potential of a buddy system utilising two new mothers.

#### *4.3.3.2 Motivational interviewing for health behaviour change*

I chose PA counselling to deliver the intervention because it enables the delivery of several chosen BCTs. The counselling style is an important consideration when designing a PA counselling intervention and is classified on a continuum, from a directing counselling style towards a guiding

style (Rollnick, Butler et al. 2005). In the directing style, the professional knows what the participant should do and tells them how to do it, often resulting in resistance when used for health behaviour change. The guiding style, at the other end of the continuum is characterised by a combination of listening to the participant and offering expertise and advice when needed.

MI is a technique that employs a guiding style, originally developed by clinicians in the field of alcohol addiction. MI is a goal-oriented, person-centred style that enables participants to explore and resolve ambivalence. It implies that the participant themselves already has what is needed to change their own behaviour (Rollnick, Miller et al. 2008). The style creates a collaboration to strengthen the participant's personal motivation and commitment to change. The conversation is conducted in a non-judgemental, respectful and empathetic manner, yet is goal oriented and guides the participant through the process of change (Linden, Butterworth et al. 2010). During a session, the professional will recognise discrepancies between the participant's current behaviour and their goals, values and beliefs, recognise, elicit and strengthen change talk, support self-efficacy and identify and manage talk that indicates status quo (Hettema, Steele et al. 2005, Martins and McNeil 2009).

I chose to use an MI style to guide the session for a number of reasons, firstly due to its person-centred approach. Chapter 3 illustrated that the factors influencing individual behaviour are highly variable and therefore MI provides a flexible approach, adaptable to differences in motivations, barriers and situations. Secondly, it is effective when working with ambivalence, which was prevalent among interview participants in Chapter 3. Participants commonly expressed desire to change alongside reasons to maintain the current behaviour. A key component of MI is to resolve such ambivalence so that participants strengthen their reason for change (Rollnick, Miller et al. 2008). Thirdly, MI has high acceptability among participants as it is considered a kind, gentle and respectful route to behaviour change, where participants feel a sense of partnership and collaboration (Martins and McNeil 2009, O'Halloran, Blackstock et al. 2014). MI offers a non-judgemental approach where the participants lead the change which reduces the feeling of being pressured (West, DiLillo et al. 2007). It is especially important not to impose pressure on new mothers to change behaviour or lose weight because they cited societal pressure, influenced largely by media and celebrities, to 'bounce back' to their pre-pregnancy bodies. Lastly, I chose MI because it has been proven effective when adapted or added to other intervention components (Hettema, Steele et al. 2005)

Although originating in the addiction literature, MI has rapidly grown and hundreds of studies have implemented the technique. Recent reviews and meta-analyses indicate it is an effective style of

counselling for changing diet and exercise behaviour (Martins and McNeil 2009). However, there is high variability in study outcomes even between multi-centre studies, likely due to the variability in MI delivery (Miller and Rose 2009). Group-based MI has been applied effectively, but introduces challenges to maintain its key elements. It challenges the person-centred approach because there is likely to be a range of views between participants which the facilitator cannot explore in detail (D'Amico, Osilla et al. 2010, Wagner and Ingersoll 2012). In addition, the group setting will introduce interpersonal dynamics (D'Amico, Osilla et al. 2010) and thirdly group participants may have different experiences and needs and may be at a different stage of change (D'Amico, Osilla et al. 2010). I chose to use a buddy-based intervention to have the greatest chance of maintaining a person-centred approach, while providing SS.

#### **4.4 Buddy Up: Intervention description**

The intervention development process resulted in Buddy Up, a buddy based intervention, where two new mothers pair up and attend PA counselling sessions based on MI principles. This section describes Buddy Up in detail.

##### **4.4.1 Forming buddy relationships**

Both buddies must be new mothers within twelve months of childbirth, and there are two options for matching participants with a buddy: 1) matching with an existing friend 2) creating a new relationship. In a pre-existing relationship, the buddies are likely to exert a greater influence compared to a new relationship, which may work bi-directionally. However, this method is likely to exclude socially isolated mothers. New relationships are unaffected by previous roles and behaviour and participants build relationships on common ground. Evidence suggests that they are more likely to make an effort, and their buddy is less influential (May and West 2000). It is unclear whether utilising existing relationships or developing new relationships will be the best method, therefore I chose include both methods in the study.

##### **4.4.2 Buddy Up Sessions**

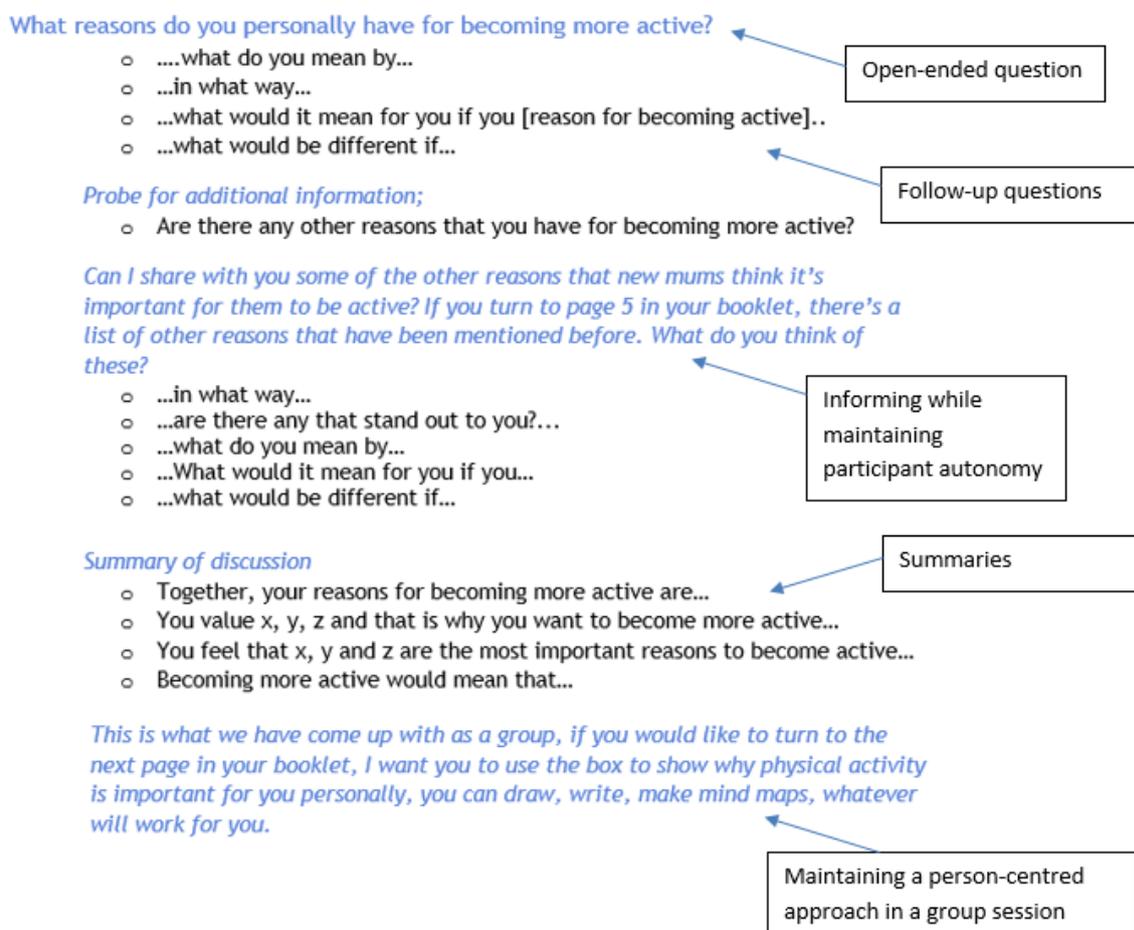
###### *4.4.2.1 Frequency and intensity*

MI is a brief intervention, typically delivered in 1-4 sessions. In one study, when participants chose their preferred number of contacts, the average was three but, importantly, the number of sessions and intervention outcomes were unrelated (Linden, Butterworth et al. 2010). In Chapter 2, there was no indication towards the optimal time between sessions. Exercise based sessions met more frequently (Cramp and Brawley 2006, Keller, Ainsworth et al. 2014) compared to PA counselling sessions. I chose two weeks in line with two of the PA counselling studies reviewed (Maturi, Afshary

et al. 2011, Ashrafinia, Mirmohammadali et al. 2015). At each Buddy Up session participants discussed their goals and action plans for the following two weeks, therefore although the sessions are delivered within four weeks, the action plans and goal-setting component are applicable for a period of six weeks, thus resulting in a six-week intervention. The duration of the first session is approximately 60 minutes and the second and third approximately 30 minutes each, based on timings from pilot sessions.

#### 4.4.2.2 Session content

I developed a script to guide participants through each section of the session (Appendix 4.2), based on MI principles and spirit. The script included examples of open-ended questions, follow-up questions, affirmations, prompts for reflective listening and summaries (Figure 4.3).



**Figure 4.3 – Excerpt from Script annotated with MI principles**

Each session included two sections: 1) strengthening motivation and reasons to change and 2) strengthening commitment to change, aligning with existing evidence on the strength of commitment of change talk and the pattern of change talk across consultations (Hettinga, Steele et

al. 2005). Originally, practitioners proposed that the frequency of change talk predicted behaviour, however, it is now acknowledged that the strength of commitment change talk and the pattern of change talk are better predictors. Change talk that expresses desire, ability and need do not predict behaviour itself, but do predict change talk directed at commitment (Hettema, Steele et al. 2005). Therefore, the first stage of an MI consultation focuses on enhancing motivation by eliciting change talk relating to desire, ability and need to change behaviour. The second stage moves on to elicit commitment change talk because the strength of commitment talk during the final minutes of a session is the strongest predictor of behaviour (Hettema, Steele et al. 2005). Table 4.4 describes the topics covered in each buddy up session.

#### *4.4.2.3 Supplementary booklet*

I designed a supplementary booklet (Appendix 4.3) that includes information on each topic. Parts of the booklet are used in the sessions and others are intended as information that participants can refer to between the sessions (Table 4.4). The purpose of the booklet was to provide participants with information using menu options (Figure 4.4), eg, ideas for activities, reasons for being active. The menu options informed participants and they chose the applicable options, thus maintaining participant autonomy, a key component of MI. The booklet provided space for participants to write personal motivations, commitment to their buddy, personal goals and action plans. This was utilised to maintain participant autonomy and focus on their individual motivations and plans, recommended as a strategy when implementing group-based MI.

#### *4.4.2.4 Delivering group MI*

To account for the challenges of delivering group-based MI, I included some aspects into the intervention sessions and booklet. The inclusion space for participants to write their own thoughts in their booklets is outlined above. As MI is delivered for more than one person, the role of the professional takes a shift from a counsellor towards a facilitator to avoid domination by one participant and ensure all participants are contributing. Delivering the sessions to two participants should minimise this group effect and I would further facilitate the sessions by directing questions specifically to one participant if there is one dominating participant.

#### *4.4.2.5 Delivery person*

I delivered the sessions after attending an MI training course. The training course covered the topics of MI principles and techniques with practical tasks and activities to practise MI skills for PA behaviour change. I used the skills learnt on the course to develop the script. Beyond the script, I learnt about the spirit and style of MI to enable me to deliver sessions that adhered to MI principles.

**Table 4.4 – Buddy Up content in relation to the BCW development process**

Buddy Up Session Content				Link to Behaviour Change Wheel		
	Overview	Buddy Up Script	Booklet	Intervention function	BCT <sup>a</sup>	COM-B Component
<b>SESSION 1</b>						
<b>Section 1:</b>	<b>Introduction:</b> Introduce session					
<b>Strengthening motivation, desire and need to change</b>	<b>Explore (and build) importance:</b> Discuss and strengthen participants' personal motivation for increasing PA	<p><i>What reasons do you personally have for becoming active?</i></p> <p><i>Can I share with you some other reasons new mums think it is important for them to be active?</i></p>	<p>Page listing short, medium and long-term benefits of PA.</p> <p>Space to write/draw personal motivations to be active</p>	<p>Persuasion</p> <p>Education</p>	<p>Information about health consequences</p> <p>Information about social and environmental consequences</p> <p>Information about emotional consequences</p>	<b>Motivation – Reflective</b>

<p><b>Section 2:</b></p>	<p><b>Exploring (and building) confidence:</b></p> <p><i>Introducing the PA guidelines:</i> Introduce PA guidelines with a focus on message about benefits of short frequent activity chunks to build confidence.</p> <p><i>Widening perceptions of PA:</i> Discuss what activities contribute to PA guidelines to discover appealing opportunities for participants. Share ideas and signpost to local activities.</p> <p><i>Strengthening buddy support:</i> Discuss what support the pair can offer and would value and commit to supporting each other to be active, ideas include rewarding each other, providing childcare, engaging in activity together, supporting messages</p>	<p><i>How much PA do you think is needed to get the benefits we've discussed?</i></p> <p><i>What activities did you enjoy before having a baby?</i></p> <p><i>Can I share with you some activities that you can do?</i></p> <p><i>How will you be able to support each other to be active?</i></p>	<p>Activity ideas appropriate for new mothers and signposting to local opportunities, websites, DVDs and books for each activity.</p> <p>Write behavioural commitment to each other with 3-4 ways to support each other</p>	<p>Education Enablement</p>	<p>NA</p> <p>NA</p> <p>Social support (unspecified)</p> <p>Social support (practical)</p> <p>Social support (emotional)</p> <p>Commitment</p>	<p>Capability – psychological</p> <p>Capability – psychological</p> <p>Motivation – automatic</p> <p>Opportunity – Social</p>
<p><b>Strengthening commitment to change</b></p>	<p><i>Set goals:</i> Participants set their own goals based on what they believe is manageable</p>	<p><i>How much PA do you think is manageable for you over the next week?</i></p> <p><i>How confident do you feel that you can increase your activity levels this week?</i></p>	<p>Space to write PA goal for week 1 and 2.</p>		<p>Goal setting (behaviour)</p> <p>Self-monitoring of behaviour</p> <p>Graded tasks</p>	<p>Motivation - Reflective</p>

	<p><b>Agreeing and strengthening a plan:</b></p> <p><i>Action planning:</i> Add specificity to the goal and strengthen their plans including, what, when and where to be active to achieve their goals.</p> <p><i>Contingency planning:</i> Identify potential barriers and create plans to be active despite the barriers.</p>	<p><i>How do you think you can achieve your goal?</i></p> <p><i>What might get in the way of you being active?</i></p> <p><i>How might you find a way around these things?</i></p>	<p>Complete weekly activity planner, with column to tick activity when completed.</p> <p>Space to write down key barriers and solutions</p>	<p>Enablement</p>	<p>Action planning</p> <p>Problem solving</p>	<p>Capability – psychological</p> <p>Opportunity - physical</p>
<b>SESSION 2:</b>						
<p><b>Section 1:</b></p> <p><b>Strengthening motivation, desire and need to change</b></p>	<p><b>Review progress and provide feedback:</b></p> <p>Discuss participant progress during the past two weeks. Explore why they have/have not met goals and use MI techniques to focus on positive behaviour change. Revisit motivations for PA to identify any additional motivations.</p>	<p><i>How have the past two weeks gone?</i></p> <p><i>Your motivations were....,are there differences after two weeks?</i></p>	<p>Add any additional motivations/reasons to be active to the reasons they wrote in session 1</p>	<p>Enablement</p> <p>Persuasion</p>	<p>Review behavioural goal(s)</p> <p>Discrepancy between current behaviour and goal</p> <p>Information about health consequences</p> <p>Information about social and environmental consequences</p> <p>Information about emotional consequences</p>	<p>Motivation - reflective</p>
	<p><b>Reviewing group support:</b> Discuss the support</p>	<p><i>Tell me about the support you</i></p>		<p>Enablement</p>	<p>Social support</p>	<p>Opportunity - Social</p>

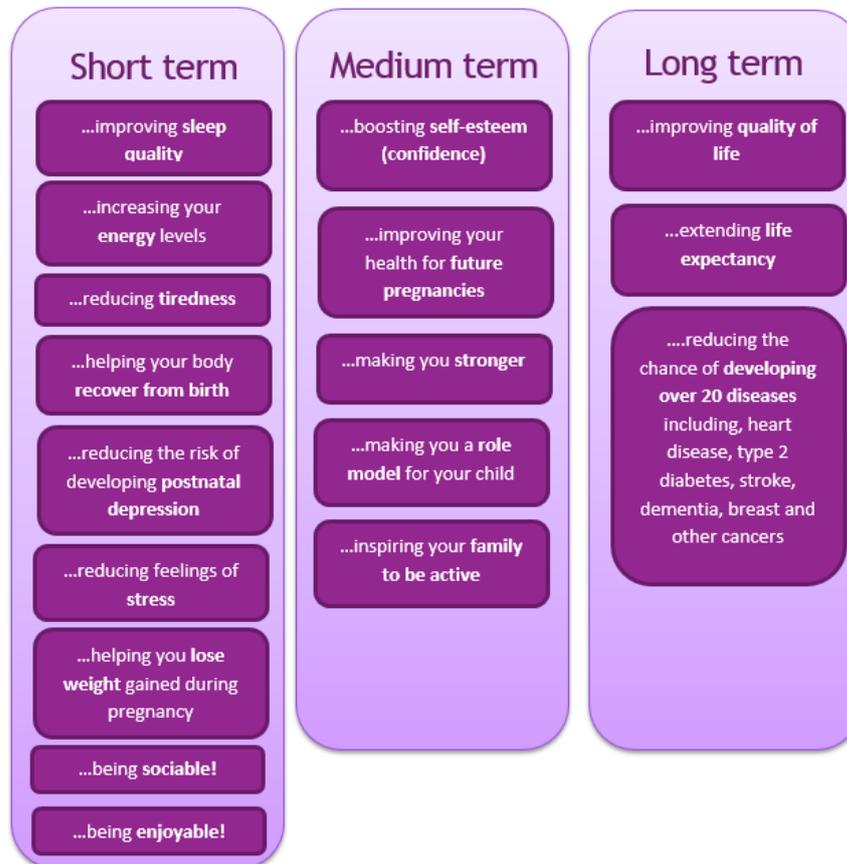
	that buddies have provided over the past two weeks, exploring what worked well and what could be better, identifying any additional support that would be useful.	<i>have given each other.</i>			(unspecified) Social support (practical)	
<b>Section 2:</b> <b>Strengthening commitment to change</b>	<b>Set goals:</b> As session 1					
	<b>Action planning:</b> As session 1					
<b>SESSION 3:</b>						
<b>Section 1:</b> <b>Strengthening motivation, desire and need to change</b>	<b>Review progress:</b> As in session 2					
	<b>Review buddy support:</b> As in session 2					
<b>Section 2:</b> <b>Strengthening commitment to change</b>	<b>Set goals and action plans:</b> As in session 2					
	<b>Looking ahead:</b> Discuss future plans and equip participants with skills and ideas for maintaining activity levels, including maintaining buddy support, effective goal setting or finding new activities.	<i>Where do you see yourselves in three months time?</i>  <i>How will you ... support each other/plan activities/overcome problems?</i>  <i>Can I share with you some things that might be useful to help you continue?</i>	Pages with information on setting new goals, rewards, trying new activities and future pregnancies to discuss if participants are interested in the topic.	Education Enablement	Goal setting (behaviour) Graded tasks Social support (unspecified) Social support (practical)	Opportunity – Social Motivation – Reflective
<sup>a</sup> BCTs outlined are potentially used during these sections because MI is led by the participant and they may not explore all BCTs, eg, when exploring motivations for PA, may focus on social and						

environmental consequences and not explore health consequences.

## Why is physical activity important?

Being active in the year after birth plays a key role in your recovery from pregnancy and childbirth. As well as helping your body physically recover, regular physical activity can improve your mood and help you feel better.

As a new mum, when you're feeling busy and extremely tired, doing some activity might be the last thing that you feel like doing, but it can help by...



**Figure 4.4 – Sample page from Buddy Up booklet providing a menu of options for participants to choose those applicable**

During the sessions we discuss participants' reasons for change without any guidance. Participants will then look at the page presented in the figure and asked to pick additional reasons that are applicable to them. They have been informed of the benefits and maintained autonomy.

### 4.5 Chapter Four Summary

This chapter presents stages two and three of the BCW and the resulting intervention. Using the BCW, I identified five intervention functions and ten BCTs deemed appropriate. A face-to-face delivery method was chosen to address participants' preferences from the formative research. Developing an intervention strategy requires creativity to operationalise the chosen intervention

functions and BCTs. Following a brainstorming session and reviews of the evidence, we chose two intervention strategies 1) a buddy intervention 2) PA counselling sessions underpinned by MI. The resulting intervention, Buddy Up, delivered ten BCTs. Buddy Up matches two mothers in a pair to support each other to increase PA, built on an existing or a new relationship. Buddies attend three sessions at two week intervals, based on MI principles. Sessions are supplemented by a booklet as a tool to deliver MI and for participants to refer to between the sessions.

## 5 Buddy Up: Feasibility study methods

This chapter presents the methods of a feasibility study of the Buddy Up intervention. Feasibility studies are recommended prior to a full intervention efficacy trial (Craig, Dieppe et al. 2008) to address the overarching question ‘Can the study work?’ (Orsmond and Cohn 2015). The MRC recommend feasibility testing of an intervention as the second stage in intervention development (Craig, Dieppe et al. 2008). Its purpose is to determine whether efficacy testing is appropriate (Bowen, Kreuter et al. 2009), to guide the design of the subsequent trial by estimating important study parameters and identify changes to the study methods (Bowen, Kreuter et al. 2009). Feasibility studies do not need to wait until the end of the study to recommend changes, rather, they can be implemented during the study to achieve the most desirable format (Orsmond and Cohn 2015).

The MRC intervention development guidance recommends that feasibility studies assess the acceptability of procedures, estimate the recruitment and retention rates and determine the sample size for a future trial (Craig, Dieppe et al. 2008). Some guides also suggest testing methods for integrating the intervention into existing settings and expanding the study (Bowen, Kreuter et al. 2009). Orsmond and Cohn (2015) collate the recommendations for feasibility study objectives and suggest five key objectives; 1) recruitment capability; 2) evaluation of data collection procedures and outcome measures; 3) acceptability and suitability of the intervention and study procedures; 4) resources and ability to manage and implement the study; and 5) Preliminary evaluation of participant responses to the intervention.

Four key parameters that were uncertain in delivering the Buddy Up intervention were the recruitment capability to recruit participants in pairs, feasibility of the data collection procedures, acceptability and utilisation of the buddy component and whether there was a promising intervention effect. The following chapter outlines how the study addressed the key uncertainties of delivering Buddy Up, based on Orsmond and Cohn’s objectives and guiding questions.

### 5.1 Aims

- a) Is it feasible to recruit participants to a paired intervention?
- b) Are the data collection procedures and outcome measures feasible and acceptable?
- c) What is the acceptability and feasibility of the intervention?
- d) What is the preliminary evaluation of intervention effect?

## 5.2 Ethical approval

The University of Cambridge Psychology Research Ethics Committee approved the study (PRE2018.055 on 31.08.2018) and all protocol changes during the trial. The research governance office arranged study insurance and sponsorship.

## 5.3 Study design

This study utilised a single-group pre-post design. I chose this design as it was considered an effective use of resource allocation, focusing all available resources on intervention delivery and data collection to provide a more accurate indication of the ability to recruit participants in pairs, intervention adherence rates and examine intervention acceptability as opposed to collecting control group data. However, a single group study does not assess the acceptability of randomization or provide a control group for comparison.

## 5.4 Participants

### 5.4.1 Sample size

The sample size calculation was based on the key objectives of this study, which were to estimate participant retention rates, therefore I proposed a range of sample sizes and calculated the 95% CI. For the calculations, I selected studies included in the systematic review in Chapter 2 that utilised physical activity counselling as part of the intervention (Cramp and Brawley 2006, Fjeldsoe, Miller et al. 2010, Kernot, Lewis et al. 2019, Lewis, Gjerdingen et al. 2014, Maturi, Ashfary et al. 2011, Norman, Sherburn et al. 2010) and calculated the mean retention rate of these interventions (mean, 85%; SD, 9). These estimates were used to test what influence a range of sample sizes would have on the 95% CI to choose a sample size (Table 5.1) balancing precision with the required resources.

**Table 5.1 – Proposed sample size and their effect on 95% CI**

<b>Sample size</b>	<b>95% CI</b>	<b>Precision</b>
30	81.64, 88.36	3.36
35	81.91, 88.09	3.09
40	82.12, 87.88	2.88
50	82.44, 87.56	2.56
60	82.67, 87.33	2.33
80	83, 87	2

Based on Table 5.1, I chose a sample size of 40 as it estimates participation rates to a precision of  $\pm 2.88\%$ , which is deemed sufficiently precise for this study. The additional gain in precision from increasing the sample size by ten was not sufficient to justify the additional resources required to deliver the intervention. As the sampling unit is the pair, I aimed to recruit 40 pairs (80 participants).

#### **5.4.2 Eligibility criteria**

The eligibility criteria matched the studies presented earlier and is presented in table 5.2. I added criteria g) to ensure that participants had medical clearance to participate in PA, and h) to ensure the intervention recruits inactive participants.

**Table 5.2 – Buddy Up eligibility criteria**

- 
- a) aged 16 years or over
  - b) living with their youngest child
  - c) not currently pregnant or planning to become pregnant in the next six months
  - d) no current postnatal depressive symptoms
  - e) no history of Gestational Diabetes Mellitus
  - f) live within Cambridgeshire, Hertfordshire or Bedfordshire
  - g) have completed their 6-8 week postnatal check
  - h) currently participate in less than 30 minutes of PA per week <sup>a</sup>
- 

<sup>a</sup> measured by a single item PA measure (Milton, Clemes et al. 2013)

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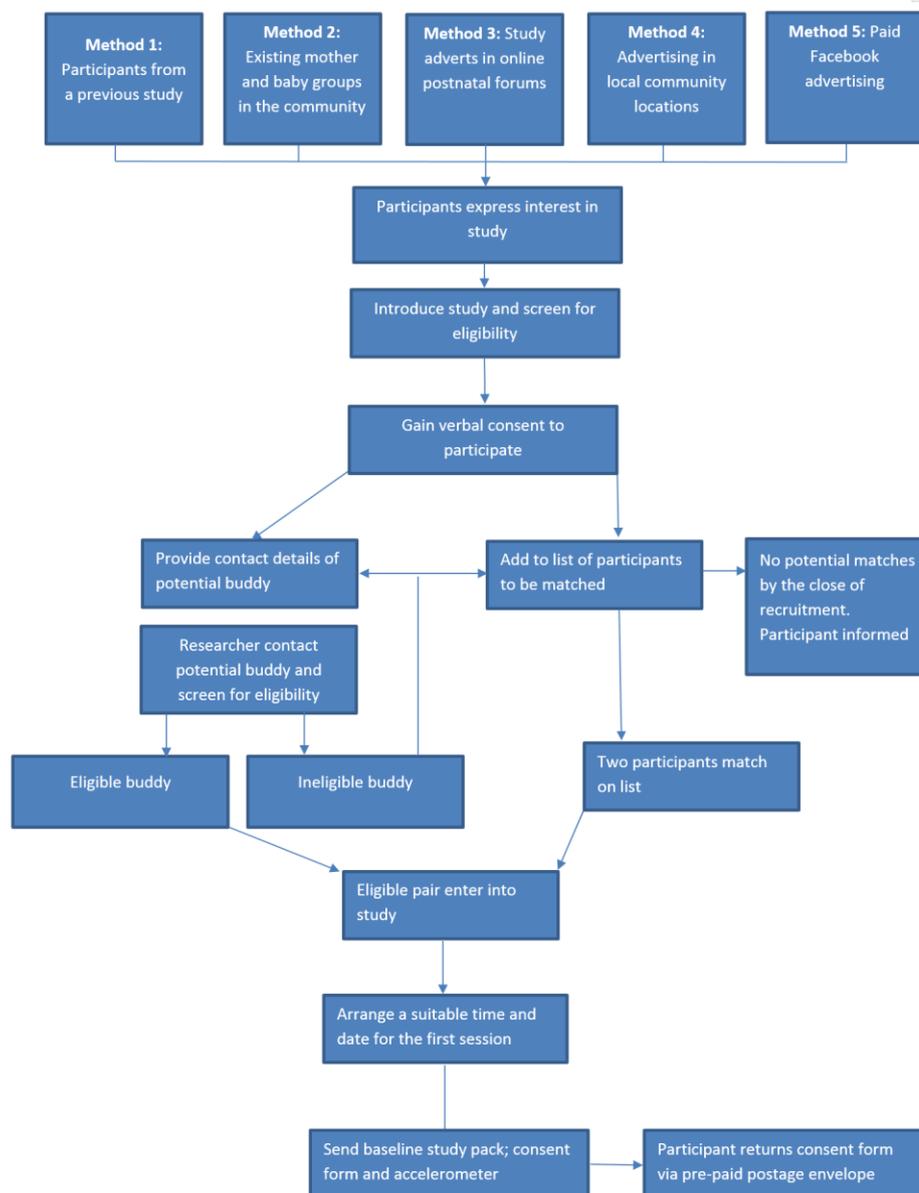
## **5.5 Procedures**

### **5.5.1 Recruitment**

I used five recruitment methods to recruit participants to the study: 1) participants from a previous study; 2) existing groups in eligible counties; 3) online forums; 4) advertising in local communities; 5) paid Facebook advertising (Figure 5.1). Each recruitment method is described below. All recruitment methods require participants to register an interest in the study either online, hosted on Qualtrics ([www.qualtrics.com](http://www.qualtrics.com)), by email or in person.

#### *5.5.1.1 Participants from a previous study*

Questionnaire participants from Chapter 3 opted to leave contact details to be contacted about future research opportunities. 73 participants left their contact details. Participants who left contact details were contacted by telephone, where possible, with up to three attempts. If telephone contact failed, I sent participants an email.



**Figure 5.1 – Buddy Up recruitment methods**

### 5.5.1.2 Existing groups in eligible counties

Childrens Centres and mother and baby groups in Cambridgeshire, Hertfordshire and Bedfordshire were contacted via email, telephone or personal visits and asked to distribute information about the study. I provided settings with advertising materials (Appendix 5.1).

I asked settings to help share information about the study either through 1) disseminating information through available channels, eg, social media, newsletters, emails or posters. Information contained a hyperlink for participants to register their interest and my contact details for them to

get in contact directly. 2) Allowing me to visit a session specifically for new mothers, during which I explained the study and collected contact details of participants who were interested in taking part.

#### *5.5.1.3 Online forums*

I identified online forums targeting postnatal women from Cambridgeshire, Hertfordshire and Bedfordshire. Depending on the format of the forum, I posted a brief explanation of the study, a hyperlink for participants to register their interest and the study flyer (Appendix 5.1). The number of times and timing of posting on the forums were dictated by their individual rules, eg, posts only allowed on a Friday or a maximum of one post a month.

#### *5.5.1.4 Advertising in local communities*

I placed study flyers on advertising boards in locations frequently visited by new mothers, which included community centres, parks/play areas, coffee shops, nurseries, and leisure centres.

#### *5.5.1.5 Paid Facebook advertising*

Advertising through Facebook was added to the recruitment protocol after identifying recruitment in online forums as an effective method to reach the target population. Facebook adverts offer the opportunity to specify demographic characteristics that determine who is targeted by the advert. The advert content was posted from a Buddy Up Facebook page, and contained two lines summarising the study, an image used elsewhere to promote the study and a hyperlink to the register of interest website (Appendix 5.1). The cost of Facebook adverts depends on the competition and there are many payment options. I had a total budget of £30 to use on the adverts, which I ran for 15 days capped at £2 per day. I specified the demographics according to location (Hertfordshire, Bedfordshire and Cambridgeshire), age (18-48 years), gender (female) and interests (New parents: 0-12 months or Parents with toddlers: aged 1-2 years).

### **5.5.2 Eligibility screening**

After registering an interest in the study, I contacted participants via telephone or email. During the initial contact I provided a brief overview of the study aims and procedures and provided a PIS. The PIS provided information on the purpose, methods, risks and benefits of the research, planned data collection and storage to enable participants to make an informed decision on whether to take part. If participants wanted to take part, I screened them to check their eligibility for the study. A standardised screening form was used to assess the eligibility criteria for the study, which was self- or telephone-administered.

The screening questionnaire used a single item measure to assess whether participants currently participate in less than 30 minutes of PA per week. The item has shown strong test-retest reliability

and modest concurrent validity when measured against a longer self-report measure (Milton, Bull et al. 2011) and has good agreement with an accelerometer to classify participants as active or inactive, suggesting it is a useful screening tool to determine participants' appropriateness for entry into an intervention (Milton, Clemes et al. 2013). Participants who answered 1 or 0 to the question asking how many days in the past week had they done more than 30 minutes of PA were eligible for the study.

### **5.5.3 Matching participants**

As discussed in section 4.4.1 participants were matched with a buddy who also met the eligibility criteria. The buddy pair were based on an existing relationship, whereby the participants knew each other prior to participating or a new relationship where the participants did not know each other prior to participating. For the remainder of this thesis P1 refers to the first participant in a pair and P2 refers to the second participant with whom they were matched. Following eligibility screening, eligible participants chose whether to participate with a buddy they have an existing relationship with or a new relationship, for which the procedures are described below.

#### *5.5.3.1 Buddies with an existing relationship*

P1 who opted to be buddied with an existing friend either provided contact details for P2 or passed the study information to P2 for P2 to contact me. If they provided contact details, I asked the participant to inform P2 that I would be contacting them. If P1 passed on the study details, I followed them up if I had not received contact from their potential buddy within a week. Upon contact with P2, I provided a brief overview of the study aims and procedures and a PIS. If they were interested, I conducted eligibility screening and eligible participants were matched with the participant that referred them. If ineligible, I contacted P1 to start the matching process again.

#### *5.5.3.2 Buddies with a new relationship*

If P1 wanted to be matched with another participant in the study, I noted participant's location, willingness to travel, age of the baby and the type of birth. The participants were matched firstly on their location and if possible according to the age of baby and type of birth. Participants were informed that it may not be possible to find a match before the end of the study. When I identified a suitable match, I contacted both participants and asked them whether they would like to participate, based on the location between buddies. If I did not find a suitable match for the participant by the end of recruitment, participants were informed.

#### **5.5.4 Informed consent**

Following eligibility screening, participants provided verbal consent to participate in the study. Informed consent forms were posted to participants ahead of the first intervention session and returned in the first instance via post or in the second instance at the first Buddy Up session. The consent forms presented a series of statements and participants signed their initials next to each statement to indicate they understood and agreed with the statement. They signed the bottom of the form to indicate they provided consent to participate in the study.

#### **5.5.5 Intervention delivery**

Once a buddy pair were matched, I contacted both participants to arrange a suitable time, date and location for the first session. A list of suitable dates and times, allowing time for baseline data collection, were provided to participants and they noted their corresponding availability. I coordinated our availability and arranged the date and time for the first session. The location was a convenient location, eg, participant homes, local libraries, coffee shops or community centres. The time, date and location of the second session was arranged at the end of the first session and likewise for the third session. A reminder email about each session was sent to each participant two days before the session. At the session, participants were given a copy of the Buddy Up booklet to use throughout the session and outside of the session. Following feedback in the first session that the page which signposted to online activities was useful but difficult to use as the links provided were long, after the first intervention session, I emailed a digital copy of the booklet to enable participants to access the hyperlinks easily on a digital device. When arranging the subsequent sessions, if participants were unable to attend a session in two weeks, the session was arranged for the first available date. If participants were unable to attend the session, for example due to baby illness, the session was rearranged as soon as possible.

#### **5.5.6 Data collection**

Data was collected from participants at baseline (T0), post-intervention (T1) and three-month follow-up (T2) (Figure 5.2).

##### *5.5.6.1 Baseline assessment*

Prior to the first Buddy Up session, participants wore an accelerometer for seven days. I charged each accelerometer and initialised the accelerometer using Actlife 6 software. During initialisation I set the dates for the accelerometer to record the data corresponding to the seven days prior to the first intervention session. I posted the accelerometer and accelerometer wear instructions, including wear-dates to participants. The accelerometer was attached to an elastic belt, which participants could adjust to their size. Participants were asked to wear the accelerometer on their right hip

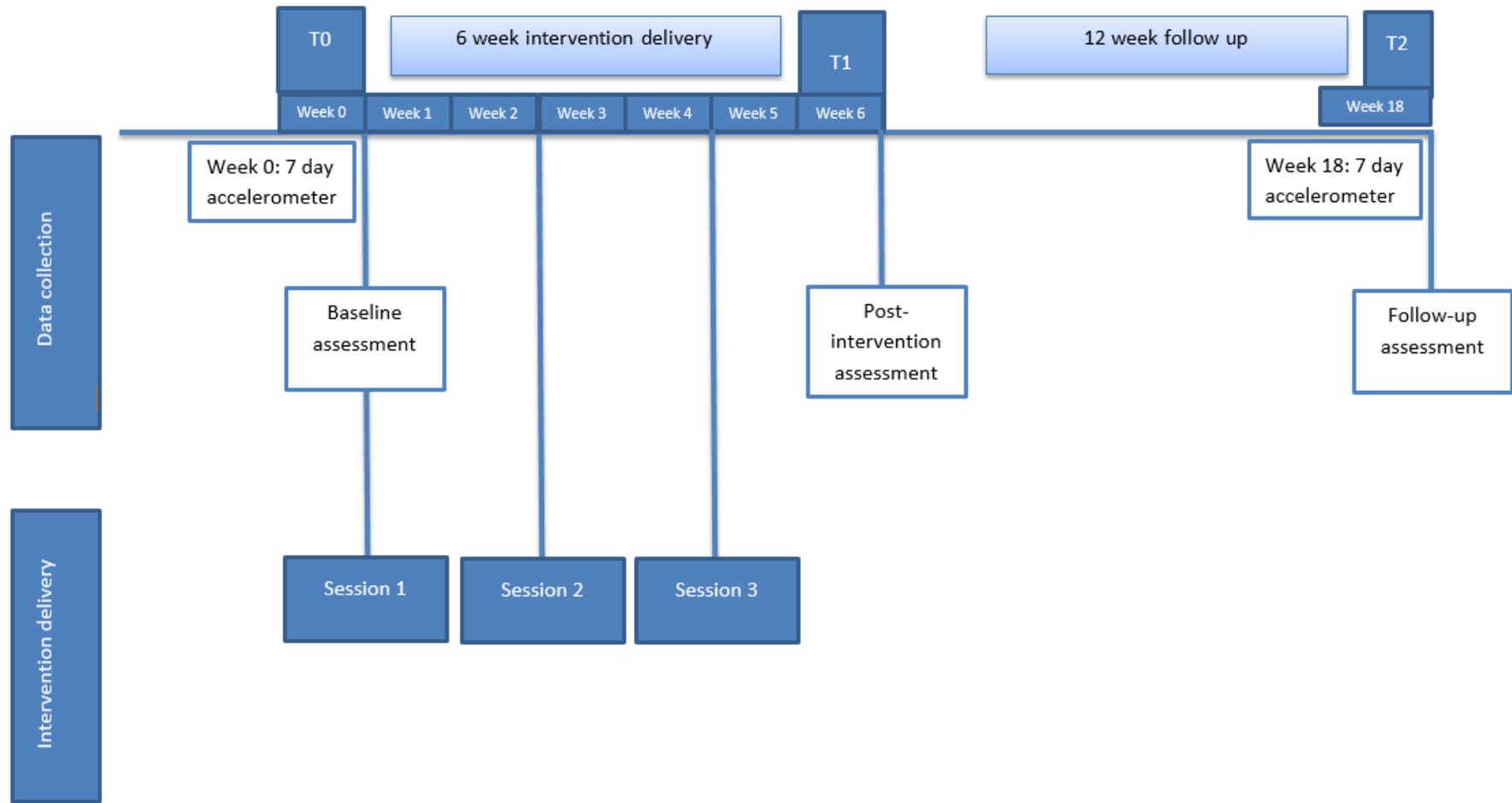
during waking hours (including night waking) for seven days before the first Buddy Up session, removing it for water-based activities. Participants were asked to complete a wear-time diary to record the times they started and ended wearing the accelerometer each day and non-wear periods or wear during the night. Participants returned the accelerometer at the first Buddy Up session. At the first session, participants completed a baseline questionnaire (Appendix 5.2), which included measures of self-report PA (Section 5.6.4.2), barrier efficacy (Section 5.6.4.3) and demographic data (Section 5.6.1.4). Upon return of the questionnaire, I verified the participants' answers to ensure there was no missing data. If there was missing data, I asked participants to complete the missing question.

#### *5.5.6.2 Post-intervention assessment*

Following the final intervention session, participants completed a post-intervention questionnaire (Appendix 5.3) including questions on utilisation of the buddy element and the acceptability of the intervention sessions and booklet (Section 5.6.3).

At the end of the post-intervention questionnaire, participants could opt to be considered to complete a qualitative telephone interview about the acceptability of the intervention and outcome measures. The telephone interview collected data from a purposive sample of participants who utilised the buddy support and a sample of participants who did not utilise the buddy support, determined by their response to the question 'how much has your buddy influenced you to be active.' Participants rate this question on a scale of 1 (none) to 7 (a lot), and participants who answered >4 were classified as using the buddy system, 4 were neutral and those scoring <4 were classified as not using the buddy system. I proposed to interview only pairs where both participants consented to be interviewed. I aimed to interview 10 pairs, five who utilised the buddy system and five that did not.

Participants eligible to participate in the telephone interview were contacted to arrange a time and date for the interview, which would take approximately 15-20 minutes. The telephone interview was recorded using a DSS Olympus Audio recorder with an attachment for telephone recording. The semi-structured telephone interviews followed a pre-prepared topic guide (Appendix 5.4), which asked questions about the buddy component, the intervention sessions and booklet and the data collection procedures. Additional probe questions were asked when appropriate.



**Figure 5.2 - Study flow and data collection procedures**

### 5.5.6.3 *Follow-up assessment*

The original protocol would collect follow-up data during the twelfth week following the end of the intervention, co-occurring with the eighteenth week following the start of the intervention (Figure 5.2). As outlined in Section 5.5, if participants were unable to arrange the second and third sessions exactly a fortnight apart, we would arrange the session at the first convenient date. As a result, in some cases intervention delivery lasted longer than six weeks. Therefore, to maintain consistency between measurement periods, the follow-up assessment was conducted during the eighteenth week following the first intervention session, regardless of the actual intervention length.

I repeated the procedures outlined in Section 5.5.6.1 for the accelerometer wear. The follow-up questionnaire (Appendix 5.5) included questions on self-reported PA, barrier efficacy and the feasibility of the data collection procedures (Section 5.6.2). At the end of the wear period, participants completed the questionnaire and returned it with the accelerometer using the pre-paid postage envelope provided. Three reminder emails or phone calls were made to participants while waiting for their follow-up data packs to be posted. Participants were sent a £10 voucher for a range of high street shops as a thank you for participating in the study.

## 5.6 **Outcome measures**

The intervention delivery and data collection procedures detailed in previous sections collected data to answer the four aims of this study.

### 5.6.1 **Is it feasible to recruit participants to a paired intervention?**

#### 5.6.1.1 *Recruitment methods*

This outcome related to response rates for contacts with local authority CCs and community mother and baby groups. The response rate (number, percentage) was calculated for responses from CCs and mother and baby groups separately. Responses were categorised to show those that disseminated information (social media, researcher visits, posters, flyers), were unable to help (including reasons, if given) and no response.

#### 5.6.1.2 *Participant recruitment rates*

Participant recruitment rates are one of the key parameters to explore in the intervention. Expressions of interests were recorded by Qualtrics or on paper forms where I visited mother and baby groups. Participant recruitment was recorded to calculate participant recruitment rates: Participants who express an interest, eligible participants, reasons for ineligibility, participants matched in a pair and participants with no suitable match. For each, percentages were calculated for

those who were in an existing buddy pair and those who were in a new buddy pair. Contacts with participants were recorded in a study database to calculate recruitment rates.

#### *5.6.1.3 Buddy type*

Each buddy pair starting the intervention were categorised as 'existing buddies' or 'new buddies'. Existing buddies were originally defined as pairs that knew each other prior to starting the intervention. However, following recruitment visits to mother and baby settings, it became apparent that within groups, some mothers had existing relationships and requested a specific buddy, whereas others did not have an existing relationship. Therefore, I defined existing buddies as pairs who requested to be buddies. New buddies were defined as participants who had not requested to be paired with a specific participant. I recorded the buddy type on the study database.

#### *5.6.1.4 Demographic data*

Demographic data was collected from participants in the baseline questionnaire (Appendix 5.2). The demographic data collected was the same as in the multi-methods study presented in chapter 3.

### **5.6.2 Are the data collection procedures and outcome measures feasible and acceptable?**

This outcome relates to the data collection procedures and outcome measures proposed for a full efficacy trial. The purpose of collecting the proposed primary and secondary outcomes for the main trial is to test the feasibility of collecting the measures. This enables the identification of any problems with the data collection procedures, materials or tools so that they can be adapted ahead of a future trial. The proposed primary outcome is objective PA and secondary outcomes are self-report PA and barrier efficacy, discussed in further detail in section 5.6.4.

#### *5.6.2.1 Valid cases*

For each proposed outcome, the number of valid and invalid cases (including reasons for invalid data) were recorded at the baseline and follow-up measurement period. Criteria for valid/invalid cases for each measure is detailed in section 5.6.2.

#### *5.6.2.2 Acceptability of data collection procedures*

The acceptability of data collection procedures was measured quantitatively in the follow-up questionnaire and qualitatively in the post-intervention interviews with a subset of participants.

The first section of the follow-up questionnaire (Appendix 5.5) related to the data collection procedures. The questionnaire presented a series of statements relating to the experience of wearing the accelerometer followed by a series of statements relating to completing the

questionnaires. Participants circled the extent to which they agree with each statement on a scale of 1 (strongly disagree) to 5 (strongly agree). The questionnaire included open-ended questions about wearing the accelerometer and the data collection procedure for participants to write any additional comments.

The post-intervention telephone interviews followed a pre-prepared topic guide including questions about data collection and probing questions to elicit additional information.

### **5.6.3 What is the acceptability and feasibility of the intervention?**

#### *5.6.3.1 Intervention adherence*

Adherence to the intervention protocol was recorded on the study database throughout the intervention. For each session and each participant, I recorded the session dates, participant attendance and correspondence with participants to rearrange the sessions. The key parameters measured were the number of sessions attended, sessions attended in pairs, completion of all sessions. As the intervention progressed, many participants were rearranging sessions, therefore I also calculated the number of rearranged sessions. The data was collated into a flow chart to visually assess participant flow through the intervention.

#### *5.6.3.2 How do participants use the buddy component of the intervention?*

Use of the buddy component was measured quantitatively and qualitatively in the post-intervention assessment. Quantitative data collected about this outcome was number of days in the past 7 days they have done activity with their buddy, the percentage contribution of paired activity to their overall activity, type of support utilised and overall influence of their buddy on their activity levels during the intervention. Post-intervention telephone interviews asked participants about how their buddy has influenced their activity levels and about the activities that they have engaged in as buddy pairs

#### *5.6.3.3 Are the 'Buddy Up' sessions acceptable?*

Acceptability of the Buddy Up sessions was measured in the post-intervention assessment. The questionnaire measured the acceptability of session length and frequency, perceived usefulness of each topic and whether the study met participant expectations (understanding postnatal PA, answered questions, easy explanations, appropriate activity examples, signposting, clear and concise information). The post-intervention interviews explored participant views of the Buddy Up sessions using probing questions to explore their positive and negative views.

#### 5.6.3.4 *Is the 'Buddy Up' booklet acceptable?*

Acceptability of the booklet was measured in the post-intervention assessment. The questionnaire measured statements relating to the presentation (print size, appeal, information clarity) and use of the booklet. The post-intervention interviews explored participants' views of the Buddy Up booklet, using probing questions to provide additional information.

### **5.6.4 What is the preliminary evaluation of intervention effect?**

As per the recommendations for a feasibility study, this study was insufficiently powered to detect an effect and the lack of a control group limits the study's internal validity. The proposed primary outcome measure for a future trial is objective PA and secondary outcomes are self-report PA and barrier efficacy. I collected the proposed outcome measures firstly to assess their feasibility and secondly, as described in this section, to assess the preliminary response to the intervention. This indicated whether the intervention shows promise that a full-scale trial will deliver an intervention effect in the right direction.

#### 5.6.4.1 *Objective physical activity*

It is recommended that researchers use objective measures when measuring PA in free-living environments (Dowd, Szeklicki et al. 2018) and when evaluating the effect of interventions, therefore I chose to use an objective measure of PA in this study. Objective measurement methods are useful to capture the incidental and childcare activity that may be missed from the self-report measure of PA (Fjeldsoe, Marshall et al. 2009). A range of objective measures are discussed in Chapter 1 and I chose to use accelerometers to measure objective PA because they offer a measure of total movement over the measurement period, which is in line with the aim of the study to increase total PA. As discussed in Chapter 1, there are several considerations when measuring PA using an accelerometer.

##### a) Accelerometer model

The Actigraph accelerometer models were chosen because they have shown acceptable test-retest reliability (Hendelman, Miller et al. 2000), inter-instrument reliability (McClain, Sisson et al. 2007) and validity compared to criterion measures (Melanson, Freedson et al. 1996) and have been previously used in this population (Lewis, Gjerdingen et al. 2014, Kernot, Lewis et al. 2019). The Actigraph GT3X+ and w-GT3X-BT accelerometers were chosen because they were available in the research unit, making them a cost-effective choice for this project.

##### b) Wear location

Common locations for wearing accelerometers are the waist, hip, back, wrist or ankle. Hip and back placement are the most common in research as it is recommended they are placed close to the centre of gravity, through a belt or clip on pouch (Ward, Evenson et al. 2005). For everyday activities, including walking, jogging, sitting, lying, standing and stair walking, the most accurate accelerometer measurements are collected when placed on the hip (Cleland, Kikhia et al. 2013), when compared to other potential sites. Wear on the right hip has been deemed accurate in previous studies for postnatal women (Hesketh, Evenson et al. 2018), so this method was chosen for the Buddy Up Study.

#### c) Total number of wear days

Research suggests that daily PA fluctuates and data across a number of days is needed to assess habitual levels of PA, balanced with minimal burden for participants (Miller, Trost et al. 2002). Previous research suggests that between three and five valid measurement days, including one weekend day is recommended to estimate habitual PA (Miller, Trost et al. 2002, Ward, Evenson et al. 2005). A seven-day monitoring period is often used to capture weekend and weekday differences and to account for participant non-compliance to the wear instructions. Therefore, I chose a seven-day wear period for this study.

#### d) Epoch length

An epoch is the interval between each measurement of the movement, typically 5, 10 or 60 seconds. Shorter epochs provide measurements that are more accurate because the movement is measured more frequently. However, this results in the collection of large volumes of data that are limited by memory capacity and reduced battery life. A 60-second epoch has demonstrated better agreement between the accelerometer measure and health indices compared to a 10-second epoch in overweight post-menopausal women and has been used previously in postnatal women. Therefore, to ensure comparability of results and to reduce the risk of memory and battery issues during data collection, I chose to collect data in 60-second epochs.

#### 5.6.4.2 *Self-report physical activity*

As discussed in Chapter 3, the IPAQ-SF was chosen to collect self-report PA measurements in this project because of its convenience as a short self-administered questionnaire that had good test-retest reliability and criterion validity. The IPAQ-SF was chosen to maintain consistency across the studies presented in this thesis. Participants completed the IPAQ-SF at the end of the accelerometer measurement week so that the two measurements referred to the same week. To ensure a

maximum number of valid cases, I contacted participants to complete the missing questionnaire data.

#### *5.6.4.3 Barrier efficacy*

A key element of the intervention was identifying individual barriers to PA and devising strategies for overcoming these barriers. PA barriers are highly variable between participants and their solutions are dependent on individual circumstances, therefore one aim of the intervention was to develop solutions to the common barriers faced by participants to enable them to overcome the barriers, thus increasing their confidence that they can engage in PA, despite the presence of the barrier.

Measures of self-efficacy for overcoming barriers to PA are available for the general population (Garcia and King 1991), which include fourteen items that reflect situations identified as PA barriers, eg, have work to do or on holiday. As identified in Chapter 3, many of the barriers facing postnatal women are unique to the population, eg, availability of childcare. An adapted measure of self-efficacy to overcome barriers for postnatal women, identified an additional nine items from research exploring barriers to PA in postnatal women (Miller, Trost et al. 2002, Albright, Steffen et al. 2012). The resulting 23-item questionnaire asks participants ‘How sure am I that I could be physically active when...’ and presents the identified barriers, eg, ‘...when I am on holiday, when I don’t have anyone to look after the baby (and other kids)?’. Participants respond on a ten-point scale from ‘Certain I cannot do’ (1) to ‘very certain I can do’ (10). The internal consistency of the modified instrument (Cronbach’s Alpha=0.93) is comparable with the score for the original questionnaire measured using Cronbach’s Alpha (0.93; 0.89 respectively) (Albright, Steffen et al. 2012). Participants completed the measure of barrier efficacy at baseline and follow-up.

## **5.7 Data management**

All participants were given a unique ID number consisting of three numerical digits followed by P1 or P2. The three numerical digits were unique to each pair and P1 or P2 indicated whether they were participant one or two. A document linking participant ID numbers and contact details was stored on the Secure Data Hosting Service, accessible only by the research team and discussed previously in Chapter 3.

Data collected on paper forms with personable identifiable data or research data, eg, consent forms, screening forms, questionnaires or field notes, were stored in a locked filing cabinet in a locked room in the Institute of Public Health, University of Cambridge. Questionnaire data was entered anonymously, identified by the participant number to the electronic version of the questionnaire on Qualtrics ([www.qualtrics.com](http://www.qualtrics.com)).

Electronic data collected on Qualtrics and interview audio recordings were transferred and stored on the Secure Data Hosting Service accessible only to the research team. Once each study phase was completed and the data from Qualtrics was transferred to the SDHS, the data was deleted from the Qualtrics platform. Identifiable data was removed from the document on the SDHS and anonymised data was transferred to SPSS for data analysis.

Qualitative data from the follow-up interviews was uploaded to the SDHS at the earliest opportunity and once I verified it had uploaded, deleted from the audio recorder. Audio recordings were transcribed and transcripts anonymised by removing all identifiable data. The anonymised transcripts were transferred to NVivo for data analysis.

Anonymised data will be stored for five years post publication.

## **5.8 Data analysis**

The data analysis process occurred at the individual level unless otherwise stated.

### **5.8.1 Missing data**

There was not a sufficient sample size to use statistical methods to impute missing data. I attempted to minimise missing data on questionnaires by verifying each questionnaire upon their return and contacting participants to obtain any missing data. Participants were given detailed written instructions to wear the accelerometer to enable participants to complete the wear protocol as required and provide valid data.

Missing data for each questionnaire item and accelerometer measurement was excluded from the analysis. For repeated data collection measurements (objective and self-report PA and barrier efficacy), measures that were missing at either measurement period were excluded from the statistical analysis.

### **5.8.2 Participant retention rates**

Participant retention rates were calculated at the pair level, using the absolute number and percentages of participants. Retention rates through the study were displayed in flow diagrams.

### **5.8.3 Questionnaire responses**

The questions included in the questionnaires fall into three types: categorical questions, scale questions and open-ended questions. The analysis process for each type of questions is discussed below. The self-report PA questionnaire and barrier efficacy questionnaire are outlined further in the paragraph because the data processing and analysis follows guidelines for the outcome measure.

#### 5.8.3.1 *Categorical questions*

Categorical questions are included in the baseline questionnaire to collect demographic variables, eg, marital status, employment and education levels and in the post-intervention questionnaire to identify the type of support that the buddies have offered each other, eg, sent encouraging messages, engaged in PA together, looked after the babies. For each categorical question, the total number of responses and percentages were calculated.

#### 5.8.3.2 *Scale questions*

Scale questions refer to the questions where participants were asked to rank their agreement or opinions on a set scale identified in the questionnaire and include the barrier efficacy questionnaire. Participants' answers were valid where there was a clearly marked response for each statement. Blank responses or those that did not clearly identify the response, eg, could indicate two answers, were invalid. For each scale question, the mean and SD was calculated.

#### 5.8.3.3 *Open-ended questions*

Open-ended questions enable participants to provide additional information or opinions that are not captured in the questionnaire and are qualitative by nature. Open-ended questions in the post-intervention questionnaire include questions about buddy support, Buddy Up sessions and in the follow-up questionnaire about data collection procedures. Open-ended questions were coded using the coding framework developed during the data analysis process for the post-intervention qualitative interviews. If a code within the coding framework did not apply to the open-ended question responses, a new code was created within the coding framework.

#### 5.8.3.4 *Continuous*

One question within the questionnaires required a continuous response, on average how much time did you spend doing activity with your buddy per active day. Participants responded in hours and minutes, which were converted to minutes during the data analysis process. Mean and SD were calculated for this outcome.

### **5.8.4 Post intervention interviews**

Qualitative data were analysed using Framework analysis, following the seven steps of framework analysis (Gale, Heath et al. 2013), as previously described in Section 3.2.1.5. The data is presented under the corresponding outcome measure in the Results section.

### **5.8.5 Accelerometer data**

Prior to analysis, accelerometer data requires a significant amount of preparation by cleaning and validating the data. The processes are described below.

#### *5.8.5.1 Data cleaning: Identifying non-wear time*

The first step involves identifying and removing accelerometer non-wear time, the time when the accelerometer is recording data, but the device was not worn. Wear time is identified by a string of zero counts that are long enough to typically represent periods when the accelerometer is not worn. In postnatal women, defining non-wear periods as 45 minutes of consecutive zeros is recommended based on a sample of 20 participants that identified legitimate non-wear periods of 45-60 minutes due to activities such as bathing the babies (Gilinsky 2014). Adopting a 60-minute non-wear time criteria would lead to misclassification of non-wear time as sedentary time. Therefore, I used a 45-minute non-wear period. The Actilife programme flagged strings of 45-minutes of consecutive zero counts as likely non-wear time. Non-wear time continued until an activity spike, identified as a non-zero count, for more than two minutes, was identified. Non-wear time identified by ActiLife was verified using participants' wear time diaries, and incorrectly designated non-wear times were reclassified as wear time.

#### *5.8.5.2 Data validation*

Following the process of removing non-wear time, each dataset was validated to identify valid measurement days and the validity of the measurement period. The measurement day was considered valid if there were more than ten hours of wear time. It is recommended in the general population that four valid days of measurement, including at least one weekend day is sufficient to gain a representation of habitual PA. In postnatal women, it is recommended that the weekend/weekday stipulation is not included because this increases the number of invalid measurements with no impact on the outcome measure of counts per minute (CPM) or minutes per day of moderate to vigorous physical activity (MVPA). Four valid days of wear time were required to include the dataset in the analysis (Evenson, Herring et al. 2012).

#### *5.8.5.3 Data processing*

Valid data was summarised into average acceleration, by dividing the total counts by the wear time minutes (CPM). This raw data was used as the main outcome, but it does not represent a meaningful unit of data. The raw data was converted to minutes spent in each activity intensity (sedentary, light, moderate, vigorous and very vigorous) per week using a common method of accelerometer cut points. Cut points denote the accelerometer counts that separate different intensities of PA. There are several cut points available to determine activity intensity, which can lead to variation in the time spent in each activity intensity even among the same dataset (Watson, Carlson et al. 2014). In the literature there is no consensus on the cut points used. The Freedson and Miller (2000) cut points were used in Buddy Up because they have been validated for use in field studies and used in

previous studies with postnatal women (Gilinsky, Hughes et al. 2012) to make our findings comparable. In addition, the Freedson cut points were used to calculate the criterion validity of the IPAQ-SF (Craig, Marshall et al. 2003), which was used as a self-report measure in this study.

### **5.8.6 Self-report physical activity**

As outlined in Chapter 3, the IPAQ data was processed using the data processing guidelines for the IPAQ-SF (IPAQ Research Committee 2005), which provides detail on identifying invalid IPAQ-SF responses. Valid data was summarised into a continuous score of total energy expenditure (MET-min/week). To enable the classification of participants into distinct activity categories, the IPAQ sets criteria for defining participants as low, moderate or highly active. The guidelines for categorising responses were followed and each participant classified as low, moderate or highly active.

### **5.8.7 Statistical analysis**

Statistical analysis was conducted in IBM SPSS Statistics 25 to process data, produce descriptive statistics and test the intervention effect. To test whether the intervention shows a promising effect, I used paired t-tests to compare PA levels, measured objectively (CPM) and via self-report (MET-min/week) at baseline and follow-up, using a p-value of 0.05 to determine significance. Although the sample size in the study was not powered for significance testing, these output were included purely to provide an indication of trends within the data.

## **5.9 Chapter five summary**

Chapter 5 presents the methods for a feasibility and acceptability study as a vital step in the intervention development process prior to determine whether it is appropriate to progress to a full intervention efficacy trial. The four study aims were to determine 1) is it feasible to recruit participants to a paired intervention 2) Are the data collection procedures and outcome measures feasible? 3) What is the acceptability and feasibility of the intervention? 4) What is the preliminary evaluation of intervention effect? The study employed a one-group pre and post study with a proposed sample size of 40 pairs, a total of 80 participants who met the same eligibility criteria as the study presented in Chapter 3, and additionally eligible participants engaged in less than 30 minutes of PA per week. Participants were recruited from a previous study, existing mother and baby groups, online postnatal forums, posters in community locations and Facebook advertising. Eligible participants proceed to the matching process where they were matched with an existing friend who is also eligible or opted to be matched by the study team. All participants provided informed consent and the first Buddy Up session was arranged. Data was collected from participants at baseline (T0) post intervention (T1) and 3-months post intervention (T2). Outcomes for objective

1 were participant recruitment methods, recruitment rates, buddy type (new/existing), resulting demographic characteristics (Collected at T0). Objective 2 outcomes were the number of valid cases of the proposed primary outcomes for a full trial and acceptability of the data collection procedures (collected at T1 in a questionnaire and telephone interviews). Objective 3 outcomes were intervention adherence, acceptability of the buddy element, intervention sessions and booklet (collected at T1 in a questionnaire and telephone interviews). Objective 4 is a preliminary evaluation of the intervention effect using the proposed outcome measures of objective PA (measured using ActiGraph accelerometer), self-report PA (IPAQ-SF) and barrier efficacy.

## **6 Feasibility and acceptability of a buddy intervention to promote postnatal physical activity: Results**

### **6.1 Is it feasible to recruit participants to a paired intervention?**

#### **6.1.1 Recruitment methods**

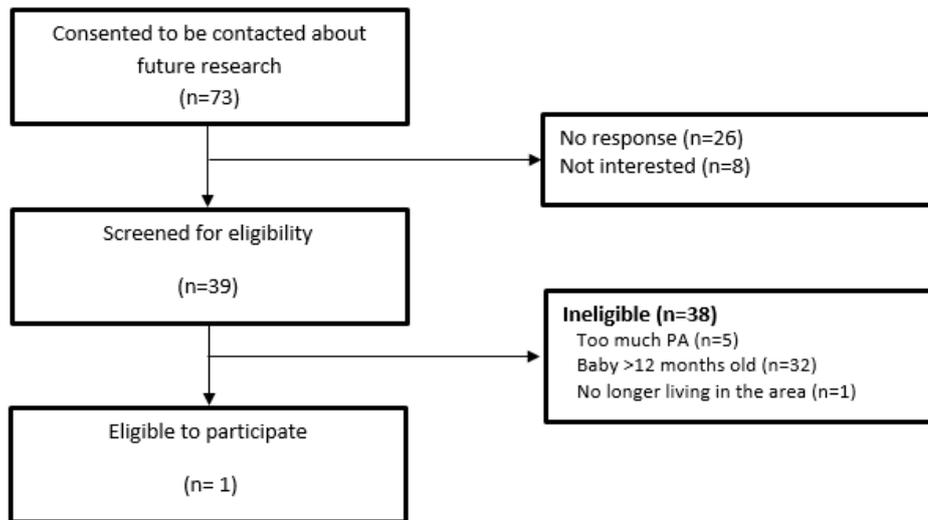
We used five recruitment methods for this study; contacting participants from a previous study, existing mother and baby groups, online forums, posters and flyers to community locations and paid Facebook advertising. This section presents data that demonstrates the effectiveness of each method. Due to the direct contact with potential participants from a previous research study, we are able to provide an accurate estimation of the recruitment effectiveness from this method. The remaining four methods disseminated a hyperlink where participants could register their interest in the study. The universal hyperlink disseminated across all methods means that we cannot definitively say where a participant saw the study advertisement, however the remainder of this chapter presents graphs which map the advertisement dates with date and locations of potential participants to try to tease out trends in effective recruitment.

##### *6.1.1.1 Previous participants*

73 participants who participated in the questionnaire study presented in Chapter 3 consented to be contacted about further research all of whom were contacted about this study (Figure 6.1). Of the 73 participants contacted, 26 (35.6%) did not respond and 8 (10.9%) were not interested in participating. 39 (53%) participants were screened for eligibility, of which 38 (52.1%) were ineligible to participate. 1 (1.3%) participant was eligible to participate in the study. 32 participants were ineligible because they had a baby over one years old, because the time period between the two studies was nine months therefore participants from the previous study with babies over three months old would be ineligible for the current study.

##### *6.1.1.2 Existing mother and baby groups*

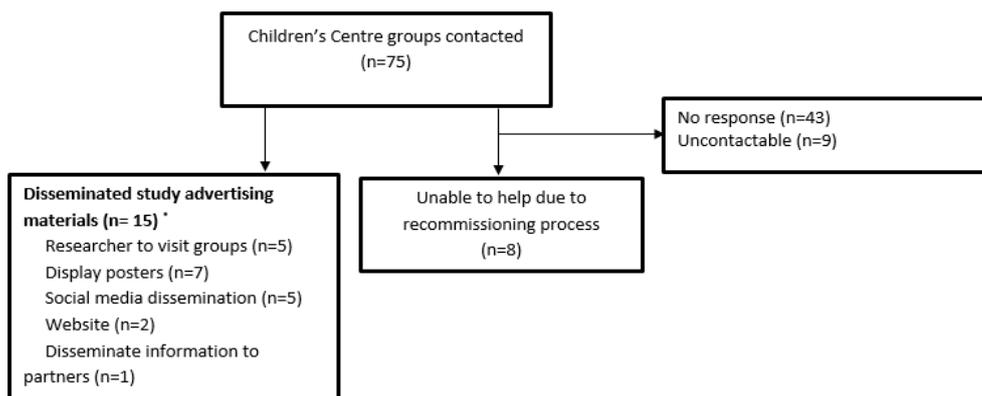
As described in Section 5.5.1, I contacted two key networks of existing mother and baby groups, local authority children's centres and National Childbirth Trust (NCT) groups.



**Figure 6.1 – Participant recruitment using participants from previous study presented in Chapter 3**

a) Children’s centres

I contacted 75 CC groups. CCs are clustered in groups including up to four individual settings. To illustrate, 55 of the contacts had the potential to reach 104 centres. Figure 6.2 displays the CC response rates. Of the groups contacted, 43 did not respond to the contact and 8 were unable to help because there was a county-wide recommissioning process happening simultaneously which meant the future of staffing and services was uncertain. 9 were uncontactable because their email addresses had been centralised after a similar recommissioning process.



**Figure 6.2 – Response of children centre groups to share recruitment information**

\*Centres may have disseminated information in more than one method.

The 15 responses had potential to reach 27 settings and some disseminated information using multiple methods; displaying posters (n=9), social media (n=5), researcher visit to sessions (n=5), placing information on websites (n=2), and distributing information to partners (n=1).

CCs that consented to a visit to recruit participants identified mother and baby groups in their timetable targeting eligible participants. I attended five mother and baby groups collecting contact details of women who were interested in participating (n=33). I had five key observations from face-to-face recruitment at settings. Firstly, many mothers appeared interested in the study, provided their contact details and did not respond to my contacts, potentially because they are polite and do not want to say they are not interested. Secondly, face-to-face contact has the potential to reach participants who would not respond to study adverts, as evidenced in a telephone interview

*it was really good, when you came round to sign people up at the mums and baby session, I don't think if I'd have seen the poster I would have gone 'oh I should do that' and then not got round to it.*

*Age of child 7-9 months, 1 child, Moderate PA*

Thirdly, many women within CCs have an existing relationship with other mothers in the setting, varying from meeting weekly at the sessions to being very good friends outside of the sessions. Thus, meeting participants at the setting can capitalise on existing relationships. Following on from this the location of CCs attract mothers from within a close geographical proximity which increases the chance of finding a suitable buddy. Lastly, I noticed a variation in participants' responses according to the setting (Appendix 6.1) with more mothers participating in the study in some settings compared to others. The reasons for this are not clear.

Figure 6.3 is a graph that shows by date, the number of CCs who disseminated information and the number of participants who registered an interest in participating in the study. The pattern on the graph shows that when a CC disseminated information, there was a subsequent increase in the number of people registering an interest in the study. By cross-referencing participant location, I found that online dissemination, specifically social media, by a CC resulted in increased sign ups from participants in the local area during subsequent days. The effect of poster dissemination is less instantaneous. During a visit to a CC, I observed that study flyers were placed on the refreshment table three weeks prior to the visit, yet when I spoke to women about the study, they were not aware of the study, suggesting this is a less effective recruitment method.

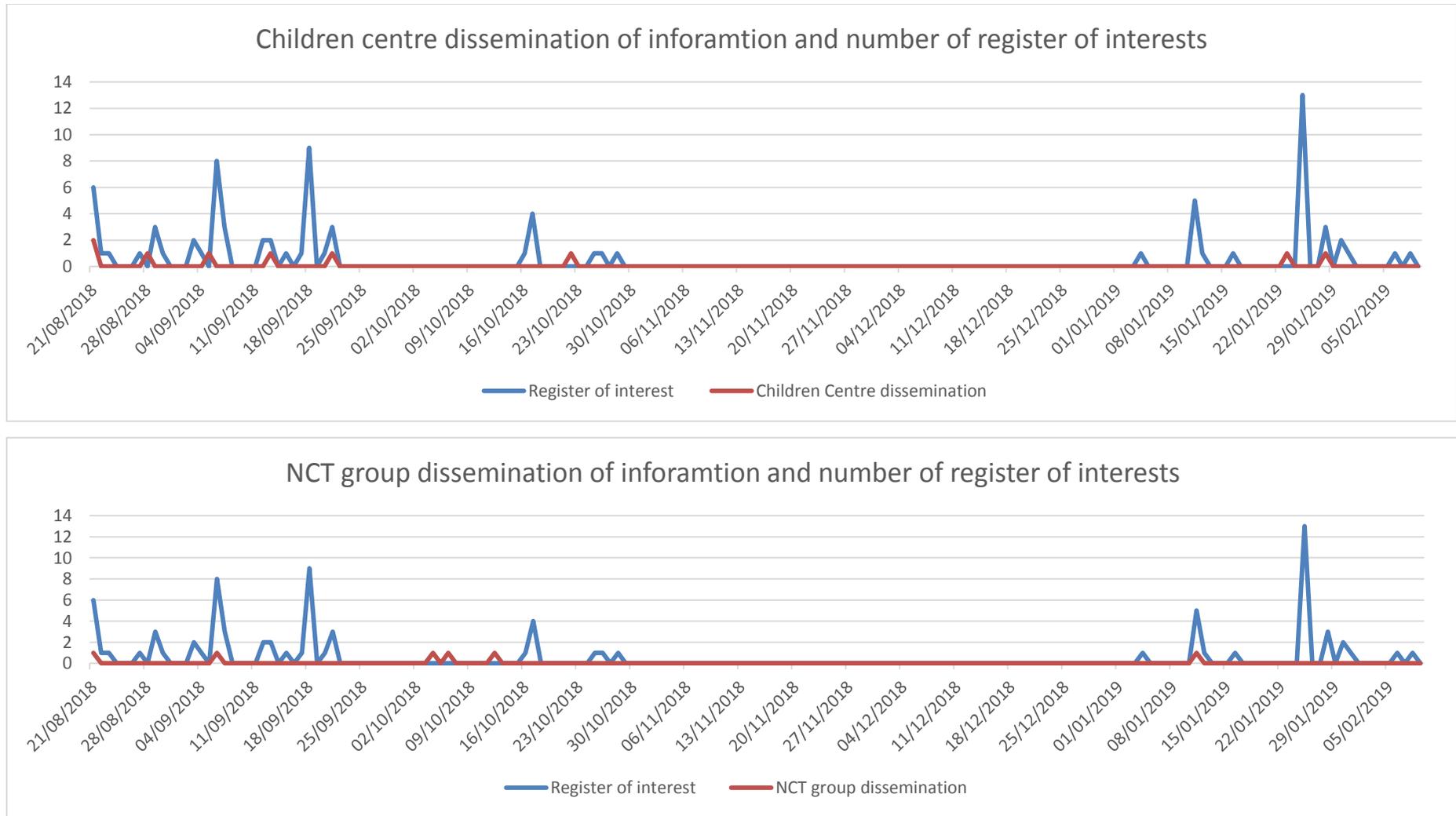


Figure 6.3 – Dissemination of study advertising materials by existing mother and baby groups and people registering an interest in the study

## b) National Childbirth Trust (NCT) groups

The NCT head office provided approval to promote the study through its network. I contacted 12 local branches of the NCT with 6 offering to disseminate information through flyers at nearly new sales (n=3) (approximately 500-600 attendees at each event), social media pages (n=3) and sharing flyers at a group (n=1). In Figure 6.3, between 2/10/2018 and 16/10/2018 there are three dates where NCT groups disseminated information via flyers at their nearly new sales events, with no subsequent register of interests. For two events, there were no participants from that location throughout the study. Social media dissemination by one branch on 06/10/2018 and 11/01/2019 co-incides with increases in the registration of interest, which is matched by participant location.

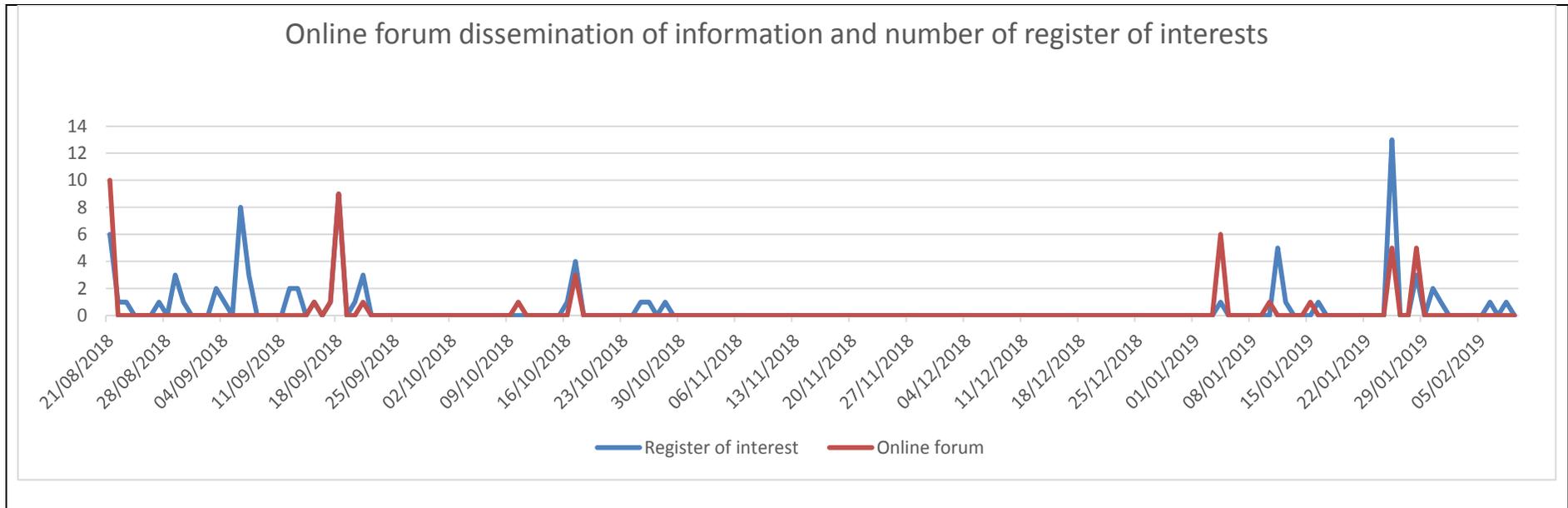
### 6.1.1.3 *Online forums*

I used three main types of online forum – websites with built in forums, Facebook groups and WhatsApp groups. In total, I contacted the administrators for 47 groups, of whom 17 did not respond. 30 administrators responded and allowed me to post in the group or posted on my behalf. Reasons for not posting in the groups were non-response from administrators, no advertising allowed, posts from local mothers only were allowed.

Adhering to group rules, 48 posts were made to 30 online groups (website forums (n=2), local Facebook groups for mothers (n=19) and WhatsApp groups (n=9)). The reach of information dissemination through this method is unknown. As with the previous recruitment methods, Figure 6.4 shows the number of posts in online groups and number of participants registering an interest in the study by date. On the dates that I posted in the online forums, there are clear increases in the number of participants registering an interest in the study. Furthermore, where the online forums target a specific location, the participants who register an interest soon after match the location. This trend is repeated several times across the recruitment time of the study.

### 6.1.1.4 *Advertising in community locations*

I contacted 29 libraries, of which 17 displayed posters, 2 included the study on social media and one disseminated flyers to mothers attending a 'rhyme time' session. In some cases, there were registers of interest from communities served by the libraries, however the timing suggests that they originated from other recruitment methods. There were a number of library locations where no participants signed up to the study.



**Figure 6.4 – Dissemination of study information via online forums and number of people who registered an interest in the study**

Given the time intensive method of distributing posters and its perceived lack of efficacy, I targeted poster advertising in communities, eg, community centres, local cafés, supermarkets and parks to locations where there was a participant looking for a buddy. I specifically targeted three towns and no participants were recruited into the study from these towns to match with the existing participant.

#### *6.1.1.5 Paid Facebook advertising*

The paid Facebook advert ran for 15 days at a total cost of £29.90. The advert reached 2028 people and 49 people (2.4%) clicked the hyperlink to the register of interest, with 3 people completing the register of interest and 1 of those participating in the study. No other recruitment activity occurred during the time the Facebook advert was live, therefore the 3 registers of interest are likely to be from this source. The estimated cost of the advertising is £0.61 per click, £9.90 per register of interest and £29.90 per participant.

### **6.1.2 Participant recruitment rates**

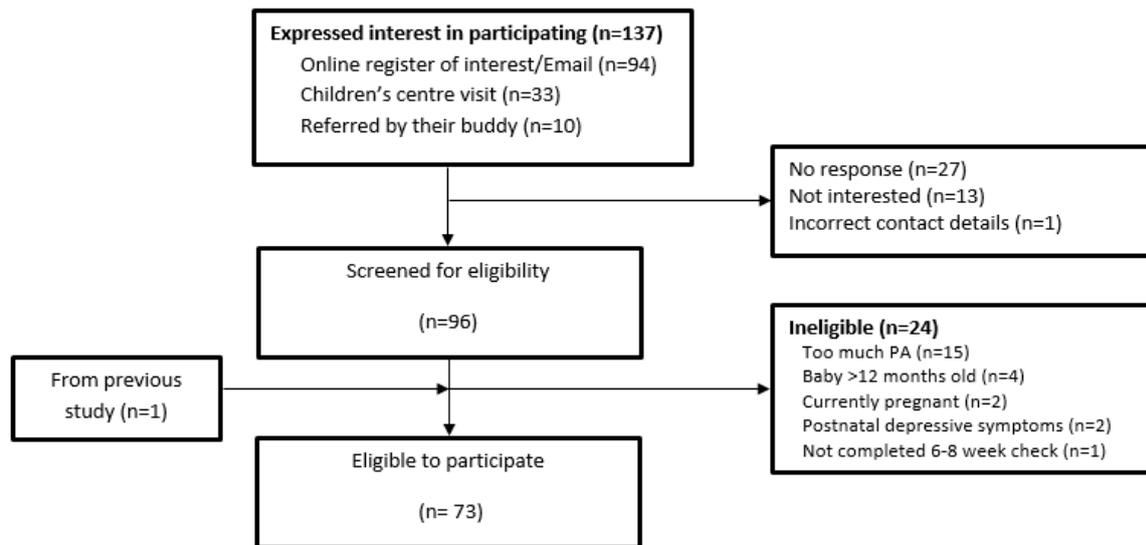
The following section describes the recruitment process after participants had registered their initial interest. Figure 6.5 displays participant recruitment to the intervention. It excludes data from previous study participants due to the high proportion of this group that were ineligible because of the time lapse between the two studies. 137 participants expressed an interest in the study, of which 27 (19.7%) did not respond, 13 (9.5%) were not interested and 1 (0.01%) provided incorrect contact details. 96 (70%) were screened for eligibility. Following eligibility screening, 24 (17.5%) participants were ineligible to participate and 72 (52.5%) met eligibility criteria with an additional 1 eligible participant from the previous study.

#### *6.1.2.1 Reasons for non-participation*

27 participants did not respond to the initial contact that provided additional detail about the study. Although the reasons for non-response are not available, potential reasons could be they did not receive the information, were not interested in the study or were not eligible. Thirteen participants were not interested in participating in the study. Where available, the reasons for refusing to participate were lack of time/too busy (n=5), not wanting to wear the accelerometer (n=2), unable to commit to the study (n=1) and one participant did not want to increase PA for fears she would lose too much weight (n=1). Four participants gave no reason. For those who cited lack of time and too busy, the reasons were returning to work (n=3) and moving house (n=1).

In total, 24 participants were ineligible to participate. Reasons for ineligibility were due to engaging in 30 minutes of PA on more than one day of the week (n=15), and although not recorded on the

eligibility screening forms, this was largely due to walking on several days of the week. Other reasons for ineligibility were having a baby over twelve months old (n=4), experiencing postnatal depressive symptoms (n=1) or had not completed 6-8 week postnatal check (n=1). Mothers who had not completed their 6-8 week postnatal check were re-contacted after their 6-8 week check to have the opportunity to take part in the study. One woman was ineligible because her 6-8 week check was scheduled after recruitment had stopped.



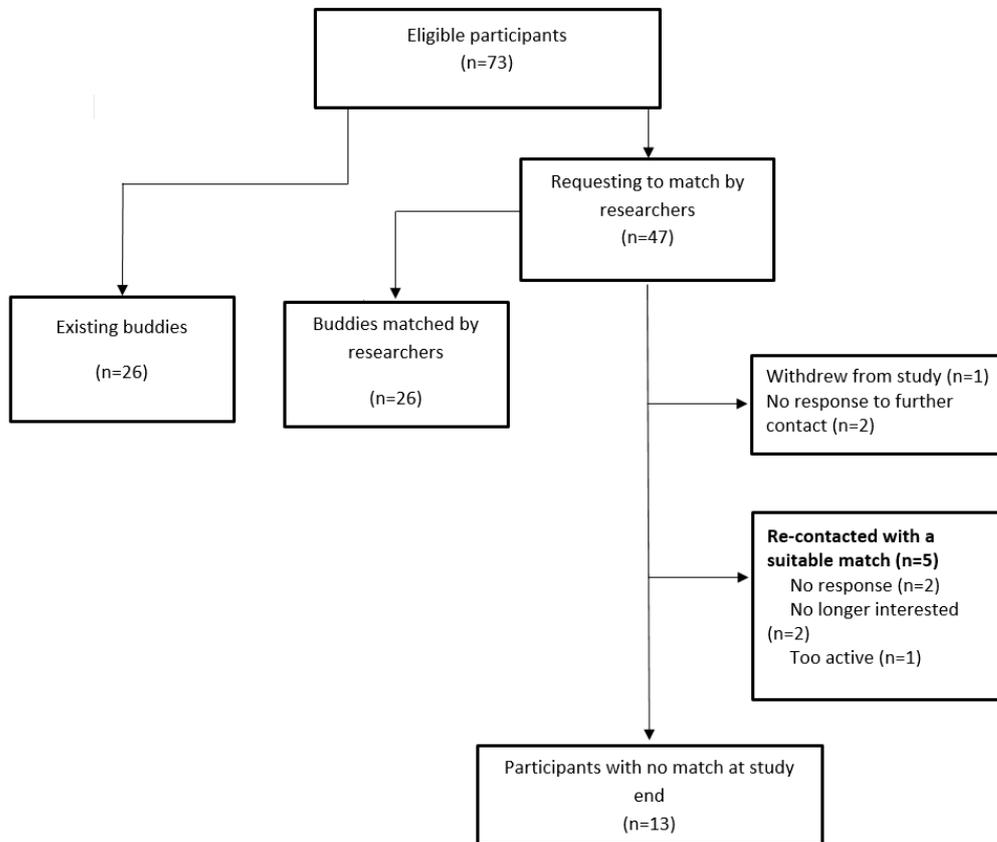
**Figure 6.5 – Flow diagram of participant recruitment to Buddy Up**

### 6.1.3 Buddy Type

Figure 6.6 is a flow diagram displaying the matching process of the eligible participants. Of the 73 eligible participants, 52 participants were matched with a buddy, resulting in 26 pairs to participate in the study. 26 participants were matched with a buddy based on an existing relationship resulting in 13 ‘existing’ buddy pairs. 47 participants wanted to participate with a ‘new buddy’. I successfully matched 26 participants with a suitable buddy resulting in 13 pairs and did not find a suitable match for 21 participants.

Following the eligibility screening and requesting to be matched with a buddy, 2 participants did not respond to further contact and 1 participant withdrew because she did not feel comfortable participating in the study with a stranger. Of the remaining 18, I found a suitable match for 5 participants, however, due to the time elapsed between the initial contact and finding a suitable buddy they were no longer interested in participating (n=2), had subsequently increased their activity levels therefore no longer eligible (n=1) and 2 participants did not respond to my contact. At the end of recruitment, 13 eligible participants remained without a suitable buddy and therefore

were unable to participate in the study. The key reason they were unable to match was because of geographical limitations. Two participants on the list were geographically compatible, but they were unable to match because one worked full time during the day and one was unable to meet in the evenings.



**Figure 6.6 – Flow diagram of participants who requested to be matched with a new buddy**

#### 6.1.4 Sample characteristics

Baseline data was available for 44 participants.

##### 6.1.4.1 Demographic characteristics

Table 6.1 displays participant demographic characteristics for the whole sample and according to the type of buddy match.

**Table 6.1 – Participant demographic characteristics**

Characteristic	Total sample (n=44)		New matches (n=22)		Existing matches (n=22)	
	N	%	n	%	n	%
<b>Age (years)</b>						
16-24	0	0.00	0	0.00	0	0.00
25-30	14	31.82	7	31.80	7	31.80
31-35	20	45.45	10	45.50	10	45.50
36-40	10	22.73	5	22.70	5	22.70
41-45	0	0.00	0	0.00	0	0.00
46+	0	0.00	0	0.00	0	0.00
<b>Age of youngest child (months)</b>						
0-3	10	22.73	4	18.20	6	27.30
4-6	13	29.55	9	40.90	4	18.20
7-9	14	31.82	8	36.40	6	27.30
10-12	7	15.91	1	4.50	6	27.30
<b>Number of children</b>						
1	32	72.73	13	59.10	19	86.40
2	10	22.73	7	31.80	3	13.60
3	1	2.27	1	4.50	0	0.00
4	1	2.27	1	4.50	0	0.00
5+	0	0.00	0	0.00	0	0.00
<b>Highest education</b>						
Some secondary school	0	0.00	0	0.00	0	0.00
GCSE	3	6.82	1	4.50	2	9.10
A level/equivalent	8	18.18	7	31.80	1	4.50
University/college degree	33	75.00	14	63.60	19	86.40
<b>Employment status</b>						
On maternity leave	30	68.18	15	68.20	15	68.20
Part time employment	5	11.36	4	18.20	1	4.50
Full time employment	2	4.55	0	0.00	2	9.10
Unemployed	7	15.91	3	13.60	4	18.20
<b>Marital status</b>						
Married	30	68.18	13	59.10	17	77.30
Cohabiting	14	31.82	9	40.90	5	22.70
Single	0	0.00	0	0.00	0	0.00
Separated	0	0.00	0	0.00	0	0.00

Similar to the studies presented in Chapter 3, the sample consists of highly educated women, all of whom are married or co-habiting, suggesting an under-representation of single women with lower

education levels. When comparing the demographic characteristics according to the type of match they were broadly similar for the age, education level, employment status and marital status. Participants who were matched with existing buddies had a higher proportion of older children and a higher proportion were first time mothers.

#### 6.1.4.2 Physical activity levels

Table 6.2 displays baseline self-report PA data. In the sample, the mean baseline PA levels were 1259.97 MET-min/week (SD=1246.71), equivalent to 315 minutes of moderate intensity PA per week using a value of 4.0 METs for moderate activity as in the IPAQ Scoring protocol (Appendix 3.1). Compared to the recommendations of 150 minutes per week of MVPA, this suggests an active sample despite participants completing a self-reported screening questionnaire. PA levels were lower for new matches (Mean=1182.36 MET-min/week; SD=1507.86) compared to existing matches (Mean=1337.57 MET-min/week; SD=946.75). Using the criteria above, this is equivalent to a difference of 38.8 minutes between existing matches and new matches. The categorical PA score, classified 17 (38.6%) participants as low, 25 (56.82%) as moderate and 2 (4.55%) as high. The IPAQ domain questionnaires show that high levels of walking contributed to relatively high baseline PA data.

**Table 6.2 – Baseline self-report physical activity data**

	Total sample (n=44)		New matches (n=22)		Existing matches (n=22)	
Continuous PA score	Mean	SD	Mean	SD	Mean	SD
Average MET-min/week	1259.97	1246.71	1182.36	1507.86	1337.57	946.75
Categorical PA score	N	%	N	%	n	%
Low	17	38.64	11	50.00	6	27.30
Moderate	25	56.82	10	45.50	15	68.20
High	2	4.55	1	4.50	1	4.50

Table 6.3 shows baseline data for objective PA with a mean CPM of 696 (SD=149). In contrast with the self-report data, there appears to be very little difference in baseline CPM data between the groups, (new match Mean=692 CPM; SD=149; Existing match: Mean=700 CPM; SD=152). When cut points (Freedson and Miller, 2000) were applied to the data, at baseline participants engaged in a mean of 263 minutes (SD=113) of moderate intensity PA, including bouts of PA less than 10 minutes. This is substantially higher than the UK PA guidelines. When the data included only PA performed in bouts greater than 10 minutes, participants engaged in a mean of 91.06 minutes (SD=93.65) of MVPA per week, which is lower than the UK PA guidelines of 150 minutes per week.

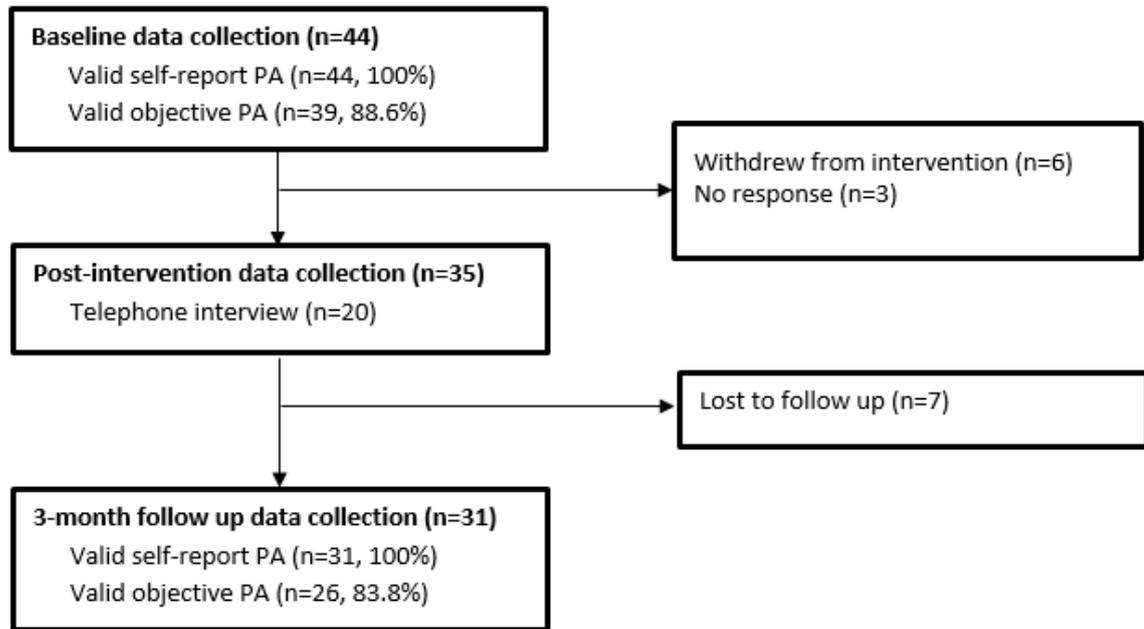
**Table 6.3 – Baseline objective physical activity levels**

	Total sample (n=39)		New matches (n=19)		Existing matches (n=20)	
	Mean	SD	Mean	SD	Mean	SD
CPM	696	149	692	149	700	152
<b>Total time in each intensity</b>						
Sedentary	3631	761	3616	884	3645	646
Light	1222	312	1252	340	1192	288
Moderate	263	113	255	101	270	125
Vigorous	5.96	7.77	3.94	3.57	7.87	10.0
Very Vigorous	0.23	0.4	0.18	0.27	0.28	0.49
<b>Time per day in each intensity</b>						
Sedentary	583	75	584	95	582	51
Light	197	39	202	34	192	43
Moderate	41.7	15.2	41.1	14.5	42.3	16.3
Vigorous	0.92	1.11	0.62	0.51	1.21	1.43
Very Vigorous	0.04	0.06	0.03	0.04	0.05	0.08
Total MVPA bouts >10 minutes	91.06	93.65	77.45	85.17	104	101.5
<b>Categorical MVPA bouts &gt;10 minutes</b>						
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
0-30 minutes	14	35.90	10	45.5	4	18.2
30-150 minutes	16	41.03	4	18.2	12	54.5
>150 minutes	9	23.08	5	22.7	4	18.2

## 6.2 Are the data collection procedures and outcome measures feasible and acceptable?

### 6.2.1 Number of valid outcome measures

Figure 6.7 displays the number of participants who completed data collection at each time point throughout the study. 44 participants completed baseline data collection, with 35 (79.5%) completing post-intervention data collection and 31 (70.4%) completing 3-month follow-up data collection.



**Figure 6.7 – Participant figures for data collection at baseline, post intervention and 3 month follow-up**

#### 6.2.1.1 Barrier efficacy measures

Table 6.4 shows the number of valid responses for each statement in the barrier efficacy questionnaire at baseline and follow-up measurement periods. At baseline, there were two statements ‘when I return to work after being off for maternity leave’ and ‘when I have a job working at home’ that had a lower number of valid cases (42 and 39 respectively), which may reflect that these are situations that participants will not encounter. For example, some participants were not returning to work following maternity leave and some do not have the option to work from home. These were the only two statements at follow-up that had less than 100% completion.

**Table 6.4 – Valid responses to each statement on the barrier efficacy questionnaire**

How sure am I that I can be physically active...	Valid cases			
	Baseline (n=44)		Follow-up (n=31)	
	n	%	n	%
...when I am tired	44	100	31	100
...during or following a crisis	44	100	31	100
...when I am feeling depressed	44	100	31	100
...when I am feeling anxious	44	100	31	100
...when I am slightly sore from the last time I was physically active	44	100	31	100
...when I am on holiday	44	100	31	100
...when there are competing interests (like my favourite TV show)	44	100	31	100
...when I have a lot of work to do	44	100	31	100
...when I haven't reached my physical activity goals	44	100	31	100
...when I don't receive support from family or friends	44	100	31	100
...when I have no one to be physically active with	44	100	31	100
...when my schedule is very busy	44	100	31	100
...during bad weather	44	100	31	100
...when it's too hot and sunny	44	100	31	100
...following complete recovery from an illness	44	100	31	100
...when the baby/children are sick or just recovered from being sick (with cold, flu, ear infection etc)	43	97.8	31	100
...when there is housework to do	44	100	31	100
...when I don't have anyone to look after the baby (and other kids)	44	100	31	100
...when I don't have any money	44	100	31	100
...when you feel like you don't have the time	44	100	31	100
...when I have family or friends visiting for the holidays or their vacation	44	100	31	100
...when I return to work after being off for family/maternity leave	42	95.4	30	96.7

...when I have a job working at home	39	88.6%	29	93.5
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### 6.2.1.2 Self-report physical activity

At baseline, 44 (100%) participants provided valid PA data. At follow-up, 100% of the self-report questionnaires received were valid. Participants who completed the questionnaire but ticked 'don't know/not sure' for the duration of PA were prompted to complete the duration to their best possible estimate (Baseline n=3; Follow-up n=3), which enhanced the number of valid responses.

### 6.2.1.3 Objective physical activity

Table 6.5 presents the number of valid responses at baseline and follow up, showing that 87.8% of all measurements are valid. There is a higher proportion of valid baseline measurements (88.9%) in comparison to follow-up measurements (83.9%).

**Table 6.5 – Number of valid objective PA measurements at baseline and 3-month follow-up**

	Total (n=74)		Baseline (n=43)		Follow-up (n=31)	
	N	%	n	%	n	%
Valid*	65	87.8	39	88.9	26	83.9
Invalid	9	12.2	4	9.3	5	16.1

\*Valid data >4 days, with wear time >10 hours

The average number of valid wear days at baseline and follow-up were 5.84 days and 5.0 days respectively. At baseline, invalid cases provided data on one day (n=1), two days (n=1) and three days (n=2) of data. One participant provided no valid measurement days because she believed the accelerometer was part of a 'superhero' costume she had ordered for her son to wear as fancy dress.

## 6.2.2 Quantitative evaluation of data collection

Table 6.6 presents participant responses to questions about the acceptability of the data collection procedures. Participants agreed that the accelerometer instructions were easy to understand (mean=4.81, SD=0.48), the questionnaires were easy to complete (mean=4.65, SD=0.55) and they wore the accelerometer as instructed (mean=3.87, SD=1.06). Participants were near neutral for the statement that 'wearing the accelerometer for 7 days was a burden' (mean=2.97, SD=1.05).

**Table 6.6 – Participant questionnaire responses for acceptability of data collection methods\***

Questionnaire statement	Mean	SD
The accelerometer instructions were easy to understand	4.81	0.48
I wore the accelerometer as instructed	3.87	1.06
Wearing the accelerometer for 7 days was a burden	2.97	1.05
The questionnaires were easy to complete	4.65	0.55
The questionnaires took too long	1.87	0.96

\*Responses on scale from 1 (strongly disagree) to 5 (strongly agree)

### 6.2.3 Qualitative evaluation of data collection measures

#### 6.2.3.1 Telephone interviews

Twenty participants completed telephone interviews (valid baseline objective PA (n=17); invalid baseline objective PA (n=3). Three out of the five participants that provided invalid data were included in the telephone interviews.

Most participants (n=15) described their wear experience with indifference, it was *'alright, fine, didn't bother me, discreet, forgot it was on, didn't affect my day'*. Of these, six participants also made minor negative comments about wear experience. Some were about the elastic belt that the accelerometer was attached to as it was too loose and non-adjustable, *'the actual belt itself was quite flimsy so it would move up quite a bit so I don't know if that affected the quality of the data that you got'*. One other was about the flashing light due to incorrect set up and one participant found it difficult to get into a routine of wearing the accelerometer. Three participants described the whole experience negatively because the accelerometer was uncomfortable on a Caesarean section scar, did not stay in place and was not discreet under clothing.

*Really uncomfortable because I hadn't long had my thingy bob, my [C] section, so it was a bit annoying.*

*Age of baby 0-3 months, 1 child, Moderate PA*

*I was quite relieved at the end of the week that I didn't have to put it on again.*

*Age of baby 7-9 months, 2 children, Moderate PA*

Some participants mentioned that they were uncertain whether the accelerometer had started recording because there was no 'on and off' button. Participants requested clarity in the wear instructions that there was no need to manually start the accelerometer data collection.

When following the wear time protocol, most participants (n=15) reported difficulties, mainly when starting the day and/or during night waking and one participant reported difficulty wearing on the first data collection day and after showering. Reasons for difficulty wearing the accelerometer in the morning (n=9) were that mornings were busy, feeding and changing the baby which took priority ahead of wearing the accelerometer and that routines were inconsistent, therefore difficult to establish a routine.

*'my first thought would be (my baby) and going to him so it might sometimes be like not be until after I'd fed him or made breakfast that I would remember to put it on.'*

*Age of child 4-6 months, 1 child, Moderate PA*

Three participants did not wear the accelerometer during night waking because they did not believe it was feasible due to the number of times their baby was waking and the process of putting on the accelerometer *'would have been too stimulating'*.

*'if I got up to feed (my baby) I would forget to put it on and 'oh my goodness I probably sort of walked half way around the bedroom a few times, and haven't been wearing this thing,'*

*Age of baby 4-6 months, 1 child, High PA*

For morning and night-wear, participants did not feel that the non-wear time was problematic because they did so little activity during these times.

Two participants reported significant periods of non-wear because their baby had *'such a bad day'* or because they took part when their baby was very young. Following baseline data collection, some participants thought that the follow-up data collection would be easier, partly due to a learning effect and because *'just being more organised now that he's older and we've got our acts together a bit more'*. Techniques that some participants used to remember to wear the accelerometer were to put it in a specific place, for example, their bedside table or by their phone so they would remember to wear it.

Two participants reported difficulties completing the accelerometer diary. One had forgotten to start wearing the accelerometer and started wearing it in a hurry without reading the instructions and the other found it stressful to write down the start, finish and break times.

Two participants identified that bias was present in their baseline measurement due to reactivity *'when I had that activity belt I tried to be more active just because I am wearing that belt'* and representativeness as her partner was on leave *'so I think we went out a bit more'*. In addition, due to the study design and time taken to match participants with a buddy, there is a time gap between recruitment and baseline measurement *'so we were talking about doing exercise and being motivated to do exercise before we'd done the first monitoring session'*.

Of the three participants interviewed who provided invalid data, one found it uncomfortable to wear due to her C-Section scar and identified long non-wear periods because *'wearing it was a bit sketchy'*. One participant forgot to wear the accelerometer on the first day because her husband was unwell and this was stressful. One participant did not provide an explanation.

Following the measurement week, some participants expressed a preference for a device on the wrist and suggested using a band that was adjustable. Other suggestions included procedural changes including blinding participants, additional emphasis on the accelerometer diary, wear while sleeping and an SMS reminder to prompt wearing.

#### 6.2.3.2 *Open-ended questionnaire analysis*

Seventeen participants provided an answer to the open-ended question *'Do you have any other comments about the accelerometer?'* No additional codes were identified beyond the final framework used to analyse the qualitative data, however, there were some comments that were not made by participants in the telephone interviews.

With accelerometer wear time, three participants found it more difficult to wear the accelerometer now that they have changed their routine and are back at work, with one of those deciding not to wear the accelerometer at all. One participant said that 7 days wear was too long. Other comments reflected those made in the telephone interviews that participants forgot to wear the monitor in the morning.

Concerning the experience of wearing the accelerometer, participants again commented on the belt used to tie the accelerometer as bulky and too loose/tight as it was not adjustable, which led to it moving out of place. One additional comment by a participant was that the device caught on the skin when sitting in a hard chair and one participant stating it was uncomfortable on her Caesarean

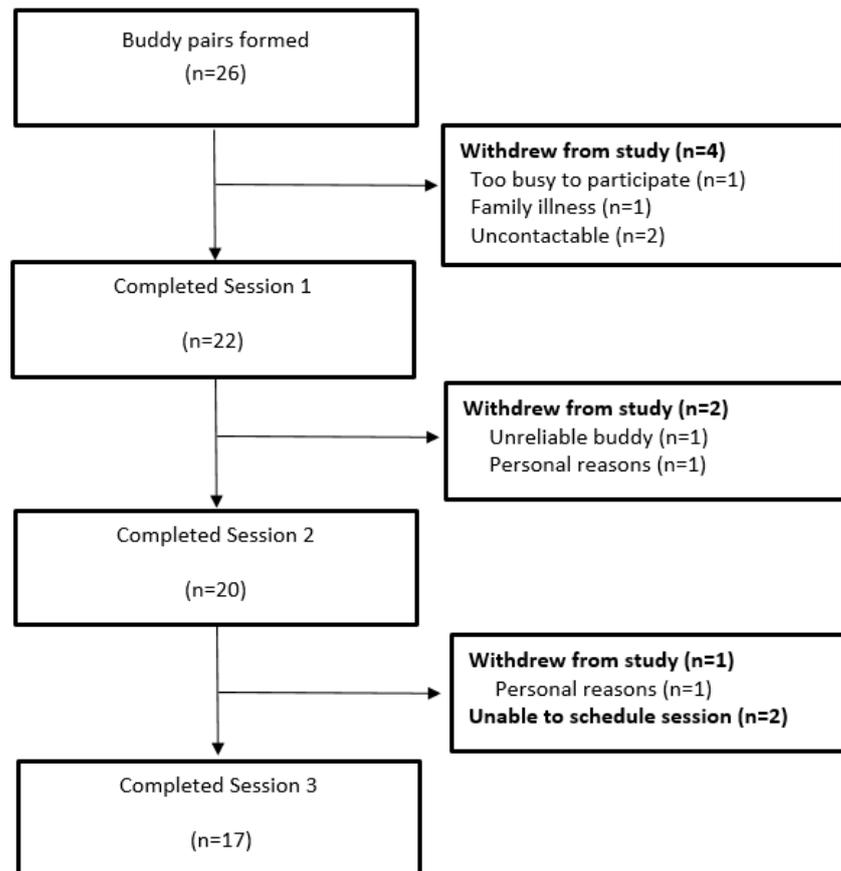
section scar. One participant states that *'the biggest burden was having a pen and paper to hand to note down wearing times'* in the accelerometer diary.

As in the interviews, one participant suggested a watch style device would be more suitable

Five participants provided an answer to the open-ended question *'Do you have any other comments about the data collection procedure?'* One comment had been mentioned in the qualitative interviews about a lack of feedback on the objective measurements. One additional comment referred to the IPAQ-SF and the difficulty of determining what activities count as moderate and one participant felt the questions were repetitive.

### 6.3 What is the acceptability and suitability of the intervention?

#### 6.3.1 Adherence to the intervention session protocol



**Figure 6.8 – Participant flow through the intervention**

Figure 6.8 is a flow diagram displaying the participant flow through the intervention. Of the 52 participants that formed buddy pairs (n=26), 4 pairs did not start the intervention or complete

baseline data collection because they did not turn up or respond to future contact (n=1), cancelled the first session and did not respond to future contact (n=1), withdrew from the study due to family circumstances (n=1) and decided to withdraw from the study because of a change in the demand of caring for the baby (n=1). Of the 22 pairs that completed the first Buddy Up session, 20 (91%) completed the second session and 17 (77%) completed the third session. Two pairs (14%) withdrew from the study between intervention session 1 and 2 and one pair withdrew from the study between intervention sessions 2 and 3. The reasons for withdrawal were personal reasons (n=2) and because her buddy had been unreliable and cancelled their meetings on several occasions (n=1). We were unable to deliver two final intervention sessions because participants were unable to attend and then we were unable to reschedule the session. With 6 (13.6%) withdrawals it is not possible to identify baseline characteristics that predict intervention dropout. Comparison of their demographic characteristics are included in Appendix 6.2.

There were good adherence rates for completing the sessions, however the protocol stated that intervention sessions were delivered at two week intervals. Early in the study it was apparent that per-protocol delivery was going to be difficult. Firstly, co-ordinating three schedules meant that at times it was not possible to arrange a session within a two-week period. Secondly, a high number of participants were unable to attend the arranged sessions due to illness or other commitments. It became apparent that delivering the intervention at a set interval was not possible. Therefore, we adapted the protocol to deliver the three intervention sessions, where possible at two-week intervals, and if not possible at the earliest opportunity. Table 6.7 shows how many times each individual session was rescheduled. 59 intervention sessions were delivered in total (non-delivery due to withdrawal=5 and unable to reschedule=2). 40 intervention sessions were delivered as arranged. Participants who were unable to attend rearranged 16 sessions once and 3 sessions were rearranged twice. Six pairs did not reschedule any of the sessions.

**Table 6.7 – Number of rescheduled sessions at each time point**

	Number of reschedules per pair		
	0	1	2
<b>Session 1</b>	16	6	0
<b>Session 2</b>	12	8	0
<b>Session 3</b>	12	2	3
<b>Total</b>	<b>40</b>	<b>16</b>	<b>3</b>

Table 6.8 presents the reasons that participants asked to reschedule the sessions. The most common reason for rescheduling a session was that either the participant or her baby was ill and did not want to risk spreading the infection, especially prominent during November and December. In addition, during these months participants were less able to make plans to see each other because it was a busy time of the year. Seven sessions were rescheduled due to other commitments, eg, exercise classes, doctors' appointments or being called into work. Only on one occasion had a participant forgotten about the other commitment and 'double booked'.

**Table 6.8 – Participant reasons for rescheduling sessions**

Reason	Number of participants who cited barrier
Baby commitment, eg, baby signing class, health visitor appointment	4
Friend/family visiting	3
Illness (Baby or themselves)	10
Other commitment	5
Forgot about session	1

Above, I have described the difficulty to deliver the intervention sessions within two-week intervals. The mean number of days between the first and second session was 18.09 days and between the second and third session was 20.7. Table 6.9 is a cross-tabulation showing how many pairs received each session within two weeks (per protocol), noting that only five pairs received the intervention as the protocol indicated.

**Table 6.9 – Cross tabulation presenting the interval (days) between each session**

		Session 2-3	
		Per protocol	<14 days
Session 1-2	Per protocol	5	6
	>14 days	2	4

### 6.3.2 Acceptability of the buddy element

#### 6.3.2.1 Quantitative results

The results presented refer to participant responses on the post-intervention questionnaire (n=35) (new buddies (n=15); existing buddies (n=20)). Participants were asked 'how much has your buddy

influenced you to be active', using a Likert scale where 1 referred to 'not at all', 4 referred to 'neutral' and 7 referred to 'a lot'. Participants' mean response was 4.74 (SD=1.27), suggesting that buddies had a slight influence on each other's PA levels. The score was higher among existing buddies (mean = 5.0; SD = 1.23) compared to new buddies (mean = 4.40; SD = 1.40). Table 6.10 presents the distribution of responses for this question.

**Table 6.10 – Response distribution to question 'How much has your buddy influenced you to be active?'**

	Total sample		Existing buddies		New buddies	
	N	%	n	%	n	%
1	0	0	1	5	0	0
2	4	11.4	1	5	3	20
3	1	2.9	0	0	0	0
4	6	17.1	3	15	3	20
5	13	37.1	7	35	6	40
6	11	31.4	8	40	3	20
7	0	0	0	0	0	0

Table 6.11 displays participant responses to how they had provided support to each other throughout the duration of the intervention. The most common method of support was to send messages (n=28), followed by sharing PA information (n=25) and doing PA together (n=21). Less common methods of support were setting up FitBit groups (n=1) and providing childcare (n=1). There appears to be a difference between new and existing buddies, with a higher percentage of existing buddies engaging in PA together (70%) compared to new buddies (46.7%). This data does not provide any details of the frequency these methods were implemented, for example, whether participants engaged in PA together once per week or once over the duration of the intervention.

**Table 6.11 – Method of support provided by buddy over duration of the intervention**

Type of buddy support	Total sample		Existing buddies		New buddies	
	n	%	N	%	n	%
Sent messages	30	85.7	15	75.0	13	86.7
Do PA together	21	60	14	70.0	7	46.7
Sharing PA information	25	71.4	14	70.0	11	73.3
Setting up FitBit Group	1	2.9	1	4.5	0	0
Looked after baby	1	2.9	1	4.5	0	0
Exchanged rewards	0	0	0	0	0	0

Participants engaged in PA together for an average of 1.06 days (SD=1.76), which was higher among existing buddies (mean=1.40; SD=2.04) compared to new buddies (mean=0.60; SD=1.24). Table 6.12 shows the distribution of the number of days participants have engaged in PA during the past 7 days. Overall 62.9% of participants did not engage in PA with their buddy in the week prior to completing the questionnaire.

**Table 6.12 – Distribution of number of days participants engaged in PA with their buddies in past 7 days**

Number of days	Total sample		Existing buddies		New buddies	
	N	%	N	%	n	%
0	21	60	10	50.0	11	73.3
1	6	17.1	4	20.0	2	13.3
2	2	5.7	2	10.0	0	0
3	1	2.9	0	0	1	6.7
4	3	8.6	2	10.0	1	6.7
5	1	2.9	1	5.0	0	0
6	0	0	0	0	0	0
7	1	2.9	1	5.0	0	0

### 6.3.2.2 Semi-structured interview results

In general, an equal number of participants interviewed had positive and negative attitudes towards their buddy or towards the buddy system in general. These comments can be grouped into affect, eg, liked, enjoyed or comments about the influence of the buddy. Six participants described positive affect including 'I was really glad to have met [my buddy]' or 'I think [the buddy] is a great element',

compared to five with negative comments *'My expectations were higher than what it was', 'it was outside of my comfort zone to do something with somebody else'*. Seven participants said the buddy had positive influences on their PA levels

*'I think it has encouraged us both to do more exercise and to do it together, which is really nice,'*

*Existing buddies, Influence - High (5), Moderate PA*

*'Definitely have done more with the buddy than I would have done on my own'*

*Neutral (4), Low PA*

One participant said that although she believed her buddy had a positive influence on PA, she was unsure of their real influence because she had not been attempting to increase PA levels prior to participating in the study.

*'[she's always said] when [my baby] hits six months, I'll do something about it [PA] and then he did and I was doing this thing [Buddy Up]. I think it's been very helpful, but not having control me to compare with it's a bit hard to tell.'*

*New buddies, Influence - High (5), Moderate PA*

Seven participants commented that the buddy had little or no influence on their PA levels. When asked if there was anything that worked well about having a buddy, one participant answered *'not really for me in this instance'*. One participant went as far as saying *'it didn't really work out as having a buddy'*

*'Beyond [the buddy] being nice to have, it wasn't like 'oh thank god you're here otherwise I'd be on the sofa.'*

*Existing buddies, Influence - Low (2), Moderate PA*

The acceptability of the buddy element is variable among participants and the reasons identified are discussed below:

#### a) Compatibility

Further analysis of the data indicates that some pairings are more compatible, with buddies who were newly matched more likely to experience compatibility issues than existing friends. One factor that influences buddy compatibility is accessibility. Participants who live near each

other were able to engage in PA together with ease and spontaneity, *'we live close enough together for it not to be a big palaver to get to the same place to do exercise'*. Living further away from each other *'has made things that little bit more difficult'* to meet up for PA.

*'We don't live a comfortable walking distance [and] I think that has had a lot of impact on us not being more active together'*

*New buddies, Influence - Neutral (4), Moderate PA.*

Participants who live close by speculate they would not meet up as often if they lived further away, which would lessen the accountability. The acceptable distance for participants to live from each other is dependent on the individual pair and influenced by their accessibility to a vehicle and willingness to use a vehicle, for example some mothers do not like putting their child in the car because the baby does not like the car seat.

The pair's compatibility is also influenced by their similarity in terms of baseline fitness levels, expectations, baby age, parenting styles and goals. When baseline fitness levels are similar, participants felt like they were able to do PA together and share ideas with their buddy.

*'in terms of being able to share ideas of what to do and saying 'this activity worked for me,' I was never worried that she couldn't do that'*

*Existing buddies, Influence – Neutral (4), Low PA*

*'you feel like you can do the same thing and you're not holding someone back or dragging them behind you'.*

*New buddies, Influence - High (6), Moderate PA.*

In addition, participants felt it was important to have babies of a similar age because they both understood the parenting challenge, *'my buddy knows what it's like for [my baby] because she's been the same with [her baby]. So we're similar in terms of how we parent'*. Conversely, some participants noted that they were different from their buddy in terms of pre-pregnancy PA, goals and some were *'just different people'* or didn't have much in common. Participants felt that not feeling similar to their buddy influenced the motivation and support they were able to offer their buddy, with one participant speculating that if she had more in common with her buddy, she would want to meet up and spend more time with her. Interestingly, there were differences in attitudes within some pairs. Notably, in one pair, one participant felt strongly that they were similar, *'we were both a lot more physically active, both trying to lose weight,*

*when she started off by saying what her goals were in the first meeting, her life and most of that I was like yes, I can identify with that.’ Yet her buddy felt very strongly that they were different ‘it was important if we both had the same kind of goals which we didn’t in our case ... so to have equal goals or at least kind of meet in the middle would have been better’.*

The last component of compatibility was the general likability of the buddy. Participants felt it was important *‘to have someone that I genuinely like’* because this influenced how much time they wanted to spend with their buddy. Five participants mentioned that they liked their buddy, of these four were from new matches and one was from an existing match, albeit a relatively new relationship as they were friends through a pre-natal group. Conversely, three participants cited that they did not *‘gel’* or *‘click’* or as one participant said, *‘just not bosom buddies’*. This meant they were not motivated to spend time together. All participants who spoke negatively about their general *‘likability’* towards their buddy were from new matches.

*‘we didn’t really gel in that way and I think that’s 90% of the problem as to why we’ve not done anything’.*

*New buddies, Influence - Neutral (4), Low PA*

The compatibility of pairs is an important factor influencing the success of the relationship and contributes to longevity of the relationship. For buddy relationships to work, pairs must be accessible, must be similar and must like spending time together. For those participants who did not feel they had *‘clicked’* with their buddy, they suggested alternative recruitment methods that gave them the option to choose from a pool of participants or additional sessions during the early stage of the intervention as an opportunity to develop new relationships, which would make it *‘less awkward’* if they were to meet each other and more likely that they keep in contact.

*‘at the beginning, just if we got to know each other a bit more maybe’ ‘We didn’t have enough time early on to build a proper friendship’*

*New buddies, Influence - High (6), Moderate PA*

## b) Buddy support

During the intervention, buddies supported each other by meeting up to engage in PA, meeting up for non-PA related reasons and general communication about PA.

### *Meeting with buddy*

When meeting up to do PA, buddies would mainly walk, with some engaging in exercise classes. For two pairs, one participant within each pair set up a group activity with a wider group of mothers for them to engage in yoga or walking. However, some buddy pairs encountered barriers which prevented them from planning PA together, eg, geographical limitation, preferences for different activities and lack of time (due to work commitments following maternity leave) and some encountered barriers to engaging in the activities they had planned due to external barriers, eg, baby behaviour. Others tried meeting but decided it was not feasible because their babies' routines did not match or they had older children who had different interests.

*'I like cycling for example, and she doesn't do cycling. I like different types of exercise and I joined different classes and she prefers um... exercising at home, which doesn't work very well for me.'*

*Existing buddies, Influence - Neutral, Moderate PA*

*'she never made it out on any of the runs that I went on in the end because [her baby] is quite a spirited little chap'.*

*New buddies, Influence - High (6), High PA*

The type of buddy match appeared to influence whether participants engaged in PA together, with buddies who were existing friends more likely to meet up for PA than new buddies. Meeting up to engage in PA provided motivation through providing accountability and social interaction. Participants stated that if they were meeting their buddy for PA, they were more likely to do the activity because there's *'no one that needs to hear your excuse'* and they are less likely to procrastinate because there is a set time. Additionally, they are more likely to *'do the whole hour'* and complete the planned activity with their buddy. Doing PA together meant that buddies were more consistent with the frequency and intensity of PA because they had a set time for PA.

*'having that session booked in on a Monday that held me accountable. Rather than feel like I was letting the class down or maybe letting my money go to waste by not going, I also felt like I would be letting her down.'*

*New buddies, Influence - High (6), Moderate PA*

The motivational aspect of accountability also introduced negative feelings of guilt if participants had to cancel appointments *'you do feel you might have let someone else down, but I think hopefully both of you understand that things come up.'* The feeling of guilt appeared to be less among buddies with existing relationships compared to new relationships.

Participants who met up for PA enjoyed having a companion, someone to talk to, have a laugh and share the joy of their children. One participant stated it was a way of overcoming feelings of isolation experienced during the postnatal period.

*'it's not really going out for a walk, we're going out for a chat and we happen to be walking'.*

*New buddies, Influence - High (6), Moderate PA.*

Two participants said that the openness in conversation during the intervention session had raised topics they would not have talked about together, eg, weight, exercise, relationships, which made it easier to talk openly and provide emotional support to each other.

*'she's worried about her stomach and things like that we might not talk about that and keep to ourselves. It's probably quite good to actually have the time to talk about them'.*

*Existing buddies, Influence - High (6), Moderate PA*

Two pairs met up for non-PA related activities such as meeting for coffee and other baby classes. Both of the buddy pairs were new matches and also engaged in PA together. Two participants from different pairs stated that although they did not manage to meet up for PA with their buddy, having their buddy at the intervention session was positive because if *'you've had a lazy day or lazy week and someone says 'oh god yeah, you what, so did I,' there's less of an impact mentally.'* Having the buddy present at the meeting also encouraged them to share ideas.

#### *Communication*

Buddies supported each other through communicating via WhatsApp, SMS and social media. The content of the messages were general encouragement (including praise when buddy had completed PA and non-judgemental and sympathetic support when they had not completed PA), planning activities, asking buddies how they were getting on, reporting progress and one

pair sent 'PA selfies'. In addition, buddies shared ideas of activities they could do. The messages were useful as prompts to remind each other to be active.

*'she helped with messaging a lot and catching up, checking in on me really ... in a nice way!'*

*Existing buddies, Influence - High (6), High PA*

Utilising buddy support in this way offered motivation through accountability because they are talking about PA and you want to make it look like you're trying and to *'hold up your end of the bargain'*. When conversing with their buddies, there was more incentive to do what they had planned.

*'if I didn't have to converse with anyone about it then I'm probably 50% less likely to do anything'*

*New buddies, Influence - High (5), Moderate PA*

However, participants found it difficult to enforce accountability in this way because they *'didn't feel that we could nag each other, and we were trying very hard to be polite to each other'*. Some participants expected their buddy to enforce accountability to a greater degree *'I expected something like 'move around' ... [my buddy] was too nice so I wasn't really bothered to move my bum off the sofa'*. Interestingly, some participants said that because they already knew each other they were not comfortable to enforce accountability because they understood each other's lives, whereas participants in a newly matched buddy pair speculated that they would feel more comfortable to enforce accountability in an existing relationship. This may be down to individual personality as opposed to the nature of the relationship.

Participants who supported each other through communicating only stated that it was unlikely to continue long-term, because the intensity of messaging *'fizzled out'* over the course of the intervention. When they didn't receive messages it *'didn't really work out as having a buddy'*. This was especially prominent among participants who found it difficult to bond and *'hadn't really got on'*, because this would be their only method of communication. Two participants identified that they *'don't think we were as good at doing it as we could have been'*, due to being busy. One participant stated they could have supported each other more to review progress and identify barriers, suggesting a prompt to remind them to contact their buddy.

*'the first weeks she was more proactive and was more into writing to me, checking on me. But as the weeks passed by I guess she's just had things going on in her life so she stopped writing basically.'*

*New buddies, Influence - Neutral (4), Moderate PA.*

Communicating with their buddy by messaging provided inspiration for participants to be active because they wanted to impress each other and provided participants with a social comparison, for example when they saw their buddy being active it prompted them to think they should be *'getting on and doing something.'* Participants acknowledged that their buddy was in the same situation, had a baby with similar needs, which inspired them to also be active.

*'looking at others who are in the same situation as yourself and looking at them trying to be active motivated me to think that yes I can do that too. It's possible to have a baby and still go out and about and do things.'*

*New buddies, Influence - High (5), Low PA.*

When participants are reporting their progress to each other, it can often provide a boost to one participant who has been less active than the other,

*'if I know she's done quite well, I can almost feel a bit like 'oh I've not done anything and it's good motivation'.*

*Existing buddies, Influence - High (6), High PA*

*'You're only comparing yourself week to week, so one you don't do anything and the next week you do one thing and you're really chuffed, whereas if someone's done a couple of things you're like 'oh I should really try and do a couple of things' so it's an extra push I suppose.'*

*Existing buddies, Influence - High (6), Moderate PA.*

On the other hand, some the benefit is not felt by the most active buddy *'if she'd been more active, I think I might have been more active'.*

*'We're friends on FitBit so I can see her steps a day and she has much much less than I do ... so that's not motivational for me.'*

*New buddies, Influence - Neutral (4), Moderate PA.*

### c) Suggested changes to the intervention

Several participants suggested that a useful addition to the intervention would be to create an overarching network of all participants. Suggestions for implementing this included an online portal, social networking site, group exercise classes or a large group meeting. Participants felt this would offer a larger support network, greater input of PA ideas and a collective sense of community among participants. Additionally, it would be an alternative source of support for participants who were not bonding with their buddy.

*'It would help by giving a sense of community to it, that everyone's going out and doing it and then coming back together.'*

*Existing buddies, Influence - Low (2), Moderate PA*

*'there would be a bigger group to support each other when you're not bonding with your own buddy at least you've got somebody in the system that you can still work with.'*

*New buddies, Influence - Neutral (4), Low PA*

Two participants suggested working in small groups of 3-4 mothers as opposed to buddy pairs. One suggested this because her buddy cancelled their plans often due to her baby not sleeping and one did not feel her buddy provided sufficient motivation, therefore working in smaller groups could ensure the support is provided when their buddy is not able to provide it.

Interestingly, suggestions to include a larger support network originated from all participants, regardless of whether they felt supported by their buddy or not.

#### 6.3.2.3 Open-ended questionnaire analysis

Most participants' responses to the open-ended questions in the post-intervention questionnaire fitted within the analytical framework developed for the telephone interviews. One notable comment which was made consistently by participants in the open-ended questionnaires was that the study was a *'helpful prompt'*, and that participants *'had been planning'* on taking steps to increase PA but the intervention ensured they stayed motivated. One participant also noted *'it has been worthwhile and has made me happier as well as more active.'* All other comments have been explained in the analysis of the telephone interviews.

### **6.3.3 Acceptability of the intervention sessions and booklet**

#### *6.3.3.1 Quantitative results*

Table 6.13 presents participants' views on the intervention. Participants felt strongly that the intervention answered their questions (mean=4.20, SD=0.83), explained in understandable terms (mean=4.57, SD=0.65), provided sufficient examples of activities (mean=4.71, SD=0.83) and provided clear and concise information (mean=4.71, SD=0.79). Helping participants understand more about postnatal PA was rated lower (mean 3.71; SD 0.79).

**Table 6.13 – Participant views on the intervention**

<b>The intervention...</b>	<b>Mean*</b>	<b>SD*</b>
... helped me understand more about postnatal PA	3.71	0.79
... answered most of the questions I had	4.20	0.83
... explained things in terms I could understand	4.57	0.65
... gave enough examples of activities	4.71	0.83
... Signposted to appropriate activities	4.57	0.85
... gave clear and concise information	4.71	0.79

\* Responses on a scale 1 (Strongly disagree) to 5 (Strongly Agree).

Table 6.14 displays participants' views on the usefulness of each intervention topic for increasing PA. Participants rated each topic included in the intervention session as helpful for helping them increase PA levels.

**Table 6.14 – Participant views on the usefulness of each intervention topic**

<b>Intervention topic</b>	<b>Mean*</b>	<b>SD*</b>
Understanding the reasons for being active	4.00	0.77
Learning about the physical activity guidelines	3.83	0.89
Considering all activity options	4.37	0.65
Committing to support your buddy/your buddy committing to support you	4.23	0.81
Setting goals	4.40	0.60
Monitoring your goals	4.26	0.70
Making weekly action plans	4.20	0.83
Making contingency plans	4.11	0.76

\* Responses on a scale 1 (Strongly disagree) to 5 (Strongly Agree).

Participants rated the frequency (Mean 3.09; SD 0.56) and duration (Mean 3.00; SD 0.00) of sessions as about right when asked to rate on a scale from 1 (too often/too long) to 5 (not often enough/too short) with 3 indicating 'about right'.

With regards to the booklet (Table 6.15), participants indicated that the appearance (print size, visual appeal and clarity of information) was acceptable. There were lower scores for referring back to booklet outside of the sessions and the lowest scores were for the use of the booklet to plan and monitor activity.

**Table 6.15 – Participant views on the Buddy Up booklet**

<b>View on booklet</b>	<b>Mean</b>	<b>SD</b>
The print size was large enough for reading	4.77	0.60
The booklet was visually appealing	4.34	0.76
The information was clear and concise	4.69	0.58
I used the booklet to plan my activity	3.23	1.14
I used the booklet to monitor my activity	2.77	1.42
I read the booklet outside of the sessions	3.43	1.27
I referred back to the booklet	3.34	1.14

\* Responses on a scale 1 (Strongly disagree) to 5 (Strongly Agree).

### 6.3.3.2 Qualitative results

Many participants made positive comments about the intervention sessions using comments such as ‘good to have those sessions’, ‘they were great’, ‘good’, ‘nice experience’, ‘easy’, ‘informal’, ‘enjoyed taking part’, ‘looked forward to them’. Other participants provided additional detail about how the intervention had positively influenced them;

*‘The meets ups were really helpful actually because each time I left, I left feeling a bit more energised to want to do a bit more than I had felt beforehand.’*

*Age of child 7-9 months, 1 child, Low PA*

Some participants said it gave them time out from their lives to focus on PA.

*‘I’ve got so much sort of going on, it’s nice to have that actual time to go, no, this is when we’re going to talk about this.’*

*Age of child 10-12 months, 1 child, Low PA*

Despite most participants feeling positively about the intervention, one participant had very strong negative feelings as she felt ‘there are so many more, much bigger obstacles in the way than just having a friend to do it with,’ and that ‘it takes more than a buddy to get out’. Additionally, she felt

*'the study didn't in any way understand the needs of a mum who has a four month old baby'*. No other participants expressed this opinion.

a) Intervention content

Table 6.16 includes participants' views on the acceptability of the topics included in the intervention sessions. The section found most useful by participants was exploring appropriate activities and signposting participants to suitable resources. One participant said *'it was far more than I was expecting'*, and three participants commented that they wouldn't have made the effort or had the time or known where to look to compile the list.

*'some of those exercises, I might not have found, or it might have taken me a while to find them, which might have put me off in the first place.'*

*Age of child 10-12 months, 1 child, Low PA*

Five participants used the links to exercise videos, especially when they knew they were at home all day, or finding it difficult to think of what they could do, using the list as a gateway to find other enjoyable activities. One mother would try out the videos, skip the ones she didn't like, repeat the ones she did and share these with her buddy. Although not all participants used the resources, they were aware that they were there *'for when the weather starts to become really revolting and going out with [my baby] starts to become a real trial.'* Within the sessions, talking about available opportunities prompted participants to *'perhaps expand our horizons a bit on where we might go and what activities we might consider actually doing'*. However, one participant thought the list of activities was unrealistic.

Despite an overall positive response to these activities, participants suggested some changes, which included categorising activities for their suitability during each postnatal period and according to the type of birth, provision of information on local activities/classes, watching the videos during the sessions or detailed weekly physical activity plans.

Participants valued the set time at sessions to focus on PA and planning. Additionally, the sessions were a good way to maintain momentum.

*'Making the time to sit down and come up with a plan which I wouldn't have necessarily do at home'*

*Age of baby 7-9 months, 2 children, Moderate PA*

During the sessions, participants liked articulating their plans and writing them in the diary to aid planning, monitor progress and understand what plans are effective.

*'the planner made you sit down and actually think about what you're going to do rather than just go, 'oh I'll do this and this', and if it's not written down I think you're less likely to do it.'*

*Age of child 4-6 months, 1 child, Moderate PA*

*'think the planning, it is very important, especially at the very beginning, because if you want to kick start something it's good to have the plan on paper'.*

*Age of child 7-9 months, 1 child, Moderate PA*

Some participants did not use the planning tools because there was not enough space in the diary or they had established a routine and did not feel that planning was necessary.

*'I'd already had a bit of a routine as to what I was doing...so for me I didn't feel it was necessary to plan that out'*

*Age of child 10-12 months, 1 child, Moderate PA*

Furthermore, some participants mentioned the importance of identifying potential barriers to PA and making plans to overcome the barriers *'it was useful to write those [barriers] down because I guess you could look at the one that says too tired and then think 'no, what's the way around this'.*

Despite using the sessions to identify potential barriers, participants cited barriers to engaging in PA throughout the interviews that include breastfeeding, lack of childcare, weather, work, holidays, illness, tiredness and housework. The ongoing presence of the barriers suggests that the intervention may need changing to ensure the intervention addresses barriers efficiently.

Four participants said the meetings were good for reviewing progress because *'somebody else just looking at your progress, just makes such a huge difference between it just being down to me'.* However, this was a section of the sessions that many participants felt could be improved *'I was expecting more of a before and after type situation to feel a sense of accomplishment.'* The sessions would benefit from feedback on their short and long-term progress. Suggestions for providing feedback were an activity monitor, online questionnaires or collecting the booklet. Some participants thought the accelerometer was an intervention component and wanted feedback on their behaviour during the measurement period.

## b) Booklet

Participants commented positively on the appearance of the booklet '*concise, beyond expectations, well put together*'. The main sections used by participants were the activity resources and planner. One participant felt we could have made better use of the booklet during the session. Despite the positive comments, most participants did not use the booklet outside of the session, with one participant saying she only looked at it on the day of the first session and others flicked through the booklet.

*'I didn't read the rest of the booklet. I don't know if there's lots of important information in there or not, but that is one thing I didn't do and I don't think [my buddy] did either.'*

*Age of child 4-6 months, 1 child, Moderate PA*

Participants cited a lack of time and energy and '*little hands grabbing*' every time they tried to read it as reasons for not using the booklet. Some had flicked through information briefly before reading the important sections.

*'I thought it was beautiful, extensive, great piece of literature, but I, as a mum, felt bad about not using it to it's full capacity. I didn't refer back to it.'*

*Age of child 4-6 months, 1 child, Moderate PA*

Participants suggested condensing the booklet, some for environmental reasons '*think of the trees!*'. Participants suggested many changes/additions to the booklet, which included improved resources for action planning and self-monitoring behaviour.

## c) Motivational Interviewing

Acceptability of Motivational Interviewing was high among participants who identified specific aspects of the technique, for example, '*they were just suggestions towards helping us to be proactive rather than telling us to do things in a certain way*' and felt this approach made it easier to absorb the information. Participants commented positively on the non-prescriptive and flexible approach. Furthermore, four participants commented that the atmosphere in the sessions was '*relaxed, informal*' and the openness in conversation made them talk about topics they would not usually approach with their buddy.

*'We both perhaps spoke more openly about things that we wouldn't necessarily have brought up just with each other.'*

*Age of child 4-6 months, 1 child, Moderate PA*

d) Intervention delivery

The face-to-face nature of the intervention was important to develop a rapport, feel personal and provided a sense of commitment to the facilitator, especially in comparison to a digital/distance intervention.

*'You come round to us and getting to know you creates that feeling of, we want to do this and we're committing to this and you're committing your time into it as well.'*

*Age of child 10-12 months, 1 child, Moderate PA*

*'maybe if you had done it all by email it wouldn't be as personal and it would have felt maybe like you weren't trying as much, so why would we?'*

*Age of baby 7-9 months, 1 child, High PA*

Participants mentioned two negative points to face-to-face delivery. Firstly, that at times their children were moving about and disrupting the sessions and secondly that they were unable to talk honestly because *'it was always the three of us together, if either of the buddies wanted to say anything negative you might have felt a little less inclined to.'*

The location of the sessions was important to some participants. Mainly among existing buddies, sessions took place at participants' homes and, mostly among new buddies, at community locations. It was important that the location was child-friendly and local, *'so that we didn't have to traipse down to the University.'*

*'That it was convenient and it's like round the corner from where I lived was super, I wouldn't have done it if it wasn't – that was really important to me.'*

*Age of child 4-6 months, 1 child, Moderate PA*

Participant opinions on the frequency and duration of the intervention were variable. Of the participants who commented on the total number of sessions, one said it was the *'right number'*, and two participants said there were too few sessions because *'if you've gone from doing nothing, it probably takes a bit longer to get going,'* and *'we were just getting in our*

*groove and then it's finished.'* Two participants thought the third session was *'superfluous'* because *'they were quite repetitive ... we seemed to go over the same stuff each time'*. The same two participants felt that for the same reason the sessions could have been shorter. Most participants felt that a fortnight between each session was a good amount of time because you *'didn't get too complacent about it and forget to be doing anything.'*

*'There wasn't a feeling, 'oh, we'll let this week slide and start next week kind of thing. There was that impetus to get going and to have got started by the time that second session.'*

*Age of baby 4-6 months, 1 child, Moderate PA*

One participant suggested that the time between sessions should gradually increase, for example, weekly for the first month followed by monthly for the next three months, and one participant felt that every fortnight was too frequent;

*We'd only done one or two walks in that time and you were asking 'how was exercising?' and you're like, 'yeah, er... it's alright', but it didn't feel like enough time has passed.'*

*Age of child 0-3 months, 1 child, Moderate PA.*

#### e) Intervention timing

Many participants said that there was an optimal time for the intervention to commence. There were participants who felt that the *'study found us at the point where we were ready to do something'* because *'I was fully recovered after giving birth and actually ready to have some more exercise, so it was good.'* One participant commented in the follow-up questionnaire that the timing was *'serendipitously perfect'*. Some participants felt they would have benefitted more from participating in the study earlier before they settled into a routine with the baby, which would allow them to establish a PA routine with their buddy before both returning to work. The optimal time would be 4-6 months postnatal to enable women to maximise the benefit of the intervention and avoid being a *'missed opportunity'*.

*'I feel six months ago, when the babies are still quite young, there was no routine for them, we could have gone out, we could have done Bounce classes with the kids in the class.'*

*Age of child 10-12 months, 1 child, Moderate PA*

*'it would have been nice to have started sooner, getting out of the house and do things. You've just got used to being a mum and things are falling into place ... then it's nice to start building a routine and what you're going to do.'*

*Age of child 4-6 months, 1 child, Moderate PA*

**Table 6.16 – Participant views on the content of the intervention sessions**

Session content	Summary of participant views	Participant quotes
<b>Exploring importance of PA</b>	<p>Positive: Good to talk about why you want to engage in PA because it helps you maintain motivation and reminds you why you are taking part</p> <p>Negative: Already aware that being active is good for your health and there was no need to spend time exploring this, writing the reasons and consolidating why it was important.</p>	<p><i>Articulating ‘why am I doing this’, for myself is quite useful for maintaining that motivation, for having to put into words and put it down on paper, so when you think no, no, no, it’s not I’m doing this because. Age of baby 4-6 months, 1 child, Moderate PA</i></p> <p><i>I didn’t need to know the benefits because I just know that doing more exercise is better... I didn’t need a big bump on what I’m going to get from it. Age of child 0-3 months, 1 child, Moderate PA.</i></p>
<b>Understanding guidelines</b>	<p><b>PA</b> Positive: Introducing the PA guidelines helped participants to realise the variety of activities that contribute to MVPA and that useful to know that activity can be accumulated in bouts as short as 10 minutes.</p>	<p><i>I didn’t have to do a full on workout for an hour, that 10 or 15 minutes was enough as long as I was doing it regularly. Age of baby 0-3 months, 2 children, Moderate PA.</i></p> <p><i>It made me appreciate a lot more that I was doing in my day. Just because I didn’t put on my leggings and a t-shirt and get down on my gym mat, I’m still doing something that’s getting my heart beat up. Age of child 7-9 months, 1 child, Low PA</i></p>

<b>Identifying opportunities</b>	<p><b>PA</b> Positive: The list of activities was useful as participants wouldn't have had the time or known how to compile the list. Participants used the video links provided. Discussing activities within the sessions encouraged participants to consider and engage in alternative activities.</p> <p>Negative: One participant thought the activities suggested were unrealistic as a new mother</p>	<p><i>'I probably wouldn't find it myself'</i></p> <p><i>If you'd said to us 'go away and think of five activities that you could have done this week, I don't think I'd know where to start</i></p> <p><i>'I just didn't feel they were actually achievable... I know that I'm not going to be like 'I'm going to go downstairs in my gym stuff, I'm going to put [my baby] there, put this on YouTube and go for it'</i></p>
<b>Goal setting</b>	<p>Positive: One comment it is good to commit goals to paper to know what you want to get out of the study</p>	<p><i>Committing to paper your goals and what you want to get out of this is always good and something to refer back to</i></p> <p><i>Age of child 10-12 months, 1 child, Moderate PA</i></p>
<b>Action planning</b>	<p>Positive: Time and space to focus on planning weekly activity to maintain momentum. Writing plans was good to be able to monitor progress and to fit PA into busy lifestyles</p> <p>Negative: Didn't use planners as much as they should</p>	<p><i>The planning, it is very important, especially at the very beginning, because if you want to kick start something it's good to have the plan on paper</i></p> <p><i>Age of child 7-9 months, 1 child, Moderate PA</i></p>

<b>Coping planning</b>	Positive: Useful to identify barriers and create alternative plans to fall back on if the barrier arose	<i>You could look at the one that says too tired and think 'no what's the way around this' and use it from that point of view. Age of baby 10-12 months, 1 child, Moderate PA.</i>
<b>Reviewing progress</b>	Positive: Subsequent sessions were a good way to review progress and reporting progress made a big difference	<i>If there's somebody else involved that you need to present your progress to ... that just makes such a huge difference between it just being down to me. Age of baby 4-6 months, 1 child, High PA</i>
	Negative: Study didn't provide specific feedback and participants would like other methods to provide more specific feedback on weekly progress and progress through the intervention period.	<i>I was expecting more of a before and after type situation to feel a sense of accomplishment, so I don't think I felt that. Age of child 4-6 months, 1 child, Moderate PA</i>

## 6.4 What is the preliminary evaluation of the intervention effect?

### 6.4.1 Barrier efficacy

Table 6.17 presents results for each barrier efficacy statement at baseline and follow-up for all participants who completed the questionnaire, and the response distribution is included in Appendix 6.3. Paired sample t-tests show that the intervention increased barrier efficacy for being physically active *'when I am feeling depressed'* ( $t_{(30)}=-2.93$ ,  $p=0.006$ ), *'when I have no one to be physically active with'* ( $t_{(30)}=-2.10$ ,  $p=0.04$ ), *'during bad weather'* ( $t_{(26)}=-2.66$ ,  $p=0.012$ ) and *'when I have no money'* ( $t_{(26)}=-2.79$ ,  $p=0.009$ ), suggesting participants felt more confident to overcome these barriers at follow-up.

**Table 6.17 – Baseline and follow-up barrier efficacy results**

How sure am I that I can be physically active...*	Total baseline (n=44)		Paired baseline <sup>†</sup> (n=31)		Follow-up (n=31)		95% CI
	Mean	SD	Mean	SD	Mean	SD	
...when I am tired	4.43	2.22	4.65	2.26	4.45	2.28	-0.78, 1.17
...during or following a crisis	4.11	2.36	4.19	2.21	4.42	2.67	-1.11, 0.66
...when I am feeling depressed	3.45	2.25	3.42	1.96	4.52	2.36	-1.86, -0.33
...when I am feeling anxious	4.75	2.29	4.65	1.87	5.06	2.19	-1.14, 0.30
...when I am slightly sore from the last time I was physically active	5.91	2.39	6.13	1.91	5.77	2.17	-0.44, 1.15
...when I am on holiday	6.00	2.89	6.03	2.79	5.65	2.75	-0.60, 1.37
...when there are competing interests (like my favourite TV show)	5.70	2.25	5.74	2.19	6.06	2.28	-1.07, 0.43
...when I have a lot of work to do	4.20	2.25	4.10	2.09	4.45	2.01	-0.99, 0.28
...when I haven't reached my physical activity goals	6.30	2.50	6.43	2.05	6.53	2.15	-0.87, 0.67
...when I don't receive support from family or friends	5.77	2.72	5.81	2.48	5.32	2.67	-0.54, 1.50
...when I have no one to be physically active with	5.70	2.47	5.71	2.25	6.58	2.60	-1.72, -0.03
...when my schedule is very busy	3.95	2.16	3.55	1.73	4.06	2.02	-1.32, 0.29
...during bad weather	4.43	2.34	4.13	2.00	5.35	2.59	-2.17, -0.28
...when it's too hot and sunny	5.80	2.35	5.68	2.21	5.55	2.25	-0.99, 1.25

...following complete recovery from an illness	4.55	2.60	4.55	2.66	4.90	2.40	-1.30, 0.59
...when the baby/children are sick or just recovered from being sick (with cold, flu, ear infection etc)	3.05	1.54	3.10	1.52	3.43	2.19	-1.18, 0.52
...when there is housework to do	5.64	2.18	6.06	2.13	5.32	2.59	-0.29, 1.77
...when I don't have anyone to look after the baby (and other kids)	3.73	2.78	3.51	2.71	3.87	2.88	-1.87, 1.17
...when I don't have any money	6.14	2.67	6.00	2.58	7.45	2.20	-2.51, -0.39
...when you feel like you don't have the time	4.02	2.30	3.42	1.59	3.94	2.05	-0.27, 0.23
...when I have family or friends visiting for the holidays or their vacation	3.77	2.56	3.39	2.17	3.42	2.20	-0.85, 0.79
...when I return to work after being off for family/maternity leave	5.12	2.67	4.93	2.26	4.79	2.82	-0.59, 0.87
...when I have a job working at home	5.00	2.13	5.04	1.99	5.21	2.74	-1.41, 1.05

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\* Participants responded to each statement on a scale of 1 (Certain I cannot do) to 10 (Certain I can do) † Results from participants with follow-up data

### 6.4.2 Self-report physical activity

Table 6.18 presents results for participant self-report PA for all participants who completed baseline (n=44) and follow-up measurements (n=31) and baseline measurements only for participants who completed both (n=31). Participants' MET-min/week determined by the IPAQ-SF was higher at follow-up compared to baseline (1917.50 vs 1533.56 respectively), however this was not statistically significant ( $t_{(30)} = -1.497$ ,  $p=0.145$ ).

**Table 6.18 – Self-report PA results using IPAQ-SF**

	Total baseline(n=44)		Paired baseline (n=31)		Follow-up (n=31)	
	Mean	SD	Mean	SD	Mean	SD
<b>Continuous PA score</b>						
Average MET-min/week	1291.83	1238.48	1533.56	1381.31	1917.50	1418.35
<b>Categorical PA score</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>n</b>	<b>%</b>
Low	14	31.8	6	19.4	5	16.1
Moderate	28	63.6	23	74.2	18	58.1
High	2	4.5	2	6.5	8	25.8

### 6.4.3 Objective PA

Table 6.19 shows that there is an increase in CPM from baseline to follow-up for all participants who provided valid data at each time point.

**Table 6.19 – Objective PA at baseline and 3-month follow-up for all valid measurements**

	Total baseline (n=39)		Follow-up (n=26)	
	Mean	SD	Mean	SD
CPM	696.05	148.98	764.38	126.86
<b>Total time in each intensity</b>				
Sedentary	3630.85	760.83	3602.96	726.09
Light	1221.50	311.73	1283.65	354.67
Moderate	262.67	112.66	314.74	131.13
Vigorous	5.96	7.77	14.21	18.26
Very Vigorous	0.23	0.40	2.22	5.22
<b>Time per day in each intensity</b>				
Sedentary	582.95	74.56	594.44	54.73
Light	196.66	38.74	210.94	33.40
Moderate	41.73	15.24	51.42	17.91
Vigorous	0.92	1.11	5.12	15.64
Very Vigorous	0.04	0.06	0.38	0.89
Total MVPA bouts >10 minutes	91.06	93.65	117.69	101.18
<b>Categorical MVPA bouts &gt;10 minutes</b>				
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
0-30 minutes	14	35.9	4	15.4
30-150 minutes	16	41.0	15	57.7
>150 minutes	9	23.1	7	26.9

Objective PA for participants who provided valid data at baseline and follow-up are presented in Table 6.20. The paired t-test consisting of 24 participants with valid data at both time points also shows that CPM are significantly higher at follow-up compared to baseline (765.04 vs 697.68) respectively; ( $t_{(23)}=-2.992, p=0.007$ ).

**Table 6.20 – Objective PA at baseline and 3 month follow-up for participant with valid data at both measurements**

	Paired sample baseline (n=24)		Paired follow-up (n=24)	
	Mean	SD	Mean	SD
CPM	697.68	126.66	765.05	131.26
<b>Total time in each intensity</b>				
Sedentary	3783.39	697.88	3561.36	734.32
Light	1253.14	297.45	1258.12	357.44
Moderate	295.32	118.43	307.41	132.57
Vigorous	6.95	9.32	14.42	19.02
Very Vigorous	0.31	0.47	2.35	5.42
<b>Time per day in each intensity</b>				
Sedentary	593.53	82.98	595.14	55.12
Light	196.63	37.09	209.59	34.43
Moderate	45.65	16.1	50.91	18.37
Vigorous	1.03	1.31	5.40	16.27
Very Vigorous	0.05	0.07	0.40	0.92
Total MVPA bouts >10 minutes	125.86	101.80	122.20	102.47
<b>Categorical MVPA bouts &gt;10 minutes</b>				
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
0-30 minutes	5	20.8	3	12.5
30-150 minutes	10	41.7	14	58.3
>150 minutes	9	37.5	7	29.2

## 6.5 Discussion

### 6.5.1 Is it feasible to recruit participants to a paired intervention?

Recruitment to the intervention was challenging, resulting in a total sample size lower than the original calculation, which has implications on the precision of the calculated recruitment rates. The most successful methods of recruitment were when a CC engaged with the study and assisted with recruitment. Face-to-face recruitment and social media dissemination by CC yielded high numbers of participants, likely due to the trusted source of information. This method was particularly effective as it targeted mothers within a specified location, often residing within the local neighbourhood, therefore aiding the matching process due to the availability of mothers within a confined location. Additionally, online recruitment on social media groups was effective for reaching mothers. Studies have found that Facebook users visit the website frequently (Munson, Lauterbach et al. 2010) and new mothers' Facebook use increases during the transition from pregnancy to the postnatal period, accessing the site daily (Bartholomew, Schoppe-Sullivan et al. 2012). In this study, using existing

Facebook groups to disseminate information appeared to be more effective than using paid Facebook advertising. This could be because mothers trusted adverts in a familiar group. Another potential explanation is the small scale of paid Facebook advertising of approximately £30 in this study, compared to a study recruiting pregnant smokers that utilised a budget of £1000 and ran for a duration of 3 months (Emery, Coleman et al. 2018), recruiting a total of 42 participants from the advert. The authors concluded that online recruitment methods may be feasible and potentially cost-effective for recruiting participants.

The key challenges encountered were engaging CCs in the recruitment process, participants not interested in the intervention and the matching process. I will discuss each challenge in detail below.

The response rate from CCs was low in this study (n=23, 31%), with 8 of those responding unable to help due to a recommissioning process in the local authority creating uncertainty for future staffing and service provision. It was not possible to determine the reason for non-responders, but possible reasons could be the recommissioning process, unable to commit the time to disseminate information or was not passed on to the relevant person within the centre.

The second recruitment challenge was the loss of participants between expressing an interest in the study and eligibility screening. This was due to non-response, not interested or ineligibility. Non-response could be due to not checking emails regularly, not answering phone calls to unknown numbers or not being interested in participating. One of the key reasons for not participating was a lack of time, which suggests the time commitment required to participate in the intervention was not acceptable for participants.

The third recruitment challenge was matching participants to a suitable buddy. Of 73 eligible participants, 21 participants were unable to find a suitable buddy. Anecdotally, from conducting this research, I can highlight that some participants shared the information with their close group of friends and were unsuccessful in finding a match, and then proceeded to ask to be matched by the researcher. The main reason that we were unable to find a match for participants was geographical limitations. When a match became available for some participants, they were no longer interested/eligible or contactable to participate in the study, suggesting that it is important that efforts to match participants occur immediately. Due to the nature of this study, participants' motivation for taking part may extend beyond becoming physically active and include social interaction and combating social isolation, which may be especially applicable to participants requesting a new match. However, these participants are missing the opportunity to participate in the study due to the recruitment procedures. One other study with mothers of young children

(under-five) has utilised a buddy strategy, where participants chose a family member or friend as their buddy. Participants predominantly chose their husbands and fewer chose to use female relatives, female friends and only one choosing a male friend (Choi and Fukuoka 2018). While this matching method would resolve the issue of non-matched participants, it would omit a key factor identified in the behavioural analysis in Chapter 3 where mothers preferred to participate in PA with other new mothers due to the mutual understanding of their challenges, body changes and can ask for advice on aspects specific to motherhood.

Additional lessons learnt during the recruitment process for this study were that simple engagement strategies towards recruitment partners, eg, emails to CC, may not be sufficient to engage them with the study. An approach that builds and maintains relationships over time or one that utilises the CC staff to recruit mothers may be more effective. It may be possible to foster these relationships with enhanced study personnel and preliminary data to support the potential effectiveness of this intervention among participants.

During the qualitative interviews, many mothers identified an optimal time for recruitment as 4-6 months following birth. Starting at this time allows mothers to recover from birth, settle into their new role and understand their new routine. In contrast, the postnatal PA guidelines suggest re-introducing PA at the earlier time of 6-8 weeks following a non-complicated birth, which mothers felt may be too early to engage in this intervention. This may not be a question of physical capability and suggests that mothers felt ready to re-engage in PA when they are familiar with the routine of being a mother and feel confident and comfortable to take on a new challenge. It may be possible that this particular intervention was appropriate for this specific time in the postnatal period and other approaches may be necessary to re-engage new mothers in PA earlier.

The recruitment procedures resulted in a sample with a high proportion of participants educated to degree level or higher and all participants residing in dual-parent households. Nevertheless, a qualitative study exploring single mothers' beliefs about physical activity reported similar findings to the study presented in Chapter 3 (Dlugonski and Motl 2016) which suggests that this study could be applicable among single parents. A study exploring recruitment strategies for engaging socio-economically disadvantaged populations in a prevention study found that face-to-face recruitment approaches were more successful than social marketing because the contact fosters enthusiasm, rapport and trust (Harkins, Shaw et al. 2010), suggesting that this method is important for engaging participants with a range of demographic characteristics.

### **6.5.2 Are the data collection procedures and outcome measures feasible and acceptable?**

The overall response rates at each data collection time were acceptable, despite decreasing as the intervention progressed. The response rate at baseline was 100%, post-intervention (92%) and 3-month follow-up (86.8%), with proportions from the two latter not including the six participants who had withdrawn during the intervention. The response rate was highest at baseline because I was present when collecting the data, whereas post-intervention and follow-up responses were reliant on postal returns. Reasons for the non-return of accelerometers at follow-up were lost in the post, non-contactable and injury. Participants were given a £10 high street voucher as a thank you for participating in the study. The provision of the voucher prior to completion and return of the data may have been less effective as studies that have promised a financial incentive upon return of the data increased the likelihood of returning a survey by 30% (Yu, Alper et al. 2017).

All self-report PA data collected at baseline and follow-up was valid, suggesting that asking participants to verify the duration of PA was effective for collecting complete data. However, despite an acceptable return of follow-up packs, not all returned accelerometers were valid, with 88.6% of data valid at baseline and 83.8% at 3-month follow-up. Comparative studies in the postnatal population using a longer-term, objective PA follow-up measurement cited a completion rate of 80% (Kernot, Lewis et al. 2019). A recent study examining the feasibility of collecting wrist-worn accelerometer data from children with Type 1 diabetes determined acceptability and feasibility of completing questionnaires as >70% and wrist worn activity monitors as 85% completion rate (Knox, Glazebrook et al. 2019), suggesting that follow-up objective PA data collection is just under the acceptable rate.

Both qualitative and questionnaire data suggests that the majority of participants found the accelerometers acceptable to wear. Additional data obtained from the telephone interviews found that participants reported difficulty wearing the accelerometer at the start of the day and reported additional difficulties at follow-up as many had returned to work. A small number of women cited that the accelerometer was uncomfortable on their abdominal scars from a Caesarean section. Some cited returning to work as a reason for not wearing the device as it was uncomfortable to sit in the work chair or was not discreet under work clothes. Perhaps, as suggested by participants, changing the wear location and device may be suitable for this population, and changing to a 24-hour wear procedure alleviate the burden of remembering to wear the device in the mornings. Indeed, a recent study exploring the device location in pregnant and postnatal women found moderate to excellent agreement between waist and hip worn accelerometers with correlations highest during the

postpartum period. In addition, compliance rates were higher for wrist worn accelerometers, with participants providing a greater number of hours and days wear when wearing a wrist worn accelerometer (Hesketh, Evenson et al. 2018).

Responses to the questionnaire for barrier efficacy were high across all items. There were three items on the questionnaire that a small number of participants did not complete because they were not applicable, eg, '*When you have a job working at home*' and '*when you return to work after being off for family/maternity leave*'. Some participants would not encounter these situations within their lives, eg, they are not returning to work following maternity leave or they are unable to work at home due to the nature of their occupation. A '*not applicable*' option for each item may be a useful addition to the questionnaire to ensure that the results are representative of participants who will encounter each situation.

One observation made during intervention delivery as noted in the session notes was that participants identified additional outcomes. For example, participants cited behavioural outcomes, eg, changes in dietary patterns or spousal behaviour, and physical outcomes and psychological outcomes, eg, weight loss (characterised by fitting into their pre-pregnancy clothes), mental wellbeing and reduced social isolation. As some participants cited a notable effect on these outcomes, a future study should consider expanding the data collection procedures to measure these as secondary outcomes.

### **6.5.3 What is the acceptability and feasibility of the intervention?**

The completion rate for the intervention was relatively high at 86.4%, with 3 pairs (6 participants) who withdrew from the intervention. One problem, which I did not foresee when planning the study, was the knock on effect of one participant's withdrawal on their buddy, eg, if one participant withdrew, their buddy was also unable to complete the intervention as planned. Only 3 participants directly withdrew from the intervention, which would yield a 93.2% completion rate; however, the buddies of the withdrawn participants also withdrew from the study, thus resulting in a lower adherence rate. The reasons for withdrawal were personal reasons (n=2), where the household were struck by flu/illness and one was because their buddy was unreliable. Future studies utilising buddy components should include a procedure for retaining participants if their buddy withdraws or they do not want to continue participating with their buddy in their protocol.

Adherence to the intervention was high with 100% completing the first session, 91% completing the second session and 77% completing the third session. There was a notable decrease in sessions delivered during the period between November and December. It was firstly difficult to schedule

sessions during this period due to scheduling difficulties in the run up to Christmas and secondly, participants cancelled a high number of sessions with short notice due to baby/mother illness, eg, cold/flu. Similar to a previous pram-walking intervention in postnatal women which found an overall attendance of 75% for the face-to-face sessions, the primary reasons for non-attendance were sick child/children (61%) and sickness (15%) (Armstrong and Edwards 2003). Face-to-face interventions with mothers and babies are susceptible to non-attendance because babies are especially susceptible to illness and mothers feel reluctant to meet others to prevent the spread of infection. This is exacerbated with a buddy intervention, as both babies need to be healthy, therefore a flexible delivery protocol is required.

Acceptability of the intervention sessions was high, likely due to the use of MI, which is a person-centred approach, guiding participants to set personal goals, delivered in a non-judgemental, empathetic and respectful manner (Linden, Butterworth et al. 2010). This was noted by participants in the qualitative interviews as a feature of the intervention sessions that was highly acceptable. The study did not measure the fidelity of MI. The MI treatment integrity code (MITI) is an example of a tool used to code the delivery of MI principles (Moyers, Rowell et al. 2016) and should be utilised in a future study. As described in section 6.5.2, participants noted additional behavioural changes, eg, dietary changes, which has been proposed and observed in other papers utilising MI because it targets a higher level of motivational constructs which may be applicable across a range of behaviours (Linden, Butterworth et al. 2010). This may be particularly applicable due to the close link between diet and PA. The acceptability of the intervention booklet was high among participants, yet its use outside of the intervention sessions was limited, due to a lack of time, energy and disruption by the baby. This is important to note to ensure that important topics are articulated during sessions as it is unlikely participants will gain information from additional materials and poses the opportunity to reduce intervention costs by reducing the booklet content.

The frequency of intervention sessions was generally acceptable. However, there was variation, with some participants citing that they were repetitive and the third superfluous, and others feeling that the stopped too soon. There are some potential explanations for this variation. Firstly, it could be dependent on the level of support offered by buddies outside of the sessions. If participants are receiving support from their buddies outside of the intervention sessions, eg, meeting up, sending encouraging messages, they may feel well supported to be active. However, in the absence of the support from the buddy, the intervention sessions are acting as the support mechanism as opposed to the buddy element, therefore participants seek additional sessions to provide support and contact with their buddy. A second possible reason is their pre-pregnancy PA levels and experiences

of PA. For example, those who engaged in PA regularly prior to pregnancy may possess self-regulatory skills required to engage in PA and the sessions acted as a catalyst to begin using these again following birth. For those who were less active prior to pregnancy, the self-regulatory skills take longer to develop. Allowing participants to choose the number of sessions may enhance intervention acceptability. One notable reason that participants felt additional sessions would be beneficial was the changing routines and circumstances throughout the postnatal period, eg, when their baby starts walking or when they return to work. Such changes have the potential to disrupt routines established in the study, and some support to re-establish PA within these circumstances may be beneficial.

The utilisation of the buddy element was highly variable among participants. The most common method of support offered by buddies was sending messages of encouragement followed by sharing PA information and then engaging in PA together. In the study 60% of participants engaged in PA with their buddy, which was higher among buddies with an existing relationship compared to those in a new relationship. This figure is higher compared to a similar pilot study in women with children under five who nominated a SS buddy. In this pilot study there was no eligibility criteria for the buddy who could therefore be a partner, female friend or similar, but buddies were required to exercise together at least once a week. In the results 50% of participants exercised with their buddies once per week (Choi and Fukuoka 2018).

From the qualitative data we can infer that the most motivating factor for increasing PA was meeting up with their buddy as this offers social interaction and a sense of accountability which is difficult to enforce through digital contact. Similarly, Choi and Fukuoka (2018) concluded that simply having a buddy was not sufficient to increase PA and active participation by the buddy is required. In our study, participants noted several barriers to engaging in PA together, including living too far away from each other, preferences for different activities and baby behaviour. The motivation to meet up was also influenced by buddy compatibility which was enhanced by similar interests and ability to generate a rapport with their buddy, more likely to be present among existing buddies. The aim of a future study should be to enhance the likelihood of this happening. Buddies should be able to develop a rapport together, want to spend time together and want to engage in similar activities at an acceptable distance for both participants. By minimising these barriers, this will maximise the likelihood that participants will engage in PA together. Even if a research study makes all efforts to maximise the chances of participants being active together, there may be other occasional reasons that participants may not be able to meet up, which include baby illness or unscheduled appointments.

Other support mechanisms utilised during this intervention were sending encouraging messages and sharing ideas on PA. However this decreased accountability, and participants found it difficult to maintain long-term support, with the frequency of contact diminishing over the duration of the intervention. Some participants said it was unlikely the contact would continue after the intervention had finished. Interestingly, a study utilising peer counselling and SS intervention for mothers with previous GDM utilising group exercise sessions observed that some participants attempted to use SMS and social media to provide encouragement, however the geographical barriers which prevented them from meeting face-to-face limited the longevity of the digital support (Ingstrup, Wozniak et al. 2019). The results suggest that digital support only is unlikely to be sufficient in the long term, but may be a useful alongside face-to-face meetings.

#### **6.5.4 What is the preliminary evaluation of the intervention effect?**

The data suggests that 'Buddy Up' has a positive influence on PA as the intervention effect is an increase in objective measurements. The study is not sufficiently powered for hypothesis testing as per the purpose of a feasibility trial (El-Kotob and Giangregorio 2018) and therefore the results of the statistical testing should be interpreted with caution. However, the promising result does suggest that the intervention may be effective and warrants further investigation.

Despite using a screening tool to exclude active participants, baseline PA levels were higher than expected. Potential reasons for this are that participants under-reported PA in the self-report screening because they were aware that they needed to be inactive to participate in the study. A second potential explanation is that there was often a time gap between eligibility screening and the measurement period, during which they may have increased their PA. It is also possible that reactivity bias was present, increasing PA in response to wearing the accelerometer. Lastly, it may be possible that new mothers do have high PA levels due to housework and/or childcare duties, but do not perceive these as PA and therefore did not report the activities.

The current study was limited by lack of a control group and cannot determine whether the increase in PA is a natural rebound effect following pregnancy, which has been evidenced in some existing studies (Borodulin, Evenson et al. 2009, Cramp and Bray 2009, Evenson, Herring et al. 2012). This is possible in the current intervention, with some mothers highlighting in the interview that they were thinking about re-engaging in PA. Due to the multi-component nature of the intervention (MI sessions and buddy element), a three group study design (Buddy+MI, MI only and control) would be appropriate to attribute whether changes in PA levels are indeed attributable to the buddy element. With a two group study it would not be possible to attribute the intervention effect to either the buddy or MI component. One ongoing study that has implemented such a design is the Healthy

Mom 2 trial, using a telephone based exercise intervention, compared with a telephone based wellness/support intervention and a usual care comparison (Lewis, Schuver et al. 2018).

Changes in barrier efficacy scores suggest the intervention had a positive effect on participant's confidence to overcome some barriers. This is promising as the intervention was designed to overcome several barriers to PA cited by participants in Chapter 3. Such strategies in Buddy Up included signposting participants to low cost or free opportunities and a section utilising problem solving skills to identify strategies to overcome personal barriers to PA, which often aligned with the barriers included in the questionnaire. Changes in barrier efficacy scores suggest the intervention had a positive effect on engaging in PA when there is no money available, when the weather is bad, when feeling depressed and when there is no one to be physically active with, which should be interpreted with caution as the study was not adequately powered to detect an effect. A future study that is adequately powered to detect an intervention effect could determine the effect of Buddy Up on barrier efficacy.

### **6.5.5 Strengths and limitations**

This is the first study that has explored the utilisation of a buddy intervention among postnatal women. Previous studies in mothers with young children have recruited non-mother buddies from the participants' existing social network, eg, partners or female friends. A strength of this study was the use of objective PA measurement to alleviate some of the bias associated with self-report PA measurement. In addition, this is one of the first studies in postnatal women with a longer follow-up period as identified in Chapter 2. The use of the Framework method for the qualitative analysis was a strength of the study as I was able to analyse the data by each participant and therefore able to determine participants' attitudes towards each specific aspect of the intervention and determine whether there was any interaction between the themes.

A limitation of this study was the lack of a control group. While this decision was made to maximise the utilisation of limited resources, it has not been possible to assess the acceptability of randomisation to an intervention or control group. Additionally, with no control group to compare data, it is not possible to determine whether the increases in PA demonstrated in this study are a natural pattern of rebounding PA levels during postnatal period. In the absence of a control group, it is also difficult to establish whether the intervention sessions without the buddy element would have resulted in an increase in PA. Additionally, conducting a larger-scale study would require other researchers/professionals to be trained to deliver the intervention, and it is unknown how this would affect the delivery of the intervention.

## 6.6 Chapter six summary

Recruitment of participants to the feasibility and acceptability trial of Buddy Up was challenging. The most effective recruitment methods were using existing mother and baby groups, eg, CCs and online groups, to disseminate information. Challenges to recruitment included engaging CCs and matching eligible participants with a buddy because of geographical limitations. The demographic characteristics of the resulting sample showed an over-representation of highly educated women and dual parent households and participants had higher PA levels than expected. 44 participants (n=22 forming new relationships, n=22 based on existing relationships) completed baseline assessment with a retention rate of 77% completing the intervention. When one participant withdrew from the study, it resulted in their buddy withdrawing from the study. Adherence to the intervention was high, but per protocol delivery was difficult due to scheduling difficulties and last minute cancellations, primarily due to baby illness during the winter months, requiring a flexible delivery method. The intervention sessions and booklet were highly acceptable to participants; however, their use of the booklet outside of the sessions was limited. The acceptability and utilisation of the buddy element was variable among participants. It appeared to be most effective when participants engaged in PA together due to the motivational elements of accountability and social interaction. Communicating through messages (SMS, WhatsApp etc) has the potential to be useful alongside engaging in PA together, but is unlikely to continue in the long term if used in isolation. Barriers to engaging in PA together were geographical limitations and compatibility issues between participants (eg, living too far away, nothing in common, didn't 'gel') which are more likely to be present among newly matched buddies. The questionnaire was acceptable to participants and yielded a high proportion of valid data. There were a sufficient number of valid objective PA data at baseline, but this was low at 3-month follow-up. Qualitative data indicated that most participants thought the objective measurement was acceptable, but a small number found it difficult to remember to wear the accelerometer at the start of the data collection period, in the morning, and some found it difficult to wear under clothing or uncomfortable on their Caesarean section scar. A few participants suggested changes to the wear protocol, which include a wrist worn device and continual wear to improve data collection. The preliminary analysis of the outcome measures suggests that the intervention had limited effect on participants' barrier efficacy, but it did have a positive effect on objective and self-report PA, with participants reporting higher PA levels at 3-month follow-up compared to baseline measurements. This feasibility study was not sufficiently powered to determine intervention effectiveness, but the results are promising and the intervention may be worth investigating further.



## 7 Discussion

The primary aim of this thesis was to develop and assess the feasibility of delivering a postnatal PA intervention. The series of studies presented in this thesis followed a systematic approach to intervention development, resulting in the development of a novel, evidence-based buddy intervention for PA. The results from Chapter 2 and Chapter 3 were intended to provide evidence to guide future intervention development within an existing intervention development framework. The remainder of this chapter discusses the issues that are important to guide future research utilising a buddy model.

### 7.1 Thesis overview

There were four key components to this thesis as outlined in Chapter 1. First, a systematic review of existing postnatal physical activity interventions, to determine their effectiveness and identify intervention components associated with intervention efficacy (Chapter 2). Second, a multi-methods study to identify the factors that influence postnatal PA according to the COM-B model of behaviour (Chapter 3). Third, a description of the intervention development process using the BCW method for intervention development (Chapter 4). Lastly, a feasibility study to assess the feasibility and acceptability of the resulting 'Buddy Up' intervention (Chapter 5 and 6). The main results from each study are outlined below, followed by a broader discussion, implications and the future directions of this research project.

#### **Study One: Effectiveness of PA interventions in postnatal women: A systematic review and meta-analysis**

The majority of existing reviews on postnatal physical activity focused on weight-related outcomes or included interventions with dietary components, thus the effectiveness of PA only interventions was unknown. This study aimed to determine the effectiveness of existing postnatal PA interventions and identify the intervention components associated with effectiveness. The search identified eleven eligible studies that were highly variable, with some utilising counselling strategies and others providing prescriptive doses of PA. The most common BCTs included in the interventions were '*goal setting (behaviour)*', '*social support (unspecified)*' and '*self-monitoring of behaviour*'. Where there was adequate reporting to assess risk of bias, it was generally low with the exception of performance bias and detection bias where nearly all studies were coded as high risk of bias. The meta-analysis demonstrated a small but significant effect on PA in the intervention group compared to the control group. These studies were limited by use of self-report PA measures and lack of long-term follow-up measurements, which cannot determine long-term effectiveness. The meta-

regression proposed to identify intervention components associated with intervention effectiveness found no intervention components associated with intervention effectiveness; however, this analysis was limited by the small number of studies and was unable to inform the intervention development process. This was the first review to identify the effect of PA only interventions on PA and the first to attempt to employ statistical methods to identify effective intervention components in postnatal women. Results suggest that existing postnatal PA interventions are effective, but further controlled trials are required to determine the effective intervention components. Furthermore, evaluations using objective PA measurements and longer follow-up periods are required.

### **Study two: A behavioural analysis of postnatal PA: A multi-methods study**

Previous studies on the factors that influence postnatal PA have limited participants to report a finite number of barriers and raise concerns that qualitative research methods have not reached saturation. The purpose of this study was to build on existing research to identify the factors that influence behaviour guided by an existing model of behaviour as part of an intervention development process. A multi-methods approach utilised a qualitative approach that aimed to provide a detailed description and a quantitative study to determine the relative importance of each factor influencing behaviour. The final aim of this study was to conduct a behavioural analysis of postnatal PA for use in subsequent stages of the BCW.

The qualitative interview data found that all COM-B components influenced behaviour, described below. Psychological capability was influenced by participants' lack of information about PA opportunities and what PA was appropriate and safe for the postnatal period. Physical capability was particularly limited among participants who had a Caesarean section or complicated birth which limited physical stamina and ability to complete some activities. Physical opportunity was the most commonly coded category, and participants reported that care must be in place for the baby either through partner, family or formal childcare or addressed by engaging in PA that enabled them to care for their baby, eg, walking or child-friendly PA classes. Additionally, breastfeeding was a barrier to PA due to unpredictable routines and inability to leave baby. Social opportunity influenced behaviour through good SS from partners and preference for participating in group-based PA, particularly with other new mothers due to shared understanding of the challenges of PA as a new mother. Automatic motivation was influenced by enjoyment, social interaction and getting out of the house as motivations for PA. Lastly, reflective motivation was influenced by maternal motivations, eg, better health in the future, role modelling and being able to join in PA with their children. There are competing priorities for mothers' time, money and energy, and the value they place on PA determines whether they will engage in PA.

The quantitative component identified lack of time, childcare, feeling tired, being part of a group, advice by a healthcare professional, having more motivation and developing a habit as the top factors influencing behaviour. The results from the two methods were integrated in a behavioural analysis. In practice, service provision may consider group-based PA for new mothers that capitalises on salient motivations identified in this research, eg, enjoyment, social interaction, benefits for babies. Future research can use the behavioural analysis presented to develop interventions for postnatal women.

### **Study three: Intervention development**

This study aimed to use the remaining steps of the BCW to develop an evidence-based postnatal PA intervention. Based on the factors identified in the previous study, five intervention functions (education, persuasion, environmental restructuring, modelling and enablement) and ten BCTs were selected. I chose a face-to-face delivery method due to participants' preference for social interaction. I chose two key intervention strategies: 1) Buddy intervention 2) PA counselling underpinned by MI principles. The resulting 'Buddy Up' intervention delivered ten BCTs. Buddy Up matches two new mothers as physical activity 'buddies' to provide mutual support to increase PA. Participants are matched with a buddy by either nominating an existing friend or opting to match with another eligible participant. The intervention consisted of three PA counselling sessions based on MI principles at fortnightly intervals, and participants were provided with a supplementary booklet. Participants were guided through two sections: 1) strengthen motivation and reason to change and 2) strengthen commitment to change. Previous interventions utilising SS among postnatal mothers involve nominating a SS person within an existing network, often partner or female friends. This is the first intervention, certainly among postnatal women and to my knowledge in PA research, where both buddies are members of the target population and have a shared goal.

### **Study four: Feasibility and acceptability of a buddy intervention to promote postnatal PA**

Due to its novelty, the final study intended to explore the feasibility and acceptability of a buddy intervention for postnatal mothers. The study aimed to address four key uncertainties of delivering a buddy intervention; 1) recruitment, 2) data collection, 3) acceptability and feasibility and 4) potential intervention effect. Firstly, the recruitment process was challenging due to difficulties engaging children's centres with recruitment and difficulties matching participants to appropriate pairs due to limited numbers and geographical limitations. Secondly, the proportions of valid questionnaires completed at baseline and follow-up were acceptable, and the proportion of valid objective PA data at baseline was acceptable, but was low at follow-up due to non-return and insufficient wear time. Participant views on acceptability of the data collection procedures were mixed. Some cited

difficulty remembering to wear the device in the morning, while others missed large periods due to the baby. Thirdly, participant retention rate was acceptable, but adherence to the fortnightly session schedule was low due to initial scheduling difficulties and last minute cancellations due to baby illness. The majority of participants viewed the intervention positively, citing signposting to PA opportunities and time to focus on PA as the important aspects. Participant views on the buddy element were mixed and were influenced by compatibility and buddy support. Lastly, outcome data indicates a promising intervention effect on self-report PA using paired results (baseline – 1533.6; follow-up – 1917.5 MET-min/week) and objective PA (baseline – 697.7; follow-up – 765.0 CPM). Results suggest that the intervention has potential to improve some items on the barrier efficacy questionnaire (depressive feelings, lack of money, bad weather and no one to be active with), but did not improve self-efficacy to overcome the majority of barriers. Future research should aim to overcome some of the challenges identified to deliver a buddy intervention for postnatal women.

## **7.2 General discussion and implication of the findings**

Based on the existing evidence and contributions of this thesis, it can be concluded that SS provided by peers is one of the key influencing factors on postnatal PA. Findings from Chapter 2 indicate that strategies to enhance SS are implemented widely across postnatal PA interventions and strategies include nominating a SS person usually a partner or female friend (Fjeldsoe, Miller et al. 2010, Choi and Fukuoka 2018). Furthermore, the findings from Chapter 3 extend knowledge and suggest that strategies to enhance peer SS may be effective in this population. This is consistent with previous experimental research demonstrating limited perceived usefulness of using existing partners for SS due to long working hours and a ceiling effect (Fjeldsoe, Miller et al. 2010). Results from the feasibility study of a buddy intervention confirm that peer SS is a promising avenue for research due to its acceptability and encouraging effect on objective PA measurement. However, the results suggest that identifying compatible buddies is a vital component of this intervention. The literature on forming adult friendships suggests that converting an acquaintance to a close friendship is dependent on attractiveness to the friendship, which is boosted by similarity, eg, social and demographic status, attitudes, interests, intelligence and personality traits (Verbrugge 1977). Thus, these factors must be taken into consideration when artificially creating a friendship. In recent years, the availability of digital methods of forming relationships has grown for dating and friendship. To my knowledge, one app exists to connect mothers within local areas with features including ‘Mush Matcher’ (Mush 2019), and similar models to match participants may be an avenue for further research. Beyond new mothers, buddy interventions may warrant investigation in other populations

with a strong identity and unique lived experiences, such as patient groups that would benefit from PA promotion, eg, cancer survivors or patients with type 2 diabetes.

The research studies attracted participants largely from dual-parent households and well-educated background. Therefore, the results for the behavioural analysis presented in chapter 3 may reflect views of this population and omit views from populations under-represented in the research. Consequently, the resulting intervention may not be generalizable to other populations. Efforts to recruit diverse samples, including single parents, low educated and from more deprived areas should be explored.

Results from Chapter 3 indicate that multiple factors influence postnatal PA across all COM-B components, and that multi-component interventions are required to target all factors. The intervention development described in Chapter 4 did not target all factors identified in the behavioural analysis; of note, factors influencing physical opportunity were not targeted. The behavioural analysis therefore provides intervention developers with a detailed starting point to develop interventions. Four potential interventions arise neatly from the behavioural analysis. First, group-based child-friendly PA opportunities would address social opportunity, automatic motivation and psychological capability components. Multiple classes exist, for example, but mothers cited cost and accessibility as key attendance barriers. This suggests that some adaptations to existing services, including cost reduction may be needed. Secondly, information provision may address psychological capability by informing mothers when it is safe to re-engage in PA and to identify appropriate PA. Information provision alone is not an effective intervention strategy among the general population (Marcus, Owen et al. 1998). In contrast, the lack of knowledge identified in chapter 3 and usefulness of signposting to appropriate activities in Chapter 6 suggest that this may be an effective strategy among postnatal women. Information provision about available opportunities is included in many existing interventions during PA counselling (Fjeldsoe, Miller et al. 2010, Albright, Steffen et al. 2014, Lewis, Gjerdingen et al. 2014); however the effectiveness of information provision alone is unknown. Following on, a third potential intervention that warrants further investigation is the provision of healthcare professional (HCP) advice. Research should focus on identifying when it is appropriate for HCP to provide advice, what advice is appropriate and strategies to engage HCPs with interventions. The extent to which such interventions would work independently or in a complementary way also warrants further investigation. Furthermore, the BCW identifies potential policy functions. Although this stage was not utilised in the current thesis due to limited access to policy levers, policies to enable postnatal PA should be investigated. Of particular interest and noted previously in the literature is the development of guidelines for postnatal PA (Evenson, Mottola et al. 2014), which

have been released recently in the UK (Chapter 1). The extent to which the guidelines will be disseminated and used remains to be seen.

The postnatal PA literature would benefit from further research to refine objective PA measurement procedures for postnatal women. The findings presented suggest that factors unique to this population negatively influenced the wear time and subsequently the collection of valid data, questioning the appropriateness of waist-worn devices for this population. Existing studies indicate that wrist- and hip-worn accelerometer data is comparable in the pregnant and postnatal population (Hesketh, Evenson et al. 2018). The effect on wrist-worn accelerometers on data collection procedures in intervention research is worth exploring.

### **7.3 Strengths and limitations of the research**

The strengths and limitations of each component of this thesis have been discussed in each chapter and need not be repeated in this section. Overall, a strength of this thesis is that it followed a systematic intervention development method, using formative research to identify existing research and establish the factors influencing behaviour as key targets to include in the final intervention. Conducting the feasibility trial was important to identify the operational difficulties of delivering the intervention. The key uncertainties prior to the study were recruitment, data collection, acceptability and potential effect. The thesis methods enabled the identification of each problem and the findings can guide future research to refine procedures to deliver the intervention and evaluation effectively.

A limitation of this thesis was that a single intervention was unable to target all factors that influenced behaviour according to the COM-B model (Chapter 3). Namely, factors influencing physical opportunity, eg, safe spaces, provision of local child-friendly PA groups, were not addressed, and some participants cited these barriers in the post-intervention qualitative interviews. If future research deemed Buddy Up effective, it would only be part of the solution to engage postnatal mothers in PA. Other interventions targeting physical opportunity are still needed. An additional limitation of this thesis is that the research is likely not to be generalizable to other geographical areas due to the differences in PA provision between local authorities. The research was conducted in an affluent area of the UK, and it is possible that characteristics associated with affluence, eg, access to a vehicle or financial stability to enable unpaid maternity leave, enhanced the feasibility of a Buddy study. Its feasibility in more deprived areas needs further investigation.

## **7.4 Future directions of this research**

The studies presented in this thesis complete the first two steps of the MRC guidance of intervention development and feasibility/piloting. The next two steps to complete the cycle are evaluation and implementation. The Buddy Up feasibility study demonstrated high acceptability and a promising effect on PA, which warrants further investigation, however it identified challenges with the current recruitment and intervention delivery procedures and consequently in its current form is inappropriate for a large-scale trial. The MRC guidance suggests a cyclical approach, and a series of feasibility studies may be appropriate in preparation for large-scale evaluation, therefore I suggest the next stage of this research would be to conduct a second feasibility trial addressing the key uncertainties of recruitment, intervention delivery and data collection. The remainder of this chapter discusses each of these in detail followed by the implications for the final two steps of the MRC intervention development process, based on a situation with greater study resources.

### **7.4.1 Refine procedures in a feasibility study**

#### *7.4.1.1 Recruitment*

The two key factors to refine under recruitment include improving effectiveness of recruitment methods and the matching process.

##### a) Recruitment methods

The methods employed in this thesis to engage CCs were 'light touch' including only an email or visit. Using the additional resources of an enhanced project team, I would suggest using methods that develop working relationships with CCs, including sharing positive preliminary results from this research as a motivation for them to engage with the project. Additionally, offering financial reimbursements for recruiting participants may be an attractive option, especially during a time of austerity and financial difficulties. This method is commonly used in primary care research to engage GP practices with participant recruitment and may be applicable to engage CC with research. Prior to a feasibility study, I recommend PPI work with CC employees to identify effective methods to engage settings and understand their capability to be involved in recruitment procedures.

Engaging additional project partners may also be appropriate. GP practices have multiple contacts with new mothers and existing networks, eg, UK Clinical Research Network (UK Clinical Research Collaboration 2019) provide infrastructure to support clinical research studies for patients. Contacts such as the 6-8 week appointment that checks that mothers are feeling and recovering well may be an opportune moment to recruit participants to health interventions.

Lastly, paid Facebook advertising in the current study demonstrated a similar cost per participant to *MiQuit*, a smoking cessation intervention for pregnant smokers (£29.90 vs £24.73 respectively), which concluded that commercial online adverts are likely a cost-effective method (Emery, Coleman et al. 2018). Improvements to the landing page from the Facebook advert may facilitate a greater number of participants registering an interest in the study. Therefore, the effectiveness of this recruitment method with an enhanced budget should be further explored.

#### b) Matching participants with a buddy

Findings from the feasibility study identified the matching process as an important recruitment barrier, which was limited by the ability to recruit mothers within close geographical proximity. Matching was most effective when I visited mother and baby groups within CC because participants lived locally, thus eliminating the geographical barriers. Therefore, the influence of efforts to recruit using project partners operating within a confined geographical area on the matching process should be explored in future research. A larger pool of local participants would enhance the likelihood that participants can choose a suitable buddy potentially leading to more favourable intervention outcomes. The matching process is time intensive for study personnel and therefore efforts to reduce the required time resource would be beneficial for large-scale evaluation and implementation, exploring the possibility of digital methods or group meet ups that allow participants to choose their buddy.

#### 7.4.1.2 *Intervention delivery*

The feasibility study identified session cancellation and participant withdrawal as barriers to intervention delivery. Firstly, last minute session cancellations required significant administrative time to contact the other participant and rearrange sessions and is not feasible in a large trial. I suggest contingency plans that involve individual telephone sessions to both participants if they are unable to attend the session. This would enhance operational feasibility by maintaining the fortnightly delivery schedule and reduce administrative load, but would reduce the exposure to the buddy element. By improving the matching process as outlined above to enhance the compatibility of buddies, I hypothesise that buddies would be more likely to meet up for PA, which would reduce the need for them to interact at the MI sessions. Secondly, participant withdrawal had negative implications for their buddy's participation. A future study protocol should deliver adapted sessions to individuals based on evidence demonstrating the effectiveness of MI delivered to individuals and employ appropriate statistical methods to account for this, eg, Intention to treat analysis (Hollis and Campbell 1999).

#### 7.4.1.3 Data collection

The validity of objective PA outcomes was acceptable and comparable to other studies in postnatal women using hip/waist worn devices (Lewis, Gjerdingen et al. 2014, Kernot, Lewis et al. 2019). However, the telephone interviews identified two changes that could enhance compliance: a wrist-worn device and a 24-hour wear protocol. Firstly, participants expressed a preference for a wrist-worn accelerometer for reasons specific to the postnatal population, eg, discomfort on C-section scar or when holding the baby. The rise in popularity of wearable wrist-worn technologies may enhance the acceptability of a wrist-worn device (McCarthy and Grey 2015), and evidence suggests greater compliance to wrist-worn compared to hip-worn accelerometers in pregnant and postnatal women (Hesketh, Evenson et al. 2018). Consequently, adopting a wrist-worn device may be one strategy to improve valid data collection. The second suggestion, a 24-hour wear protocol, arose because mothers forgot to wear the accelerometer when they first woke up or after a shower and has been found to significantly increase waking wear time and proportion of valid cases (Tudor-Locke, Barreira et al. 2015).

### 7.4.2 Completing the MRC guidance

#### 7.4.2.1 Evaluation

The results of a second feasibility trial would indicate whether a large-scale evaluation is feasible. For this to be feasible, we would need to be confident that the challenges identified above were resolved and that the new procedures are feasible and result in acceptable rates of participant recruitment, retention and valid data collection. Additionally, if a full efficacy trial was deemed appropriate, the results from the second feasibility trial would be used to calculate the sample size required for a full efficacy trial.

#### 7.4.2.2 Implementation

The appropriateness of implementing the intervention on a large scale is highly dependent on the outcome of the efficacy trial. If the trial yielded effective change in objective PA and other secondary outcomes, it may be appropriate for the intervention to be scaled up, defined as *‘the process by which efficacious health interventions are expanded under real world conditions into broader policy or practice’* (Milat, Laws et al. 2013, Milat, King et al. 2014). As identified in the MRC guidance, implementing interventions at scale requires behaviour change and/or advocacy from a range of people involved in a community to deliver the interventions. Features of this research outlined above that would be conducive to increasing scale are the proposed recruitment model using existing settings, eg, CCs or GP practices, and using automated matching approach. One key aspect of scaling up the intervention would be to identify appropriate persons to deliver the intervention.

Likely candidates are health promotion officers working within local authorities or activity coaches working within local leisure settings.

## **7.5 Conclusion**

This thesis presents a systematic intervention development process resulting in the first buddy intervention for postnatal PA. The feasibility study suggests that buddy interventions are promising for increasing postnatal PA and acceptable to participants, but some operational difficulties were identified, including matching participants. Further research exploring recruitment, protocol adherence and data collection procedures is needed to improve the feasibility of conducting a large-scale efficacy trial.

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## Appendix 2.1: PRISMA Checklist

Section/topic	#	Checklist item	Reported in section #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	2
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2.7
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	2.1
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2.1.1 2.2.3.1
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	2.2.1
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	2.2.3.1
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	2.2.2
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	2.2.3 Appendix 2.2
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	2.2.4

Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	2.2.5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	2.2.5
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	2.2.5.1
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	2.2.6.2
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	2.2.6.2

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	2.2.6.2 b)
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	2.2.6.2 b) c)
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	2.3.1 Figure 2.1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	2.3.2 Table 2.2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	2.3.3 Figure 2.2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	2.3.5 Figure 2.3

Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	2.3.5.1
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	2.3.5
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	2.3.5
<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	2.4.1
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	2.4.4
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	2.4
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

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

For more information, visit: [www.prisma-statement.org](http://www.prisma-statement.org).

## **Appendix 2.2: Search strategy for Medline (via Ovid 1946 to present)**

1. physic\* activ\*.mp.
2. exp exercise/
3. walking/ or walking.mp.
4. fitness.mp. or physical fitness/
5. running.mp. or running/
6. physical exertion/ or cycling.mp. or bicycling/
7. swimming/ or swimming.mp.
8. yoga.mp. or yoga/
9. pilates.mp.
10. energy expend\*.mp.
11. sport.mp. or sports/
12. dancing.mp. or dancing/
13. active lifestyle.mp.
14. leisure activities.mp. or leisure activities/
15. activities of daily living.mp. or "Activities of daily living"/
16. or/1-15
17. randomized controlled trials as topic/
18. random allocation/
19. double blind method/

20. single blind method/
21. clinical trial/
22. Clinical trial phase i.pt.
23. clinical trial phase ii.pt.
24. clinical trial phase iii.pt.
25. clinical trial phase iv.pt.
26. controlled clinical trial.pt.
27. multicenter study.pt.
28. clinical trial.pt.
29. exp clinical trial as topic/
30. (clinical adj trial\$).tw.
31. ((singl\$ or doubl\$ or trebl\$ or tripl\$) adj (blind\$3 or mask\$3)).tw.
32. placebos/
33. placebo\$.tw.
34. quasi.mp.
35. randomly allocated.tw.
36. or/17-35
37. case report.tw.
38. letter/
39. historical article/

40. or/37-39
41. 36 not 40
42. postnatal.mp. or postnatal care/
43. post natal.mp.
44. postpartum.mp. or postpartum period/
45. post partum.mp.
46. peripartum.mp. or perinatal care/
47. or/42-46
48. urinary incontinence.mp.
49. postnatal depression.mp. or Depression, Postpartum/
50. gestational diabetes.mp. or Diabetes, Gestational/
51. or/48-50
52. 47 not 51
53. 16 and 41 and 52
54. limit 53 to (english language and humans)

## **Appendix 3.1: Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire – Short form**

### **3.1.1 Continuous physical activity score equations**

Walking MET-Minutes/week = 3.3 \* walking minutes \* walking days

Moderate MET-minutes/week = 4.0 \* moderate intensity activity minutes \* moderate days

Vigorous MET-minutes/week = 8.0 \* vigorous intensity activity minutes \* vigorous intensity days

Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores.

### **3.1.2 Categorical scores**

Low

Individuals who do not meet criteria for 'moderate' or 'high' are considered to have a 'low' physical activity level.

Moderate

Patterns of activity that meet either of the following criteria:

- i) 3 or more days of vigorous-intensity activity of at least 20 minutes per day
- ii) 5 or more days of moderate intensity activity and/or walking of at least 30 minutes per day
- iii) 5 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum Total physical activity of at least 600 MET-minutes/week.

Individuals meeting at least one of the criteria above would be defined as accumulating a minimum level of activity to be classified as 'moderate'.

High

The two criteria for classification as 'high' are:

- i) vigorous-intensity activity on at least 3 days achieving a minimum Total physical activity of at least 1500 MET-minutes per week.

ii) 7 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET-minutes per week.

### **3.1.3 Data processing rules**

#### *3.1.3.1 Data cleaning*

i) any responses to duration (time) provided in the hours and minutes response option should be converted from hours and minutes to minutes.

ii) To ensure that responses in 'minutes' were not entered in the 'hours' column by mistake during self-completion or during data entry process, values of '15', '30', '45', '60' and '90' in the hours column should be converted to '15', '30', '45', '60' and '90' minutes respectively in the minutes column.

iii) In some cases, duration (time) will be reported as weekly (not daily). These data should be converted into an average daily time by dividing by 7.

iv) If 'don't know' or 'refused' or data are missing for time or days then that case is removed from analysis.

#### *3.1.3.2 Maximum values for excluding outliers*

All cases in which the sum total of all walking, moderate and vigorous time variables is greater than 960 minutes (16 hours) should be excluded from the analysis. This assumed that on average an of 8 hours per day is spent sleeping.

The days variables can take the range 0-7 days, or 8, 9 (don't know or refused); values greater than 9 should not be allowed and those cases excluded from analysis.

#### *3.1.3.3 Minimum values for duration of activity*

Only values of 10 or more minutes of activity should be included in the calculation of summary scores. Responses of less than 10 minutes (and their associated days) should be re-coded to zero.

#### *3.1.3.4 Truncation of data rules*

It is recommended that all walking, moderate and vigorous time variables exceeding '3 hours' or '180 minutes' are truncated (that is re-coded) to be equal to '180 minutes' in a new variable. This rule permits a maximum of 21 hours of activity in a week to be reported for each category (3 hours \* 7 days).

### *3.1.3.5 Calculating MET-minute/week scores*

Using the resulting variables from the earlier steps, convert time and days to MET-minute/week scores using the equations in section 3.1.1.

### *3.1.3.6 Calculating total days for presenting categorical data on moderate and high levels*

Using categorical variables required the total number of 'days' on which all physical activity was undertaken.

To calculate moderate activity, Individuals who undertake activity on at least five days per week should be coded in a new variable called 'at least five days' and this variable should be used to identify those meeting criterion i) and ii) for moderate activity outlined in section 3.1.2.

The original frequency of days for each type of activity should remain in the data file for use in other calculations.

To calculate vigorous activity, individuals who undertake activity on at least 7 days/week should be coded in a new variable called 'at least 7 days' and this variable can be used to identify those meeting criterion ii) for high activity outlined in section 3.1.2.

## Appendix 3.2: Quantitative COM-B Questionnaire

### A quantitative behavioural analysis of postnatal physical activity according to the COM-B model

Please read the statements below and rate each one on a scale of 1-7 how strongly you agree or disagree with the statement, by circling the number that matches how you feel.

**1.1. I would be more active if I had a better understanding of why physical activity is important**

Strongly disagree

Strongly agree

1                      2                      3                      4                      5                      6                      7

**1.2 I would be more active if I knew what to do**

Strongly disagree

Strongly agree

1                      2                      3                      4                      5                      6                      7

**1.3 I would be more active if I were physically stronger**

Strongly disagree

Strongly agree

1                      2                      3                      4                      5                      6                      7

**1.4 I would be more active if I learnt strategies such as setting goals**

Strongly disagree

Strongly agree

1                      2                      3                      4                      5                      6                      7

**1.5 I would be more active if I didn't give up so easily**

Strongly disagree

Strongly agree

1                      2                      3                      4                      5                      6                      7

**1.6 I would be more active if I had more stamina physically**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.7 I would be more active if I had more stamina mentally**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.8 I would be more active if I had more time**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.9 I would be more active if I had more money**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.10 I would be more active if I felt less tired**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.11 I would be more active if I had childcare**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.12 I would be more active if I had the right kit, eg, clothes, trainers, pram**

Strongly disagree

Strongly agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

**1.13 I would be more active if it were easier to access facilities, eg, leisure centres, gyms, swimming pools**

Strongly disagree

Strongly agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

**1.14 I would be more active if there were suitable spaces to be active, eg, public parks, greenspaces, well lit/safe footpaths**

Strongly disagree

Strongly agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

**1.15 I would be more active if I were part of a group**

Strongly disagree

Strongly agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

**1.16 I would be more active if I were prompted to do so**

Strongly disagree

Strongly agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

**1.17 I would be more active if I had encouragement from those around me**

Strongly disagree

Strongly agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

**1.18 I would be more active if I was advised to do so by a healthcare professional**

Strongly disagree

Strongly agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

**1.19 I would be more active if I had more motivation**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.20 I would be more active if I felt it would do me good**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.21 I would be more active if I felt I could develop a habit**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.22 I would be more active if I had a plan**

Strongly disagree

Strongly agree

1            2            3            4            5            6            7

**1.23 Is there anything else that influences your physical activity levels?**


**About**

**you**

Finally, we would just like to know a little bit more about you. We will use the data you provide below to help us understand who has taken part in our research. The first part asks questions about you,

and the second asks about your physical activity levels.

Please circle the answer that applies to you

**2.1 Age (years):**

16-24

25-30

31-35

36-40

41-45

46-50

**2.2 Number of children:**

**2.3 Age of youngest child:**

\_\_\_\_\_

\_\_\_\_\_

**2.4 Marital status:**

Married

Co-habiting

Single

Separated

Divorced

Widowed

**2.5 Employment:**

On maternity leave

Full-time employment

Part-time employment

Not  
employed

**2.6 Education level:** *Please circle the highest level of education you have obtained*

Some secondary school

GCSE

A level or equivalent

University/college  
degree

**Physical activity levels**

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place and in your spare time for recreation, exercise or sport.

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

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

- a. \_\_\_\_ days per week
- b.  No vigorous physical activities (skip to question 3.3)

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

- a. \_\_\_\_ hours per day
- b. \_\_\_\_ minutes per day
- c.  Don't know/not sure

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

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

- a. \_\_\_\_ days per week
- b.  No moderate physical activities (skip to question 3.5)

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

- a. \_\_\_\_ hours per day
- b. \_\_\_\_ minutes per day
- c.  Don't know/not sure

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

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

- a. \_\_\_\_ days per week
- b.  No walking (skip to question 3.7)

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

- a. \_\_\_ hours per day
- b. \_\_\_ minutes per day
- c.  Don't know/not sure

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

3.7 During the **last 7 days**, how much time did you spend sitting on a **weekday**?

- a. \_\_\_ hours per day
- b. \_\_\_ minutes per day
- c.  Don't know/not sure

In the future, we will be conducting more studies involving new mums. If you would like to be contacted about taking part in this research, please leave your contact details below:

Name: \_\_\_\_\_

Email address: \_\_\_\_\_

Telephone number: \_\_\_\_\_

**Thank you for taking the time to answer the questions in this survey. Your responses are very valuable to help us design a programme to support new mothers to become more active.**

If you have any further questions please contact the research team:

Kate Ellis

Email: [nke22@medschl.cam.ac.uk](mailto:nke22@medschl.cam.ac.uk)

Telephone: 01223 746547

Address: Institute of Public Health, Robinson Way, Cambridge, CS2 0SR

## Appendix 4.1: Candidate BCTs for the intervention

COM-B component	Behavioural analysis	Chosen functions <sup>a</sup>	Intervention	Appropriate Behaviour change techniques
Physical capability	<b>Pain and tiredness;</b> Mothers, particularly those with complicated births, experienced pain and tiredness when walking during very early postnatal period.	Enablement		8.7 Graded tasks
Psychological capability	<b>Knowledge of activity opportunities;</b> Don't know about local activity opportunities, don't know where to look to find out about them. Could be due to psychological capability, could be due to lack of opportunities.	Education		1.1 Goal setting (behaviour) 1.4 Action planning 1.5 Review behavioural goals 1.7 Review outcome goals 2.3 Self-monitoring of behaviour 4.1 Instruction on how to perform the behaviour 6.1 Demonstration of the behaviour 8.1 Behavioural practice/rehearsal 8.7 Graded tasks
	<b>Knowing what to do;</b> Don't know when and how to re-engage in PA. Unsure what activities to do to regain strength and fitness.	Education Enablement		1.1 Goal setting (behaviour) 1.4 Action planning 4.1 Instruction on how to perform the behaviour** 8.7 Graded tasks*
Physical opportunity	<b>Baby;</b> Baby makes engaging in PA impractical by; demanding attention, eg, crying, disrupting PA attempts; sleeping and feeding routines are unpredictable – planning PA is difficult; walking long distances with baby in a sling can be uncomfortable.	Enablement		1.2 Problem solving 1.4 Action planning 3.2 Social support (practical)
	<b>Weather;</b> Poor weather prevents outdoor activity and active travel	Enablement		1.2 Problem solving
	<b>Environment;</b> Environment unsuitable to engage in PA. Walking environment not suitable for prams, eg, uneven footpaths, traffic, feeling unsafe. Home environment may lack space/have too much baby equipment for home-based activity.	Enablement		1.2 Problem solving 12.5 Adding objects to the environment
	<b>Childcare;</b> often not available or expensive alongside activity opportunities. Mothers do not feel comfortable leaving baby in	Enablement		1.2 Problem solving 3.2 Social support (practical)

childcare at this early stage. Partners cannot provide childcare during the day due to work. Families have other commitments or live far away.

**Child-friendly activity opportunities;** involve baby in PA/create an environment where mothers feel comfortable to tend to baby’s needs (feeding, changing, soothing). Opportunities not available locally, are not on at appropriate times, are not activities that participants will enjoy.

**Cost;** Opportunities for new mothers are expensive or have block payment systems which mean that missed classes due to baby illness, doctors appointments, are chargeable leading to accumulating costs. Mothers have lower income while on maternity leave. The additional cost of childcare to engage in PA leads to added expense.

**Not motivated to engage in activity alone;** New mothers lack motivation to engage in activity on their own. Lack motivation to initiate activity bouts and complete intended activities. Specifically, mothers want to engage in physical activity with other new mothers as they ‘are all in the same boat’, understand their current situation and can offer additional advice as they are all going through the same thing.

**Lack of support from non-mum friends;** many new mothers moved to new areas and do not have friends in the areas. Some report losing contact with friends due to the change in circumstances. Meeting with friends and family often results in

Enablement

Enablement

Environmental restructuring  
Enablement

- 4.1 Instruction on how to perform the behaviour\*\*
- 6.1 Demonstration of the behaviour\*\*
- 12.2 Restructuring the social environment
- 12.5 Adding objects to the environment

Not within the scope of the project to put on classes or child friendly opportunities

- 1.2 Problem solving
- 12.5 Adding objects to the environment

- 1.1 Goal setting (behaviour)
- 1.2 Problem Solving
- 1.4 Action planning
- 1.9 Commitment\*\*
- 2.1 Monitoring of behaviour by others\*\*
- 3.1 Social support (unspecified)
- 3.2 Social support (practical)
- 7.1 Prompts/Cues
- 8.3 Habit formation \*\*
- 12.1 Restructure the physical environment
- 12.2 Restructure social environment\*\*
- 12.5 Adding objects to the environment

sedentary activities.

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Reflective motivation	<b>Leaving baby;</b> Reluctant to spend time away from baby for fear of missing developmental milestones, feelings of guilt for leaving the baby when the person caring might not soothe it.	Enablement	4.1 Information about how to perform the behaviour** 6.3 Information about others approval 13.1 Identification of self as role model 15.3 Focus on past successes
	<b>Injury and tiredness;</b> belief that engaging in physical activity may lead to injury or tiredness. This was an afterthought by participants.	Education Persuasion	2.2 Feedback on behaviour 4.1 Instruction on how to perform the behaviour** 5.1 Information about health consequences 5.3 Information about social and environmental consequences 8.1 Behavioural practice/rehearsal** 8.7 Graded tasks** 9.1 Credible source 9.2 Pros and cons 15.3 Focus on past successes
	<b>Priorities;</b> housework and babies take priority when there are only 'so many hours in a day'. Physical activity is seen as a 'nice to do' not an essential thing.	Education Persuasion	1.2 Problem solving ** 1.4 Action planning** 2.3 Self-monitoring of behaviour 5.1 Information about health consequences 5.2 Salience of consequences 5.3 Information about social and environmental consequences 6.3 Information about others approval 7.1 Prompts/cues 9.1 Credible source 13.5 Identity associated with changed behaviour
	<b>Tiredness;</b> Sleep deprivation leads to feeling too tired to engage in PA. Prefer to use spare time to sleep over PA, especially during early postnatal stage. Tiredness more pronounced during evening when partners are available to provide childcare.	Education Persuasion	1.2 Problem solving** 1.4 Action planning ** 2.2 Feedback on behaviour 5.1 Information about health consequences 5.2 Salience of consequences

**Time;** Not enough time in the day and physical activity does not feel achievable as it is perceived as a very time consuming activity.

Education  
Persuasion

- 9.1 Credible source
- 10.4 Social reward (praise)
- 13.1 Identification of self as role model
- 2.2 Feedback on behaviour
- 2.3 Self-monitoring of behaviour
- 5.1 Information about health consequences
- 5.3 Information about social and environmental consequences
- 6.3 Information about others approval
- 8.3 Habit formation\*\*
- 10.1 Material incentive (behaviour)
- 10.2 Material reward (behaviour)
- 10.3 Non-specific reward
- 10.4 Social reward
- 10.5 Social incentive
- 10.6 Non-specific incentive

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Automatic motivation	<b>Motivation;</b> lack of motivation to participate in activity. Generally 'can't be bothered', lack of desire to engage in PA or laziness.	Persuasion Environmental restructuring Modelling	<ul style="list-style-type: none"> <li>1.8 Behavioural contract**</li> <li>1.9 Commitment**</li> <li>2.1 Monitoring of behaviour by others without feedback</li> <li>2.2 Feedback on behaviour</li> <li>2.3 Self-monitoring of behaviour</li> <li>2.5 Monitoring the outcome of behaviour</li> <li>2.7 Feedback on the outcome of behaviour</li> <li>3.1 Social support (unspecified)**</li> <li>3.2 Social support (practical)**</li> <li>3.3 Social support (emotional)**</li> <li>5.1 Information about health consequences</li> <li>5.2 Salience of consequences</li> <li>5.3 Information about social and environmental consequences</li> <li>5.4 Monitoring of emotional consequences**</li> <li>6.3 Information about others approval</li> </ul>
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9.1 Credible source 9.2 Pros and cons\*\*  
9.3 Comparative imagining of future outcomes\*\*  
10.1 Material incentive (behaviour)  
10.2 Material reward (behaviour)  
10.3 Non-specific reward  
10.4 Social reward  
10.5 Social incentive  
10.6 Non-specific incentive  
13.1 Identification of self as role model\*\*  
15.3 Focus on past successes

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\*\* Identified from additional searching of the BCT taxonomy

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## Appendix 4.2 Buddy Up Session script

### Session 1:

#### 1. Introduction (5 minutes)

Purpose: Introduce the session and make participants feel comfortable. We are setting the scene for the discussion and letting the participants know that they are in control of the sessions and upcoming plans.

*Hi my name is Kate and I am doing today's session with you.*

*Can I just start by outlining how this session usually works? I'd like to find out about what you hope to get out of the sessions, your hopes for the future. We're going to explore your reasons for becoming more active and then look at ideas for how you can achieve that. We'll be working through the booklet that I have given you. There is a lot of information in the booklet, and we'll talk through it all in the sessions. You don't need to read the booklet outside of the session, but the information is there for you to look back on if you want.*

*You are here together because other new mums have said that they're more likely to enjoy and carry on doing physical activity if they have someone else to be active with. I'd like you to feel comfortable to share your thoughts, feelings and emotions in these sessions. Some of these may be sensitive so I'd like us all to agree that we will respect everyone's confidentiality. Is that ok?*

*I'm not going to be rushing you, or pushing you into changes that you are not ready to make. You will be making the decisions on how you want to approach this, but I can certainly give you some guidance and advice about what can make this successful.*

*How does that sound?*

**To begin with, what are you hoping to get out of these sessions?**

- ...what do you mean by that?...
- ...can you tell me why?...
- ...what would that mean to you?...
- ...how would that be different?...
- ...how would that make you feel?...

**Summary of discussion**

- ...as a group, you want to think about...
- ...you would like to learn about...
- ...you hope that these sessions will...

#### 2. Exploring (and building) importance (10 minutes)

Purpose: To guide participants to discover (and strengthen) their reasons and motivations to be active. It gives the researcher a chance to learn about the participants and their current situations and builds rapport and relationships between the participants and the researcher.

**What reasons do you personally have for becoming more active?**

- ...what do you mean by.....
- in what way.....
- what would it mean for you if you [reason for becoming active].....
- what would be different if...

**Probe for additional information;**

- Are there any other reasons that you have for becoming more active?

**Can I share with you some of the other reasons that new mums think it's important for them to be active? If you turn to page 5 in your booklet, there's a list of other reasons that have been mentioned before. What do you think of these?**

- ...in what way.....
- are there any that stand out to you?.....
- what do you mean by.....
- What would it mean for you if you.....
- what would be different if...

**Summary of discussion**

- Together, your reasons for becoming more active are...
- You value x, y, z and that is why you want to become more active...
- You feel that x, y and z are the most important reasons to become active...
- Becoming more active would mean that...

This is what we have come up with as a group, if you would like to turn to the next page in your booklet, I want you to use the box to show why physical activity is important for you personally, you can draw, write, make mind maps, whatever will work for you.

**3. Exploring (and building) confidence**

**3a. Breaking down the guidelines (10 minutes)**

Purpose: Introduce the guidelines as the first step for goal setting. Introduces the concept that small bouts of activity can be beneficial and aims to increase confidence that short, frequent chunks of activity are manageable.

**How much physical activity do you think it takes to get the benefits that we have just discussed?**

*Response 1: Participants do not know*

- Can I share with you what the physical activity recommendations for after birth are?

OR

*Response 2: Participants guess incorrectly*

- That's not quite right, can I share with you the physical activity recommendations?

OR

*Response 3: Participants guess correctly, but don't include specifics*

- That's right. Can you give any more detail?

*Dependant on response above, use appropriate sections of text below*

- In terms of starting the activity, you can start with gentle activities as soon as you feel up to it.
- It's a good idea to wait until your 6-8 week check up until you start any high impact exercise.
- Anything is better than nothing so building up small bits of activity is a good way to get started.
- Once you have started, you can aim to build your activity levels gradually to 150 minutes per week or two and a half hours.
- How does that sound?

*Researcher response dependent on participants answers;*

*Participants answer: 'that sounds like a lot'*

- I can understand that the 150 minutes might be a little daunting, but lets look at this another way. If you or I were to say, 'I want to run a half marathon,' and we laced up our trainers and started running, what do you think would happen? Yes, it is likely that we would go out, run for a little bit and give up. There is no way that we would be able to run the half marathon.
- What would we have to do to run a half marathon? Yes, we would have to train, and gradually increase the miles that we were running. Building up to the 150 minutes is similar to this. We should start where we are and add on a little bit extra every week until we get to 150 minutes.

*Participant answer: 'I couldn't fit this in'*

- You don't have to block out a lot of time to fit this into your lives, you can build up to the 150 minutes in chunks as short as 10 minutes, whether that's a walk to the local shop, the school run, walk to the children's centre. Every 10 minutes counts.
- The other thing to remember, as you're talking about more vigorous activities, such as Zumba, jogging. These are anything that get you really out of breath, you will be sweating and you would struggle to hold a conversation. But these activities count as

two minutes towards your 150 minutes. So if you for instance went jogging for 30 minutes, as this is vigorous activity, then it would actually be equal to 60 minutes.

*Participant answer: 'I'll never be able to do that amount'*

- It is important to remember, that any activity is better than no activity, so just fitting in one ten minute walk is better for your health than staying on the sofa, or getting in the car. Often that first bit of activity increase, is where we get the most benefits. There is a lot to gain from increasing your activity levels a little bit – anything is better than nothing.

*Participant answer: 'list barriers that will stop them'*

- I can understand that this might get in the way. Please keep this in the back of your mind, we're going to think later in the session about what might get in the way of you doing activity. We'll come back to your point in the next part of the session. Is that ok?

#### **How manageable does this sound to you?**

- What do you like about this?
- How will this work for you?
- you feel like this will be manageable because...[it doesn't take long periods of time], [you can build up to the 150 minutes slowly],
- ...this is achievable for you because...

#### **3b. Widening perceptions of physical activity (5 minutes)**

Purpose: for participants to discuss what activity options are appealing to them and explore a wide variety of activity opportunities that they may not have considered.

#### **We're going to move on to think about what activities you could do. What activities did you enjoy before having a baby?**

- ...What do you mean by that? ...
- why do you say that?...
- What else do you know about the different types of activity? ...
- What activities do you think you would enjoy?...

#### **Move on discussion to preference for activity:**

- What do you think of those activity options?
- Why do you like the sound of these activities?
- What is appealing about that activity?
- What do/would you enjoy about those activities?

#### **Can I share with you some activities that you can do?**

*If we turn to page 8 in your booklet, there's examples of moderate activities there. So on the list you will see, XYZ, but they also find abc appealing. Take a minute to look through the*

*activities and add in your own in the blank spaces. Are there any there that you would enjoy or like to try?*

- What do you think of those activity options?
- Why do you like the look of those activities?
- What is appealing about that activity?
- What do you/would you enjoy about those activities?

#### **Summarise discussion**

- So you would like to try x, y, z
- X, y, z are activities that you think you will enjoy

*Turning to the appendix in your booklets, page 20, there are different ways that you can take part in these activities. You can take a brief look through it now, but you might need to take a few minutes outside of the session to look at it again. How it works is that it's split into the different places you can be active, so we have home, outdoors and more formal settings. Under each of those, there are some activities you could do in those places. So for example, you mentioned (insert activity), so if we look at home (you can do x, y, z), if we look at the more formal settings (you can do x, y, z). Thinking about the activities you mentioned, what do you think of these activities?*

- Which of these appeal to you?
- The activities that we have talked about aren't on the list, how could you find out about opportunities in your area?

#### **Summarise discussion**

- So you would like to try x, y, z
- X, y, z are activities that you think you will enjoy

*To help you remember which activities you want to try in the future, turn to the first page in your activity planner and list the activities that you want to try or look into for more information*

### **3c. Strengthening group support (10 minutes)**

Purpose: Explore the group support that participants can offer each other. They will realise that they are not alone, identify the support they think they need and resolve how to group can fulfil the needs.

**We're going to move on now to think about your buddy support. How will you be able to influence each other to be active?**

- ...How will that help?...
- What will that mean? ...
- How will that work?

**Probe for additional information;**

- Are there any other ways that you can support each other?

**Summary of discussion**

- ...you believe that being buddies will help...
- ...buddy support will...
- ...buddy support will be a positive thing for you...

**Some other buddies have said that these things will help them...(choose 2-3)**

- Doing group activities
- Setting joint rewards, such as trips to the cinema,
- Setting up a WhatsApp group, to send encouraging messages.
- You can also ask each other how you got on and offer advice.
- Telling each other your plans so you feel like you are committed to them
- Step competitions if you have a means to measure this
- Knowing that you are not letting each other down.

**What do you think of these?**

- What do you think of those ideas?
- Why do you like these ideas?
- How do you think this would help?

**As a group, it is clear that the top 3-4 ways you can help each other are....[insert list]**

*If, we turn to page X of the booklet, we're going to commit to help each other in these ways. So I want you to fill in your name, and the name of your buddy, and then discuss and write down the ways that you will support each other.*

**3d. Building confidence and setting goals (5 minutes)**

Purpose: To build participants confidence that they can achieve 150 minutes per week of activity and guide them towards setting this as a behavioural goal.

**We're going to move on to think about how much physical activity you can do. How much do you think is manageable for you over the next week?**

- Why do you think that?
- How does that make you feel?
- Why not any more?
- Why not any less?

**Thinking about the week after, what do you think about increasing that by a little bit?**

- Why do you think that?
- How does that make you feel?

- Why not any more?
- Why not any less?

**How confident are you that you can do XX minutes next week and XX minutes the week after? Using a scale of 1-10?**

- ...everyone has said a minimum of 4. You could have said 1 or 2, why do you think you can make the change if you put your mind to it? ...
- what are the reasons that you think you can make that change?...
- ...what would have to happen to make your confidence levels increase to, say 6/7?...
- What would help you be more confident?
- What will make it more likely that you achieve the goal?

**Do you want to set that as your goal for the next two weeks? On page 11, you can complete the table for the next two weeks.**

#### **4. Agreeing and strengthening a plan: (15 minutes)**

Purpose: To add specificity to the goal set at the end of step three and strengthen their plans to increase the likelihood that they will engage with the goal.

##### **4a. Action planning**

**Our goal for the next two weeks is to increase activity levels by XX minutes per week, how do you think you can achieve this?**

- Together, you all want to...
- ...where will you do this?...
- ...when will you do this?...

##### **Summary of discussion**

*You have decided that in week one, you will meet in [insert place] on [day of the week], at [time] and you will do [insert activity].*

*What we have just done there is a technique called action planning. Action plans tell us what, when, where and how you will do activities to meet your goal. So, we've already done this for week one and can fill this in for week 1 in the activity planner*

**For week 2, how do you feel about setting your week two plans?**

- Together, you all want to...
- What about other activities.....
- where will you do this?.....
- when will you do this?...

*It's always good to know that you have achieved and completed an activity, so in the column on the right you can tick off your activity.. When you complete the activity, you can stick in*

*one of your stickers to there to show what you have achieved. On this table, you can also add extra activity that you do throughout the week, as we don't want to miss this.*

#### **4b. Contingency planning**

**We've now made your plan towards achieving your goals up until our next sessions. But it's important to think about what might stop you doing the activity. What might get in the way of doing this?**

- ...why do you say the baby will get in the way?...
- Why do you say that?
- What do you mean by that?

#### **Summary of discussion**

- You feel that when you have planned the activity, on the day, you just might not get it done because xyz.

*In your booklets, on page 13 can you fill in the first column of the table with the reasons you can think of that you might not make it to the group activities planned?*

#### **How might you find a way around these things?**

- Why would that help?
- How could the group help?
- Is there anyone else that could help you with that?
- How will you ask them for their help?

*This is something that we call contingency planning, you make your first plan and then you make a contingency plan for some of the possible situations that may get in the way. Staying on the same page, let's make some contingency plans for the things that we think might get in the way...*

#### **5. Close**

*Between now and the next session, I want you to carry out your plan as we have planned it today, support each other in the ways that you have said you will.*

*Next session, we are going to be talking about how you have got on, and looking at how you can add more activity into your week.*

### **Session 2: (30 minutes)**

Purpose: Review progress and strengthen plans for moving forwards. Explore and build confidence to engage in individual activities.

#### **1. Review progress and provide feedback (5 minutes)**

Purpose: Review progress to see whether they have achieved their goals or not. Explore why they have met/not met goals and how they feel about continuing with progress.

## How have the past two weeks gone?

*Response 1: Positive response from participants about reaching goals*

- What went well/what was good?
- How do you feel about achieving them?
- How did you achieve them?
- Did you find anything difficult?
- Is there anything that you think you should do differently?
- What are your activity options for the next two weeks?

### Summarise response

*If participants have reached their goals, researcher will say, you've made a fantastic effort to reach your goals, despite (insert challenges that participants have faced), you've overcome these and really (insert achievement, eg, worked well as a group, committed to activity) to reach your goals.*

OR

*Response 2: Participants have not met goals or found it difficult.*

- What was difficult?
- How could you do things differently?
- What would make things easier?
- I understand that you found it difficult, tell me what went well?
- If participants talk about barriers; keep this in mind, we're going to do some more work on overcoming those barriers later in the session. Is that ok?
- If group support is problematic, revisit group support principles;
- What should be different here?

### Summary of discussion

*You've set some goals, but due to x, y, z, haven't managed to achieve them. Don't let that dishearten you, you've still (insert comment on effort, eg, been going on your group walk once a week).*

**In the last session, your reasons for becoming active were x, y, z. You wrote or drew your personal reasons on page X. After two weeks of doing some physical activity, are there any differences?**

- ...what do you mean by that?..
- ...can you explain that?...
- ...tell me why you say that?...
- If they don't have any additional reasons researcher will briefly ask, tell me how you felt after doing your activities?

### Summary of discussion

- ...as well as what we said last time, you also feel that x,y,z are good reasons for becoming active...
- ...you value x, y, z and that is why you want to become more active...
- becoming more active means that...

## 2. Reviewing group support (5 minutes)

### Tell me about the support you have given each other

- ...how did that help?...
- ...what did that mean.?...
- ...how is this different from being on your own?...
- ...How would you it to be different?...

### Probing for more information

- Is there anything else you can do to support each other?

### Summary of discussion

- ...you've supported each other by...
- ...the support has meant that...
- ...you think that you could also support each other by (x,y,z), do you want to add that to your commitment on page 10 in your booklet.

## 3. Set goals (5 minutes)

**Thinking about the next two weeks, how much physical activity do you think is manageable for you?**

- ...why do you think that?...
- Why not more?...
- Why not less?

**How confident on a scale of 1-10 do you feel that you can add an additional 15 minutes of group activity for the next two weeks?**

- Why do you feel that way...
- What could make you more confident?
- What would have to happen for you to meet your goals?

**Do you want to set that as your goal for the next two weeks? On page 11, you can complete the table for the next two weeks.**

- ...you can see the minutes gradually increasing.

## 4. Action planning (15 minutes)

**Thinking about the list you made at the front of your activity planner in the last session, are there any activities that you would particularly like to try over the next two weeks?**

- ...why do you like the look of that activity?
- ...what is appealing about that activity?
- ..what do/would you enjoy about that activity?

**How will you do your XX minutes this week?**

- ...think about adding in some individual activities, eg, small bits of walking...
- ...where will you do this?...
- ...what activities would you like to do?...
- How will you do this?...
- what about (insert activity they have mentioned)?

**Last session, we learned about action planning our activities, in your activity planner, can you discuss and write down your action plan your group activity for this week?**

- ...when will you do this activity?...
- ...where will you do this?..
- ....how will you do this?...

**How do you feel about making plans for the week after?**

- ...how will you make your plans?...
- ...what will you do?...
- ...how will you help each other?...

**Last week, we looked at what might get in the way of your activity and came up with plans to overcome these. How did this work for you?**

- ...what influence did that have?...
- ...how did you deal with that?...
- ...how did the plan help?...
- ...what did you do?...

**From your experience over the past couple of weeks, are there any additional challenges that you could add to the list?**

- ...what happened..?
- ...what did you do?...
- ...what could you do next time?...
- ...how did you deal with that?...

**From your experience over the past couple of weeks, are there any other solutions that you have come up with?**

- ...can you explain that a little bit...
- ...how would that work?..
- ....how confident do you feel that you could do this?...

## Session 3: Equipping for the future

Purpose: Review progress over the past weeks. Discuss future plans and equip participants with skills and ideas for maintaining activity levels, for example, maintaining group support, goal setting or finding new activity.

### 1. Reviewing progress (5 minutes)

Purpose: To discuss participants progress since the last session. Explore what worked well and what participants found challenging.

#### How have the past two weeks been?

*Response 1: Positive response from participants about reaching goals*

- What went well/what was good?
- How do you feel about achieving them?
- How did you achieve them?
- Did you find anything difficult?
- Is there anything that you think you should do differently?
- What are your activity options for the next two weeks?

#### Summarise response

*If participants have reached their goals, researcher will say, you've made a fantastic effort to reach your goals, despite (insert challenges that participants have faced), you've overcome these and really (insert achievement, eg, worked well as a group, committed to activity) to reach your goals.*

OR

*Response 2: Participants have not met goals or found it difficult.*

- What was difficult?
- Why did you find this challenging?
- How could you do things differently?
- How could you overcome that?
- What would make things easier?
- What support would be useful?
- I understand that you found it difficult, tell me what went well?
- If participants talk about barriers; keep this in mind, we're going to do some more work on overcoming those barriers later in the session. Is that ok?
- If group support is problematic, revisit group support principles?
- What should be different here?

#### Summary of discussion

*You've set some goals, but due to x, y, z, haven't managed to achieve them. Don't let that dishearten you, you've still (insert comment on effort, eg, been going on your group walk once a week).*

## **2. Reviewing group support (5 minutes)**

**Tell me about the support you have given each other**

- ...how did that help?..
- ....what did that mean.?...
- ...how is this different from being on your own?...
- ...How would you it to be different?...

**Probing for more information**

- Is there anything else you can do to support each other?

**Summary of discussion**

*...you've supported each other by.....the support has meant that.....you think that you could also support each other by (x,y,z), do you want to add that to your commitment on page 10 in your booklet.*

## **3. Set goals and action planning (10 minutes)**

**Thinking about the next two weeks, how much physical activity do you think is manageable for you?**

- ...why do you think that?
- ...Why not more?
- ...why not less?

**How confident on a scale of 1-10 do you feel that you can add an additional 15 minutes of group activity for the next two weeks?**

- Why do you feel that way...
- What could make you more confident?
- What would have to happen for you to meet your goals?

**Do you want to set that as your goal for the next two weeks? On page 11, you can complete the table for the next two weeks.**

- ...you can see the minutes gradually increasing.

**Thinking about the list you made at the front of your activity planner in the last session, are there any activities that you would particularly like to try over the next two weeks?**

- ...why do you like the look of that activity?...
- what is appealing about that activity?..
- what do/would you enjoy about that activity?

**How will you do your XX minutes this week?**

- ...think about adding in some individual activities, eg, small bits of walking...
- where will you do this?...
- ...what activities would you like to do?...
- How will you do this?...
- what about (insert activity they have mentioned)?

**Last session, we learned about action planning our activities, in your activity planner, can you discuss and write down your action plan your group activity for this week?**

- ...when will you do this activity?...
- ...where will you do this?...
- ...how will you do this?...

**How do you feel about making plans for the week after?**

- ...how will you make your plans?...
- ...what will you do?...
- ...how will you help each other?...

**Last week, we looked at what might get in the way of your activity and came up with plans to overcome these. How did this work for you?**

- ...what influence did that have?...
- ...how did you deal with that?...
- ...how did the plan help?...
- ...what did you do?...

**From your experience over the past couple of weeks, are there any additional challenges that you could add to the list?**

- ...what happened..?
- ...what did you do?...
- ...what could you do next time?...
- ...how did you deal with that?...

**From your experience over the past couple of weeks, are there any other solutions that you have come up with?**

- ...can you explain that a little bit...
- ...how would that work?...
- ...how confident do you feel that you could do this?...

**2. Looking ahead (15 minutes)**

**As this is our last session, lets look at where you're going from here and how you will progress. Where do you see yourselves in three-months time?**

- What kind of things do you see yourselves doing?
- How will you do this?
- What inspires you to want to do that?
- How will that make you feel?
- How will your life be different if you have reached your goal?

**How confident do you feel in your ability to stay active over the next three months?**

- Why do you feel that you can achieve this?
- What could help you achieve this?

**How will you be able to support each other in the future?**

- ...how will that help?
- ...what will you do..?
- ...how will you do that?

**Summarise discussion**

- ...in the future you will do....and support each other by...

**How will you plan your activities?**

- ...how will you do this..?
- ...why is this important...?

**How will you overcome problems?**

- ...what do you mean by...?
- ...tell me more about that...?

**Can I share with you some things that other people find useful to continue their activity?**

- Set new goals (discuss and talk through page 14), what do you think of these?
- Set rewards (discuss through page 17)
- Trying a new activity (discuss page 18)
- Coping with setbacks
- Inviting new people to join your group
- Involve your family

**What do you think of these?**

*Direct participants to the appropriate pages and probe*

- Why do you like the sound of that?
- Why does that inspire you?
- What will it mean to you to reach your goal in six months?

### **Summary of discussion**

- To summarise, in three months time, you visualise yourselves...

*You can write your visions and intentions for three months time on the back page of your activity planners.*

### **3. Close**

*The moving forward section of the booklet has more information on all of the things that can help you maintain activity for you to come back to as often as you like. There are also weekly plans for you to fill in and monitor your progress to help you over the next few weeks and months. You have each others support that you have promised to give each other, and this can continue for the future.*

## Appendix 4.3: Buddy Up Booklet



# Buddy Up

Active with baby - Active with friends - Active for me

Name: \_\_\_\_\_



**UNIVERSITY OF  
CAMBRIDGE**

Public Health and Primary Care  
The Primary Care Unit  
Professor Stephen Sutton



**National Institute for  
Health Research**

School for Primary Care Research  
Increasing the evidence base for primary care practice



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## Summary:

- Physical activity helps your body physically recover from birth, improves your sleep, boosts your mood and makes you feel better.
- Taking part in physical activity sets a positive example for your baby of how to lead an active life.
- Ten minutes of activity is beneficial to your health and is a good starting point. We recommend building up ten-minute blocks of activity until you reach 150 minutes of physical activity per week to get the maximum benefit.
- Physical activity is any activity that makes you out of breath, makes you feel a little bit warmer and your heart beat faster. You don't have to be in a gym, dressed in lycra or in an exercise class. There are lots of activities for you to choose from.
- Doing physical activity with a friend makes it more enjoyable and will help you be more motivated.
- Setting realistic goals gives you a target to work towards and you can track your progress towards your goal.
- Planning what, when, how and where for each activity helps you commit to the plan and workout where physical activity fits into your daily routine.
- Naturally, life with a new baby may throw challenges at you, which will disrupt your plans. Thinking ahead about how you can cope with these disruptions and adapt your plans will help keep you on track.



## Introduction

Welcome to Buddy Up, sessions for you and your buddy designed to help motivate you to support each other in your journeys to an active, healthy lifestyle after having your babies. We are running Buddy Up because other new mums have told us that they would be more likely to start, enjoy and carry on doing physical activity if they could share the experience with another new mum who understands what life is like with a new baby.

The three sessions aim to:

- explore why physical activity is important to you
- find out what support you and your buddy can offer each other
- choose the activities that you would like to take part in
- make weekly activity plans
- review progress and overcome any problems that you are facing.

During the sessions, we will be working through this booklet. We will cover the information in the booklet in these sessions. You do not have to read this booklet in your spare time. You can use it if you want to read more or remind yourself of what we talked about in the sessions.

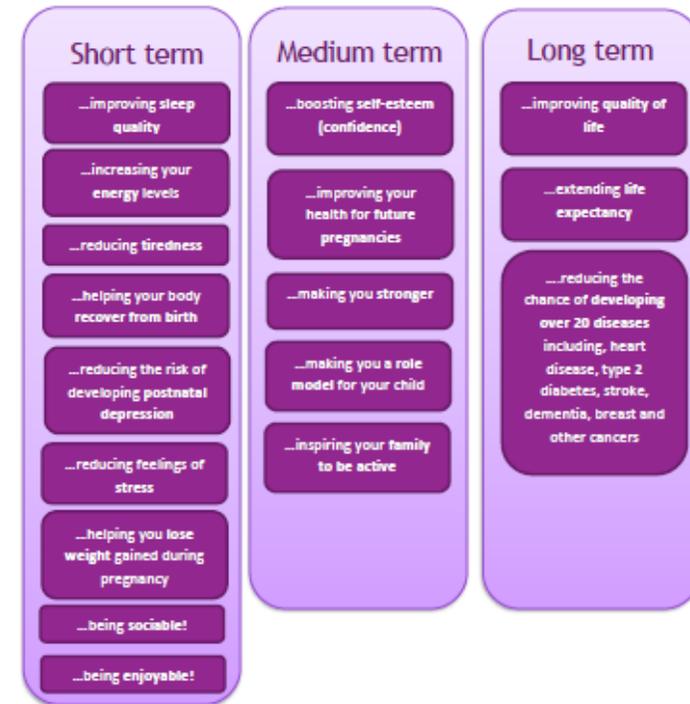
The sessions will be guided by your choices and your decisions. I will not be rushing you or pushing you into any changes that you are not ready to make, the decisions on how you want to approach this are yours to make. I can give you some guidance and advice on what might make this successful for you.



## Why is physical activity important?

Being active in the year after birth plays a key role in your recovery from pregnancy and childbirth. As well as helping your body physically recover, regular physical activity can improve your mood and help you feel better.

As a new mum, when you're feeling busy and extremely tired, doing some activity might be the last thing that you feel like doing, but it can help by...





### Try not to overdo it...

Your body has been through remarkable changes during pregnancy and childbirth and is still recovering from this change. It is important that you listen to your body, and take rest when you need it.

A sign that you might be doing too much is if your postnatal bleeding becomes heavier or changes colour (if you are still experiencing this). Another is if you feel exhausted after physical activity and are finding it difficult to recover in the one or two days following the activity. This is different from the general pregnancy-related tiredness that you will become used to. These signs suggest you should take things a little easier for a few days and reduce how long, how often or how hard your physical activity sessions are. If you are concerned about how you feel, please speak to your GP.

## Activity

### Why is physical activity important to me?

There are so many reasons to be active, while all of them are important, you may have one or two reasons that stand out to you. Use the space below, to draw or write your main reasons for becoming active.



## How much physical activity?

### Starting physical activity after childbirth

You can start gentle exercise as soon as you feel up to it. Gentle exercise includes walking, stretching, pelvic floor exercise or deep tummy strengthening exercise.

Once you've had your 6-8 week postnatal check and feel comfortable, you may want to do high impact activities, such as, aerobics, brisk walking, jogging, gardening or cycling.

### Physical activity recommendations

To stay healthy, all adults should try and aim for at least 150 minutes of moderate activity per week. This amount may seem daunting, but there are three key principles to remember:

#### 1. 10 minutes is all you need

You can benefit from only 10 minutes of physical activity at a time. 10 minutes of moderate activity is enough to start building the benefits of activity that we have already talked about.

#### 2. Some activity is better than none

You can benefit from physical activity by increasing your physical activity just a little bit.

#### 3. More is better

Increasing physical activity levels, by adding blocks of ten minutes leads to greater health benefits. Working towards a target of 150 minutes of moderate activity is recommended.

### Moderate physical activity

Movement that makes you breathe harder, makes you warmer and makes your heart beat faster than normal, for example, brisk walking, gardening or riding a bike.





### Vigorous physical activity

Movement that makes you breathe very hard, be short of breath, have a fast heartbeat and not be able to carry on a conversation. Examples of vigorous activities are swimming, cycling, aerobic dancing or running.

Vigorous intensity activity, described in the box above, has additional benefits to health. As you begin to recover and feel more comfortable doing activity, you may want to think about adding some vigorous intensity activity to your routine.

Every minute of vigorous activity counts as two minutes towards your 150 minutes.

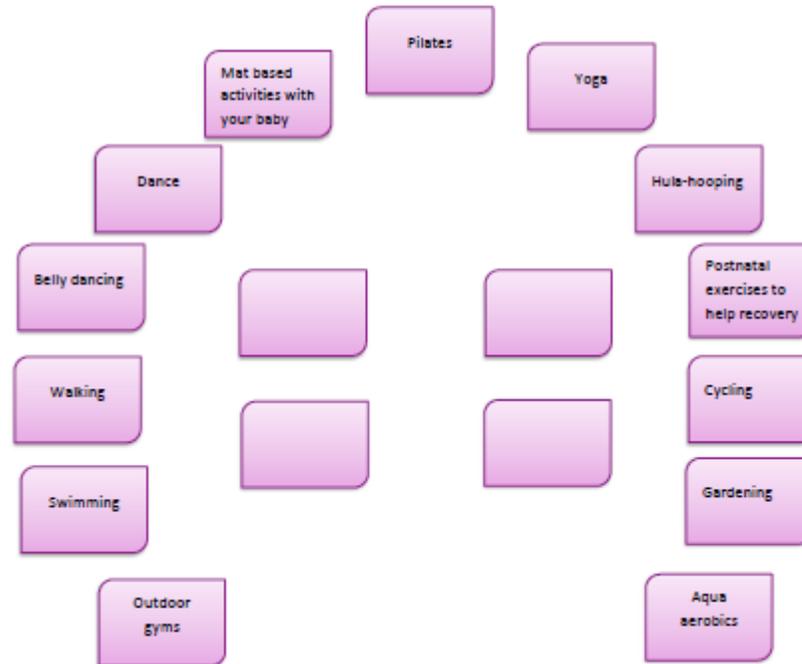
This means that if you went for a ten-minute run or aerobic dancing, eg Zumba at a vigorous intensity, this would count as 20 activity minutes.



## What activities can I do?

There is a variety of activities to choose from that count as your activity, which means you can always find ones that work for you. You don't have to be dressed in lycra, sweating in a gym or running for miles - any activity that gets you out of breath and a little bit warmer counts.

You can take part in these activities at home, outdoors in spaces such as parks or nature reserves, or in more formal settings like gyms or exercise classes. Everybody will have their own preference, but take a moment to look through the activities below to see which ones you will enjoy. You can write your own ideas in the blank spaces. Once you have decided, turn to page 20 to find out more about how you can take part in the activities.





## Buddy support

Having a friend or someone to do regular physical activity with is a good way to keep you motivated as it is sociable, enjoyable and more fun! Thinking about the support that you can offer your buddy and what support you would like from them helps you to understand how you can make this partnership work for you.

Committing to your buddy makes it more likely that you will stick with it in the long term.

### Our commitment

I \_\_\_\_\_, commit to support \_\_\_\_\_ to be more active by:

- 1) \_\_\_\_\_
- 2) \_\_\_\_\_
- 3) \_\_\_\_\_
- 4) \_\_\_\_\_



## Setting goals

Many people find that choosing a realistic goal motivates them to stay on track because it gives them something to work towards. Tracking your progress towards that goal can keep you interested in the activity.

It is important to consider goals that are within your reach but are still challenging. For example, setting a goal to run a marathon in six weeks is not achievable and you are unlikely to feel motivated to make any progress towards this goal. Setting a goal to walk for 30 minutes five times per week in six weeks may be more motivating because it is within your grasp. Goals work best when they offer a challenge, something that you will have to work hard to achieve.

### My goal

Using the table below, you can set a weekly goal for how many minutes of physical activity you would like to do every week.

Start by thinking about week one. How many minutes do you think are manageable for you? Lets use this as your goal for week one, then add a little bit extra for week two. In session 2, we'll revisit this page and think about what is manageable for you in week three and four.

My weekly goals					
Week 1	Week 2	Week 3	Week 4	Week 5	Week 6



## Making plans

Making plans for when, where and what activity you will do is useful so that you know exactly how you will be active throughout the week. Spending a little bit of time doing this at the start of every week gives you the chance to think about how you can fit activity into your week. For example, if you have an appointment at the doctors on Wednesday morning, you could use the park opposite to do some activity afterwards.

Writing down your plans for the week like appointments in a diary helps you to commit to completing the activity.

### Activity

In your activity planning sheets, you can complete your action plans for the next two weeks. Provide details in the plan such as what, when, where and how you will complete the activity. Try and be as specific as you can when filling out your action plan.

Over the next two weeks, when you have done the activity you can come back to the plans and tick off the final column when you have completed the activity, by either putting a smiley face, a tick, a star or a sticker in the column.

You can use the tables to make plans, but also to make a note of any other activities that you did throughout the week. At the end of the week, you can add up how much activity you did to see whether you reached your goal.



## When life gets in the way...

As a new mum, life is challenging and things may creep up which mean that you might not get to do the activity you had planned. In this section, we will think about strategies that might help you cope with these interruptions to keep you on track with your activity.

### Activity

Think about the challenges that you may face when you are committing to increasing your physical activity levels. For example, rain could stop you from doing the walk around the park you had planned or your baby might be sick and need to go to a doctors appointment. When things like this get in your way, it is a good idea to have an alternative plan to overcome this. Instead of the walk you had planned, your alternative plan could be doing one of the YouTube videos recommended in this booklet (page 29). Think about solutions that are manageable and are realistic for you to do if you come up against the challenge.

Challenges	Solutions

### Don't be too hard on yourself...

Even with these plans, there may just be some days or activities that you find particularly challenging and just can't fit in. If you miss an activity, don't be too hard on yourself. Think about the next activity you have planned and commit to making these work for you.



## Moving on...Setting new goals

At the start of this process, you set goals for the six weeks. Now you have made it to the end of the six weeks, it may be time to think about setting new goals. Setting goals is proven to help people continue doing physical activity as it helps to keep you motivated and tracks your progress.

Goals can be long term, like building up to running 5k, or they can be short term, for example walking for 30 minutes five times this week. There are some principles to follow when setting goals that make them more manageable. These are called SMART principles:

<b>S</b>	<b>Specific:</b> Setting detailed goals gives you a clear target to work towards
<b>M</b>	<b>Measurable:</b> Measurable goals make it easy to keep track and know when you have achieved your goals. Make your goals measurable by setting distances, times, step targets etc.
<b>A</b>	<b>Achievable:</b> Set goals that are possible for you to achieve but still challenging. Setting impossible goals will de-motivate you.
<b>R</b>	<b>Relevant:</b> Set goals that are relevant to your life and circumstances. This could also mean that your short-term goals should be relevant to where you see yourself longer term.
<b>T</b>	<b>Time limited:</b> Set a time limit on the goal. Pick a date or an event that gives your goal an end line. After this you can review your progress and set new goals which keeps things interesting.

**Tip:** Setting rewards for reaching your goals can help you stay motivated. What about treating yourself to a day out with the family, a beauty treat, new clothes, a new book/magazine or taking time out for a soak in the bath? Remember, you only get the reward if you reach your goal!



## Activity

Below is a list of goals to increase physical activity levels. Some of them are SMART, others are not. Work through the goals and tick the SMART goals. Think about what makes them smart. For the "not so" smart goals, think about what you could add to make them SMART.

Goal	SMART? Not SMART?	Why is the goal smart/What could make the goal smart?
Start running		
Walk the 5km Race for Life in 2018		
Walk to the Children's Centre twice per week until Easter		
Increase my physical activity levels		
Do my exercise DVD three times this week		
Go walking in the park		
Join the gym		
Walk two laps of the park twice per week for six weeks		



## My new goal...

You may have a clear idea about the goals you would like to achieve to maintain your new activity habits. Using the SMART principles, set your new physical activity goals in the box below



If you are finding it difficult to think of a new goal, here are some ideas that might inspire you:

- Use the step counter on your phone to set a daily step goal.
- Walk, jog or run a local 5k. The Race for Life and Parkrun are events which encourage people of all abilities to take part.
- Increasing the intensity (how hard) of your activity by adding hills or short bursts of running into your walk.
- Try a new activity.



## Moving on...Rewards

Setting rewards for working hard and reaching your goals keeps you motivated when times are tough. They are a great way to celebrate your achievement! You may feel guilty about taking some time away or spending a little bit of money on yourself but these rewards are to celebrate your hard work - you've earned it!

You could set your own rewards or you can set them with your buddy, you could exchange rewards when you both reach your goals. This might be added motivation because you will be doing this together.

How often and what you set as rewards is up to you, but here are some ideas.

### Physical activity rewards:

- Try a new activity
- Buy some new kit - trainers, headphones, leggings.
- A new activity tracker (Fitbit etc)
- Download a new activity app

### Beauty:

- New nail polish
- New make up
- Treat yourself to a massage
- Time out for a bath
- Home spa afternoon with a friend

### Family/friend activity rewards:

- Go for a cinema trip (Cinebabies is a baby friendly cinema showing by Cineworld).
- Have a movie afternoon with a friend.
- Take a day out to a local National Trust location or a country park.
- Try a new cooking recipe (you could invite your buddy and their partner too).
- Buy rewards for each other and exchange them when you reach your goals.

### Your ideas:



## Moving on...Trying new activities

Trying new activities adds variety to your activity routines and can be exciting and fun! This could be an activity that you loved when you were younger or have always wanted to try.

There are two websites that give you a long list of activity options that you could try. They give you advice on how you can get involved with that activity:

- **This Girl Can** - a campaign to get women active across the country and take part in any activity without the fear of being judged. Their 'ways to take part' webpage gives a range of activities you can try and links to how you can get involved in that activity. <http://www.thisgirlcan.co.uk/activities/>
- **Get Inspired** - a website by the BBC with inspiring stories and videos from people who have taken up activities. Their activity guides give information on how you can give your chosen activity a try. <http://www.bbc.co.uk/sport/get-inspired>

You can Google search the activity that you would like to do to see if there are any local opportunities.

Ask in your children's centre or people in the local community, eg, community Facebook groups about the activities that you would like to try.



## Moving on...Future pregnancies

You might have plans to have another baby and the good news is that being active improves your fertility because it help you stay a healthy weight.

As a general rule of thumb, if you have been active in the run up to your pregnancy, you can keep up your normal routine while you feel comfortable doing this without any harm to your baby.

The guidelines of 150 minutes of moderate activity are still in place for pregnancy. Staying active will help you adapt to your changing body, help you cope with labour and recover from the birth.

Speak to your GP for advice on engaging in activity while pregnant.

The table below also has some general resources that might be useful to help you adapt your activity routine throughout pregnancy.

Resource	Hyperlink
 NHS Exercise and pregnancy guide: Tips for engaging in activity during pregnancy. A guide on what activities to avoid and what activities will help you during your pregnancy.	<a href="https://www.nhs.uk/conditions/pregnancy-and-baby/pregnancy-exercise/?tabname=pregnancy">https://www.nhs.uk/conditions/pregnancy-and-baby/pregnancy-exercise/?tabname=pregnancy</a>
 Bump It Up: Guide to specific and safe exercises for each trimester of your pregnancy.	<a href="https://www.amazon.co.uk/dp/B01D9WUY42/ref=dp_kinderedirect?_encoding=UTF8&amp;btcr=1">https://www.amazon.co.uk/dp/B01D9WUY42/ref=dp_kinderedirect?_encoding=UTF8&amp;btcr=1</a>
 NHS Pre and postnatal yoga: A 45-minute video for pre-natal purposes.	<a href="https://www.nhs.uk/conditions/nhs-fitness-studio/prenatal-and-postnatal-exercise/">https://www.nhs.uk/conditions/nhs-fitness-studio/prenatal-and-postnatal-exercise/</a>

### Moving on...

In the last sessions, we discussed how you will continue to be active. The strategies and plans will be different for everybody. Use the space below to write the strategies and plans that you will use to be active in the future.



## Appendix: Activities for you

During the first session, you thought about which activities you would enjoy. The following pages give useful resources to help you find the activity you want to do in a way that suits you, whether that is at home or as a group.

There is a lot of information on the next few pages, you do not have to look at, or do all of the activities. Pick and choose what you will enjoy. You can revisit these pages at any time if you fancy adding variety to your activities.

Online or DVD Video Website Book App

### Home-based activities

Doing activity at home is convenient, cheap and cuts out the preparation needed to get out of the house. Starting with activities at home can be a good way of building confidence or trying new types of activities before venturing outside or joining a class or group session. It is especially good when the weather is bad outside. You can do it while your baby is asleep or is content.

There is a variety of home-based activities and the table below includes a selection. We can look for some others if there are other activities you would like to try.

Without the guidance of an instructor, remember to listen to your body and not be afraid to take a break or stop if you become too tired. You can always try to do a little bit more next time. If you are concerned, talk to your doctor before starting the activity again.

Activity	Resource	Hyperlink
General	NHS Fitness Studio: A series of videos and programmes created by the NHS with a variety of activities for all fitness levels	<a href="https://www.nhs.uk/conditions/nhs-fitness-studio/">https://www.nhs.uk/conditions/nhs-fitness-studio/</a>
	Ready Steady Mums - The blast workout DVD: Full body workouts for you to do at home that are fun and help you get fit after your baby (£4.50 from Amazon)	<a href="https://www.amazon.co.uk/Ready-Steady-Mums-Workouts-Workout/dp/B0001PT4S1">https://www.amazon.co.uk/Ready-Steady-Mums-Workouts-Workout/dp/B0001PT4S1</a>
	BabyFit by Amy: Series of 14 videos for new mums created by a new mum. Choose the activity and intensity that suits you	<a href="https://www.youtube.com/watch?v=g7oXPB_hqU8list=PLWHyU3oeyh1EjXr_VvHH_TuYhT2jLJo">https://www.youtube.com/watch?v=g7oXPB_hqU8list=PLWHyU3oeyh1EjXr_VvHH_TuYhT2jLJo</a>
Activities involving your baby	BabyFit by Amy: Video involving your baby in a range of exercises	<a href="https://www.youtube.com/watch?v=Ni9lxZpChbk&amp;index=11&amp;list=PLWHyU3oeyh1EjXr_VvHH_TuYhT2jLJo">https://www.youtube.com/watch?v=Ni9lxZpChbk&amp;index=11&amp;list=PLWHyU3oeyh1EjXr_VvHH_TuYhT2jLJo</a>



Postnatal activities to help recovery	Ready Steady Mum: Website explaining specific exercises that can help your body recover from childbirth	<a href="http://readysteadymums.org/our-exercise-programme/postnatal-exercise/#new-one">http://readysteadymums.org/our-exercise-programme/postnatal-exercise/#new-one</a>
Dance	Bump It Up: Guide to specific and safe exercises for your postnatal body to recover from birth. Designed for 1-6 weeks after birth but useful to recap if you feel unsure of your capability	<a href="https://www.amazon.co.uk/dp/B01D9MLY42/ref=dp_kinderedirect?_encoding=UTF8&amp;btcr=1">https://www.amazon.co.uk/dp/B01D9MLY42/ref=dp_kinderedirect?_encoding=UTF8&amp;btcr=1</a>
	La Bomba: NHS approved dance-based activity	<a href="https://www.nhs.uk/conditions/nhs-fitness-studio/dance-la-bomba/">https://www.nhs.uk/conditions/nhs-fitness-studio/dance-la-bomba/</a>
	DanceThatWalk: A low impact dance activity using walking as a base	<a href="https://www.youtube.com/watch?v=POX8NWX8sw">https://www.youtube.com/watch?v=POX8NWX8sw</a>
Pilates	Ready Steady Mums - The Happy Mummy workout DVD - dances to much loved nursery rhymes for postnatal women	<a href="https://www.amazon.co.uk/Ready-Steady-Mums-Dance-Windfulness/dp/B00G40S5DQ">https://www.amazon.co.uk/Ready-Steady-Mums-Dance-Windfulness/dp/B00G40S5DQ</a>
	BabyFit by Amy: 15 minute postnatal pilates video to strengthen core muscles for new mums.	<a href="https://www.youtube.com/watch?v=VQ_84qv_EA0">https://www.youtube.com/watch?v=VQ_84qv_EA0</a>
Yoga	Kim Seha, Postnatal Pilates: Four part pilates series aiming at developing the core muscles to aid recovery from birth. Later videos have a split screen with cartoons for your baby!	<a href="https://www.youtube.com/playlist?list=PLqEm6Y4KmW38MdC449Eol-TFulhO3MeW0">https://www.youtube.com/playlist?list=PLqEm6Y4KmW38MdC449Eol-TFulhO3MeW0</a>
	NHS Postnatal yoga: 45 minute yoga session suitable for all mums focusing on muscles in your tummy, back, hips and arms	<a href="https://www.nhs.uk/conditions/nhs-fitness-studio/postnatal-yoga/">https://www.nhs.uk/conditions/nhs-fitness-studio/postnatal-yoga/</a>
Belly dancing	Ready Steady Mums - The Happy Mummy workout DVD - dances and yoga targeted at postnatal women.	<a href="https://www.amazon.co.uk/Ready-Steady-Mums-Dance-Windfulness/dp/B00G40S5DQ">https://www.amazon.co.uk/Ready-Steady-Mums-Dance-Windfulness/dp/B00G40S5DQ</a>
	Belly dancing: Video recommended by the NHS with 10-45 minutes of belly dancing	<a href="https://www.nhs.uk/conditions/nhs-fitness-studio/belly-dancing-for-beginners/">https://www.nhs.uk/conditions/nhs-fitness-studio/belly-dancing-for-beginners/</a>
Building strength	Ready Steady Mum: Step-by-Step activity guide to strengthen your core	<a href="http://readysteadymums.org/our-exercise-programme/core-postnatal-exercise/">http://readysteadymums.org/our-exercise-programme/core-postnatal-exercise/</a>

### Outdoor activities

Outdoor activities offer the added benefit of being outdoors and getting some fresh air. It can really brush away the cobwebs and improve your mood. Outdoor activities can be as simple as taking walks from your home, but there are facilities and spaces available for free, which can make it a more pleasant and enjoyable experience.

A good starting place for outdoor spaces and facilities to be active is the leisure and/or sport sections on your local authority and local district council websites. They provide information on outdoor spaces, walking routes, cycling routes and outdoor facilities such as outdoor gyms and multisport areas that are accessible.



Activity	Resource	Hyperlink
Outdoor Gyms	<p><b>Local authorities:</b> Your local authority website will have information on local parks that offer outdoor gym equipment</p>	
	<p><b>Using outdoor gym equipment:</b> Video explaining how to use outdoor gym equipment</p>	<a href="https://www.youtube.com/watch?v=KClSPinV1o">https://www.youtube.com/watch?v=KClSPinV1o</a>
Walking	<p><b>Parks and nature reserves:</b> Local authorities maintain parks and nature reserves often with buggy friendly routes and paths for you to walk</p>	
	<p><b>Walking for health:</b> Website with walking routes. It shows whether they are suitable for wheelchairs/buggies. Once you know how far you can carry your baby in a sling, you can try some of the shorter walks.</p>	<a href="https://www.walkingforhealth.org.uk/">https://www.walkingforhealth.org.uk/</a>
	<p><b>Active10:</b> An app that tracks every ten minutes of walking and adds it up for you while it's in your pocket</p>	<a href="https://www.nhs.uk/oneyou/active10/home#230e57m4lwFPpxz_92">https://www.nhs.uk/oneyou/active10/home#230e57m4lwFPpxz_92</a> Download the app at your chosen app store
	<p><b>Reedy steady mum:</b> Buggy exercises that you can add to your walk to increase the intensity of your walk.</p>	<a href="http://readysteadymums.org/our-exercise-programme/buggy-exercises/">http://readysteadymums.org/our-exercise-programme/buggy-exercises/</a>
	<p><b>Walk4Life:</b> Website with local walking routes. Type in your location and the website shows local walking routes. A £5 per year subscription fee to see the routes in detail.</p>	<a href="https://www.walk4life.info/">https://www.walk4life.info/</a>
Cycling	<p><b>Breeze:</b> Maps of local cycling routes. Type in your postcode to find your local routes</p>	<a href="https://www.letsride.co.uk/breeze">https://www.letsride.co.uk/breeze</a>
	<p><b>Sustrans:</b> Website with articles and advice on cycling for women and cycling with children and families.</p>	<a href="https://www.sustrans.org.uk/">https://www.sustrans.org.uk/</a> (click on the tab 'what you can do')

### Lifestyle activities

Lifestyle activities are those that you can do as part of your everyday life. Thinking about how you can add extra activity into your daily routine will help you fit in your activity and create active habits.



Activity	Description
Parking further away	Allowing some extra time for a journey and planning to park a 10 minute (or more!) walk away is a good way to add a little bit of activity. Every little helps, so even if you can't park 10 minutes away, how about the parking in the space furthest away?
Family walk after dinner	You could get some fresh air after you've had dinner and spend some quality time as a family.
Active travel	Swapping a car journey for a walk where possible can add extra activity to your day (and save you money on fuel!). You can also consider cycling further distances.

### Exercise classes/groups

Group activities are growing in popularity, can add variety and fun to your activities and are a great way to get some social interaction. Classes that involve your baby offer an opportunity for you and your baby to bond and be active together. Class availability varies by location, so the table below lists websites, which have search options for you to search for classes in your local area.

Activity	Group	Hyperlink
Walking groups	<p><b>Socialise:</b> Groups of mums who meet in parks and greenpaces to walk together and have a chat with their babies in tow.</p>	<a href="http://readysteadymums.org/socialise/find-a-local-socialise-group/">http://readysteadymums.org/socialise/find-a-local-socialise-group/</a>
	<p><b>Walking for health:</b> Walks across England open to everyone. Walkers often join to improve health, but carry on to see the new friends they've made. Health walks are listed on the website, but some local authority websites have more information.</p>	<a href="https://www.walkingforhealth.org.uk/">https://www.walkingforhealth.org.uk/</a>
Baby friendly classes	<p><b>NetMums:</b> Listings of local baby friendly classes in your area.</p>	<a href="https://www.netmums.com/">https://www.netmums.com/</a> click on local tab, clubs and classes. Group classes will be under classes for you.
	<p><b>Word of mouth:</b> Recommendations from other mums is one of the best ways to find out about activities going on in your area. Ask your friends, your children's centre, health visitor or local Facebook groups for recommendations.</p>	
	<p><b>Local authority:</b> Some local authority websites (sport and recreation/leisure sections) have details of classes for new mums.</p>	
Dance classes	<p><b>NetMums:</b> Listings with local dance classes. Genre vary by each local area but could include belly dancing, Latin, ballroom or dancing for fitness. These are less likely to allow you to take your baby along, so you may have to think about childcare.</p>	<a href="https://www.netmums.com/">https://www.netmums.com/</a> click on local tab, clubs and classes. Dance classes will be under classes for you.

Cycling		<b>Breeze bike rides:</b> Fun, free bike rides for women of all abilities across the UK. Filter by rides or groups to find an activity for you.	<a href="https://www.letsride.co.uk/breeze">https://www.letsride.co.uk/breeze</a>
---------	---	---	---

**Activity**

When using the activity planner, it is useful to keep in mind what activities you enjoy and would like to try over the next six weeks. Use the space below to write down the activities that you would like to try, or look for more information about.



Planning and monitoring your activity: Week 1

Goal: \_\_\_\_\_ minutes

Day	What?	When?	Activity plans	Where?	Duration	Activity progress
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						
						Total activity minutes:

**Activities to research** for example, I will look up local walking groups.



Planning and monitoring your activity: Week 3

Goal: \_\_\_\_\_ minutes

Day	What?	When?	Activity plans	Where?	Duration	Activity progress
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						
Total activity minutes:						

Activities to research:



Planning and monitoring your activity: Week 2

Goal: \_\_\_\_\_ minutes

Day	What?	When?	Activity plans	Where?	Duration	Activity progress
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						
Total activity minutes:						

Activities to research:



Planning and monitoring your activity: Week 5

Goal: \_\_\_\_\_ minutes

Day	What?	When?	Activity plans	Where?	Duration	Activity progress
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						
Total activity minutes:						

Activities to research:



Planning and monitoring your activity: Week 4

Goal: \_\_\_\_\_ minutes

Day	What?	When?	Activity plans	Where?	Duration	Activity progress
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						
Total activity minutes:						

Activities to research:



Planning and monitoring your activity: Week 6

Goal: \_\_\_\_\_ minutes

Day	Activity plans				Activity progress
	What?	When?	Where?	Duration	
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					
					Total activity minutes:

Activities to research:

## Appendix 5.1: Buddy Up Advertising materials



# Buddy Up

Active with baby - Active with friends - Active for me

Have you recently had a baby?

Would you like to become more active with the support of a buddy?

Buddy Up is a research study, which aims to build support between you and your buddy, who is also a new mum, to motivate each other and take part in physical activity after having a baby.

Your buddy can either be a friend that you already have, or we can match you with a buddy.



Follow this link to register your interest:  
<https://bit.ly/2qTY9RA>

For more information, please contact Kate Ellis on:  
[nke22@medschl.cam.ac.uk](mailto:nke22@medschl.cam.ac.uk)  
01223 764547

We're looking for volunteers. You can take part in the research if...

...you had a baby in the last 12 months

...you are over 16

...you are in good general health

...you are not pregnant or planning to become pregnant in the next six months

...you consider yourself inactive



**UNIVERSITY OF  
CAMBRIDGE**

Public Health and Primary Care  
The Primary Care Unit  
Professor Stephen Sutton



**National Institute for  
Health Research**

**School for Primary Care Research**  
Increasing the evidence base for primary care practice

Buddy Up:  
[nke22@medschl.cam.ac.uk](mailto:nke22@medschl.cam.ac.uk)

### **Advertising text**

Have you recently had a baby?

Would you like to become more active with the support of a buddy?

Buddy Up is a research study, which aims to build support between you and your buddy, also a new mum, to help motivate each other take part in physical activity after having a baby.

Researchers at Cambridge University have designed three Buddy Up sessions for new mums, because you have told us that it is easier to start being active and staying active if you have another new mum to do it with.

We're looking for volunteers to take part in Buddy Up, who have a baby under one years old. Your buddy can either be a friend that you already have, or we can try and match you up with a buddy.

To register your interest please click this link: <https://bit.ly/2qTY9RA>

For more information please contact Kate Ellis

Email: [nke22@medschl.cam.ac.uk](mailto:nke22@medschl.cam.ac.uk)

Tel: 01223 746547

### **Facebook advert**



The image shows a Facebook advertisement for the 'Buddy Up' research study. At the top left is the 'Buddy Up' logo, which consists of a stylized purple figure with arms raised, and the text 'Buddy Up' next to it. Below the logo, it says 'Sponsored' with a small globe icon. The main text of the ad reads: 'Volunteer in a research study to help new mums be more active with the support of a buddy'. Below this text is a photograph of a woman lying on a green mat on the floor, holding a baby. In the background, another woman is also lying on a mat. At the bottom of the ad, there is a 'LEARN MORE' button. Below the button, the text 'CAMBRIDGE.EU.QUALTRICS....' is visible, followed by 'Buddy Up'. At the very bottom of the ad, there are three icons: a thumbs up for 'Like', a speech bubble for 'Comment', and a share icon for 'Share'.

**Appendix 5.2: Baseline Questionnaire**  
Baseline questionnaire

Participant number: \_\_\_\_\_

**SECTION 1: Physical activity levels**

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place and in your spare time for recreation, exercise or sport.

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

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics or fast bicycling?
  - a. \_\_\_\_ days per week
  - b.  No vigorous physical activities (Skip to question 3)
  
2. How much time did you usually spend doing **vigorous** activities on one of those days?
  - a. \_\_\_\_ hours per day
  - b. \_\_\_\_ minutes per day
  - c.  Don't know/not sure

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

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace or doubles tennis. Do not include walking.
  - a. \_\_\_\_ days per week
  - b.  No moderate physical activities (Skip to question 5)
  
4. How much time did you usually spend doing **moderate physical** activities on one of those days?
  - a. \_\_\_\_ hours per day
  - b. \_\_\_\_ minutes per day
  - c.  Don't know/not sure

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

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

b.  No walking (skip to question 7)

6. How much time did you usually spend **walking** on one of those days?
- a. \_\_\_ hours per day
  - b. \_\_\_ minutes per day
  - c.  Don't know/not sure

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

7. During the last **7 days**, how much time did you spend sitting on a **week day**?
- a. \_\_\_ hours per day
  - b. \_\_\_ minutes per day
  - c.  Don't know/not sure

## Section 2: Confidence to overcome barriers

Below is a list of barriers that might stop you from being active. Please read each item and rate how confident you are that you could be active in the situation by circling your answer.

### How sure am I that I could be physically active...

Certain I cannot do

Moderately certain I can do

Very certain I can do

...when I am tired?

1      2      3      4      5      6      7      8      9      10

...during or following a crisis?

1      2      3      4      5      6      7      8      9      10

...when I am feeling depressed?

1      2      3      4      5      6      7      8      9      10

...when I am feeling anxious?

1      2      3      4      5      6      7      8      9      10

...when I am slightly sore from the last time I was physically active?

1      2      3      4      5      6      7      8      9      10

...when I am on holiday?

1      2      3      4      5      6      7      8      9      10

...when there are competing interests (like my favourite TV show)?

1      2      3      4      5      6      7      8      9      10

...when I have a lot of work to do?

1      2      3      4      5      6      7      8      9      10

...when I haven't reached my physical activity goals?

1      2      3      4      5      6      7      8      9      10

...when I don't receive support from family or friends?

1      2      3      4      5      6      7      8      9      10

...when I have no one to be physically active with?

1      2      3      4      5      6      7      8      9      10

...when my schedule is very busy?

1      2      3      4      5      6      7      8      9      10

...during bad weather?

1      2      3      4      5      6      7      8      9      10

...when it's too hot and sunny?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...following complete recovery from an illness?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...when the baby/children are sick or just recovered from being sick (with cold, flu, ear infection, etc)?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...when there is housework to do?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...when I don't have anyone to look after the baby (and other kids)?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...when I don't have any money?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...when I feel like you don't have the time?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...when I have family or friends visiting you for the holidays or their vacation?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...when I return to work after being off for family/maternity leave?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

...when I have a job working at home?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

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### SECTION 3: About you

Finally, we would like to know a little bit more about you. We will use the data you provide below to help us understand who has taken part in our research.

Date of birth (DD/MM/YY): \_\_\_\_\_

Number of children \_\_\_\_\_ Date of birth of \_\_\_\_\_  
youngest child:

Name of GP \_\_\_\_\_

GP Practice address: \_\_\_\_\_  
\_\_\_\_\_

**Marital status:** *Please circle your answer*

Married      Co-habiting      Single      Separated      Divorced      Widowed      Prefer not to say

**Employment:** *Please circle your answer*

On maternity leave      Full time employment      Part time employment      Not employed      Prefer not to say

**Education level:** *Please circle the highest level of education you have obtained*

Some secondary school      GCSE      A level or equivalent      Bachelors degree      Masters degree      Doctoral degree PhD      Prefer not to say

## Appendix 5.3: Post intervention questionnaire

### Section 1: Intervention evaluation

#### Activity with your buddy

The questions in this section are about the study that you have been taking part in. We are interested to know if it has worked as we intended it to, and whether you think it is suitable. Please answer all questions honestly as we will be using your answers to make improvements in the future.

Think about the activity you have done with your buddy over the **past week**.

On how many days in the past week, did you do activity with your buddy? (Please circle your response)

0            1            2            3            4            5            6            7

On average, how much time did you spend doing activity with your buddy?

\_\_\_\_\_ hours            \_\_\_\_\_ minutes

What activity/activities did you do with your buddy? Please include as much detail as possible, eg type of activity, where you did the activity?

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As a percentage of your overall physical activity in the past week, approximately what percentage of your activity was with your buddy?

\_\_\_\_\_%

#### Buddy support

Think about the support your buddy has given you. Tick each type of support your buddy has given you.

Sent encouraging messages

Looked after your baby

- Done physical activity with you
- Shared information or ideas about physical activity
- Set up a FitBit (or other) group
- Exchanged rewards for physical activity
- Sent messages prompting you to be active

Other: \_\_\_\_\_  
 \_\_\_\_\_

Using a scale or 1-7, how much has your buddy influenced you to be active?

Not at all			Neutral				A lot
1	2	3	4	5	6	7	

Do you have any comments about how your buddy has influenced you to be active?

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### Intervention feedback

The next questions relate to the sessions. Please think about the sessions you attended and the booklet that you worked through. Rate the answers from 1 (Strongly disagree) to 5 (Strongly agree).

The study...

	Strongly disagree	1	2	3	4	5	Strongly agree
...helped me understand more about postnatal physical activity		1	2	3	4	5	
...answered most of the questions I had		1	2	3	4	5	
...explained things in terms I could understand		1	2	3	4	5	

...gave enough examples of activities	1	2	3	4	5
...signposted to appropriate activities	1	2	3	4	5
...gave clear and concise information	1	2	3	4	5

Thinking about the topics that we covered in Buddy Up. How helpful was each topic for helping you increase your activity levels?

	Not at all helpful				Extremely helpful
Understanding the reasons for being active	1	2	3	4	5
Learning about the physical activity guidelines	1	2	3	4	5
Exploring all physical activity opportunities	1	2	3	4	5
Committing to support your buddy/your buddy committing to support you	1	2	3	4	5
Setting goals	1	2	3	4	5
Monitoring your goals	1	2	3	4	5
Making weekly plans	1	2	3	4	5
Making contingency plans for	1	2	3	4	5

when life gets in the way

For the next set of questions, please think about the sessions only.

I thought the Buddy Up sessions happened...

Too often

About right

Not often enough

1

2

3

4

5

I thought the length of the sessions were...

Too long

About right

Too short

1

2

3

4

5

For the next set of questions, please think about the booklet only.

	Strongly disagree		Neutral		Strongly agree
The print size was large enough for reading	1	2	3	4	5
The booklet was visually appealing	1	2	3	4	5
The information was clear and concise	1	2	3	4	5
I used the booklet to plan my activity	1	2	3	4	5
I used the booklet to monitor my activity	1	2	3	4	5
I read the booklet outside of the session	1	2	3	4	5
I referred back to the booklet	1	2	3	4	5

Is there anything else you would like to say about Buddy Up, including both the sessions and the booklet?

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We would like to conduct some short telephone interviews to get some further feedback about Buddy Up. Would you be happy to be contacted to discuss this further?

Yes

No

## **Appendix 5.4: Interview Schedule**

### **Interview schedule**

#### **Buddy element:**

**Tell me about the activity that you have done with your buddy.**

What activities have you done together?

How is doing activity with your buddy different from on your own?

Why do you do activity with/without your buddy?

**How has your buddy influenced your activity levels?**

How could they provide more support?

What support did they offer?

#### **Intervention sessions:**

**Thinking about the intervention sessions, what did you think of them?**

Why did you think that?

What elements worked well?

What didn't work so well?

**Thinking about the booklet that we used, what did you think of that?**

How did you use the booklet?

What was good about the booklet?

#### **Data collection:**

**Think about the data we collected before and after the intervention. Tell me how you found that.**

Thinking about the process of wearing the accelerometers and completing the questionnaires, do you have any comments?

**Overall, how could the intervention be improved?**

## Appendix 5.5: Follow-up questionnaire

### Section 1: Data collection

This section asks questions about the data collection procedures.

The first set of questions relate to the accelerometer, which you wore for seven days. Please rate how much you agree with each statement on a scale of 1 (strongly disagree) to 5 (strongly agree)

Strongly disagree

Strongly agree

I found the instructions for wearing the accelerometer easy to understand

1

2

3

4

5

I wore the accelerometer as instructed

1

2

3

4

5

Wearing the accelerometer for seven days was a burden

1

2

3

4

5

Do you have any other comments about the accelerometer? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

The next questions relate to the questionnaires which we asked you to fill in. Please rate how much you agree with each statement on a scale of 1 (strongly disagree) to 5 (strongly agree)

Strongly disagree

Strongly agree

The questionnaires were easy to complete

1

2

3

4

5

The questionnaires were difficult to understand

1

2

3

4

5

The questionnaires took too long to complete

1

2

3

4

5

Overall, do you think the amount of data we collected was

Too little

About right

Too much

1

2

3

4

5

Do you have any other comments about the data collection procedure? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Appendix 6.1: Recruitment via Children Centre visits by location

	Broxbourne East			Cambridge	Attleborough	Total
	Green-fields	High Trees	Arlesdene	The Fields		
Contacted by researcher	3	9	8	9	4	<b>33</b>
No response	0	5	2	2	2	<b>11</b>
Not interested	0	2	1	0	1	<b>4</b>
Incorrect contact details	0	0	1	0	0	<b>1</b>
Screened for eligibility	3	2	4	7	1	<b>17</b>
Ineligible	0	1	3	1	0	<b>5</b>
Too active	0	1	2	1	0	<b>4</b>
Currently pregnant	0	0	1	0	0	<b>1</b>
Eligible	3	1	1	6	1	<b>12</b>
Paired	2	0	0	6	1	<b>9</b>
Awaiting pairing	1	1	1	0	0	<b>3</b>

## Appendix 6.2: Baseline characteristics of participants who completed the intervention and those who withdrew

Participant demographic characteristics						
Characteristic	Total sample (n=44)		Completed intervention (n=38)		Withdrew from intervention (n=6)	
	n	%	n	%	n	%
<b>Age (years)</b>						
25-30	14	31.82	11	28.9	3	50
31-35	20	45.45	17	44.7	3	50
36-40	10	22.73	10	26.3	0	0
<b>Age of youngest child (months)</b>						
0-3	10	22.73	10	26.3	0	0
4-6	13	29.55	12	31.6	1	16.7
7-9	14	31.82	9	23.7	5	83.3
10-12	7	15.91	7	18.4	0	0
<b>Number of children</b>						
1	32	72.73	29	76.3	3	50
2	10	22.73	7	18.4	3	50
3	1	2.27	1	2.6	0	0
4	1	2.27	1	2.6	0	0
5+	0	0.00	0	0	0	0
<b>Highest education</b>						
Some secondary school	0	0.00	0	0	0	0
GCSE	3	6.82	1	2.6	2	33.3
A level/equivalent	8	18.18	6	15.8	2	33.3
University/college degree	33	75.00	31	80.8	2	33.3
<b>Employment status</b>						
On maternity leave	30	68.18	26	68.4	4	66.7
Part time employment	5	11.36	5	13.2	0	0
Full time employment	2	4.55	1	2.6	1	16.7
Unemployed	7	15.91	6	15.8	1	16.7
<b>Marital status</b>						
Married	30	68.18	27	71.1	3	50
Cohabiting	14	31.82	11	28.9	3	50
Single	0	0.00	0	0	0	0
Separated	0	0.00	0	0	0	0
<b>Type of match</b>						
New	22	50	18	47.4	4	66.7

Existing	22	50	20	52.6	2	33.3
----------	----	----	----	------	---	------

#### Participants self-report PA

	Total sample (n=44)		Completed intervention (n=38)		Withdrew from intervention (n=6)	
	Mean	SD	Mean	SD	Mean	SD
<b>Continuous PA score</b>						
Average MET-min/week	1259.97	1246.71	1370.39	1304.71	794.25	500.22
<b>Categorical PA score</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>n</b>	<b>%</b>
Low	17	38.64	10	26.3	4	66.7
Moderate	25	56.82	26	68.4	2	33.3
High	2	4.55	2	5.3	0	0

PA data shows baseline objective PA a mean CPM of the whole sample of 696 (SD=149). In contrast with the self-report data, there appears to be very little difference in baseline CPM data between the groups, (new match Mean=692; SD=149; Existing match: Mean=700; SD=152).

#### Participants objective PA

	Total sample (n=39)		Completed intervention (n=33)		Withdrew from intervention (n=20)	
	Mean	SD	Mean	SD	Mean	SD
CPM	696	149	699.24	156.42	678.55	107.93
<b>Total time in each intensity</b>						
Sedentary	3631	761	3584.77	772.76	3884.28	697.48
Light	1222	312	1204.84	328.60	1313.14	188.58
Moderate	263	113	272.34	116.75	203.97	65.92
Vigorous	5.96	7.77	6.51	8.31	2.92	1.91
Very Vigorous	0.23	0.4	0.25	0.42	0.11	0.20
<b>Time per day in each intensity</b>						
Sedentary	583	75	581.85	78.83	588.98	49.33
Light	197	39	195.64	41.59	202.23	17.09
Moderate	41.7	15.2	43.68	15.54	31.03	7.61
Vigorous	0.92	1.11	1.01	1.19	0.45	0.28
Very Vigorous	0.04	0.06	0.04	0.07	0.02	0.03
Total MVPA bouts >10 minutes	91.06	93.65	99.31	98.43	45.73	41.64
<b>Categorical MVPA bouts &gt;10 minutes</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
0-30 minutes	14	35.90	11	33.3	3	50
30-150 minutes	16	41.03	13	39.4	3	50
>150 minutes	9	23.08	9	27.3	0	0

### Appendix 6.3: Distribution of barrier efficacy scores at baseline and follow-up

How sure am I that I can be physically active...		1	2	3	4	5	6	7	8	9	10	Baseline (n=44) Mean, SD (n)	Follow-up (n=31) Mean, SD (n)	T-Test significance
...when I am tired	Baseline	4 (9.1)	5 (11.4)	8 (18.2)	6 (13.6)	8 (18.2)	5 (11.4)	4 (9.1)	2 (4.5)	1 (2.3)	1 (2.3)	4.43, 2.22 (44)	4.45, 2.28 (31)	
	Follow-up	3 (9.7)	2 (6.5)	8 (25.8)	5 (16.1)	4 (12.9)	1 (3.2)	5 (16.1)	1 (3.2)	2 (6.5)	0 (0)			
...during or following a crisis	Baseline	7 (15.9)	6 (13.6)	8 (18.2)	2 (4.5)	10 (22.7)	5 (11.4)	0 (0)	5 (11.4)	0 (0)	1 (2.3)	4.11, 2.36 (44)	4.42, 2.67 (31.)	
	Follow-up	6 (19.4)	2 (6.5)	6 (19.4)	2 (6.5)	5 (16.1)	3 (9.7)	1 (3.2)	4 (12.9)	1 (3.2)	1 (3.2)			
...when I am feeling depressed	Baseline	8 (18.2)	9 (20.5)	12 (27.3)	3 (6.8)	5 (11.4)	3 (6.8)	0 (0)	2 (4.5)	1 (2.3)	1 (2.3)	3.45, 2.25 (44)	4.52, 2.36 (31)	<0.05
	Follow-up	4 (12.9)	2 (6.5)	7 (22.6)	3 (9.7)	4 (12.9)	3 (9.7)	4 (12.9)	3 (9.7)	1 (3.2)	0 (0)			
...when I am feeling anxious	Baseline	3 (6.8)	4 (9.1)	10 (22.7)	4 (9.1)	7 (15.9)	3 (6.8)	7 (15.9)	5 (11.4)	0 (0)	1 (2.3)	4.75, 2.29 (44)	5.06, 2.19 (31)	
	Follow-up	1 (3.2)	2 (6.5)	6 (19.4)	6 (19.4)	3 (9.7)	3 (9.7)	4 (12.9)	5 (16.1)	1 (3.2)	0 (0)			
...when I am slightly sore from the last time I was physically active	Baseline	2 (4.5)	2 (4.5)	3 (6.8)	6 (13.6)	8 (18.2)	2 (4.5)	6 (13.6)	10 (22.7)	3 (6.8)	2 (4.5)	5.91, 2.39 (44)	5.77, 2.17 (31)	
	Follow-up	1 (3.2)	0 (0)	4 (12.9)	5 (16.1)	4 (12.9)	6 (19.4)	2 (6.5)	5 (16.1)	4 (12.9)	0 (0)			
...when I am on holiday	Baseline	6 (13.6)	2 (4.5)	2 (4.5)	3 (6.8)	3 (6.8)	3 (6.8)	10 (22.7)	7 (15.9)	3 (6.8)	5 (11.4)	6.00, 2.89 (44)	5.65, 2.75 (31)	

	Follow-up	3 (9.7)	4 (12.9)	2 (6.5)	1 (3.2)	2 (6.5)	3 (9.7)	6 (19.4)	7 (22.6)	2 (6.5)	1 (3.2)			
...when there are competing interests (like my favourite TV show)	Baseline	1 (2.3)	3 (6.8)	5 (11.4)	5 (11.4)	5 (11.4)	7 (15.9)	7 (15.9)	7 (15.9)	3 (6.8)	1 (2.3)	5.70, 2.25 (44)	6.06, 2.28 (31)	
	Follow-up	1 (3.2)	1 (3.2)	3 (9.7)	3 (9.7)	5 (16.1)	1 (3.2)	8 (25.8)	5 (16.1)	3 (9.7)	1 (3.2)			
...when I have a lot of work to do	Baseline	6 (13.6)	5 (11.4)	8 (18.2)	5 (11.4)	8 (18.2)	4 (9.1)	5 (11.4)	2 (4.5)	0 (0)	1 (2.3)	4.20, 2.25 (44)	4.45, 2.01 (31)	
	Follow-up	2 (6.5)	5 (16.1)	2 (6.5)	7 (22.6)	6 (19.4)	4 (12.9)	2 (6.5)	3 (9.7)	0 (0)	0 (0)			
...when I haven't reached my physical activity goals	Baseline	2 (4.5)	1 (2.3)	2 (4.5)	5 (11.4)	7 (15.9)	6 (13.6)	7 (15.9)	2 (4.5)	5 (11.4)	6 (13.6)	6.30, 2.50 (43)	6.58, 2.13 (31)	
	Follow-up	0 (0)	2 (6.5)	2 (6.5)	0 (0)	5 (16.1)	3 (9.7)	8 (25.8)	6 (19.3)	3 (9.7)	2 (6.5)			
...when I don't receive support from family or friends	Baseline	3 (6.8)	2 (4.5)	6 (13.6)	3 (6.8)	6 (13.6)	9 (20.5)	3 (6.8)	1 (2.3)	6 (13.6)	5 (11.4)	5.77, 2.72 (44)	5.32, 2.66 (31)	
	Follow-up	3 (9.7)	3 (9.7)	2 (6.5)	4 (12.9)	5 (15.1)	2 (6.5)	5 (16.1)	2 (6.5)	4 (12.9)	1 (3.2)			
...when I have no one to be physically active with	Baseline	4 (9.1)	2 (4.5)	3 (6.8)	5 (11.4)	4 (9.1)	5 (11.4)	9 (20.5)	8 (18.2)	3 (6.8)	1 (2.3)	5.70, 2.47 (44)	6.58, 2.60 (31)	<0.05
	Follow-up	0 (0)	2 (6.5)	4 (12.9)	2 (6.5)	2 (6.5)	5 (16.1)	2 (6.5)	4 (12.9)	6 (19.4)	4 (12.9)			
...when my schedule is very busy	Baseline	3 (6.8)	9 (20.5)	12 (27.3)	5 (11.4)	6 (13.6)	2 (4.5)	3 (6.8)	3 (6.8)	0 (0)	1 (2.3)	3.95, 2.16 (44)	4.06, 2.02, (31)	
	Follow-up	4 (12.9)	3 (9.7)	6 (19.4)	5 (16.1)	6 (19.4)	3 (9.7)	2 (6.5)	2 (6.5)	0 (0)	0 (0)			
...during bad weather	Baseline	2 (4.5)	9 (20.5)	7 (15.9)	9 (20.5)	3 (6.8)	5 (11.4)	2 (4.5)	5 (11.4)	1 (2.3)	1 (2.3)	4.43, 2.34 (44)	5.35, 2.59 (31)	<0.05
	Follow-up	1 (3.2)	3 (9.7)	7 (22.6)	2 (6.5)	3 (9.7)	4 (12.9)	3 (9.7)	3 (9.7)	4 (12.9)	1 (3.2)			
...when it's too hot and sunny	Baseline	2 (4.5)	4 (9.1)	3 (6.8)	5 (11.4)	2 (4.5)	6 (13.6)	8 (18.2)	13 (29.5)	0 (0)	1 (2.3)	5.80, 2.35 (44)	5.55, 2.25 (31)	
	Follow-up	0 (0)	3 (9.7)	4 (12.9)	5 (16.1)	3 (9.7)	4 (12.9)	4 (12.9)	5 (16.1)	3 (9.7)	0 (0)			

...following complete recovery from an illness	Baseline	4 (9.1)	9 (20.5)	7 (15.9)	2 (4.5)	7 (15.9)	4 (9.1)	3 (6.8)	4 (9.1)	3 (6.8)	1 (2.3)	4.55, 2.60	4.90, 2.40	
	Follow-up	3 (9.7)	2 (6.5)	6 (19.4)	0 (0)	8 (25.8)	5 (16.1)	3 (9.7)	1 (3.2)	2 (6.5)	1 (3.2)	(44)	(31)	
...when the baby/children are sick or just recovered from being sick (with cold, flu, ear infection etc)	Baseline	7 (16.3)	11 (25.0)	10 (22.7)	7 (15.9)	5 (11.4)	2 (4.5)	1 (2.3)	0 (0)	0 (0)	0 (0)	3.05, 1.54	3.55, 2.25	
	Follow-up	8 (25.8)	5 (16.1)	2 (6.5)	6 (19.4)	4 (12.9)	2 (6.5)	3 (9.7)	0 (0)	1 (3.2)	0 (0)	(43)	(31)	
...when there is housework to do	Baseline	1 (4.5)	1 (2.3)	4 (9.1)	8 (18.2)	6 (13.6)	5 (11.4)	8 (18.2)	7 (15.9)	2 (4.5)	1 (2.3)	5.64, 2.18	5.32, 2.59	
	Follow-up	3 (9.7)	3 (9.7)	2 (6.5)	5 (16.1)	1 (3.2)	5 (16.1)	4 (12.9)	6 (19.4)	1 (3.2)	1 (3.2)	(44)	(31)	
...when I don't have anyone to look after the baby (and other kids)	Baseline	15 (34.1)	5 (11.4)	5 (11.4)	3 (6.8)	3 (6.8)	2 (4.5)	7 (15.9)	1 (2.3)	2 (4.5)	1 (2.3)	3.73, 2.78	3.87, 2.88	
	Follow-up	8 (25.8)	6 (19.4)	4 (12.9)	2 (6.5)	3 (9.7)	1 (3.2)	1 (3.2)	3 (9.7)	2 (6.5)	1 (3.2)	(44)	(31)	
...when I don't have any money	Baseline	1 (2.3)	4 (9.1)	4 (9.1)	4 (9.1)	6 (13.6)	4 (9.1)	6 (13.6)	3 (6.8)	7 (15.9)	5 (11.4)	6.14, 2.67	7.45, 2.20	<0.05
	Follow-up	0 (0)	0 (0)	1 (3.2)	2 (6.5)	5 (16.1)	2 (6.5)	6 (19.4)	3 (9.7)	3 (9.7)	10 (29)	(44)	(31)	
...when you feel like you don't have the time	Baseline	4 (9.1)	8 (18.2)	11 (25.0)	6 (13.6)	5 (11.4)	3 (6.8)	3 (6.8)	2 (4.5)	0 (0)	2 (4.5)	4.02, 2.30	3.94, 2.05, (31)	
	Follow-up	5 (16.1)	3 (9.7)	5 (16.1)	6 (19.4)	5 (16.1)	4 (12.9)	2 (6.5)	0 (0)	1 (3.2)	0 (0)	(44)	(31)	
...when I have family or friends visiting for the holidays or their vacation	Baseline	10 (22.7)	8 (18.2)	7 (15.9)	2 (4.5)	7 (15.9)	2 (4.5)	4 (9.1)	2 (4.5)	0 (0)	2 (4.5)	3.77, 2.56	3.42, 2.20	
	Follow-up	7 (22.6)	7 (22.6)	4 (12.9)	4 (12.9)	3 (9.7)	2 (6.5)	2 (.65)	2 (6.5)	0 (0)	0 (0)	(44)	(31)	
...when I return to work	Baseline	2 (4.5)	4 (9.1)	9 (20.5)	7 (15.9)	3 (6.8)	3 (6.8)	5 (11.4)	3 (6.8)	2 (4.5)	4 (9.1)	5.12, 2.67	4.93, 2.78	

after being off for family/maternity leave	Follow-up	3 (10.0)	6 (20.0)	2 (6.7)	4 (13.3)	2 (6.7)	0 (0)	6 (20.0)	5 (16.7)	1 (3.3)	1 (3.3)	(42)	(30)	
...when I have a job working at home	Baseline	2 (4.5)	3 (6.8)	5 (11.4)	6 (13.6)	8 (18.2)	4 (9.1)	6 (13.6)	3 (6.8)	2 (4.5)	0 (0)	5.00, 2.13	5.28, 2.71	
	Follow-up	4 (13.8)	1 (3.4)	2 (6.9)	4 (13.8)	6 (20.7)	2 (6.9)	3 (10.3)	3 (10.3)	2 (4.5)	2 (4.5)	(39)	(29)	