AN EXAMINATION OF PRE AND POSTNATAL PHYSICAL ACTIVITY

AN EXAMINATION OF PRE AND POSTNATAL WOMEN'S LEISURE-TIME PHYSICAL ACTIVITY BEHAVIOUR AND BELIEFS: A SOCIAL COGNITIVE PERSPECTIVE

By

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Abstract

Health research has demonstrated that regular leisure-time physical activity (LTPA) during pregnancy and the postnatal period may play a crucial role in managing the physical and psychological challenges that women face during these times of transition. The purpose of this dissertation was to investigate LTPA patterns during pregnancy and in the postnatal period and identify social-cognitive correlates associated with regular LTPA. Three inter-related studies were conducted.

The purpose of Study 1 was to conduct an in depth month-to-month investigation of LTPA from 3 months prior to conception to 7 months following childbirth. An assesement of 309 pre and postnatal women revealed that LTPA started to decline in the first trimester of pregnancy, continued to decline at a steady rate until childbirth and then increased during the postnatal period. In addition to illustrating the average growth curve, the results from the multi-level moding analyses indicated substantial individual variability around the average growth curve. Future research should identify social cognitive factors that are associated with LTPA during this time of transition.

Accordingly, Study 2 investigated psychosocial correlates of LTPA during pregnancy. The study engaged pregnant women in the listing of salient barriers to LTPA at 4 different time points during pregnancy (e.g., pregnancy weeks 18, 24, 30 and 36) and examined if barrier self-efficacy as well as a general measure of exercise self-efficacy were associated with LTPA during pregnancy. A total of 1168 barriers were content analyzed, yielding nine major themes. Hierarchical regression analyses supported both forms of self-efficacy as predictors of LTPA.

While Study 2 examined LTPA during pregnancy, Study 3 focused on the postnatal period. The first objective was to identify postnatal women's perceived LTPA barriers and outcome expectations. In general, the barriers reported were consistent with barriers experienced by both asymptomatic and symptomatic populations as well as previous research examining barriers to exercise among postnatal women. The results of the open-ended outcome expectation elicitation generated a large number of physical, psychological and social outcome expectations. Approximately 90% of all outcome expectations listed under each category were classified into four groups. The second objective of Study 3 was to examine if outcome expectation likelihood, exercise self-efficacy and barrier self-efficacy were associated with LTPA. In support of our hypothesis, and consistent with social cognitive theory, self-efficacy was significantly associated with LTPA.

For many women engaging in regular LTPA during pregnancy and following the birth of a child is a challenge. The average growth curve results from Study 1 are promising; however the random effects analyses was significant indicating substantial individual variability about the average growth curve. Study 2 and Study 3 identified a number of salient barriers to LTPA which may hinder the initiation and maintenance of regular LTPA. Study 3 also identified salient outcome expectations that may severe a motivational factors to engage in LTPA. The results suggest that self-efficacy represents an important social cognition is linked to higher levels of LTPA in the postnatal period. In conclusion, barrier and exercise self-efficacy may be important targets for intervention efforts to promote LTPA during pregnancy.

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List of Abbreviations

ACOG	-American College of Obstetricians and Gynecologists
ACSM	-American College of Sports Medicine
ANOVA	-analysis of variance
HLM	-hierarchical linear modeling
ICC	-interclass correlation
LTPA	-leisure-time physical activity
MANOVA	-multivariate analysis of variance
MAQ	-modifiable physical activity questionnaire
MET	-metabolic equivalents
METs-hrs/week	-metabolic equivalents hours per week
MLM	-multilevel modeling
PA	-physical activity
SCT	-social cognitive theory
SD	-standard deviation
TPB	-theory of planned behaviour

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CHAPTER 1

GENERAL INTRODUCTION

Introduction

The Problem of Exercise Adherence among Young Adult Women

Engaging in regular physical activity throughout one's lifespan is associated with numerous health benefits (Health Canada, 2004; Warburton, Nicol, & Bredin, 2006). Regrettably, many people fail to engage in a sufficient amount of physical activity to achieve such health benefits (Miller, Sales, Kopjar, Fihn, & Bryson, 2005). Accordingly, understanding physical activity patterns and the factors associated with adherence to regular physical activity is a research priority (Orleans, 2000).

Epidemiological data show a significant trend of decreasing physical activity levels during the transition from adolescence to adulthood (Anderssen, Jacobs, Sidney, Bild, Sternfeld, Slattery et al., 1996; Caspersen, Pereira, & Curran, 2000; Gordon-Larsen, Nelson, & Popkin, 2004; Nelson, Gordon-Larsen, Adair, & Popkin, 2005; Sallis, 1999; Van Mechelen, Twisk, Post, Snel, & Kemper, 1999). For example, data from the 2005 Canadian Community Health Survey (Gilmore, 2007) and Fortier and colleagues (Fortier, Katzmarzyk, Malina, & Bouchard, 2001) revealed that the proportion of people who reported being physically active (defined as using >1.5 kilocalories per kilogram of body weight/day) significantly declined after the adolescent years.

While declines in physical activity are evident in both genders, it appears that young adult women are at a higher risk of experiencing greater declines in leisure-time physical activity (LTPA) than young men (Gilmore, 2007). Therefore, understanding this drop in LTPA levels among young adult females and developing interventions to increase

LTPA is recognized as an important research agenda (Brown & Trost, 2003; Marcus, Williams, Dubbert, Sallis, King, Yancey, 2006).

Why Does LTPA Decline Among Young Adult Women?

Although numerous factors such as pursuing higher education and entering the workforce can disrupt or interfere with LTPA (Malina, 2001), pregnancy and the demands of parenthood have been identified as factors contributing to the sharp decline in regular physical activity among young adult women (Brown & Trost, 2003; Godin, Vezina, & Leclerc, 1989; Mottola, 2002; Ringdahl, 2002). During pregnancy and the year following childbirth, women experience many physical, psychological and behavioural changes (Mottola; Ringdahl). While the list of changes is extensive a few examples include weight gain, fluctuating hormones, feelings of discomfort (e.g., joint and back pain), altered schedules, and sleepless nights. As such, it is not surprising that pregnancy and parenthood have been identified as contributing factors to the decline in LTPA behaviour among young adult women.

LTPA Behaviour during Pregnancy and in the Postnatal Period

Research studies of both cross-sectional and prospective design have revealed that a majority of pregnant women are insufficiently active (i.e., less than 150 minutes of physical activity per week). For example, studies have demonstrated that as pregnancy progresses, physical activity levels decrease (Clark, Rousham, Gross, Halligan, & Bosio, 2005; Mottola & Campbell, 2003). In a cross-sectional study involving a convenience sample of 529 women, 30% reported participating in no LTPA prior to pregnancy. This percentage increased to 36% during trimester one, 44% during trimester two, and 51%

during trimester three (Mottola & Campbell, 2003). Clark and colleagues (2005) reported similar results from their prospective study that collected data from 51 pregnant women during the 16th, 25th, 34th and 38th weeks of pregnancy. The results of the study demonstrated that as pregnancy progressed, self-reported daily activity levels declined. Specifically, daily activity levels were significantly lower at week 38 of pregnancy compared to week 16. The study also examined participation in structured exercise and sport and found that only 31% of women self-reported some form of weekly sport or exercise on one occasion during pregnancy. Furthermore, only 19% reported some form of weekly sport or exercise two times per week and 11% three or more times per week, respectively. In another study that measured physical activity objectively using accelerometers, physical activity was found to decline by 23% from gestation weeks 12 to 36 (Poudevigne & O'Connor, 2005).

All three of these studies demonstrated that LTPA consistently decreases as pregnancy progresses. Recently, Poudevigne & O'Connor (2006) concluded similar results in their review of 31 pregnancy and exercise studies. Systematic database searches (e.g., PsycInfo, Medline, PubMed) and manual cross referencing of bibliographies yielded 10 additional studies. A complete summary of these 10 studies is displayed in Table 1 and a quantitative summary of those studies and the studies reviewed by Poudevigne & O'Connor are presented in Table 2. Overall, 32 studies published between 1982 and 2007 have examined change in exercise during pregnancy. Twenty-six of the studies found that physical activity declined during pregnancy. Twelve studies did not specify the measure used to collected physical activity data, 10 studies used a reliable and

valid paper and pen measure, 8 studies used objective measures, and 4 used diaries. Twenty studies collected data prospectively and 12 studies relied on retrospective recall. Interestingly, only 15 of the 32 studies provided specific information about the when physical activity data were collected. Furthermore, 17 studies examined change in physical activity during pregnancy compared to prepregnancy. All 17 studies found that physical activity levels were lower during pregnancy compared to prepregnancy. A quantitative summary of those studies is displayed in Table 2.

In the postnatal period, women remain at risk for being inactive (Bellows-Riecken & Rhodes, 2007). A study of LTPA patterns among 543 Australian mothers demonstrated that more than two-thirds of the sample reported levels of LTPA that were considered inadequate for attaining health benefits (Brown, Brown, Miller, & Hansen, 2001). However, studies that have compared women's LTPA across pregnancy and the postnatal period have revealed inconsistent results. While some studies have shown LTPA to increase in the postnatal period (Pereira, Rifas-Shiman, Kleinman, Rich-Edwards, Peterson, & Gilman, 2007; van Raaij, Schonk, Vermaat-Miedema, Peek, & Hautvast, 1990), others have shown that LTPA remains the same as in the latter stages of pregnancy (Blum, Beaudoin, & Canton-Lemos, 2004; Grace, William, Stewart, & Franche, 2006; Stein, Rivera, & Pivarnik, 2003). A summary of studies examining change in LTPA during the postnatal period compared to pregnancy or prepregnancy obtained through systematic database searches (e.g., PsycInfo, Medline, PubMed) and manual cross referencing of bibliographies is presented in Table 1. Six studies examined change in physical activity from prepregnancy to postnatal. In general, these studies

relied on retrospective data collection methods and used reliable and valid measure of physical activity. Five of the 6 studies concluded that physical activity decreased from prepregnancy to postnatal. Six studies reported data on change in physical activity from pregnancy to postnatal. Two studies collected physical activity information retrospectively, while 4 studies collected it prospectively. Of the 4 prospective studies, 1 study measured physical activity objectively. Overall, the results of these studies were mixed; 2 studies found no change in physical activity, 3 studies concluded that physical activity increased and 1 study reported that physical activity decreased. A quantitative summary of the studies included is displayed in Table 2.

Only 3 studies included in the review examined change in LTPA participation during each of these three time periods. While the studies that have examined either exercise during pregnancy or exercise in the postnatal period provide information on activity patterns during these two distinct periods, perhaps the most informative studies are those that have examined the trajectory of LTPA from prepregnancy, through pregnancy, and into the postnatal period. In one study (Schramm, Stockbauer, & Hoffman, 1996), postnatal women were asked to retrospectively recall the frequency of physical activities participated in prior to pregnancy, during each trimester of pregnancy, and three months after pregnancy. The results revealed that 30% of women reported engaging in three or more bouts of LTPA per week prior to pregnancy. During trimesters one, two, and three, the percentage of women who engaged in three or more bouts of LTPA dropped to 23%, 19%, and 16%, respectively. By three months postnatal, the percentage of women exercising three or more times per week had increased to 19%.

A more recent study by Pereira and colleagues (2007) reported similar findings. Prepregnancy physical activity levels were obtained retrospectively (i.e., pregnant women in their first trimester recalled their average weekly levels of physical activity during the 12 months prior to becoming pregnant). At 26 – 28 weeks of pregnancy (i.e., early trimester three), participants completed a second physical activity questionnaire that assessed their average weekly levels of activity during the previous three months (i.e., over the course of trimester two). LTPA was once again assessed at six months postpartum, with participants reporting their average level of activity during the previous month. The results revealed that prior to pregnancy women reported engaging in an average of 9.6 hours of LTPA per week. During pregnancy the amount of LTPA dropped to 6.9 hours per week, while following pregnancy it increased to 8.0 hours per week. Although exercise increased in the postnatal period, participation was still not as high as prepregnancy exercise participation.

In another study, Symons Downs and Hausenblas (2004) surveyed 74 postnatal women (i.e., within one year of childbirth) and asked them to retrospectively recall how much LTPA they had engaged in prior to, during, and following pregnancy. Results showed that women's strenuous and moderate LTPA was significantly lower during pregnancy and in the postnatal period compared to prepregnancy. However, exercise behaviour during pregnancy was not significantly different than during the postnatal period.

Scientifically strong conclusions about how LTPA changes during pregnancy and in the postnatal period compared to prepregnancy are difficult to infer due to

methodological limitations. Generally, studies thus far have focused on changes in LTPA using discrete time period designs (i.e., one measure of physical activity during each period prior to, during, and following pregnancy), failing to capture variations in LTPA that may also occur within each discrete phase (i.e., from month to month, rather than simply during pregnancy or during the postnatal period). In addition, few studies actually set out to examine physical activity as their primary research question (Poudvigne & O'Connor, 2006). Furthermore, studies generally fail to report changes in physical activity according to frequency, duration, intensity, and type.

The Health Benefits of LTPA during Pregnancy and in the Postnatal Period

From a public health standpoint, LTPA declines among pre and postnatal women are cause for concern because pre and postnatal women who do not engage in LTPA forgo numerous health benefits and place themselves at higher risk for health problems. Studies have clearly demonstrated that the health benefits of engaging in LTPA during pregnancy and in the postnatal period are extensive and evident in physical, psychological and social domains.

Among pregnant women, exercise is associated with reduced risk of preeclampsia (Hegaard, Pedersen, Nielsen, & Damm, 2007; Marcoux, Brisson, & Fabia, 1989; Sorenson, Williams, Edwards et al., 2003), gestational diabetes (Dempsey, Sorenson, Williams, Lee, Miller, Dashow et al., 2004; Hegaard et al.; Mottola, 2007) and preterm birth (Hegaard et al.; Juhl, Andersen, Olsen, Madsen, Jorgensen, Nohr et al., 2008) as well as improved exercise potential (measured as a 10% increase in maximal oxygen consumption during the third trimester; Avery, Leon, & Kopher, 1997), improved pain

tolerance, lower total weight gain and less fat mass gain, and improved self-image (Clapp & Kiess, 2000). In addition, exercise may also have favourable effects on the subjective experience of discomfort during pregnancy. Women who exercised in the 3 months before pregnancy felt better physically (e.g., less aches and pains) during the first trimester than those who did not exercise. Likewise, exercise in the first and second trimesters was correlated with feeling better physically in the third trimester (Sternfeld, Quesenberry, Eskenazi, & Newman, 1995).

Research has also demonstrated that engaging in regular physical activity in the postnatal period is associated with a variety of health benefits, including retaining less pregnancy-associated weight gain (Boardley, Sargent, Coker, Hussey, & Sharpe, 1995; Lovelady, Nommsen-Rivers, McCrory, & Dewey, 1995; Rooney & Schauberger, 2002; Sampselle, Seng, Yeo, Killion, & Oakley, 1999), less body fat (Lovelady et al.), reduced incidence of urinary incontinence (Morkved & Bo, 2000), decreased risk of postpartum depression (Clapp, 1998; Kolytn & Schultz; 1997) and symptoms of depression, less anxiety and distress (Barclay, Everitt, Rogan, Schmied, & Wyllie, 1997; Koltyn & Schultzes), improved body image perceptions (Clapp), and maternal adjustment (Hinton & Olsen, 2001; Lox & Treasure, 2000; Miller, Trost, & Brown, 2002; Polman, Kaiseler & Borkoles, 2007). Thus, there is clear evidence that exercise is an effective means for promoting a variety of health outcomes among pre and postnatal women.

Pre and Postnatal Physical Activity Guidelines

In light of the promising health benefits associated with LTPA, and in an effort to promote the adoption of LTPA during pregnancy and in the postnatal period, the

American College of Obstetricians and Gynecologists (ACOG) revised their previously published physical activity recommendations. Prior to 2002, the ACOG recommended that pregnant women limit intense exercise participation to 15 minutes per session and keet their heart rate below 140 beats per minute. In addition, women who were not active prior to pregnancy were cautioned against starting an exercise program during pregnancy. Currently, the guidelines encourage all women without complications to engage in 30 minutes of moderate physical activity on most days of the week (ACOG, 2002).

For postnatal women, the recommendations are to initiate exercise gradually once it is physically and medically safe. Because the exercise progression may vary from person to person, women are recommended to consult with their physician before starting a postnatal exercise program. However, there are no published studies to indicate that, in the absence of medical complications, engaging in regular physical activity will result in adverse effects (e.g., breast milk production). Therefore, women who are not experiencing postnatal complications are encouraged to accumulate 30 minutes of moderate to vigorous intensity exercise on most days of the week (Haskell, Lee, Pat, Powell, Blair, Franklin et al., 2007).

Pre and Postnatal LTPA Determinants

To begin to understand why women are not meeting the physical activity guidelines set out by the ACOG, numerous studies have examined correlates of LTPA during and after pregnancy. Factors such as age (Brownson, Eyler, King, Brown, Shyu, & Sallis, 2000; Zhang & Savitz, 1995), education (Mottola & Campbell, 2003; Ning, Williams, Dempsey, Frederick, & Luthy, 2003), marital status (Brownson et al.; Hinton & Olson,

2001), race (Ning et al.; Zhang & Savitz), income (Brownson et al.; Wilkenson, Huang, Walker, Sterling, Kim, 2004), body satisfaction (Hinton & Olson), BMI (Hinton & Olson; Mottola & Campbell; Zhang & Savitz), weight (Brown & Trost, 2003; Brownson et al.), employment status (Brown et al., 2003), number of children (Brown et al.; Hinton & Olsen; Ning et al.), prepregnancy physical activity (Ning et al.) and previous miscarriage or stillbirth (Zhang & Savitz) have been found to be associated with pre and postnatal LTPA.

Identifying demographic correlates of LTPA is informative for recognizing individuals or groups of individuals that may be most receptive to interventions, but does not provide insight into what might constitute effective intervention strategies. On the other hand, social cognitions represent characteristics that are modifiable and can be targeted for change in interventions aimed to affect LTPA (Baranowski, Anderson, & Carmack, 1998). Thus far, research has demonstrated that body image perceptions, social support (Brownson et al., 2000; Brown et al., 2001; Miller et al., 2002), beliefs about the safety of exercise (Duncombe, Wertheim, Skouteris, Paxton, & Kelly, 2007), ethic of care (Miller & Brown, 2005), and attitudes about exercise during pregnancy (Doran & O'Brian, 2007) are all psychosocial correlates of LTPA among pre and postnatal women.

Unfortunately, interpretation of results from studies examining psychosocial correlates of LTPA is severely limited because they have been cross-sectional and, in most cases, have lacked a guiding theoretical framework. The difficulty with cross-sectional studies is that it cannot be determined whether the psychosocial variable in question influences LTPA behaviour or vice versa (Weinstein, 2007). Furthermore, the

application of theory in research represents an important goal that is often overlooked. According to Lewin (1945) "there is nothing more practical than good theory" (pg.129). Theories and models attempt to explain behaviour and help to identify what variables should be monitored, measured, or compared (Glanz, Rimer, & Lewis, 2002). Ultimately, well-designed theory-based studies contribute to our understanding of behaviour change and aid in the design of effective interventions (Glanz et al.).

Theory-based Research Examining LTPA Determinants

Symons Downs and Hausenblas (2003; 2007) and Hausenblas and Symons Downs (2004) have conducted the only studies to date that examined theory-based psychosocial predictors of LTPA among pregnant women. Their research used the Theory of Planned Behaviour (TPB; Ajzen, 1991) to predict pregnant women's LTPA intentions and behaviour during each trimester. Overall, the studies demonstrated that the TPB constructs explained between 17% and 47% of the variance in LTPA. However, there were significant discrepancies from study to study in terms of the amount variance explained by each TPB construct. For example, perceived behavioural control was found to be a significant predictor of LTPA during the first trimester (Hausenblas & Symons Downs, 2004), but not during the second (Symons Downs & Hausenblas, 2003) or third trimesters (Symons Downs & Hausenblas, 2007). While these studies represent an initial step towards establishing theory-based modifiable determinants of LTPA during pregnancy and in the postnatal period, the authors recommend that additional research be conducted examining theory-based predictors of pregnant women's LTPA.

Using SCT to Examine LTPA Determinants

Social cognitive theory (Bandura, 1986; 1997; 2004) is a theory that helps explain human behavioural patterns, and provides the basis for intervention strategies (Glanz et al., 2002). The theory emphasizes that behaviour is regulated antecedently through cognitive processes. For example, behaviour will occur if a person expects a desired outcome to result from successful completion of the behaviour, values the outcome, and is efficacious in his or her ability to execute the necessary motor tasks to complete the behaviour (Conner & Armitage, 2001). Accordingly, self-efficacy and outcome expectation play a role in influencing behaviour (Bandura 1986; Maddux, 1995)

Self-efficacy is defined as a person's "belief about their capabilities to exercise control over events that affect their lives" (Bandura, 1989, p1175). According to Bandura, self-efficacy is the underlying construct of social cognitive theory that is fundamental for competent performance. People who perceive themselves to be more efficacious with respect to their physical capabilities are more likely to adopt and maintain a physically active lifestyle (McAuley & Mihalko, 1998). Major reviews of exercise-related self-efficacy have demonstrated that higher self-efficacy is associated with greater exercise participation (Culos-Reed, Gyurcsik, & Brawley, 2001; McAuley & Blissmer, 2000; McAuley & Mihalko, McAuley, Pena, & Jerome, 2001). In fact, self-efficacy is among the most frequently identified psychosocial correlates of adherence to physical activity (Bandura, 1986; 1997; Dishman, Washburn & Heath, 2004; Sallis & Owen, 1999).

While it is well established that self-efficacy is an important construct in understanding human behaviour, Bandura (1997, 2004) has also emphasized that individuals must have motives to engage in behaviour. Motives or outcome expectations are defined as one's belief that engaging in a particular behaviour will produce a certain outcome (Maddux, 1995). According to Bandura, without meaningful personal outcome expectations, behaviour is unlikely to occur. Thus, both self-efficacy and outcome expectations are important variables for understanding behaviour and processes of behaviour change.

While a great deal of the social cognitive theory-based research in the exercise domain has focused on examining self-efficacy, the construct of outcome expectations has been investigated to a far lesser degree (Williams, Anderson, & Winett, 2005). Thus, to date, there is a lack of empirical evidence examining both outcome expectations and self-efficacy, which limits our ability to fully understand how these two variables operate together in predicting or changing physical activity. Of the studies that have been conducted, the results are equivocal. For example, some studies have demonstrated that outcome expectations account for additional variation in physical activity beyond that explained by self-efficacy, while other studies have found that outcome expectations contribute little in addition to self-efficacy (cf. Williams et al.). Given these divergent results, further research is needed to examine the influence of outcome expectations and self-efficacy on LTPA behaviour. Since both constructs are proposed to affect exercise behaviour, the measurement of both outcome expectations and self-efficacy for the purpose of predicting behaviour may prove to be useful (Rodgers & Brawley, 1993).

Dissertation Objective

Collectively, pre and postnatal LTPA research reveals that pregnant women and women with young children are at risk for sedentary lifestyles. Most of the research carried out thus far has been cross-sectional and atheoretical. Consequently, our understanding of how and why LTPA is affected during pregnancy and parenthood is limited. Therefore, the general purpose of the thesis was to examine LTPA during and after pregnancy, and to identify theory-based social cognitive correlates of LTPA during both time periods. A series of three studies was conducted.

The objectives of Study 1 were to examine LTPA patterns prior to pregnancy, during pregnancy, and in the postnatal period, and to investigate possible associations between selected demographic characteristics and LTPA. Over 300 participants signed up for Study 1. The LTPA data for Study 1 was collected retrospectively (e.g., when participants signed up for the study they were asked to recall their LTPA over the past 12-months). Studies 2 and 3 involved a more in-depth analysis of LTPA during pregnancy and in the postnatal period. These data were collected from the same participants from Study 1, however the data were collected prospectively over the course of the pre and postnatal periods. Specifically, the objective of Study 2 was to prospectively track LTPA and examine the association between social cognitive constructs and LTPA during pregnancy, while Study 3 pursued the same objective during the postnatal period.

This series of studies has the potential to provide valuable theoretical and practical information. Investigating the relationships between exercise and barrier self-

efficacy as predictors of LTPA will contribute to the advancement of self-efficacy theory. Furthermore, understanding how and why LTPA changes during the pre and postnatal period will help guide future intervention research.

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Table 1.

Summary of Studies Examining Change in Leisure-time Physical Activity

Study	Sample Size	Design	LTPA Measure	LTPA Data Collection Timeline	Change in LTPA
Albright, Maddock & Nigg, 2005	79	R	Unspecified	Prior to pregnancy unspecified and following birth unspecified	Of the 65% of participants who were active before pregnancy, 43% were active in the postnatal period
Blum, Beaudoin & Laurie Caton-Lemos, 2004	92	R	Kaiser Physical Activity Survey	Prior to pregnancy (unspecified) and with 6 months postnatal	No significant difference between prepregnancy and postnatal sport and exercise index
Clark, Rousham, Gross, & Halligan, 2004	GW 16, 25 & 34: 57 GW 38: 51	P	Baecke Questionnaire (modified)	GW: 16, 25, 34, 38	GW 16: METs/day = 1.54 GW 25: METs/day = 1.51 GW 34: METs/day = 1.40 GW 36: METs/day = 1.31
Derbyshire, Davies, Costarelli & Dettmar, 2006	Trimester 1: 70 Trimester 2: 58 Trimester 3: 59 Postnatal: 54	P	Unspecified	Trimester 1: unspecified Trimester 2: GWs 24-28 Trimester 3: GWs 34-38 Postnatal: 6 weeks	Trimester 1: Min/day = 173 Trimester 2: Min/day = 159 Trimester 3: Min/day = 207 Postnatal: Min/day = 167
DiNallo, Le Masurier, Williams & Symons Downs, 2008	36	P	Accelerometer	GW: 20 and 32	GW 20: Activity counts = 2292 GW 32: Activity counts = 1663

Table 1 Continued

Study	Sample Size	Design	LTPA Measure	LTPA Data Collection Timeline	Change in LTPA
Domingues & Barros, 2007	4471	R	Investigator-developed	Prepregnancy unspecified & each trimester unspecified	Prepregnancy: 14.8% reported engaging in LTPA Trimester 1: 10.4% reported engaging in LTPA Trimester 2: 8.5% reported engaging in LTPA Trimester 3: 6.5% reported engaging in LTPA
Duncombe, Wertheim, Skouteris, Paxton & Kelly, 2007	Prepregnancy & Trimester 1: 158 Trimester 2: 152 Trimester 3: 144	R/P	7-day exercise diary unspecified	Prepregnancy (retrospectively recalled) GW: 16-23, 24-31, 32-38	Prepregnancy: Min/day = 311.5 GW16-23: Min/day = 140 GW 24-31: Min/day = 126.5 GW 32-38: Min/day = 85.4
Grace, Williams, Stewart & Franche, 2006	42	P	Health-Promoting Lifestyle Profile II	Pregnancy: GW: 17 – 31 Postnatal (average of 9 months)	During pregnancy 19% reported routinely exercising, whereas 18.8% reported routinely exercising in the postnatal period
Hausenblas & Symons Downs, 2005	Prepregnancy: 169 Trimester 1: 169 Trimester 2: 127 Trimester 3: 89	R/P	Leisure-time Exercise Questionnaire	Prepregnancy (retrospectively recalled) and each trimester unspecified (prospective)	Prepregnancy: METs/wk = 26.2 Trimester 1: METs/wk = 14.5 Trimester 2: METs/wk = 13.2 Trimester 3: METs/wk = 10.5

Table 1 Continued

Study	Sample Size	Design	LTPA Measure	LTPA Data Collection Timeline	Change in LTPA
Mottola & Campbell, 2003	529	R	Health and Welfare Canada Survey	Prepregnancy and each trimester unspecified	Prepregnancy: 30% reported no structured and 19% reported no recreational exercise. Trimester 1: 37% reported no structured exercise and 24% reported no recreational exercise. Trimester 2: 44.2% reported no structured exercise and 27% reported no recreational exercise. Trimester 3: 51.2% reported no structured exercise in and 34% reported no recreational exercise.
Pereira, Rifas-Shiman, Kleinman, Rich-Edwards, Peterson & Gilman, 2007	1242	R/P	Physical Activity Scale for the Elderly	Prepregnancy (unspecified, retrospectively recalled) GW: 26 – 28 Postnatal (6 months)	Prepregnancy: Hours/week = 9.6 Pregnancy: Hours/week = 6.9 Postnatal: Hours/week = 8.0
Schmidt, Pekow, Freedson, Markenson & Chasan-Taber, 2006	233	R	Standardized Interview	Each trimester unspecified	Trimester 1: MET-hrs/day = 33.4 Trimester 2: MET-hrs/day = 33.8 Trimester 3: MET-hrs/day = 32.6
Schramm, Stockbauer & Hoffman, 1996	2828	R	Missouri Maternal and Infant Health Survey.	3 months prior to pregnancy, each trimester unspecified and 3 months postnatal	7% decrease in LTPA from prepregnancy to trimester 1 3% decrease in LTPA from trimester 1 to 2 3% decrease in LTPA from trimester 2 to 3 3% increase in LTPA from trimester 3 to postnatal

Table 1 Continued

Study	Sample Size	Design	LTPA Measure	LTPA Data Collection Timeline	Change in LTPA
Stein, Rivera & Pivarnik, 2003	56	P	PAR	GW 20 and 32 Postnatal week 12	GW 20: EE = 2173 GW 32: EE = 2416 Postnatal: EE = 1965
			Accelerometer		GW 20: EE = 1352 GW 32: EE = 1374 Postnatal: EE = 1326
Symons Downs & Hausenblas, 2004	74	R	Godin Leisure-time Exercise Questionnaire	Prepregnancy (unspecified) Pregnancy (unspecified) Postnatal (with 5 months)	Prepregnancy: METs/week =26.9 Pregnancy: METs/week =11.5 Postnatal: METs/week = 12.0
van Raaij, Schonk, Vermaat-Miedema, Peek & Hautvast, 1990	25	P	PA Diary	GW: 10,16,22,28,24 Postnatal weeks: 5,9,13,27,56	Recreational activities remained stable between weeks 10, 16 and 22 of pregnancy. At week 28 of pregnancy recreational activities declined and remained stable until week 13 postnatal. At week 27 postnatal recreational activities increased back up to early pregnancy levels.
Watson & McDonald, 2007	Month 4: 194 Month 7: 184	P	3-day diary	Month 4 and 7 of pregnancy	Month 4: METs/day = 1.93 Month 7: METs/day = 1.88

Note. LTPA = leisure-time physical activity; GW = gestational week; R = retrospective, P = prospective, MET = metabolic equivalent; EE = energy expenditure.

Table 2

Quantitative Summary of Table 1

	Δ in PA: preg	Δ in PA: prepreg to preg	Δ in PA: Prepreg to PN	Δ in PA: Preg to PN
Total Number of Studies	32[a]	17[b]	6	6
Sample Size Range	10-4471	10-4471	54-2828	42-2828
Design				
Retrospective	12	10	4	2
Prospective	20	7	2	4
Physical Activity Measure[c]				
Unspecified	12	7	2	0
SR Reliable & Validate	10	6	5	5
Objective	8	4	0	1
SE Diary	3	0	0	1
Recall Timeframe				
Unspecified	17	13	5	3
Specified	15	4	1	3
Physical Activity Outcome				
No Δ in PA	4	0	1	2
PA increased	2	0	0	3
PA decreased	26	17	5	1

Note. Δ = change; preg = pregnancy; prepreg = prepregnancy; PN = postnatal.; SR = self-report; PA = physical activity. A total of 40 studies were available for review. Fourteen studies examined change in physical activity between two different periods (e.g., prepregnancy to pregnancy and during pregnancy), 2 studies examined change in physical activity between three different periods (e.g., prepregnancy to pregnancy, pregnancy to postnatal, and prepregnancy to postnatal), and 1 study examined change in physical activity between four different periods (e.g., prepregnancy to pregnancy, during pregnancy, pregnancy to postnatal, and prepregnancy to postnatal). Thus a total of 61 observations are reported.

[a] 20 studies were reviewed by Poudevigne & O'Connor and thus are not duplicated in Table 1.

[b] 10 studies were reviewed by Poudevigne & O'Connor and thus are not duplicated in Table 1.

[c] Columns 1,3, and 4 do not add up to total number of studies because 1 study collected LTPA using multiple methods (e.g., reliable & valid and objective).

CHAPTER 2

PRE AND POSTNATAL WOMEN'S LEISURE-TIME PHYSICAL ACTIVITY PATTERNS: A MULTILEVEL LONGITUDINAL ANALYSIS

Abstract

The purpose of the current study was to examine women's leisure-time physical activity (LTPA) prior to pregnancy, during pregnancy, and through the first 7-months postnatal. Pre and postnatal women (n = 309) completed the 12-month Modifiable Activity Questionnaire (MAQ) and demographic information. Multilevel modeling was used to estimate a growth curve representing the average change in LTPA over time and intra-individual variations in the average growth curve over time. Growth curve estimates for the linear, quadratic and cubic trends were significant ($p < .05$) indicating that LTPA declined during pregnancy but then increased following birth. The results also demonstrated that the individual trajectories of LTPA varied substantially from the average growth curve suggesting that the average growth curve may not be reflective of any one individual. One demographic predictor variable (having other children at home) was significant ($p < .05$).

Introduction

Being pregnant or adjusting to life with a new baby is characterized by many physical and behavioural challenges such as coping with nausea, fluctuating mood states, lack of sleep, unregimented feeding patterns, and weight gain (Heron, O'Connor, Evans, Golding & Glover, 2004; Lacroix, Eason, & Meizack, 2000; Mindell & Jacobson, 2000; Mottola & Campbell, 2003; Ohlin & Rossner, 1996; Poudevigne & O'Connor, 2005). One additional behavioural change includes decreased physical activity participation (Mottola & Campbell; Pereira, Rifas-Shiman, Kleinman, Rich-Edwards, Peterson, & Giman, 2007; Schramm, Stockbaurer, & Hoffman, 1996; Symons Downs & Hausenblas, 2004).

Studies that have examined the influence of pregnancy on women's physical activity patterns have shown that physical activity levels decline with the onset of pregnancy (Hausenblas & Symons Downs, 2005; Mottola, 2002; Mottola & Campbell, 2003; Poudevigne & O'Connor; 2005). Although pregnancy and exercise studies have demonstrated fairly consistent results, Poudevigne & O'Connor (2005; 2006) have criticized those findings, arguing that scientifically strong conclusions are difficult to infer because of infrequent assessments of physical activity (e.g., only two to three times during pregnancy) and the limited number of studies that measured physical activity using reliably and valid scales.

Studies examining women's physical activity participation during the postnatal period have demonstrated equivocal results. For example, some studies have shown that physical activity levels increase in the postnatal period (van Raaij, Schonk, Vermaat-

Miedema, Peek, & Hautvast, 1990), while other studies have shown that physical activity levels stay the same as in the latter stages of pregnancy (Blum, Beaudoin, & Canton-Lemos, 2004; Grace, William, Stewart, & Franche, 2006; Stein, Rivera, & Pivarnik, 2003).

While these studies provide information on activity patterns during pregnancy and in the postnatal period, perhaps the most informative studies in terms of understanding exercise patterns during this time of transition are those that examine LTPA prior to pregnancy, during pregnancy, and in the postnatal period as the primary research question. We are aware of only three studies that have examined LTPA during each of these 3 time periods. Two of the three studies demonstrated that LTPA continuously decreased as pregnancy progressed and that postnatal LTPA increased slightly compared to LTPA measured at the later stages of pregnancy (Pereira et al., 2007; Schramm et al., 1996). In another study, the results showed that women's strenuous and moderate exercise behaviour was significantly lower during pregnancy and in the postnatal period compared to prepregnancy. However, there was no significant difference in LTPA behaviour during pregnancy compared to postnatal (Symons Downs & Hausenblas, 2004).

Studies that have examined LTPA across prepregnancy, pregnancy, and postnatal periods have provided considerable information on exercise patterns during this time of transition. While the information provided by these studies may be useful, the methods employed have inherent limitations in terms of furthering our understanding of longitudinal patterns of activity associated with pregnancy and the months following

childbirth. Thus far, studies have focused on changes in LTPA using discrete time period designs (i.e., one measure of LTPA during each period prior to, during, and following pregnancy). While these study designs can provide information about longitudinal variations in behaviour and possible curvilinear trends, Collins (2006) argued that longitudinal designs should integrate a theoretical model of change and an appropriate temporal design. Therefore, the timing of observations should correspond with hypothesized models of change. As noted above, pregnancy and the year following childbirth offer a number of complex challenges, and subtle and important variations in LTPA may also occur within each discrete phase (e.g., from month to month, rather than simply during pregnancy or during the postnatal period). This information, if studied, could provide important data regarding when LTPA changes occur and the circumstances surrounding those changes, rather than simply how much change occurs from one discrete measurement to the next (e.g., second trimester to 6-months postpartum). Thus, an investigation of LTPA at multiple brief and regularly-spaced intervals stands to advance our knowledge of women's LTPA in and around pregnancy.

Furthermore, studies to date have only examined group variations in activity (i.e., the average changes that occur in the sample over time) as the focus of analysis. These methods and the statistics applied (e.g., repeated measures ANOVA) examine changes in the group means over time and treat individual variations in behaviour (about the mean trends) as error. The problem is thus: average levels of activity during pregnancy and after pregnancy provide information to describe the average person in the sample, but fail to describe the activity patterns at the individual level. Because growth (or change) is a

phenomenon that occurs within the individual and can vary considerably across individuals (Collins, 2006), investigating longitudinal trajectories of physical activity change as both intra- and inter-individual variations or hierarchical growth curves stands to advance our knowledge of individual LTPA trajectories of change in and around pregnancy.

Therefore, the purpose of the present study was to investigate month-to-month variations in women's LTPA from 3 months prior to conception to 7 months following childbirth. Multilevel modeling was used to examine growth curves representing within- and between-individual variations in LTPA over time. Based on the results of a recent review (Poudevigne & O'Connor, 2006) it was hypothesized that LTPA would decline during pregnancy compared to prepregnancy activity levels, but the nature (e.g., linear or curvilinear) and extent of that decline was to be determined. Guided by previous research (Pereira et al., 2007; Schramm et al., 1996), it was also hypothesized that LTPA would increase following childbirth, but again, the nature and extent of the increase was to be determined. Because multilevel modeling allows examination of intra-individual variations in LTPA over time, we also set out to estimate within-individual change. It was predicted that there would be substantial variability around the average growth curve, representing differences in LTPA across time and across women.

The trajectory of LTPA during the pre and postnatal periods may depend on socio-demographic covariates (e.g., age, socioeconomic status, education, marital status). Previous research has demonstrated that demographic factors linked to pre and postnatal women's exercise participation include age, education, marital status, income,

employment, and number of children (Brown & Trost, 2003; Hinton & Olson, 2001; Mottola & Campbell, 2003; Ning, Williams, Dempsey, Frederick, & Luthy, 2003; Zhang, & Savitz, 1996). Thus, in addition to examining LTPA growth trajectories, associations between these socio-demographic characteristics and LTPA were also examined.

Method

Participants

Three-hundred and fifty-three pregnant and postnatal women (≤ 52 weeks since giving birth) were recruited through a variety of pre and postnatal programs offered by regional public health units in southwestern Ontario, Canada. The populations served by the individual health units ranged from 150,000 to just over 400,000. Study brochures were given to each public health unit and were distributed by nurses running the programs. It is unknown how many women actually received the study information as no attendance list was available for all the various programs in which women received the information. A total of 309 women completed all the study measures. The mean age of study participants was 30 (SD = 4.02). Demographic information for participants is presented in Table 1.

Measures

Demographic information. The demographic questionnaire was developed specifically for the current study and inquired about participant age, education, marital status, employment, income and number of children. Demographic information was collected using open-ended questions, but was later collapsed into meaningful categories (see Table 1).

LTPA. The Modifiable Activity Questionnaire (MAQ; Kriska, Knowler, LaPorte, Drash, Wing, Blair et al., 1990) was administered to gauge participants' LTPA (e.g., competitive/recreational sports and exercise) over the previous 12 months. Based on the exercise recommendations made by the American College of Obstetricians and Gynecologists (AGOG, 2002) and the American College of Sports Medicine (Haskell, Lee, Pat, Powell, Blair, Franklin et al., 2007) for pregnant and postnatal women, LTPA with a minimum energy requirement of at least 3.0 metabolic equivalents (i.e., moderate intensity exercise) was measured.

Participants completed the MAQ by reading a list of moderate to vigorous intensity LTPA's (e.g., aerobics, volleyball, bicycling, brisk walking, hiking) and selecting the activities they had engaged in during the past 12 months. While the list was comprehensive, an item labeled "other" was provided in the event that participants engaged in some form of LTPA that was not included. If participants selected "other" they were asked to indicate the activity. Any activities listed that were not leisure in nature (e.g., household/occupational) were not included in the calculation of overall LTPA. Next, the online system generated a chart with the activities selected appearing in the far left column. This list of activities was followed by a column for each of the previous 12 months. For example the second column in the chart referred to "last month" whereas the third column was labeled "2 months ago". To ensure that participants did not round to the nearest month, the instructions defined "last month" as the month preceding the current month. For each LTPA selected, participants estimated the average frequency per month that they had engaged in that activity. In the last column of the chart,

participants indicated the average number of minutes they had engaged in the LTPA per session. A working copy of the MAQ is presented in Kriska and Casperson (1997, p. S79-S82). The MAQ has been shown to be both reliable and valid in studies using doubly-labeled water and accelerometers (Aaron, Kriska, Dearwater, Anderson, Olsen, Cauley et al.,1993; Aaron, Kriska, Dearwater, Cauley, Metz, & LaPorte, 1995; Kriska et al., 1990; Schulz, Haper, Smith, Kristka, & Ravussin, 1994), and it has been widely used in a number of populations including pregnant women (Bauer, 2006).

The information derived from the MAQ was transformed in order to approximate the amount of energy expenditure across the various activities. A transformation of the raw values was carried out based on a methodology described by Lefevre and colleagues (2000). That is, each LTPA was assigned a MET using the compendium of physical activities (Ainsworth, 2002). Each of those values was then multiplied by the average monthly frequency and duration to arrive at a standard unit of measure represented by MET hours per month (MET-hrs/month). For example, if an individual reported playing singles tennis (an LTPA corresponding to 8.0 METs) 12 times for 60 minutes per session during the month of August, those activities would convert to 96 MET hours for that month. For each month, all MET hour values for each LTPA performed were summed to create an overall composite measure representing total MET-hrs/month. Aaron and colleagues (1993) have demonstrated past-year MAQ scores that have been converted to MET hours to be moderately correlated (r range = -.33 to -.47) with fitness (e.g., time to run/walk 1 mile).

Procedure

Prior to commencing the study, approval was obtained by the institutional ethics review board. After receiving an initial invitation to participate in the study, interested women contacted the researcher (via email or telephone) or visited the study website. Participants had the option of signing up for the study and completing the study measures online (via secured access) or over the telephone. All participants utilized the online study procedures. The procedure for online study participation was as follows. To sign up for the study, participants had to first read and complete an informed consent letter and then set up a username and password. Next, participants indicated if they were pregnant or in the postnatal period. In order to determine their pre/postnatal stage, pregnant participants indicated their expected due date, whereas postnatal participants indicated their baby's date of birth. Participants were then automatically directed back to the study homepage and prompted to log into the secured end of the website and complete the LTPA measure (MAQ) as well as the demographic questionnaire. Questionnaire responses were submitted to a secure data file that was accessible only by the principal investigator.

Design and Analytic Strategy

The 12-month LTPA recall data were first coded according to each participant's timeline upon entering the study. For example, if a woman entered the study during her 5th month of pregnancy, the 12-month LTPA recall would span from prepregnancy month 8 to pregnancy month 4. Whereas, if a person entered the study during her 5th month postnatal, the 12-month LTPA recall would span from pregnancy month 2 to postnatal

month 4. Although the study generated LTPA data ranging from 10 months prepregnancy to 11 months postnatal (i.e., 30 months), only 20 months of data were used for the analysis: 3 months prior to prepregnancy, 9 months of pregnancy, the month in which women had their baby and 7 months following childbirth. LTPA data for prepregnancy months 4 to 11 and postnatal months 8 to 11 were not included in the analysis due to a small number of observations in each tail of the distribution (i.e., < 60; Eliason, 1993).

To determine both the average pattern of LTPA and the intra-individual variation around this pattern, data were analyzed using hierarchical liner modeling (HLM Version 6.1; Raudenbush, Byrk & Congdon, 2004). Time was treated as the level 1 within-person predictor, with the individual modeled at level 2. Data were centered so that month=0 represented the month women either had or expected to have their babies. Months prior to childbirth were coded as descending negative numbers, whereas months following childbirth were coded as ascending positive numbers. Placing the zero point equal to the birth month meant that the Y-intercept was the predicted MET-hrs/month in the month that women had, or expected to have their baby. To determine the basic growth curve model, change in LTPA within-persons (i.e., level 1) was first modeled by assessing the linear trend, followed by adding quadratic and then cubic trends. The linear trend was modeled based on the hypothesis that women's LTPA participation would decline during pregnancy. The quadratic trend was modeled to allow for an accelerated rate of change in LTPA and the cubic trend was modeled to allow women's LTPA patterns in the postnatal period to increase. Following the level 1 modeling, each of the demographic predictors was assessed at level 2. Model fit was assessed by comparing the deviance scores (-2 log

likelihood) of each model with a chi-square distribution, where the degrees of freedom were equal to the difference between the number of modeled parameters. At each step of the growth curve analysis, the following assumptions of normality were assessed: (i) within-subject level 1 residuals are normally distributed with a mean of zero and a variance that is homogenous across the sample (ii) level 1 predictors (linear, quadratic and cubic trends) and residuals have a zero covariance and (iii) error and the level 2 random effects have zero covariance, means equal to 0, and a distribution that is multivariate normal. For each analysis, the model exhibiting the best fit to the data was used to derive the coefficient estimates presented in the results.

Results

Participants

Of the 353 women recruited, 158 entered the study during pregnancy and 195 entered the study in the postnatal period. Thirty-three participants were removed from the analysis because they failed to give complete LTPA and demographic information. In addition, eleven participants were eliminated from the analysis because they were considered to be extreme multivariate outliers on the LTPA measure (e.g., LTPA value > 256, equivalent to a z score >3.29; Tabachnick & Fidell, 2007). Therefore, the final sample for the growth curve analysis was comprised of 309 women. Table 2 presents the total number of participants who provided LTPA data prior to pregnancy, during pregnancy, and in the postnatal period. Power and sample size calculations in multilevel modeling are complicated and not straightforward due to the presence of random effects (Snijders & Bosker, 1999). However, Snijders and Bosker (1999) state that sample size at

the highest level (e.g., fixed effects parameters) is usually the most restrictive element in the design. Therefore, had we analyzed the data using only a fixed-effects model (i.e., multiple regression) with 4 predictors (e.g., linear, cubic, quadratic, and number of children) sample size could have been determined using Green's (1991) estimation procedures for regression analyses. Based on those estimates, to find a medium effect size consistent with previous pregnancy and exercise studies (e.g., Symons Downs & Hausenblas, 2004) with 4 predictors, a minimum of 82 observations would be required. Therefore, it was deemed that the final sample size of 309 would afford sufficient power to test the hypotheses.

LTPA

The raw descriptive data representing LTPA MET-hrs/month are presented in Table 2. Those data are also displayed graphically in the upper panel of Figure 1. The distributions for each month's LTPA data (MET-hrs/month) were positively skewed (i.e., skewness > .89; Tabachnick & Fidell, 2007). Because the data were positively skewed, a square root transformation was performed as recommended by Tabachnick and Fidell (2007). All analyses were performed using the square root transformed MET-hrs/month data. These values are presented in the middle panel of Figure 1.

Level 1 growth curve analysis. When the average growth curve was plotted (see Figure 1: bottom panel), as hypothesized the results demonstrated that LTPA levels gradually declined during pregnancy compared to prepregnancy levels. Following childbirth, LTPA levels increased. As shown in Table 3, the results for the growth curve estimates for the linear, quadratic and cubic trends were all significant ($p < .01$). Model

fit was assessed by comparing the difference between each model's overall deviance score, which indicated that the model that included the quadratic and cubic curve estimates provided the best fit to the data. Thus, as expected, the null hypothesis stating that there was no change in LTPA prior to and following childbirth was rejected. The results also showed that by 5 months postnatal, LTPA levels had resumed to prepregnancy levels. Furthermore, the results showed that by 7 months estimates for postnatal LTPA levels were higher than prepregnancy levels. The variance estimates for the random effects (see Table 3), which represent the amount of between-subject variance, were significant for the Y intercept and the linear quadratic and cubic effects (p <.01). As hypothesized, these values indicate the individual trajectories of MET-hrs/month varied significantly about the average growth curve.

Level 2 predictors. Once the initial growth curve model was specified, demographic variables were added as predictors in the model in order to explain the between-subject variability around the average growth curve. Only one demographic predictor variable, having other children at home, was significant (β = -.87, SE = .48, t = -1.98, p <.05). The average growth curve was then modeled to include a fixed effect parameter for having other children. The reduction in deviance statistic between the two models was 5.92. Using a chi-square distribution with 1 degree of freedom, the model including the level 2 variable "having other children" produced a better fit of the data (p < .05). Therefore, on average, women who had other children were less active than first-time mothers. The estimated growth curves for first-time mothers compared to women

who had other children are illustrated in Figure 1. The parameter estimates for the final growth curve model are presented in Table 3.

Discussion

The purpose of this study was to examine LTPA prior to pregnancy, during pregnancy, and in the postnatal period using a growth curve analysis. As predicted, and consistent with previous research (Pereira et al., 2007; 2006; Schramm et al., 1996), results of the study revealed that LTPA started to decline in the first trimester of pregnancy, continued to decline at a steady rate until childbirth, and then increased during the postnatal period.

The pre and postnatal periods are characterized by many physical and psychological changes that challenge women's regular participation in physical activity and can result in continuous modifications to their LTPA behaviour (Gennaro & Fehder, 2000; Mottola & Campbell, 2003; Poudevigne & O'Connor, 2005; Schmidt, Pekow, Freedson, Markenson, & Chasan-Taber, 2006). This theoretical model of change served as our rationale for measuring LTPA at month-by-month intervals across prepregnancy, pregnancy ,and postnatal periods. Together, the theoretical model of change and the 12-month retrospective measurement of LTPA allowed us to capture subtle variations in LTPA that occurred from month to month. The average growth curve demonstrated that LTPA changed in a curvilinear manner over the course of pregnancy and having a new baby. The nature of the growth curve illustrated a gradual linear deceleration in LTPA from the first trimester to childbirth and a slightly more rapid acceleration in LTPA following childbirth. Although the results demonstrated that LTPA continually

accelerated in the postnatal period, those results should be interpreted with caution as such acceleration may reflect characteristics of the cubic term of the growth curve model and would not be expected to continue beyond the study window. In summary, the results provide clear evidence of gradual rates of deceleration and acceleration patterns that could not otherwise be determined by measuring LTPA at discrete intervals.

In addition to illustrating the average growth curve, the results from the HLM analyses indicated significant ($p < .001$) random effects. In other words, individual participants' growth curves varied significantly from the average growth curve for the sample. Therefore, future research should look to identify factors that account for the average changes in LTPA that occur from prepregnancy, through pregnancy, and into the postnatal period as well as factors that help account for variations in both the extent and rate of change across individuals. Although numerous biological, psychological, social, and environmental determinants of LTPA change could be examined, ecological models and psychosocial theories could provide useful frameworks for explaining how pregnant and postnatal women acquire and maintain certain behavioural patterns. For example, social cognitive theory identifies self-efficacy and outcome expectations as a primary mechanism implicated in behavioural adaptations (Bandura, 2004; William, Anderson, & Winnett, 2005). Assessing and modeling women's self-efficacy to exercise and to manage potential barriers to exercise throughout pregnancy and the postnatal period may help explain some of the intra-individual variability around the average growth curve that was evident in the present study.

The results also demonstrated that LTPA levels were higher for first-time mothers compared to women who already had other children at the time of the study. Consistent with previous research (Bellows-Riecken & Rhodes, 2007; Brown & Trost, 2003; Mottola & Campbell, 2003), it appears that having other children is associated with lower levels of LTPA. Investigating the mechanisms by which having children in the household may reduce LTPA should be a consideration for future research. However, it is important to note that the present study only measured LTPA and included no assessment of occupational or household activity. Previous studies have observed a positive association between parity and household/caregiving activity (Chasan-Taber, Schmidt, Roberts, Hosmer, Markenson, & Freedson, 2004). Thus, the results cannot be generalized to overall levels of energy expenditure.

The current study adds to the body of literature in several ways. First, LTPA was examined by treating LTPA as a continuous variable across the prepregnancy, pregnancy, and postnatal periods. Second, LTPA was analyzed using multilevel modeling. In longitudinal data, the same response variable (e.g., LTPA) is measured at numerous time points for each participant. Thus, each measurement occasion is nested within subjects. Traditional regression models assume that the regression model is uniform across each measurement occasion and thus, do not allow the regression relationship to vary at the individual level (Austin, Goel, & van Walraven, 2001). Therefore, by analyzing the data using HLM, the current study was able to examine intra-individual variations in the trajectory of LTPA as well as individual-level factors (e.g., having other children) that might affect the individual trajectory of LTPA.

Limitations and Future Research

Although the present study builds on current knowledge about LTPA during the prepregnancy, pregnancy, and postnatal periods, several limitations are worth noting. One limitation is that the study participants were self-selected. Thus, study findings may not be representative of a sample of postnatal women who are not motivated to take part in a study of exercise and pregnancy. In addition, despite recruiting participants across a large geographic area and through multiple public health units, the sample was primarily comprised of white, married, educated, middle to upper-middle class women, which limits the generalizability of the findings to lower socioeconomic and ethnically diverse populations. Future studies of this nature should attempt to recruit a more diverse sample of participants.

A further limitation includes the measurement of LTPA. Although the reliability and validity of the MAQ has been tested in a host of varied populations (Aaron et al., 1993; Aaron et al., 1995; Kriska & Casperson, 1997, Schulz et al., 1994), it is important to recognize that our LTPfA data were based on retrospective self-reports of LTPA engaged in over a one-year period and may be subject to recall errors and other biases such as social desirability. In addition, the current study used calendar month cut points as opposed to salient life event cut points (e.g., onset of pregnancy, first trimester, second trimester, etc.) in order to obtain a continuous measure of LTPA and adhere to the protocol of the MAQ. The use of calendar month cut points could have resulted in months which include 1) both nonpregnant and pregnant LTPA levels combined, or 2) both pregnant and postpartum LTPA levels combined. As such, we were unable to

precisely capture some potentially important variations in LTPA that may have occurred over time. Future work should consider attending to salient life events over the course of pregnancy in the assessment of LTPA through the use of cognitively relevant time periods as well as memory cues to increase the validity of the recall measure. Furthermore, future studies would benefit from measuring overall levels of LTPA, using prospective designs, and utilizing objective assessment tools for LTPA such as accelerometers.

Another limitation relates to the web-based nature of anonymous data collection. While this method provides a convenient and protective form of data collection that is comparable to other survey methods (e.g., telephone, mail, etc.), its open accessibility warrants an issue of caution regarding the validity of the data collected. The study was also limited in terms of individual level predictors of LTPA being confined to a small number of demographic characteristics. As noted above, future research is needed examining additional (e.g., psychosocial) predictors of pre and postnatal women's LTPA at multiple levels (e.g., within-person, between persons, between geographical regions).

Conclusion

Physical or sedentary activities may change dramatically during pregnancy and in the postnatal period, and could lead to the adoption of behavioural patterns (e.g., in LTPA) that could affect women's health for the rest of their lives. The present study revealed that, on average, women's LTPA drops gradually during pregnancy and then gradually resumes again in the postnatal period. However, this average pattern does not fit the actual pattern for most women. More research is needed that will examine factors

associated with intra-individual variations in LTPA during this time of transition, which will hopefully translate into effective intervention strategies in an effort to establish and preserve healthy levels of LTPA for women during pregnancy, in the postnatal period, and beyond.

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Table 1.

Demographic Information

Characteristics	n(%)
Marital Status	
Married/Common law	294(95.2)
Other	15(4.8)
Ethnicity	
White	289(93.5)
Other	20(6.5)
Education	
Non College/University	54(17.5)
College/University	255(82.5)
Income	
Less than 60,000	71(23)
60,000 or greater	238(77)
Have other children at home	
Yes	115(37.7)
No	194(62.3)
Employment	
Full time	195(63.1)
Other	114(36.9)

Table 2.

Actual LTPA MET-hrs/month

	N	MET-hrs/month	SD
Prepregnancy			
Month 3	156	66.21	70.54
Month 2	172	66.61	76.79
Month 1	194	68.10	74.40
Pregnancy			
Month 1	217	63.83	67.24
Month 2	247	58.37	61.60
Month 3	251	53.47	58.50
Month 4	250	52.54	58.49
Month 5	239	49.01	57.35
Month 6	221	49.17	57.11
Month 7	208	48.25	57.93
Month 8	193	38.58	52.47
Month 9	184	30.73	44.10
Postnatal			
Month 0	184	31.17	45.78
Month 1	169	40.75	53.47
Month 2	148	50.36	58.47
Month 3	124	55.00	59.19
Month 4	94	63.70	66.54
Month 5	78	58.51	63.16
Month 6	64	55.91	61.22
Month 7	57	67.82	69.47

Table 3.

Results of the Final Growth Curve Model

Fixed Effects	Coefficient	SE	df	t	*p*
β_{00}	5.55	0.37	304	14.26	<0.001
β_{01}(other children)	-.87	0.48	304	-1.98	0.048
β_{10}(month)	0.14	0.04	304	3.34	<0.01
β_{20}(month^2)	0.05	0.01	304	5.22	<0.001
β_{30}(month^3)	0.002	0.001	304	2.71	<0.01

Random Effects	Variance	Chi-Square	*p*
Var(π_{00i})	3.82	3319	<0.001
Var(π_{10i})	0.58	1015	<0.001
Var(π_{20i})	0.12	700	<0.001
Var(π_{30i})	0.01	519	<0.001
Var(e_{it})	1.54		

Note.

Model 2: $Yij = \pi_{00i} + \pi_{01i} + \pi_{10i} + \pi_{20i} + \pi_{30i} + e_{it}$

Where,

$\pi_{00i} = \beta_{00} + u_{00i}$, where β_{00} is the grand mean MET hrs/month score during the month women had their baby and u_{00i} is the random effect of person i on MET hrs/month at during the month women had their baby.

$\pi_{01i} = \beta_{01}$(other children), where β_{01} is the effect of having other children, Xi = 0 if no other children and Xi = 1 if participant had other children

$\pi_{10i} = \beta_{10} + u_{01i}$, where β_{10} is the expected rate of change in MET hrs/month and u_{01i} is the random effect of person i on the rate of change in MET hrs/month

$\pi_{2i} = \beta_{20} + u_{20i}$, where β_{20} is the quadratic effect of month for person i and u_{20i} is the random effect of person i

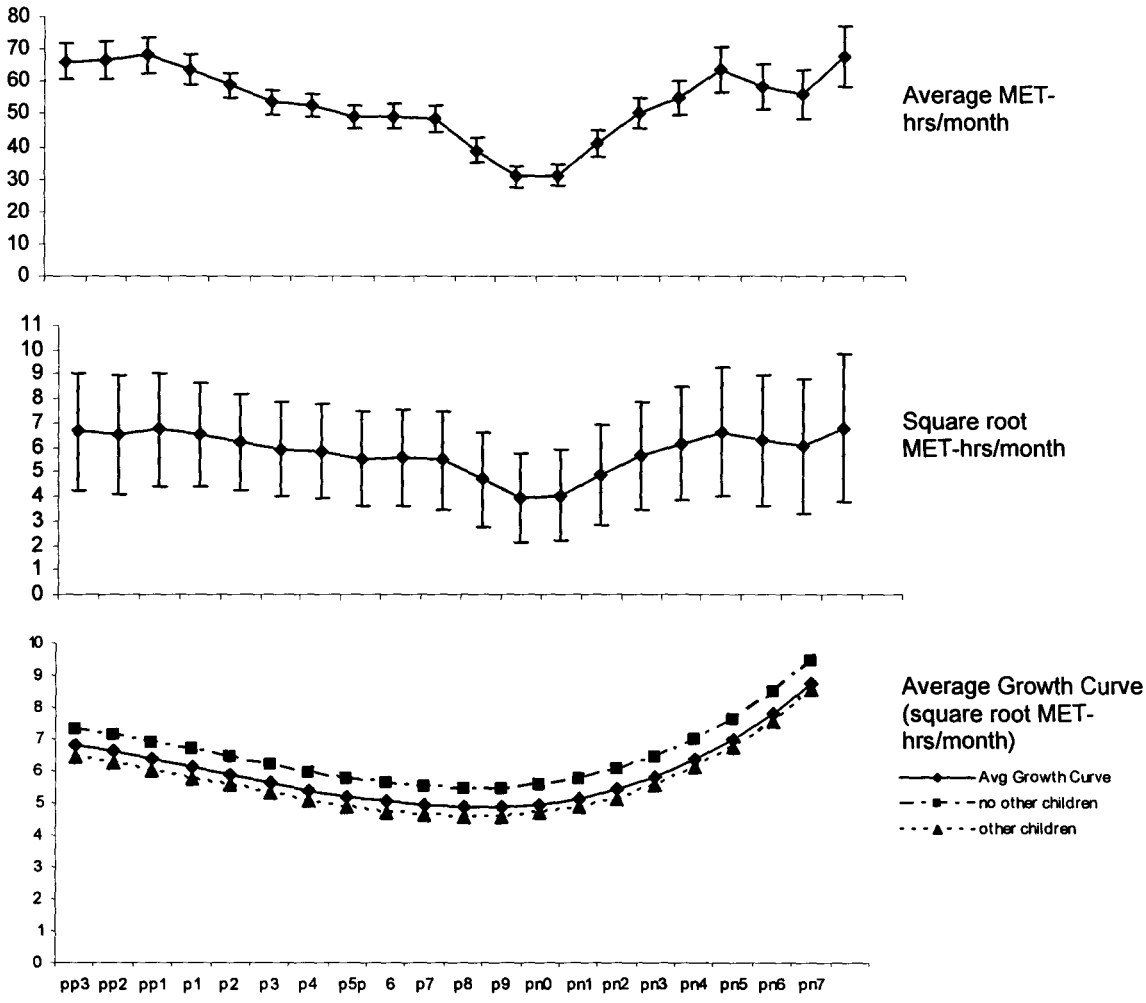
$\pi_{30i} = \beta_{30} + u_{30i}$, where β_{30} is the cubic effect of month for person i and u_{30i} is the random effect of person i

e_{it} = error

Figure Caption

Figure 1. Mean MET-hrs/month, the square root MET-hrs/month and the fitted growth curves ranging from prepregnancy (pp) months 1 to 3, across pregnancy (p) and up to 7 months postnatal (pn).

Figure 1.


Average MET-hrs/month
Square root MET-hrs/month
Average Growth Curve (square root MET-hrs/month)
Avg Growth Curve
no other children
other children
pp3 pp2 pp1 p1 p2 p3 p4 p5p 6 p7 p8 p9 pn0 pn1 pn2 pn3 pn4 pn5 pn6 pn7

CHAPTER 3

A PROSPECTIVE EXAMINATION OF LEISURE-TIME PHYSICAL ACTIVITY AND BARRIER SELF-EFFICACY TO ENGAGE IN LEISURE-TIME PHYSICAL ACTIVITY DURING PREGNANCY

Abstract

Pregnant women without medical contraindications should accumulate 30 minutes of moderate exercise on most days of the week, yet many pregnant women do not exercise at recommended levels. The purpose of the study was to investigate barriers to leisure-time physical activity (LTPA) and examine social cognitive predictors of LTPA during pregnancy. At gestational weeks 18, 24, 30, and 36, participants completed questionnaires eliciting barriers to LTPA, measures of task and barrier self-efficacy, and LTPA over the previous 6 weeks. A total of 1168 barriers were content analyzed, yielding nine major themes. Barrier and exercise self-efficacy were correlated with LTPA. Hierarchical regression analyses supported both forms of self-efficacy as predictors of LTPA. Self-efficacy to overcome exercise barriers and to exercise is positively related to LTPA during pregnancy. Interventions designed to promote LTPA during pregnancy should aim to foster women's confidence to overcome barriers and to exercise regularly.

Introduction

In recent years, research has demonstrated that mild to moderate level intensity exercise during pregnancy is safe and has beneficial outcomes for both mother and baby (Lokey, Tran, Wells, Myer, & Tran, 2004; Pivarnik, Chambliss, Clapp, Dugan, Hatch, Lovelady et al., 2006). For example, studies have demonstrated that physical activity during pregnancy is associated with reduced risk of preeclampsia (Dyck, Klomp, Tan, Turnell, Boctor, 2002; Dye, Knox, Artal, Aubry, Wojtowycz, 1997; Hegaard, Pedersen, Nielsen, & Damm, 2007; Marcoux, Brisson, & Fabia, 1989) gestational diabetes (Dempsey, Sorenson, Williams, Lee, Miller, Dashow et al., 2004, Hegaard et al.; Mottola, 2007), preterm birth (Hegaard et al.; Juhl, Andersen, Olsen, Madsen, Jorgensen, Nohr et al., 2008), improved pain tolerance (Clapp & Keiss, 2000), less back pain (Kihlstrand, Stenman, Nilsson, & Axelsson, 1999), lower total weight gain and less fat mass gain, more rapid postnatal recovery and weight loss (Wolfe, Ohtake, Mottola, & McGrath, 1989), and improvements in emotional well-being (Poudevigne & O'Connor, 2005; Polman, Kaiseler, & Borkoles, 2007) and body image perceptions (Boscaglia, Skouteris, & Wertheim, 2003; Clapp & Keiss).

In light of these positive outcomes, the American College of Obstetricians and Gynecologists (ACOG, 2002) encourages virtually all pregnant women without obstetric or medical problems to engage in regular physical activity. Specifically, the guidelines state that pregnant women should aim to accumulate 30 minutes of moderate exercise a day on most days of the week. However, meeting these guidelines remains a challenge. Study 1 demonstrated that LTPA declined as pregnancy progressed. This finding is

consistent with previous research. For example, Evenson and colleagues (2004) determined that only 20% of the women in their sample were active at least 3 times per week for a minimum of 20 minutes per session during their first trimester of pregnancy. Furthermore, by the third trimester, participation rates had dropped to 8% (Evenson, Savitz, & Huston, 2004). Similarly, Symons Downs and Hausenblas (2004) found that only 17% of pregnant women engaged in 5 or more weekly bouts of moderate or strenuous exercise during their first trimester. That percentage fell to 14% in the second trimester and 7.5% in the third trimester.

In order to understand why a large percentage of pregnant women do not participate in regular leisure-time physical activity (LTPA), studies have examined demographic and social cognitive correlates of exercise participation. Demographic factors such as income (Ning, Williams, Dempsey, Sorensen, Frederick, & Luthy, 2003), education (Dempsey et al., 2004; Evenson et al., 2004; Ning et al.; Clarke & Gross, 2004), ethnicity, marital status (Hinton & Olson, 2001), and parity (Mottola & Campbell, 2003; Study 1; Zhang & Savitz, 1996), have been shown to be significantly related to LTPA during pregnancy.

While identifying demographic correlates of LTPA is informative, they are largely unmodifiable, whereas social cognitions represent modified characteristics and therefore targeted for intervention. Unfortunately, only a few studies to date have examined social cognitive factors associated with prenatal women's physical activity participation (Brown, Brown, Miller, & Hansen, 2001; DeMontigny & Lacharité, 2005; Duncombe, Wertheim, Skouteris, Paxton, & Kelly, 2007; Hausenblas & Symons Downs,

2004; Hinton & Olson, 2001, Miller & Brown, 2005; Symons Downs & Hausenblas, 2003, 2007). Most of the research carried out thus far has been cross-sectional and atheoretical. Consequently, our understanding of whether the psychosocial variable in question influences physical activity behaviour or vice versa is limited (Weinstein, 2007).

To date, only three known studies have examined theory-based psychosocial correlates of LTPA among pregnant women using a prospective design (Hausenblas & Symons Downs, 2004; Symons Downs & Hausenblas, 2003, 2007). The research used a collection of variables based on the Theory of Planned Behaviour (Ajzen, 1991) to predict pregnant women's exercise intentions and behaviour. Results showed positive correlations between attitudes, perceived control, and intentions as well as a moderate intention-behaviour relationship. While these studies have provided a solid theory-based foundation for understanding exercise during pregnancy, the authors recommend that further research be conducted examining additional theory-based psychosocial predictors of pregnant women's LTPA.

Therefore, the general purpose of the present study was to build upon the limited extant research by investigating psychosocial predictors of LTPA during pregnancy. The first objective was to investigate perceived barriers to LTPA during pregnancy, because barriers or constraints to LTPA are among the most frequently cited correlates of physical activity (Sallis & Hovell, 1990; Sallis & Owen, 1999). A few studies that have previously examined barriers among pregnant women noted that feeling too tired, too busy, and experiencing physical limitations were among the most commonly-reported barriers (Duncombe et al., 2007; Hausenblas & Symons Downs, 2004; Clapp, 1989; Clapp &

Dickstein, 1984). However, these studies have several limitations. For instance, the research is limited in terms of representing barriers across pregnancy as a whole rather than by phases (e.g., segmenting trimesters; Hausenblas & Symons Downs; Clapp; Clapp & Dickstein). This is problematic because pregnancy is characterized by many physical and behavioural changes and it is conceivable that barriers experienced early in pregnancy might be different from those experienced later in pregnancy. For example, the most frequently cited barrier in Symons Downs and Hausenblas' study was physical limitations such as nausea and vomiting (Symons Downs & Hausenblas, 2004). However, such symptoms may be more prevalent during the early stages of pregnancy, and so the extent to which that barrier affects LTPA participation at different stages of pregnancy remains questionable. Another limitation involves recalling pregnancy-related barriers after women had given birth to their babies (up to 1-year postpartum; Hausenblas & Symons Downs), which raises concerns about the validity of their recall (Brawley, Martin, & Gyurcsik, 1998). Ideally, barriers should be assessed at the same point in time at which they occur (Brawley, Culos-Reed, Angove, & Hoffman-Goetz, 2002). Finally, previous research has been limited to the assessment of investigator-developed lists of barriers (Duncombe et al., 2007). Therefore, to gain a more detailed description of physical activity barriers during pregnancy, we assessed women's perceived LTPA barriers at regular (6-week) intervals following the first trimester of their pregnancy. Eliciting pregnancy-related barriers should help broaden our understanding of factors affecting LTPA during pregnancy and may be useful for informing the development of physical activity interventions for pregnant women.

The second objective of the study was to utilize Bandura's social cognitive theory (SCT; Bandura, 1997) to examine correlates of LTPA during pregnancy. SCT has been applied to understanding and promoting numerous health-related behaviours including LTPA (Bandura, 1997; 2004; McAuley, Pena, & Jerome, 2001). The core construct of SCT is self-efficacy, which is defined as one's confidence in his or her capabilities to execute specific actions required to achieve specific outcomes (Bandura, 1997; 2004). Several review papers have demonstrated that higher self-efficacy is associated with greater exercise participation (Culos-Reed, Gyurcsik, & Brawley, 2001; McAuley & Blissmer, 2000; Woodgate & Brawley, 2008).

Although by Bandura's definition, self-efficacy appears a relatively straightforward and unidimensional concept, it has been conceptualized and operationalized in several different ways in physical activity research. For example, Woodgate and Brawley (2008) illustrated a distinction between exercise self-efficacy and self-regulatory efficacy in the context of cardiac rehabilitation, where exercise self-efficacy captures physical characteristics of the exercises (e.g., performing a cardiovascular exercise routine) and self-regulatory efficacy focuses on actions such as planning and scheduling one's exercise sessions. Other studies examining self-efficacy in exercise contexts have utilized more omnibus measures such as McAuley's (1993) "exercise self-efficacy", which assesses confidence to engage in regular exercise (40+ minutes of activity, 3 times per week) forecasting towards "next week" and on through "the next 8 weeks" using 1-week intervals. According to Bandura (1995) these more generalized self-efficacy judgements are based on self-efficacy perceptions about

performing the requisite motor acts as well as perceptions about performing various self-regulatory skills such as overcoming barriers. In the present study, self-efficacy to overcome LTPA barriers as well as a general measure of exercise self-efficacy as predictors of LTPA during pregnancy was examined. In line with the strategy to assess barriers across pregnancy, measures of self-efficacy and LTPA were obtained at regular (i.e., 6-week) intervals and self-efficacy measures were used to prospectively predict LTPA during each 6-week window. It was hypothesized that barrier self-efficacy and exercise self-efficacy would independently be correlated with LTPA behaviour. In addition, because the more generalized exercise self-efficacy perceptions should be informed by barrier self-efficacy (Bandura), it was hypothesized that when exercise self-efficacy was controlled for, the relationship between barrier self-efficacy and LTPA would be attenuated.

Method

Participants

Pregnant women, between 18 and 36 weeks post-conception, were recruited through a variety of prenatal programs offered by four different regional public health units. The populations served by the individual health units ranged from 150,000 to just over 400,000. Study brochures were distributed by nurses to participants attending the programs. No attendance lists were available for all the various programs in which women received the study information, thus it is unknown how many women actually received the study information. Recruitment spanned a 10-month period.

Study Design and Procedure

The study design included four data collection time points: gestational week 18 (T1), 24 (T2), 30 (T3), and 36 (T4). We limited our investigation to the second (e.g., gestation weeks 13 – 26) and third trimesters (e.g., gestation weeks 27 – birth) of pregnancy given the increased risk of miscarriage in the first trimester. Data were collected at 6-week intervals to be sensitive to subject burden while still obtaining assessments at two time points during each of the second and third trimesters.

The study protocol was reviewed and approved by an institutional research ethics review panel and involved the following procedures. After receiving an initial invitation to participate in the study, interested women contacted the researcher (via email or telephone) or visited the study's website. Participants had the option of signing up for the study and completing the study measures online (via secured access) or over the telephone. Despite having both options, all participants utilized the online study procedures. In order to register for participation in the study, participants had to first read the informed consent letter and give their consent by setting up a username and password. Next, participants entered their expected due-date stage in order to determine their current stage of pregnancy (e.g., gestational week). Once this was completed, the online system generated a personal profile for each participant. Participants were then automatically directed back to the study homepage and prompted to access their personal profile by logging into the secured end of the website using their username and password. Each participant's personal profile displayed a schedule that outlined the dates for completion of the four data collection time points. This schedule was generated based on

the expected due date the participant entered when signing up for the study. Measures of barrier and exercise self-efficacy as well as LTPA were collected at each measurement occasion. Participants could only complete measurement periods which coincided with their stage of pregnancy. For example, if a participant entered the study during her 26th week of pregnancy, she would only be eligible to complete surveys at T3 and T4. When participants entered a data collection period, they were immediately contacted via email and asked to complete the study measures by accessing their personal profile on the study homepage. Participants had 7 days to complete the study measures, beyond which time the system would time out and not allow further access to the questionnaires. This aspect of the procedure aimed to ensure that data that was acquired accurately reflected each participant's stage of pregnancy during the study.

Measures

Exercise barriers and barrier self-efficacy. Drawing from a procedure described by Gyurcsik, Bray and Britton (2004), barriers to LTPA were measured using a questionnaire that consisted of both open- and close-ended questions. As a definitional control, barriers were defined as "anything that may stop you from doing physical activity". The questionnaire instructions were as follows. First, participants were asked to list up to 4 barriers to LTPA that they believed were likely to arise over the next 6 weeks. These lists of barriers were collated at each time point and subjected to content analysis. After listing each barrier, participants were asked to rate their confidence to overcome the barrier should it arise in the next 6 weeks. Efficacy was rated using a scale ranging from 0 (absolutely not confident) to 100 (absolutely confident) percent, increasing in 10 point

increments. Each participant's response sets were summed and an average was calculated to gauge their overall strength of barrier self-efficacy. The average interclass correlation values for the scales were high at each time-point (i.e., ICC =.78, ICC =.85, ICC =.84 and ICC =.85 for T1, T2, T3 and T4 respectively), indicating a high degree of within-subject consistency and between-subject variability.

Exercise self-efficacy. Exercise self-efficacy was measured using a scale that was created based on recommendations by Bandura (1997), and McAuley and Mihalko (1998). The 5-item exercise self-efficacy subscale assessed participants' degree of confidence in their ability to complete 30+ minutes of moderate intensity LTPA once, twice, etc., up to five times per week in the subsequent 6 weeks. Participants indicated their efficacy using a scale ranging from 0 percent to 100 percent, increasing in 10 point increments. A score of 0 percent indicated that the participant was "absolutely not confident" whereas a score of 100 percent indicated that the participant was "absolutely confident". An overall mean exercise self-efficacy value was calculated for each participant and used in the analyses. The internal consistencies for this scale were α = .93, α =.94, α =.94, α =.95, at T1, T2, T3, and T4, respectively.

LTPA. For the purpose of this investigation, the physical activity measure concerned only LTPA with a minimum energy requirement of 3.0 metabolic equivalents (i.e., moderate intensity exercise), as these intensities are those encouraged by the ACOG (ACOG, 2002) and the American College of Sports Medicine (Haskell, Lee, Pate, Powell, Blair, Franklin, et al., 2007) for pregnant women.

The Modifiable Activity Questionnaire (MAQ; Kriska, Knowler, LaPorte, Drash, Wing, Blair et al., 1990) was used to measure participants' LTPA. To complete the MAQ, participants selected from a list of 40 common moderate to vigorous intensity LTPA's (e.g., aerobics, volleyball, bicycling, brisk walking, hiking) the activities they had engaged in during the past 6 weeks. For each LTPA selected, participants estimated the average frequency per week they had engaged in that activity. Next, participants indicated the average number of minutes they had engaged in the LTPA per session. For example, if a participant selected walking briskly from the list, they indicated the number of times they performed the behaviour last week, two weeks ago, and continuing up to 6 weeks ago, and the average number of minutes they spent doing the activity per session. A working copy of the MAQ is presented in Kriska and Casperson (1997). The MAQ has been shown to be both reliable and valid in studies using the doubly-labeled water technique and accelerometers (Aaron, Kriska, Dearwater, Anderson, Olsen, Cauley et al.,1993; Aaron, Kriska, Dearwater, Cauley, Metz, & LaPorte, 1995; Kriska et al.), and it has been widely used in a number of populations including pregnant women (Bauer, 2006).

In order to approximate the amount of energy expenditure across the various activities, each activity's metabolic equivalent (Ainsworth, 2008) was multiplied by the reported time (i.e., frequency x duration) spent performing that activity. These values were then totaled across all activities and expressed in MET-hrs/week. This procedure generated a score for each of the previous 6 weeks, representing participants' total MET

hours of LTPA. The mean of these 6 values was computed as a measure of participants' average LTPA in the preceding 6 weeks (average MET-hrs/week).

Analytic Strategy

The analysis proceeded in two steps. First, data obtained from the open-ended barriers questionnaire were grouped into major categories by two independent researchers. The researchers discussed all barriers that were not commonly grouped until agreement was reached. In a few cases (i.e., < 10), some responses were left unclassified because of their vague nature. A frequency analysis was conducted on the categories of open-ended responses by data collection period.

Second, three prediction periods were established using data provided from the four data collection periods: T1 barrier and exercise self-efficacy were used to predict T2 LTPA, T2 barrier and exercise self-efficacy were used to predict T3 LTPA, and T3 barrier and exercise self-efficacy were used to predict T4 LTPA. To examine the study hypothesis regarding the effects of barrier and exercise self-efficacy in predicting physical activity, linear regression analyses were conducted for each prediction period. Following recommendations by MacKinnon and colleagues (MacKinnon, Fairchild, & Fritz, 2007) for the product of coefficients method, exercise self-efficacy was regressed on barrier self-efficacy and, in a separate regression, LTPA was regressed on exercise self-efficacy and barrier self-efficacy. To determine the significance of the attenuated effect of barrier self-efficacy on LTPA, a Sobel test (Sobel, 1982) was computed. According to Green (1991), 66 observations are necessary to achieve adequate power ($\beta = .80$) to detect medium-sized effects with ($r = 0.30$) and an alpha of .05 in a multiple

regression with 2 predictor variables. The sample sizes were adequate (> 60) for two of the regressions, but for the Time 1 regression analysis the sample was slightly below the recommended requirement ($n = 47$).

Results

Participants

A total of 169 pregnant women enrolled in the study and provided data for at least one of the four data collection periods. Nine were removed from the analysis because they failed to provide complete LTPA or demographic information, thus 160 women participated in the study. Participant flow through each of the four data collection time points depended on when during their pregnancy women signed up for the study and attrition. Consequently, there was a total of 16 possible data profile combinations (e.g., some women completed all four data collection time points while others completed, for example, only T3 and T4, or T1 and T3; refer to Appendix D.4). The total number of participants providing data for each time point is displayed in Table 1 along with the relevant demographic characteristics. Multivariate analysis of variance (MANOVA) of the demographic variables revealed that there were no significant differences between participants who provided data at one, two, three, or four data collection time points on those measures. Overall, a large percentage of participants were married (92.8%), white (95.7%), and had completed some post-secondary education (87.6%). Most women reported working either part time or full time (81.8%) and having a family income of greater than $80,000 per year (78.3%). Just over half of the participants were first time mothers (56.4%).

Barriers to LTPA

The open-ended barriers elicitation procedure resulted in the generation of 1168 barriers; 208 barriers at T1, 271 barriers at T2, 336 barriers at T3, and 353 barriers at T4. On average, participants listed 3.5 barriers at each data collection point. Barriers listed by participants were content analyzed by two independent researchers resulting in 9 different barrier classification categories. The designation of specific barriers to categories yielded a high degree of between-rater agreement (Kappa = .74; Landis & Koch, 1977). The most commonly reported barriers to LTPA among both first time mothers and non-first time mothers included being too tired, having a lack of time to exercise, and experiencing physical limitations. The experience of physical limitations was the most common barrier at all time points. Examples of barriers classified as physical limitations included joint pain, swelling, leg cramps, sore back, physical discomfort, and becoming "too big". At T1, being too tired, having a lack of time to exercise, and physical limitations accounted for 64% of all the barriers reported. At T2, T3, and T4 respectively, these 3 categories of barriers accounted for 70%, 70%, and 79% of all barriers reported.

Based on the relative frequency of barriers reported across each of the four time points several notable findings were observed. First, the emergence of one category, "childcare responsibilities", generated some concern given the sample was comprised of women who were pregnant with their first child as well as women who already had at least one other child and it was likely this barrier was more prevalent among those in the latter group. Accordingly, the barrier frequency data appear in Table 2 displaying the barrier category groupings, examples for each category, and the relative frequency that

barriers were reported as a function of first time versus non-first-time mothers across the four data collection periods. The percentage of first time versus non-first time women who reported childcare-related barriers was clearly different, with no women who were expecting their first child reporting childcare barriers.

A second notable finding was that the relative frequency of physical limitations increased as pregnancy progressed. That is, at T1 28.1% of women identified physical limitations as barriers to exercise and that statistic increased to 41.6, 46.9, and 73.3 at T2, T3, and T4, respectively. Finally, work-related barriers (e.g., long work days, busy at work) were reported less frequently as pregnancy progressed. The percentage of women who reported work as a barrier to exercise was similar at T1 and T2 (e.g., 21.8% and 26.4%), however figures decreased to 14.7% for T3 and 8.4% for T4. The relative frequency of all other reported barriers remained consistent across the four measurement periods.

Predicting LTPA.

To examine hypothesized relationships between barrier self-efficacy, exercise self-efficacy, and LTPA, a series of linear regression analyses were conducted for each prediction period. At each time point, the 6-week LTPA recall data were positively skewed (i.e., skewness > .89; Tabachnick & Fidell, 2007). Because the data were positively skewed, a square root transformation was performed as recommended by Tabachnick and Fidell (2007).

As shown in Table 3, barrier and exercise self-efficacy were significantly ($p <$ .05) correlated with each other, and as predicted, were both correlated with LTPA at each

time point. To determine if barrier self-efficacy and exercise self-efficacy would independently predict LTPA behaviour linear regression analyses were conducted for each prediction period. As hypothesized, for each prediction period, the results of the regression analysis revealed that barrier self-efficacy and exercise self-efficacy independently predicted LTPA behaviour ($p < .001$; See Table 4).

To examine predictive relationships between barrier self-efficacy, exercise self-efficacy, and LTPA, linear regression analyses were conducted for each prediction period, and the product of coefficients method was used to assess the contributions of each predictor to the model as recommended by MacKinnon and colleagues (2007). At each time point, a regression model was computed regressing barrier self-efficacy on exercise self-efficacy, followed by a second regression model that regressed LTPA on barrier self-efficacy while controlling for exercise self-efficacy.

Results of the three sets of regression analyses are presented in Table 4. In the first analysis, T1-T2 LTPA was regressed on T1 barrier self-efficacy. The model was significant ($F(1, 46) = 10.44, p = .002$), with barrier self-efficacy explaining 19% of the variance in LTPA ($R^2 = 0.19$, $B = 0.43$, $SEB = 0.10$, $p = .002$). In the hierarchical regression analysis, LTPA was regressed on T1 exercise self-efficacy followed by T1 barrier self-efficacy. The overall model was significant ($F(1, 46) = 7.81, p = .001$) with barrier and exercise self-efficacy explaining 26% of the variance in LTPA ($R^2 = 0.26, p = .001$). However, after controlling for exercise self-efficacy ($B = 0.32$, $SEB = 0.10$, $p = .04$), the effect of barrier self-efficacy was attenuated ($B = 0.26$, $SEB = 0.10$, $p = .10$). A Sobel test was conducted to examine if the reduction in the effect size associated with

barrier efficacy between the two regressions was significant. The Sobel test revealed a significant *z*-score (Sobel $Z = 2.00$, $p < .05$), supporting attenuation of the barrier self-efficacy effect.

In the second analysis, T2-T3 LTPA was predicted by T2 barrier self-efficacy ($F(1, 62) = 24.94$, $p < .001$), with barrier self-efficacy explaining 29% of the variance in T3 LTPA ($R^2 = .29$, $B = 0.54$, SE = 0.08, $p < .001$). When LTPA was regressed on T2 exercise self-efficacy and T2 barrier self-efficacy, the overall model was significant ($F(1, 62)=13.79$, $p < .001$), with barrier and exercise self-efficacy explaining 32% of the variance in LTPA ($R^2 = 0.32$, $p = .001$). After controlling for exercise self-efficacy ($B = 0.21$, SE$B = 0.09$, $p = .147$), the effect of barrier self-efficacy remained a significant predicator of LTPA ($B = 0.40$, SE = 0.11, $p = .005$). The Sobel test was not significant (Sobel $Z = 1.40$, $p > .05$), suggesting that although the effect size associated with barrier self-efficacy was reduced (e.g., $B = 0.54$ versus $B = 0.40$), the reduction was not significant.

In the third analysis, T3-T4 LTPA was predicted by T3 barrier self-efficacy, $F(1, 64) = 23.30$, $p < .001$, accounting for 28% of the variance in LTPA ($R^2 = .28$, $B = 0.53$, SE = 0.08, $p < .001$). When LTPA was regressed on T3 exercise self-efficacy and T3 barrier self-efficacy, the overall model was significant $F(1, 64) = 17.61$, $p < .001$, with barrier and exercise self-efficacy explaining 37% of the variance in LTPA ($R^2 = 0.37$, p < .001). However, after controlling for exercise self-efficacy ($B = 0.41$, SE$B = 0.06$, $p = .004$), the effect of barrier self-efficacy was not significant ($B = 0.25$, SE = 0.10, $p = .074$). The *z*-score produced by the Sobel test was significant (Sobel $Z = 2.75$, $p<.05$).

Discussion

The general purpose of the present study was to examine barriers to exercise and prospectively investigate psychosocial predictors of LTPA during pregnancy. The first objective was to have pregnant women identify salient barriers to exercise at four different time points during pregnancy. In general, the barriers reported were consistent with barriers experienced by both asymptomatic and symptomatic (e.g., lack of time, being tired, and weather) populations (Blanchard, Reid, Morrin, Beaton, Pipe, Courneya et al., 2007; Bray, 2007; Courneya, McKenzie, & Reid, 2008), as well as previous research examining barriers to exercise during pregnancy (e.g., physical limitations; Duncombe et al., 2007; Clapp, 1984; Clapp & Dickstein, 1984; Symons Downs & Hausenblas, 2004). Lack of time, being tired, and physical limitations accounted for over half of all barriers reported across the four data collection periods. The frequency of reported barriers appeared consistent across the four data collection time periods with the exception of physical limitations and work. Pregnant women frequently reported physical limitations, such as back pain, swelling, and joint pain, as barriers to exercise participation during pregnancy. While identifying these types of physical limitations as barriers to exercise during pregnancy is consistent with previous research (Duncombe et al.), it is inconsistent with the types of physical limitations reported by Symons Downs and Hausenblas. For example, physical limitations reported by Symons Downs and Hausenblas (2004) included nausea and vomiting. In the current study physical limitations generally reflected physical discomforts, such as joint pain and swelling. One possible explanation for this difference is that we measured barriers during the second

and third trimesters. Had we included a measure of barriers during the first trimester, nausea and vomiting may have been more frequently reported. Nonetheless, the fact that different types of physical limitations were observed between the current study and the study by Symons Downs and Hausenblas (2004) indicates that types of physical limitations may be pregnancy-stage specific.

Given the types of physical limitations reported in the current study, it is not surprising that the relative frequency in which this barrier was reported across the four measurement time periods increased as pregnancy progressed. Results were consistent for first time mothers compared to non-first time mothers with the exception of childcare-related barriers. No first time mothers reported that caring for their children was a barrier to LTPA. This finding suggests that interventions designed to help pregnant women overcome barriers to exercise should take into consideration whether or not women are first time mothers. With regards to barriers that become less frequently reported as pregnancy progresses, the results demonstrated that work-related barriers were more frequently reported in the early stages of pregnancy compared to the later stages. While this finding likely reflects the tendency for women to go on maternity leave, the fact that we observed changes in the frequency in which barriers were reported across pregnancy, shows how researchers and practitioners should be cognizant that barriers may be variable and that skills required to navigate barriers may need to be modified over the course of pregnancy.

The assessment of barriers to LTPA during pregnancy in the current study contributes to the existing body of literature in two main ways. First, the present study

identified salient and influential barriers. Previous research has been limited to the assessment of investigator-developed lists of barriers (Duncombe et al., 2007; Pereira, Rifas-Shiman, Kleinman, Rich-Edwards, Peterson, & Gilman, 2007), and thus salient barriers may have been missed (e.g., physical limitations, childcare). Second, barriers were measured at four different times to consider that barriers might change over time. Previous studies have only measured barriers across pregnancy as a whole rather than by segmenting by trimester (Symons Downs & Hausenblas, 2004). Given that pregnancy is characterized by many changes, it is an important consideration that barriers be measured over time as these changes occur.

The second objective of the present study was to examine barrier self-efficacy and exercise self-efficacy as predictors of LTPA during pregnancy. Three prediction periods were examined. As hypothesized, barrier and exercise self-efficacy independently predicted LTPA ($p < .05$) in each prediction period. The regression coefficients ranged from .43 to .58, indicating that when analyzed independently both barrier and exercise self-efficacy have relationships with LTPA representing medium to large-sized effects (Cohen, 1988).

Previous studies examining correlates of LTPA during pregnancy have focused primarily on demographic factors with only a few studies examining psychosocial factors (Clarke & Gross, 2004; Hausenblas & Symons Downs, 2004; Symons Downs & Hausenblas, 2003). The present study expands on that research by integrating a broader social cognitive perspective focused on self-efficacy perceptions. Barrier and exercise self-efficacy have consistently been found to correlate with exercise behaviour in healthy

(Bray, 2007) and symptomatic (Woodgate & Brawley, 2008) populations. Together, this broad evidence base along with the strong and consistent relationships observed between these forms of self-efficacy and LTPA in the present study suggest barrier and exercise self-efficacy may be important targets for intervention efforts to promote LTPA during pregnancy.

The results of the multiple regression analyses predicting LTPA revealed exercise self-efficacy had attenuating effects on the relationship between barrier self-efficacy and LTPA in two of the three analyses. These findings may be interpreted in several ways, but are consistent with a view that barrier self-efficacy influences exercise self-efficacy, which in turn predicts LTPA. These results support Bandura's assertion that self-efficacy judgements about performing a complex behaviour (i.e., exercise self-efficacy) are also influenced by self-efficacy perceptions about constituent skills that underlie the behaviour in question (e.g., efficacy to overcome barriers), which together, determine or enable the performance of complex tasks such as engaging in regular LTPA (Bandura, 1995). Investigating and establishing the causal connections between various forms of self-efficacy represents an important contribution to theory and may have important implications for intervention efforts as well. For example, without a strong skill-set and associated efficacy to cope with barriers to LTPA, there may be considerable limits to one's ability to incorporate a regular pattern of physical activity into one's lifestyle. Consequently, early intervention efforts could focus on developing barrier self-efficacy. However, because this study did not involve an experimental manipulation of the self-efficacy constructs of interest, a directional relationship between barrier and exercise self-

efficacy can only be inferred. Future research should attempt to systematically manipulate barrier self-efficacy and determine how changes in barrier self-efficacy relate to changes in exercise self-efficacy and subsequent LTPA.

Overall, the present study contributes to the existing body of literature examining exercise during pregnancy, and has potentially important theoretical and practical implications. The current study contributes solidly to a sparse body of previous research examining barriers to physical activity during pregnancy and is bolstered by a process of actively engaging pregnant women in identifying salient barriers to LTPA at different time points during their pregnancy. The results indicated that barriers experienced early in pregnancy differ in some ways from those experienced later in pregnancy, but have many common characteristics. Future studies should continue to focus on barriers specific to pregnancy stages and seek to elicit or develop strategies for coping with these barriers as these may also have features that are unique to the population that experiences them.

The study also builds on previous research by prospectively examining theory-based psychosocial predictors of LTPA during pregnancy. While both barrier and exercise self-efficacy were found to independently predict LTPA, when analyzed hierarchically, exercise self-efficacy was the only construct significantly contributing to the overall model in the first and third prediction periods. In the second prediction period, barrier self-efficacy was the only construct significantly contributing to the overall model. One possible explanation for this is that under relatively "normal" circumstances a general measure of self-efficacy may be a good predictor of behaviour. However, in

reality, individuals are continuously faced with challenges that may alter their efficacy in one for more of these sub-domains. In those instances, barrier self-efficacy exerted the greatest effect on LTPA. It is plausible that barrier efficacy came into stronger play in the second prediction period because women were facing new or heightened barriers. This explanation is partially supported by the open-ended barriers data, where the percentage of pregnant women reporting physical limitations as a barrier increased at T2 and barrier self-efficacy was the significant predictor of LTPA in the subsequent 6 weeks.

Limitations and Future Directions

Although the present study makes important contributions, several limitations are worth noting. First, study participants were self-selected. Thus, study findings may not be representative of a sample of pregnant women who are not motivated to take part in a study of exercise and pregnancy. In addition, despite recruiting participants across a large geographic area and through multiple public health units, the sample was primarily comprised of white, married, educated, middle to upper-middle class women in their second and third trimesters of pregnancy. Thus, the results are limited in terms of its generalizability to lower socioeconomic, ethnically diverse populations and women who are in their first trimester of pregnancy. Future studies of this nature should attempt to recruit a more diverse sample of participants.

A second limitation is that the measure of physical activity employed in the present study was based on self-report and concerned physical activity participation that was carried out in one's leisure-time that excluded an assessment of occupational or household physical activity. Thus, the results cannot be generalized to overall levels of

physical activity or energy expenditure. Although the reliability and validity of the MAQ has been tested in a variety of populations (Aaron et al., 1993; 1995; Kriska & Casperson, 1997; Schulz, Harper, Smith, Kriska, & Ravussin, 1994), self-report measures may be subject to recall errors and other biases such as social desirability. Future research would benefit from using objective assessment tools for activity (e.g., accelerometers), which could also provide a measure of overall levels of daily energy expenditure.

Conclusion

Pregnancy is a major life event that often results in a number of behavioural changes, such as decreased LTPA. Barriers such as being too tired, having no time to exercise, and experiencing physical limitations such as back pain and swelling, may contribute to decreased LTPA during pregnancy. The current study revealed that having greater confidence in one's ability to overcome barriers and to exercise regularly are related to greater LTPA during pregnancy and that having higher barrier self-efficacy may contribute to a more generalized sense of exercise self-efficacy.

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Table 1

Participant Demographic Characteristics

Variable	T1 M(SD) % (n=59)	T2 M(SD) % (n=86)	T3 M(SD) % (n=97)	T4 M(SD) % (n=106)	Average M(SD) % (n=160)
Age	30.6(3.6) -	30.5(4.3) -	30.8(3.5) -	30.3(3.7) -	30.5(3.8) -
Married/Common law	94.9	91.9	91.6	92.9	92.8
White	94.6	96.5	95.8	96.1	95.7
College/University	92.5	87.2	87.4	83.5	87.6
Nulliparas[a]	42.4	46.5	45.4	44.3	44.6
Paras ≥ 1[b]	57.6	57.6	54.6	55.7	56.4
Work Part/Full time	82.9	80.0	84.1	80.2	81.8
Income > 80,000/year	79.6	76.0	82.4	75.0	78.3

[a] Nulliparas refers to first time pregnant women, no other children at home
[b] Paras ≥ 1 refers to women with at least one child at home.

Table 2

Relative and Raw Frequencies of Reported Barriers

	T1		T2		T3		T4	
Barrier	NP[a] (n=34)	P≥1[b] (n=25)	NP(n=46)	P≥1(n=40)	NP(n=53)	P≥ 1 (n=44)	NP(n=59)	P≥1(n=35)
Being tired (e.g., fatigue, no energy, tiredness)	26.6(32)	27.3(24)	24.8(38)	27.1(32)	25.3(46)	26.6(41)	28.1(55)	23.6(37)
Lack of time (e.g., too busy, other commitments)	23.3(28)	19.3(17)	24.2(37)	22.9(27)	24.7(45)	15.6(24)	17.4(34)	16.7(23)
Physical limitations (e.g., back pain, swelling feet)	13.3(16)	14.8(13)	19.6(30)	22.0(26)	20.3(37)	26.6(41)	38.3(75)	35.0(55)
Work (e.g., long work day, busy at work)	15.0(18)	6.8(6)	13.7(21)	12.7(15)	8.2(15)	6.5(10)	4.6(9)	3.8(6)
Weather (e.g., cold outside, too hot)	13.3(16)	5.7(5)	11.8(18)	4.2(5)	12.1(22)	8.4(13)	5.1(10)	5.1(8)
Lack of motivation (e.g., feeling unmotivated, no desire)	2.5(3)	2.3(2)	5.9(9)	3.4(4)	7.1(13)	5.2(8)	2.6(5)	4.5(7)
Lack of support (e.g., no facility, no classes)	3.3(4)	1.1(1)	2.0(3)	1.70(2)	.60(1)	.70(1)	0(0)	.6(1)
Injury/Contraindication (e.g., on bed rest, physician's orders)	.8(1)	0(0)	2.6(4)	.9(1)	1.1(2)	2.6(4)	.5(1)	3.2(5)
Childcare duties (e.g., no babysitter, parenting responsibilities, childcare demands)	0(0)	12.5(11)	0(0)	11.0(13)	0(0)	7.8(12)	1.0(2)	7.6(12)
Total Responses	100(120)	100(88)	100(153)	100(118)	100(182)	100(154)	100(196)	100(157)

Note. Raw frequencies are reported in parentheses.

[a] NP refers to first-time pregnant women, [b] P≥1 refers to women with at least one child at home.

Table 3

Means, Standard Deviations and Correlations between Variables for Concurrent Samples at each Time Point

	M	*SD*	1	2
T1 efficacy predicting T2 LTPA (n=47)				
1. Barrier self-efficacy	5.62	2.02	-	-
2. Exercise self-efficacy	6.64	2.33	.576**	-
3. T2 LTPA	11.52	9.95	.434**	.464**
T2 efficacy predicting T3 LTPA (n=63)				
1. Barrier self-efficacy	5.12	2.30	-	-
2. Exercise self-efficacy	6.14	2.69	.687**	-
3. T3 LTPA	11.67	9.33	.539**	.469**
T3 efficacy predicting T4 LTPA (n=65)				
1. Barrier self-efficacy	4.88	2.27	-	-
2. Exercise self-efficacy	5.54	2.87	.679**	-
3. T4 LTPA	8.30	8.87	.526**	.579**

Note. For LTPA, raw values are presented for ease of interpretation.

* Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

Table 4

Hierarchical Regression Analyses

Predictor	Outcome	R^2	adj R^2	ß	*p*
Prediction Period 1 (*n*=47)					
Exercise self-efficacy	LTPA	.22	.20	.46	.001
Barrier self-efficacy	LTPA	.19	.17	.43	.002
Overall Model	LTPA	.26	.23	-	.001
Step 1: Exercise self-efficacy		-	-	.32	.04
Step 2: Barrier self-efficacy		-	-	..26	.10
Prediction Period 2 (*n*=63)					
Exercise self-efficacy	LTPA	.22	.21	.47	<.001
Barrier self-efficacy	LTPA	.29	.28	.54	<.001
Overall Model	LTPA	.32	.29	-	<.001
Step 1: Exercise self-efficacy		-	-	.21	.147
Step 2: Barrier self-efficacy		-	-	.40	.005
Prediction Period 3 (*n*=65)					
Exercise self-efficacy	LTPA	.34	.32	.58	<.001
Barrier self-efficacy	LTPA	.28	.27	.53	<.001
Overall Model	LTPA	.37	.35	-	<.001
Step 1: Exercise self-efficacy		-	-	.41	.004
Step 2: Barrier self-efficacy		-	-	.25	.074

CHAPTER 4

UNDERSTANDING POSTNATAL WOMEN'S LEISURE-TIME PHYSICAL ACTIVITY:

A SOCIAL COGNITIVE APPROACH

Abstract

The overall purpose of the current study was to investigate social cognitive correlates of leisure-time physical activity (LTPA) among postnatal women during the first six months following childbirth. A total of 230 women enrolled in the study and provided data for at least one of the study data collection periods. Participants provided descriptive data regarding barriers to LTPA as well as expected outcomes pertaining to participation in physical activity. Measures of LTPA, self-efficacy (exercise and barrier), and outcome expectations were collected at postnatal weeks 12, 18, 24, and 30. Participants identified fatigue, lack of time, and childcare responsibilities as common barriers to LTPA. The most common outcomes expected to arise from participation in LTPA were associated with physical health benefits such as increased fitness and weight control, and psychological benefits including stress reduction and mood management. Both self-efficacy for exercising and self-efficacy for effectively coping with LTPA barriers were positively associated with subsequent LTPA levels, accounting for between 13% and 30% of the variance in LTPA scores at the various study intervals. The results of the study demonstrated that self-efficacy represents an important social cognitive process that leads to regular LTPA in the postnatal period. Outcome expectations did not explain additional variance beyond self-efficacy. These findings provide direction for future study and have implications for the development of interventions.

Introduction

Research has demonstrated that engaging in regular physical activity following pregnancy is associated with health benefits such as retaining less pregnancy-associated weight gain (Boardley, Sargent, Coker, Hussey, & Sharpe, 1995; Lovelady, Nommsen-Rivers, McCrory, & Dewey, 1995; Rooney & Schauberger, 2002; Sampselle, Seng, Yeo, Killion, & Oakley, 1999), preventing lactation-associated bone loss (Larson-Meyer, 2002), lower levels of anxiety and distress, fewer symptoms of depression (Barclay, Everitt, Rogan, Schmied, & Wyllie, 1997; Koltyn & Schultzes, 1997), and improved body image perceptions (Clapp, 1998). To achieve these benefits, the American College of Obstetricians and Gynecologists (ACOG, 2002) and the American College of Sports Medicine (Haskell, Lee, Pate, Powell, Blair, Franklin, et al., 2007) recommend that postnatal women engage in 30 minutes of moderate intensity exercise on at least 5 days per week.

Despite widespread acknowledgement of these benefits, studies have demonstrated that following childbirth, women are at high risk for physical inactivity and generally show lower levels of leisure-time physical activity (LTPA) compared to prepregnancy (Bellow-Riecken & Rhodes, 2007). Empirical estimates suggest that approximately two thirds of postnatal women do not meet the current exercise recommendations (Albright, Maddock & Nigg, 2005; Brown, Brown, Miller, & Hansen, 2001; Sampselle et al., 1999). For example, Sampselle and colleagues investigated LTPA among a sample of 1003 postnatal women and found that nearly 65% of the sample reported engaging in fewer than 3 bouts of LTPA per week. Another study, which

examined LTPA among 543 mothers in Australia, demonstrated that one quarter of the sample reported no time spent in active leisure, while an additional 41% of women reported engaged in less than 150 minutes (i.e., < the equivalent of 5, 30 minute bouts) of LTPA per week (Brown et al., 2001). However, results from Study 1 demonstrated that LTPA increased following pregnancy. While these results are promising, one limitation is that the study relied on 12-month retrospectively recalled LTPA data. Therefore, the issues surrounding exercise initiation and maintenance warrant further investigation.

Research on exercise initiation and maintenance in the general population has focused on identifying correlates of LTPA. Demographic factors represent one category of potential correlates that have been shown to be positively associated with LTPA during the postnatal period. Such demographic correlates include: greater income (Grace, Williams, Stewart, Franche, 2006; Wilkenson, Huang, Walker, Sterling, & Kim, 2004), less pregnancy weight retention (Periera, Rifas-Shiman, Kleinman, Rich-Edwards, Peterson, & Gilman, 2007; Sempselle et al., 1999), not working (Periera et al.; Sempselle et al.), lower BMI (Grace et al.), and ethnicity (Boardly et al., 1995). While an understanding of demographic correlates of LTPA is informative and may identify segments of the population that may be at higher risk for inactivity, little research attention has been aimed at psychological or behavioural correlates of LTPA. This lack of research is surprising given that psychosocial variables represent modifiable factors that can be targeted in interventions.

The overall purpose of the current study was to investigate social cognitive correlates of LTPA during the first 6-months following birth. Three specific objectives

are outlined. The first objective was to investigate women's perceived barriers to LTPA during the postnatal period. Barriers to LTPA are among the most frequently cited correlates of physical activity (Sallis & Hovel, 1990; Sallis & Owen, 1999), yet few studies have examined this construct among postnatal women (Bellows-Riechen & Rhodes, 2008). Moreover, among the studies that have examined barriers to LTPA, several methodological limitations exist. For example, previous studies have often relied on scales developed from the broader literature on physical activity barriers in the general population, rather than assessing barriers that are salient within the specific population under study (Cody & Lee, 1999; Cramp & Brawley, 2006; Fahrenwald, Atwood, Walker, Johnson, & Berg, 2004; Miller, Trost & Brown, 2002; Verhoef & Love, 1992). Such an approach may fail to capture unique barriers experienced by postnatal women. Another limitation is that many studies fail to report time since birth when barriers were experienced (Brown et al., 2001; Cody & Lee, 1999; Currie & Devlin, 2004), or they include data from participants whose time since birth varied substantially (e.g., 6 days to 5 month postnatal; Symons Downs & Hausenblas, 2004). These approaches may be problematic given that the postnatal period is characterized by many physical, social, psychological, and behavioural adaptations and it is conceivable that barriers may change in the initial months compared to 6 months following birth. Accordingly, in the present study, we examined mothers' perceived barriers to LTPA at multiple time points during the first 6 months following the birth of their children.

One further limitation of the current literature on barriers to LTPA following childbirth is that it has been primarily descriptive in nature, focusing only on the

reporting of different barriers. Although gaining an understanding of what barriers exist is important, research on how coping with barriers and other psychosocial factors are perceived by postnatal women may afford valuable insight into ways of promoting LTPA participation. Thus, the second objective of the current study was to examine relationships between social cognitions and LTPA among postnatal women. Specifically, self-efficacy, defined as a person's "belief about their capabilities to exercise control over events that affect their lives" (Bandura, 1989, p1175), was examined. According to Bandura's social cognitive theory (SCT; 1997), self-efficacy represents an important construct of behaviour change, and within the physical activity domain, studies have consistently identified self-efficacy as a strong correlate of adherence to physical activity (Bandura, 1986, 1997; Dawson & Brawley, 2000; Dawson, Brawley, & Maddux, 2000; DuCharme & Brawley, 1995). It was predicted that self-efficacy would predict LTPA.

While self-efficacy has gained considerable research attention in the physical activity literature, outcome expectations represent an additional construct considered central to the social cognitive perspective (Bandura 1986; Maddux, 1995; Williams, Anderson & Winett, 2005). Outcome expectations represent one's beliefs that engaging in a particular behaviour will lead to specific outcomes (Maddux) and are said to work in concert with self-efficacy as primary motivators of behaviour (Bandura, 1997). According to SCT, without meaningful expected outcomes, behaviour is unlikely to persist or change regardless of one's self-efficacy (Maddux). For example, when people do not expect they will attain beneficial outcomes as a result of engaging in 30 minutes of

exercise five times per week, they may have little motivation to exercise even if they have strong self-efficacy for performing the exercise behaviour.

Despite having a central role in SCT, a review by Williams and colleagues (2005) noted that outcome expectations represent a largely understudied SCT construct in physical activity research. Ultimately, this lack of focus on outcome expectations limits our ability to fully understand how social cognitions operate in changing or maintaining LTPA. To date, Symons Downs and Hausenblas (2004) have conducted the only theory-based study to examine behavioural beliefs among postnatal women, which they defined as an individual's perceived consequences associated with engaging in LTPA (a similar construct to SCT's outcome expectations). In that study, women who were on average 3 months postnatal, reported that perceived outcomes associated with engaging in LTPA included controlling weight, staying fit, and improving mood. While these findings represent an initial step towards understanding outcome expectations, additional research is needed to examine different forms of outcomes (e.g., physical, psychological, and social; Bandura, 2002) at specific times (e.g., 12 weeks postnatal versus 30 weeks postnatal). Previous research has found that people's outcome expectations can vary depending on the time and situation (Ajzen, 1991; Carron, Hausenblas & Estabrooks, 2003).

Given the lack of evidence regarding physical activity-related outcome expectations and the opportunity to extend the work by Symons Downs and Hausenblas (2004), the third objective of the study was to investigate postnatal women's perceived

LTPA outcome expectations through the use of descriptive evidence regarding physical, psychological, and social outcomes that were expected from participation in LTPA.

The final objective of the present study was to examine outcome expectations as predictors of LTPA behaviour among postnatal women. Furthermore, following Bandura's (1997) theorizing, it was hypothesized that outcome expectations would account for additional variation in LTPA beyond that accounted for by self-efficacy.

Method

Participants

Women, between 12 and 30 weeks postnatal, were recruited through a variety of prenatal programs offered by four different regional public health units. The populations served by the individual health units ranged from 150,000 to just over 400,000. Study brochures were distributed by nurses to participants attending the programs. Attendance lists were not available for all the various postnatal programs in which women received the study information, thus it is unknown how many women actually received the study information.

Study Design and Procedure

Prior to commencing the study, approval was obtained by the institutional review board. The study design included four data collection time points: postnatal week 12 (T1), 18 (T2), 24 (T3), and 30 (T4). Data were collected at 6-week intervals to minimize participant burden while still obtaining frequent assessments of the study variables. The procedure was as follows. After receiving an initial invitation to participate in the study, interested women contacted the researcher (via email or telephone) or visited the study

website. Participants had the option of signing up for the study and completing the study measures online (via secured access) or over the telephone. Despite having both options, all participants utilized the online study procedures. To sign up for the study, participants had to first read the informed consent letter. The following statement was printed at the bottom of the consent letter: "By setting up a username and password you are consenting to participate in the study". Participants then had the option of setting up a username and password. Next, participants who set up a username and password were asked to enter their baby's date of birth. This information was used to determine how many weeks postnatal the participant was. Using this information, the system generated a personal profile for each participant. Participants were then automatically directed back to the study homepage and prompted to access their personal profile by logging into the secured end of the website using their username and password. Upon access of the personal profile, participants were prompted to complete a demographic questionnaire. In addition, each participant's personal profile displayed a schedule which outlined the dates for completion of the four data collection time points. This schedule was generated based on their baby's date of birth. Measures of barrier and exercise self-efficacy as well as outcome expectations and LTPA were collected at each measurement occasion. Participants could only complete measurements for periods that coincided with their postnatal stage. For example, if a participant entered the study during her 20th week postnatal, she would only be eligible to complete T3 (week 24 postnatal) and T4 (week 30 postnatal) measures. When participants entered a data collection period, they were contacted by the principal investigator via email prompt and asked to complete the study

measures. The email included a link to the study homepage, from which participants could access their personal profile and complete the study questionnaires. Participants had 7 days to complete the study measures before the system would time out and not allow them further access to the questionnaires. This restriction aimed to ensure that data acquired were linked to perceptions and behaviours in each measurement window.

Measures

Demographic information. The demographic questionnaire was developed specifically for the current study and inquired about variables such as participant age, education, marital status, employment, ethnicity, income, and number of children.

Barrier self-efficacy. Barriers to physical activity, defined as "anything that may stop you from doing LTPA", were measured using a questionnaire that consisted of both open- and close-ended questions (cf. Gyurcsik, Bray, & Britton, 2004). The questionnaire instructions were as follows. First, participants were asked to list up to 4 barriers to LTPA that they believed were likely to arise over the next 6 weeks. These lists of barriers were collated at each time point and subjected to content analysis. After listing each barrier, participants were asked to rate their confidence to cope with the barrier should it arise in the next 6 weeks. Efficacy was rated using an 11-point scale ranging from 0 (absolutely not confident) to 100 (absolutely confident) percent, increasing in 10 percentage point increments. Scores for each participant's response set were summed and an average was calculated to represent their overall strength of barrier self-efficacy. The average interclass correlation values for the scales were high at each time-point (i.e., .85,

.86, .80, and .85 for T1, T2, T3, and T4, respectively), indicating a moderately high degree of within-subject consistency and between-subject variability.

Exercise self-efficacy. Exercise self-efficacy was measured using a scale that was created based on recommendations by Bandura (1997), and McAuley and Mihalko (1998). The 5-item exercise self-efficacy subscale assessed participants' degree of confidence in their ability to complete 30+ minutes of moderate intensity aerobic activity once, twice, etc., up to five times per week in the subsequent 6 weeks. Participants indicated their efficacy using a scale ranging from 0 percent to 100 percent, increasing in 10 point increments. A score of 0 percent indicated that the participant was "absolutely not confident" whereas a score of 100 percent indicated that the participant was "absolutely confident". An overall mean exercise self-efficacy value was calculated for each participant and used in the analyses. At T1, T2, T3, and T4, the internal consistency values for the scale were $\alpha = .93$, $\alpha = .94$, $\alpha = .93$, $\alpha = .93$, respectively.

Outcome expectations. Following recommendations by Williams et al. (2005) and procedures used previously by Dawson and colleagues (2001), outcome expectations for LTPA were assessed using a combination of open- and close- ended questions. For example participants were asked to list up to 6 outcome expectations (2 physical, 2 psychological, and 2 social). A definition and example of each was provided. For each outcome listed, participants were asked to rate the likelihood of achieving this outcome if they engaged in regular LTPA over the next 6 weeks. Likelihood was assessed on a 9-point Likert-type scale, where 1 represented "very unlikely and 9 represented "very likely". Next, participants rated each outcome in terms of value (i.e., the value that the

participant places on achieving the outcome) using a 9-point Likert-type scale (1 = "little value to me" to 9 = "very great value to me"). An overall outcome expectation score for each of the three domains (e.g., physical, psychological, and social) was calculated based on the procedures described by Dawson and colleagues. First, the 2 likelihood estimates were summed, then the two value estimates were summed. The composite likelihood and outcome expectation value score was then calculated by multiplying these two summed variables. The use of a composite score has been advocated in the literature because the likelihood of an outcome occurring does not include motivational properties (Dawson, Gyurcsik, Culos-Reed, & Brawley, 2001; Rodgers & Brawley, 1991; Williams et al., 2005). According to SCT, behaviour is motivated by the value a person places on expected outcomes. Thus, a measure that taps both likelihood and value properties is expected to predict LTPA better than a measure that only taps one's perceived likelihood of an outcome occurring.

LTPA. The current investigation was only concerned with measuring LTPA with a minimum energy requirement of 3.0 metabolic equivalents (i.e., moderate intensity exercise) or greater, as these intensities are those encouraged by the ACOG (ACOG, 2002) for postnatal women and the American College of Sports Medicine (Haskell et al., 2007) for healthy adults.

The Modifiable Activity Questionnaire (MAQ; Kriska, Knowler, LaPorte, Drash, Wing, Blair et al., 1990) was used to measure participants' current moderate to vigorous LTPA (e.g., in the past 6 weeks). To complete the MAQ, participants selected from a list of 40 common moderate intensity physical activities (e.g., aerobics, brisk walking,

bicycling) the activities they had engaged in during the past 6 weeks. Next, for each activity selected from the list, participants estimated the average frequency per week they spent doing the activity for each of the previous 6 weeks. For example, if a participant selected walking briskly from the list, they indicated the number of times they performed the behaviour last week, two weeks ago, and continuing up to 6 weeks ago. Participants were also asked to indicate the average number of minutes they spent doing the activity per session. A working copy of the MAQ is presented in Kriska and Casperson (1997, pp. S79-S82). The MAQ has been shown to be both reliable and valid in studies using doubly-labeled water and accelerometers (Aaron, Kriska, Dearwater, Anderson, Olsen, Cauley et al., 1993; Aaron, Kriska, Dearwater, Cauley, Metz, & LaPorte, 1995; Kriska et al., 1990; Schulz, Harper, Smith, Kriska, & Ravussin, 1994).

In order to approximate the amount of energy expenditure across the various activities, each activity's metabolic equivalent (Ainsworth, 2000) was multiplied by the habitual time (i.e., frequency x duration) engaged in that activity. These values were then totaled across all activities and expressed in MET-hrs/week. This generated a score for each of the previous 6 weeks that represented participants' total MET hours of LTPA. The mean of these 6 values was computed as a measure of participants' average LTPA in the preceding 6 weeks (average MET-hrs/week).

Analytic Strategy

Data obtained from the open-ended barriers and outcome expectations questionnaire were grouped into major categories by 2 independent researchers. The researchers discussed all barriers and outcome expectations that were not commonly

grouped until agreement was reached. A frequency analysis was conducted on the categories of open-ended responses by data collection period.

Next, three prediction periods were established using data provided from the four data collection periods: T1 social cognitions (i.e., exercise efficacy, barrier efficacy, and outcome expectations) were used to predict T2 LTPA, T2 social cognitions were used to predict T3 LTPA, and T3 social cognitions were used to predict T4 LTPA. Pearson correlations were used to examine the associations among demographic factors, social cognitions, and LTPA and to test for multicollinearity. Only those variables significantly correlated with LTPA were used in the subsequent regression analysis. Finally, 3 hierarchical regression analyses were conducted (e.g., one for each prediction period) to examine exercise and barrier self-efficacy as well as outcome expectations as predictors of LTPA behaviour among postnatal women. The order of entry into the hierarchical regression model was based on SCT and past research demonstrating that exercise efficacy is a more proximal predictor of behaviour compared to barrier efficacy (Gyurcsik et al., 2004). Accordingly, exercise self-efficacy was entered into the first block, followed by barrier self-efficacy in the second block. Outcome expectations were subsequently entered into the final block of the regression. This block included the average of the two likelihood and two value scores for each of the physical, psychological and social dimensions as well as the interaction terms. (cf. Dawson et al., 2001). Outcome expectations were entered following self-efficacy to test the hypothesis that outcome expectations would account for additional variance beyond self-efficacy, a

research recommendation made in a recent review of outcome expectations (Williams et al., 2005).

Results

Participants

A total of 243 pregnant women enrolled in the study and provided data for at least one of the four data collection periods. Thirteen cases were removed from the analysis because they failed to provide complete physical activity or demographic information, thus 230 women participated in the study. Participant flow through each of the four data collection time points depended on attrition and when women signed up for the study (e.g., if a participant signed up in her 22nd week postnatal, she was only eligible to complete T3 and T4). Consequently, there were a total of 16 possible data collection combinations (see Appendix D.5). The total number of participants providing data for each time point is displayed in Table 1 along with participant demographic characteristics. Multivariate analysis of variance (MANOVA) revealed that there were no significant differences between participants who provided data at one, two, three, or four data collection time points for the demographic variables. Overall, a large percentage of participants were married (98.6%), white (91.0%), and had completed some post-secondary education (83.8%). Most women reported working either part time or full time when not on maternity leave (67.5%) and having a family income of greater than $80,000 per year (53.4%). Just over one third of the sample (e.g., 38.3%) were first time mothers.

Types of Barriers

The open-ended barriers elicitation procedure resulted in the generation of 1520 barriers: 355 barriers at T1, 386 barriers at T2, 373 barriers at T3, and 406 barriers at T4. On average, participants listed 3.1 barriers for each data collection period completed.

Barriers listed by participants were content analyzed by two independent researchers resulting in 9 different barrier categories with a high degree of between-rater agreement (Kappa = .78; Landis & Koch, 1977). The most commonly reported barriers to LTPA included being too tired, having a lack of time to exercise, and childcare duties. At T1, these 3 barrier categories accounted for 72.5% of all the barriers reported. At T2, T3, and T4, respectively, they accounted for 67.8%, 77.8%, and 66.4% of all barriers reported. Based on the relative frequency, the major types of barriers reported were consistent across the four measurement periods.

Types of Outcome Expectations.

The open-ended OE elicitation procedure resulted in the generation of 2472 exercise outcome expectations. At T1 participants listed 573 outcome expectations: 214 of the outcome expectations listed were physical, 199 were psychological, and 160 were social. At T2, participants listed 606 outcome expectations, of which 229 were related to physical outcome expectations, while 210 were related to psychological and 176 were related to social outcome expectations. At T3, participants listed 627 outcome expectations: 232 of the outcome expectations listed were physical, 222 were psychological and 234 were social. At T4, participants listed 666 outcome expectations: 244 were listed as physical, while 234 and 188 were identified as psychological and social outcome expectations.

On average participants listed 5 out of a possible 6 outcome expectations across each data collection period completed. Each outcome expectation category (e.g., physical, psychological, social) was content analyzed by two independent researchers.

The designation of outcome expectations to categories yielded a high degree of between-rater agreement (Kappa = .78; Landis & Koch, 1977). The most commonly reported physical outcome expectations were improved fitness (e.g., have more endurance, gain muscle), weight loss, increased energy, and appearance-related expectations (e.g., improved appearance, look better). At each of the four measurement periods, those 4 outcome expectations accounted for over 90% of all the physical outcome expectations reported. Other outcome expectations less frequently reported included decreased pain, weight maintenance, and general physical health outcomes (e.g., be healthier and reduced risk of disease). The most commonly reported psychological outcome expectations were decreased stress and anxiety, improved mood, more confidence, and increased energy. Similar to physical outcome expectations, these 4 outcome expectations accounted for over 90% of all the outcome expectations reported at each of the four measurement periods. The most commonly reported social outcome expectations were meet new people, spend time with friends, spend time with family, and in general, be more social (e.g., "be more social", or "socialize with others"). At T1, these 4 outcome expectations accounted for 79% of all the social outcome expectations reported. At T2, T3, and T4, respectively, they accounted for 86%, 78%, and 83% all social outcome expectations reported. Other outcome expectations less commonly reported included social acceptance, and companion support. Based on the patterns of relative frequency, outcome expectations were consistent across the four measurement periods.

Predicting LTPA

At each time point, the 6-week LTPA recall data were positively skewed (i.e., skewness > .89; Tabachnick & Fidell, 2007). Because the data were positively skewed, a square root transformation was performed as recommended by Tabachnick and Fidell.

To examine the relationship between social cognitions and LTPA, correlation analyses were conducted for each prediction period (see Table 4). Exercise and barrier self-efficacy were significantly ($p < .05$) correlated with each other at each prediction period, however all r values were <.90, indicating that multicollinearity was not a concern for the multiple regression analyses (cf. Tabachnick & Fidell, 2007). Furthermore, both efficacy measures were significantly correlated with LTPA at each prediction period ($p < .05$). Physical and social outcome expectations were correlated with LTPA in the final prediction period only (e.g., T3 social cognitions predicting T4 LTPA). Given that the number of observations were close to the minimum number recommended for multiple regression using Green's (1991) formula of 50 + 8(m), where m = the number of predictors in the regression equation, only the variables significantly correlated with LTPA were included in the regression analysis.

To examine exercise and barrier self-efficacy and outcome expectations as predictors of LTPA behaviour among postnatal women, 3 hierarchical regression analyses were conducted. In the first hierarchical analysis, T1-T2 LTPA was regressed on T1 exercise self-efficacy, followed by T1 barrier self-efficacy. The overall model was significant, $F(1, 61) = 6.48$, $p = .003$, with exercise self-efficacy and barrier self-efficacy explaining 18% of the variance in LTPA ($R^2 = 0.18$). Based on the standardized beta

weights and the associated significance levels, it is evident that exercise self-efficacy (R^2 = .18, β = .40 t = 2.78, p = .007) was the only significant predictor in the model.

In the second hierarchical analysis, T2-T3 LTPA was regressed on T2 exercise self-efficacy followed by T2 barrier self-efficacy. The overall model was significant, $F(1, 70) = 5.18$, p = .008, with exercise and barrier self-efficacy explaining 13% of the variance in LTPA (R^2 = 0.13). Based on the standardized beta weights and the associated significance levels, only barrier self-efficacy (R^2 change =.06, β = .33, t = 2.17, p = .03) emerged as a significant predictor in the model.

In the third hierarchical analysis, T3-T4 LTPA was regressed on T3 exercise self-efficacy, followed by T3 barrier self-efficacy and then by T3 physical and social outcome expectations. The overall model was significant, $F(1, 79) = 5.06$, $p < .001$, with the predictors explaining 37% of the variance in LTPA (R^2 = 0.37). Based on the standardized beta weight and the associated significance levels exercise self-efficacy (R^2 = .30, β = .61, t = 3.16, $p < .001$) was the only significant predictor in the model.

Discussion

The purpose of the present study was to investigate women's perceived LTPA barriers and outcome expectations following childbirth. In addition, social cognitive correlates of women's LTPA during the first six months following their giving birth to a child were examined. Postnatal women identified a host of potential barriers to LTPA as well as numerous physical, psychological, and social outcome expectations. As hypothesized, social cognitions representing self-efficacy to exercise and to overcome LTPA barriers were predictors of subsequent LTPA.

Participants engaged in the listing of LTPA barriers and outcome expectations at four time points following birth (i.e., weeks 12, 18, 24, and 30). In general, the barriers reported were consistent with barriers experienced by both asymptomatic and symptomatic populations (e.g., lack of time, being tired, and weather) (Blanchard, Reid, Morrin, Beaton, Pipe, Courneya et al., 2007; Courneya, McKenzie, & Reid, 2008; Gyurcsik, Spink, Bray, Chad, & Kwan, 2006), as well as previous research examining barriers to exercise among postnatal women (Symons Downs & Hausenblas, 2004). These findings reinforce previous research and build on the current evidence base by actively engaging new mothers in identifying barriers at sequential time points in the postnatal period. The top three barriers listed included being tired, lack of time, and lack of childcare. The frequency of reported barriers across each data collection period appeared to remain stable, indicating that perceived barriers did not change from 12 to 30 weeks postnatal. The stability in the relative frequency of barriers is also interesting to interpret in light of the flow of participants through the study. That is, if the same cohort had reported their barriers throughout the study, it might be expected that barriers would exhibit consistency owing to a common participant pool. However, the method of sampling involving a combined representation of same and different respondents throughout the postnatal assessment windows helps illustrate a more generalizable pattern of barriers that arise in the first postnatal year.

The listing of outcome expectations at multiple time points in the postnatal period in the current study is also a novel characteristic of the study that contributes to current knowledge. To the best of my knowledge, Symons Downs and Hausenblas (2004) have

conducted the only theory-based study to examine outcome expectations among postnatal women. Similar to the present study, participants reported behavioural beliefs (e.g., outcome expectations) using an open ended methodology. While the current study used a similar methodology to that used by Symons Downs & Hausenblas, the present study extends their work in two main ways. First, women's outcome expectations were compared across time. Second, women were asked to list physical, psychological and social outcome expectations versus asking for an open ended list with no categorization structure provided. According to SCT, health behaviours (e.g., exercise initiation and maintenance) are affected by outcomes that can take several forms (e.g. physical, psychological, and social; Bandura, 2002). Women in Symons Downs & Hausenblas' study primarily listed physical outcomes (e.g., control weight, stay fit).

The results of the open-ended outcome elicitation generated a large number of physical, psychological, and social outcome expectations. Approximately 90% of all outcome expectations listed under each category were classified into four groups. Major physical outcome expectations included improved fitness and weight loss, while major psychological outcome expectations included improved mood and confidence. "Meeting new people" and "generally being more social" were two major social outcome expectations listed. Similar to barriers, the frequency of reported outcome expectations across each data collection period appeared to remain stable, indicating that key outcome expectations do not change from 12 to 30-weeks postnatal. The combined findings that barriers and outcome expectations remain stable suggest that interventions designed to

target these two variables might effectively incorporate similar strategies among women within 12 – 30 weeks postnatal.

Another purpose of the present study was to examine exercise and barrier self-efficacy along with outcome expectations as predictors of LTPA behaviour among postnatal women. In support of our hypothesis and consistent with SCT, self-efficacy was significantly associated with LTPA. It appears that both generalized (e.g., exercise self-efficacy) and specific forms of self-efficacy (e.g., barrier efficacy) predict LTPA. That is, persons with higher levels of self-efficacy are more likely to engage in LTPA. However, in the first and third prediction periods, exercise self-efficacy exerted the strongest effect on LTPA. When exercise self-efficacy was controlled for, no other predictors in the model were significant. In the second regression analysis, barrier efficacy exerted the strongest effect on LTPA. This pattern of results is similar to Study 2. It is plausible that barrier efficacy came into stronger play in the second analyses because women were facing new or heightened barriers. For example, a postnatal woman is highly efficacious in her ability to engage in the necessary motor tasks associated with LTPA. However, she is not confident in her ability to overcome childcare barriers. In the event that she does not encounter any childcare barriers, a general measure of self-efficacy would be a good predictor. However, should childcare barriers arise, the generalized measure of self-efficacy may not effectively predict LTPA; while barrier self-efficacy would prevail.

In response to a recent review by Williams and colleagues (2005), the current study also examined outcome expectations as predictors of LTPA behaviour among postnatal women. Contrary to our hypothesis, the results demonstrated that outcome

expectations explained no additional variance beyond exercise self-efficacy. One possible explanation for these results relates to behaviour initiation versus behaviour maintenance. According to Schwarzer and Fuchs (1995), outcome expectations are important determinants in the initiation phase of behaviour but are less important in the maintenance phase. Rothman, Baldwin and Hertel (2004) also suggest that outcome expectations may change or take on different meanings for people who are maintaining behaviours vs. initiating them. No distinction was made between exercise initiates and maintainers in the present study. In addition, it is plausible that the open-ended questionnaire assessing outcome expectations limited the findings. While the listing of outcome expectations provides significant descriptive information, women primarily listed positive outcomes and thus no negative outcomes were assessed. According to Schwarzer and Fuchs (1995), a variety of outcome expectations should be assessed, including both positive and negative ones.

Although the present study contributes to the existing body of literature examining exercise during the postnatal period, several limitations are worth noting. Despite recruiting participants across a large geographic area and through multiple public health units, the sample was primarily comprised of white, married, educated, middle to upper-middle class women. Thus, the results are limited in terms of its generalizability to lower socioeconomic, ethnically diverse populations and women who are not motivated to partake in a study of postnatal physical activity. Future studies of this nature should attempt to recruit a more diverse sample of participants.

In addition, the current study only measured physical activity participation that was carried out in one's leisure-time and did not include an assessment of occupational or household physical activity. Thus, the results cannot be generalized to overall levels of physical activity or energy expenditure. Furthermore, LTPA was self-reported. Although the reliability and validity of the MAQ has been tested in a variety of populations (Aaron et al., 1993; Aaron et al., 1995; Kriska et al., 1990; Schulz et al., 1994), self-report measures may be subject to recall errors and other biases such as social desirability. Future research would benefit from measuring LTPA as well as other forms of physical activity using objective assessment tools (e.g., accelerometers).

For many women, engaging in regular LTPA following the birth of a child is a challenge. The present study identifies a number of salient outcome expectations that could potentially undermine motivational factors to engage in LTPA, as well as barriers to LTPA, which may hinder the initiation and maintenance of regular LTPA. The results suggest that self-efficacy represents an important social cognition that is linked to higher levels of LTPA in the postnatal period.

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Table 1

Participant Demographic Characteristics

Variable	T1 M(SD) % (n=114)	T2 M(SD) % (n=120)	T3 M(SD) % (n=97)	T4 M(SD) % (n=129)	Average M(SD) % (n=230)
Age	30.8(4.3) -	30.9(3.9) -	30.9(4.0)) -	31.0(3.9) -	30.9(3.9)
Married/Common law	89.2	90.8	90.7	93.1	98.6
White	94.6	96.5	95.8	96.1	91.0
College/University	84.6	86.6	82.2	81.7	83.8
Nulliparas[a]	55.3	59.2	65.1	67.2	61.7
Paras ≥ 1[b]	44.7	40.8	34.9	32.8	38.3
Work Part/Full time	69.3	68.3	64.3	68.0	67.5
Income > 80,000/year	53.5	53.3	51.9	55.0	53.4

[a] Nulliparas refers to first time pregnant women, no other children at home
[b] Paras ≥ 1 refers to women with at least one child at home.

Table 2

Percentage of Reported Barriers

Barriers	T1 (n=114)	T2 (n=120)	T3 (n=129)	T4 (n=131)
Being tired (e.g., lack of sleep, no energy, tiredness)	23.6(86)	26.2(102)	29.5(96)	22.1(90)
Lack of time (e.g., too busy, social commitments, busy schedule, to much housework)	25.2(92)	19.0(74)	25.5(83)	24.0(98)
Childcare duties (e.g., fussy baby, parenting responsibilities, childcare demands)	23.7(86)	22.6(88)	22.8(74)	20.3(83)
Physical limitations (e.g., illness, flu, aches & pains)	8.5(31)	8.7(34)	9.2(30)	8.1(33)
Weather (e.g., to hot/cold, poor weather)	8.2(30)	8.5(33)	12.3(40)	10.3(42)
Lack of motivation (e.g., feeling unmotivated, no desire, don't feel motivated)	5.0(18)	8.2(32)	6.8(22)	6.7(28)
Lack of support (e.g., no facility, no one to exercise with)	2.2(8)	3.9(15)	4.9(16)	3.4(14)
Work (e.g., long work day, busy at work)	0	1.3(5)	2.5(8)	3.7(15)
Money	3.3(3)	.77(3)	.62(2)	.25(1)
Depression	.2(1)	0	.6(2)	.5(2)

Note. Raw frequencies are reported in brackets.

Table 3

Types of Outcome Expectations

Outcome Expectations	T1 (n=114)	T2 (n=120)	T3 (n=129)	T4 (n=131)
Physical				
Improve fitness	40.65 (87)	44.10 (101)	44.40 (103)	45.49 (111)
Weight loss	35.51 (51)	26.64 (61)	31.03 (72)	28.28 (69)
Increase energy	7.48 (16)	13.54 (31)	12.50 (29)	13.52 (33)
Appearance related	7.94 (17)	5.68 (13)	5.60 (13)	4.92 (12)
Psychological				
Improve mood	34.17 (68)	42.86 (90)	37.84 (84)	35.47(83)
More confidence	27.14 (54)	23.81 (50)	28.83 (64)	22.65 (53)
Decrease stress/anxiety	14.07 (28)	12.38 (26)	9.91 (22)	20.09 (47)
Increase energy	16.58 (33)	12.86 (27)	16.22 (36)	17.95 (42)
Social				
Meet new people	29.38 (47)	37.72 (63)	34.68 (60)	29.79 (56)
Be more social	26.88(43)	23.35 (39)	19.65 (34)	20.74 (39)
Spend time with friends	16.25 (26)	18.56 (31)	17.34 (30)	21.81 (41)
Spend time with family	6.25 (10)	6.59 (11)	6.36 (11)	10.64 (20)

Table 4

Means, Standard Deviations and Correlations between Variables for Concurrent Samples at each Time Point

	M(SD)	1	2	3	4	5
T1 social cognitions predicting T2 LTPA (n=62)						
1. OE physical	134.58(46.04)	-				
2. OE psychological	131.90(51.51)	.77**	-			
3. OE social	83.85(63.05)	.21*	.40**	-		
4. Exercise efficacy	6.40(2.43)	.27**	.17	.14	-	
5. Barrier efficacy	5.13(2.25)	.27**	.21*	.23*	.47**	-
6. T2 LTPA	14.26(11.08)	.08	.02	-.04	.42**	.27*
T2 social cognitions predicting T3 LTPA (n=71)						
1. OE physical	133.52(45.80)	-				
2. OE psychological	129.67(52.52)	.78**				
3. OE social	75.47(60.82)	.35**	.37**			
4. Exercise efficacy	6.33(2.44)	.45**	.34**	.03		
5. Barrier efficacy	5.10(2.32)	.39**	.28**	.14	.62**	
6. T3 LTPA	15.62(10.74)	.01	-.01	-.10	.27*	.36**
T3 social cognitions predicting T4 LTPA (n=80)						
1. OE physical	132.59(49.39)	-				
2. OE psychological	126.46(56.77)	.81**				
3. OE social	69.86(59.86)	.42**	.46**			
4. Exercise efficacy	6.25(2.49)	.35**	.35**	.25**		
5. Barrier efficacy	5.23(2.19)	.50**	.46**	.32**	.72**	
6. T4 LTPA	16.52(12.50)	.22*	.21	.26*	.54**	.44**

Note. OE = outcome expectations; LTPA = leisure-time physical activity. LTPA raw values versus the transformed values used in the regression analysis are presented for ease of interpretation.

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

Table 5

Hierarchical Regression Analyses

Prediction Period 1 (n=62)							
Predictor	R^2	F	p	R^2 Change	p	ß	p
Overall model	.18	6.48	<.01	-	-	-	-
Step 1: Exercise efficacy				.18	.001	.40	.007
Step 2: Barrier efficacy				.001	.21	.05	.74
Prediction Period 2 (n=71)							
Predictor	R^2	F	p	R^2 Change	p	ß	p
Overall model	.13	5.18	>.01	-	-	-	-
Step 1: Exercise efficacy				.07	.02	.05	.71
Step 2: Barrier efficacy				.06	.03	.33	.03
Prediction Period 3 (n=80)							
Predictor	R^2	F	p	R^2 Change	p	ß	p
Overall model	.37	5.06	>.01	-	-	-	-
Step 1: Exercise efficacy				.30	>.001	.61	<.001
Step 2: Barrier efficacy				.01	.57	.03	.87
Step 3: OE Physical Likelihood				.07	.29	.44	.158
OE Physical Value				-	-	.10	.78
OE Physical Interaction				-	-	-.49	.39
OE Social Likelihood				-	-	.15	.51
OE Social Value				-	-	.004	.99
OE Social Interaction				-	-	.038	.91

CHAPTER 5

GENERAL DISCUSSION

General Discussion

Pre and postnatal women are at risk for physical inactivity (Bellow-Riecken & Rhodes, 2007; Evenson, Savitz, & Huston, 2004; Pereira, Rifas-Shiman, Kleinman, Rich-Edwards, Peterson, & Gilman, 2007; Sampselle, Seng, Yeo, Killion, & Oakley, 1999; Zhang & Savitz, 1996). The initiation and maintenance of an inactive lifestyle can have both acute and long-term health implications (Health Canada, 2004; Warburton, Nicol, & Bredin, 2006). Consequently, promoting leisure-time physical activity (LTPA) among pre and postnatal women is a priority. The overall purpose of the current dissertation was to examine pre and postnatal women's LTPA behaviour and to identify theory-based social cognitive correlates of LTPA. For Study 1 participant's recalled their LTPA over the past 12-months. In studies 2 and 3, the same participants reported their LTPA prospectively over the course of the pre and postnatal periods. Collectively, the 3 dissertation studies represent an initial step in advancing the pre and postnatal exercise-related literature by (a) investigating LTPA on a continuum using a reliable and valid measure of LTPA, (b) assessing LTPA behaviour using cross-sectional and prospective research methods and applying advanced statistical methods to analyze the data, (c) identifying participant generated LTPA barriers and outcome expectations, and (d) examining the relationship between social cognitions and LTPA. The dissertation also contributes to the broader literature of social cognitive theory (SCT) applied to physical activity and provides direction for future research.

Contributions to Understanding LTPA

A series of 3 interrelated studies were conducted specifically for the purpose of understanding LTPA behaviour and beliefs during pregnancy and in the postnatal period. The contributions that each of these studies make in understanding LTPA prior to and following pregnancy are discussed. Study 1 represents the only study to date that has examined LTPA on a continuum from prepregnancy to postnatal. Studies to date have only examined changes in physical activity using discrete time period designs (i.e., one measure of physical activity during each period prior to, during, and following pregnancy). Although these studies demonstrate variations in behavior, they fail to capture subtle and possibly important variations in LTPA that may also occur within each discrete phase (e.g., from month to month, rather than simply during pregnancy or during the postnatal period). Therefore, by measuring LTPA continuously it was possible to assess when LTPA changes occurred rather than simply demonstrating how much change occurred from one discrete measurement to the next.

Furthermore, study 1 contributes to the existing body of literature from a data analysis standpoint. Previous studies have examined changes in the group means over time and treated individual variations in behavior (about the mean trends) as error. Multilevel modeling was applied to Study 1 in order to understand the average pattern of LTPA as well as intra-individual variation around the average. By analyzing the data using multilevel modeling, the study was able to examine both the average pattern of LTPA and the intra-individual variation in the trajectory of LTPA.

While Study 1 relied on LTPA being recalled over a 12 month period, Studies 2 and 3 assessed LTPA prospectively at 6 week intervals. These frequent assessments of LTPA during pregnancy and in the postnatal period represent an additional contribution to the literature. The pre and postnatal periods are characterized by frequent physical, psychological and behavioural changes. Thus, assessing LTPA at frequent continuous intervals integrates a theoretical model of change with an appropriate temporal design (cf. Collins, 2006).

Another contribution to the literature is the consistency between the three studies regarding the reporting of LTPA. Even though the recall periods differed substantially (e.g., 6 weeks versus 12 months) and different participants provided information for different periods of time (e.g., 12 months retrospectively and 6 week intervals prospectively), the LTPA data collected from Study 2 and 3 are consistent with the data from the Study 1. As shown in Figure 1, data from Studies 1 and 2 showed that LTPA declines during pregnancy. Furthermore, Study 1 and Study 3 demonstrated that LTPA increased following pregnancy.

These consistent findings may be attributed to the use of a valid and reliable measurement tool. The MAQ has been shown to be both reliable and valid in studies using doubly-labeled water and accelerometers (Aaron, Kriska, Dearwater, Anderson, Olsen, Cauley et al.,1993; Aaron, Kriska, Dearwater, Cauley, Metz, & LaPorte, 1995; Kriska, Knowler, LaPorte, Drash, Wing, Blair et al., 1990; Schulz, Haper, Smith, Kristka, & Ravussin, 1994), and it has been widely used in a number of populations including pregnant women (Bauer, 2006). Previous research examining pre and postnatal LTPA has

been criticized for not using reliable and valid measure of LTPA (Poudevigne & O'Connor, 2006). Therefore, the use of the MAQ represents an additional contribution to the literature. However, it is important to note that the measure of physical activity used in each of the 3 studies concerned physical activity participation that was carried out in one's leisure-time and did not include assessment of occupational or household physical activity.

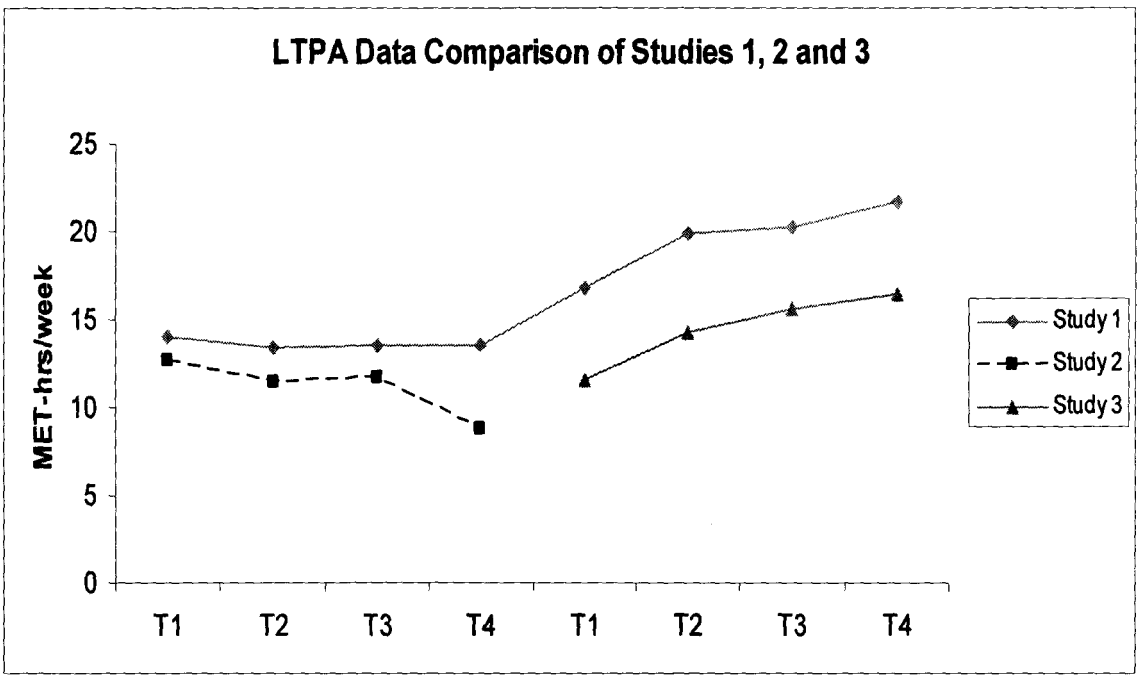

Figure 1. LTPA data comparison of Studies 1, 2 and 3

Contributions to Understanding LTPA Barriers during Pregnancy and in the Postnatal Period

While each of the three studies focused on describing LTPA behaviour, Study 2 and Study 3 also identified barriers to LTPA. Previous research has been limited to the

assessment of investigator-developed lists of barriers (Duncombe, Wertheim, Skouteris, Paxton, & Kelly, 2007; Pereira et al., 2007). As a result, salient and influential barriers might have been missed (e.g., physical limitations, childcare). In both Studies 2 and 3, women actively engaged in identifying salient barriers to LTPA at different time points during their pregnancy and in the postnatal period. In both studies, 9 categories of barriers were identified (e.g., being tired, lack of time and physical limitations). Therefore, the findings from the open-ended barriers elicitation in Study 2 and Study 3 make a significant contributes to a sparse body of previous research examining barriers to LTPA during pregnancy. In addition, the findings may be useful for developing pre and postnatal specific LTPA barrier measures, such as self-efficacy.

Furthermore, the measurement of barriers at multiple time points makes a significant contribution to previous research that extends beyond simply identifying barriers. Given that pregnancy and the postnatal period is characterized by many changes, it is important to consider measuring barriers over time as these changes occur. The results from the frequency analysis indicated that barriers experienced early in pregnancy differ in some ways from those experienced later in pregnancy, and that barriers remain relatively stable during the postnatal period. In summary, the results provide clear evidence of salient barriers at various time points during pregnancy and in the postnatal period that could not otherwise be determined by a single assessment of barriers.

Contributions to Understanding Perceived LTPA Outcome Expectations during the Postnatal Period

To date, there is a lack of empirical evidence examining outcome expectations in physical activity research which limits our ability to fully understand how this constructs operates in changing physical activity (Williams, Anderson, & Winett, 2005). In response to Williams and colleagues recent recommendations, Study 3 examined outcome expectations for descriptive and predictive purposes. Although outcome expectations did not explain significant variance beyond self-efficacy in the regression analyses, the descriptive results make several contributions to the current body of literature.

Symons Downs and Hausenblas (2004) have conducted the only theory-based study to examine perceived outcomes associated with engaging in LTPA among postnatal women. The results of Study 3 are consistent with the findings from Symons Downs and Hausenblas. For example, major reasons for engaging in LTPA included controlling weight, staying fit and improving mood. However, the current extends their work in two main ways. First, postnatal women actively engaging in identifying LTPA outcome expectations at 4 different time points. By assessing outcome expectations at four different time points, we were able to compare women's outcome expectations across time and determine if outcome expectations changed from week 12 postnatal to week 30. Second, the current study specifically set out to examine different forms of outcome expectations. According to SCT, health behaviours (e.g., exercise initiation and maintenance) are affected by outcomes that can take several forms (e.g. physical,

psychological and social; Bandura, 2002). Thus, participants were asked to list physical, psychological and social outcome expectations rather than asking for an open ended list with no categorization structure provided. In summary, the descriptive analysis of outcome expectations undertaken in Study 3 is the first of its kind in the postnatal exercise literature and provides a significant contribution by identifying salient LTPA outcome expectations.

Contributions to Understanding Leisure-time Physical Activity Determinants

Given that non-adherence to exercise is problematic for both pre and postnatal women, identifying potential determinants of LTPA is an important research objective. Bandura's (1986, 2004) SCT is a useful theoretical framework for identifying determinants of LTPA. Consistent with SCT, the results from Studies 2 and 3 indicated that participants who reported greater exercise and barrier self-efficacy engaged in greater amounts of LTPA. Previous pre and postnatal LTPA research has focused on identifying demographic correlates of physical activity, that are not amenable to change. Exercise and barrier self-efficacy on the other hand, represent individual level factors that may be more easily modified and can be targeted for change in interventions.

Interestingly, outcome expectations did not emerge as a significant predictor of LTPA in Study 3. Failure to demonstrate that outcome expectations predicted significant variance beyond self-efficacy is consistent with investigations in other younger adult samples (Pavone, Burnett, La Perriere, & Perna, 1998; Steptoe, Rink, & Kerry, 2000). However, these findings contradict the results from studies in older adult samples (Conn,

1997; Resnick, 2001; Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2000), which may be due to a variety of factors as outlined in the discussion of Study 3.

Contributions to Advancing Psychosocial Theory

The results from Studies 2 and 3 support Bandura's (1997, 2004) assertions regarding self-efficacy theory at two levels. First, these studies offer support that self-efficacy is an important construct in understanding LTPA behaviour. The results from Studies 2 and 3 demonstrated that self-efficacy has a moderate to strong prospective association with LTPA.

Second, these studies address Bandura's advice regarding specificity of self-efficacy assessment. Bandura (1986, 1995) noted that the assessment of self-efficacy needs to correspond with the critical tasks involved in carrying out the behaviour in question. Despite the importance of assessing self-efficacy for the critical tasks involved in LTPA participation, a majority of studies have relied on omnibus measures such as McAuley's (1993) "exercise self-efficacy" (e.g., how confident are you that you can engage in 30 minutes of LTPA once a week, versus two times per week, three times per week, etc.). One explanation for the extensive use of omnibus or more generalized measures of self-efficacy is its predictive ability (Bandura, 1997). For example, in Studies 2 and 3, 4 of the 6 regression models, exercise self-efficacy exhibited the strongest relationship with LTPA and, when controlled for, exercise self-efficacy had attenuating effects on the relationship between barrier self-efficacy and LTPA. This is consistent with a view that one's general perception of self-efficacy is contingent upon one's efficacy in a variety of sub-domains such as task (confidence to perform the motor

aspects of behavior), barriers (confidence to perform the behaviour in the face of challenges) and scheduling (confidence to arrange one's schedule). Together, these facets of self-efficacy determine more generalized perceptions regarding performance of complex tasks such as engaging in regular LTPA (Bandura, 1995).

Under relatively "normal" circumstances a general measure of self-efficacy may be a good predictor of behaviour. However, in reality, individuals are continuously faced with challenges that may alter their efficacy in one or more of these sub-domains. To illustrate, consider the following example. A pregnant woman is highly efficacious in her ability to plan and schedule LTPA, as well as engage in the necessary motor tasks associated with LTPA. However, she is not confident in her ability to overcome barriers such as lower back pain. In this situation, the overall general perception of self-efficacy may be high, because she is highly efficacious in 3 of the 4 sub-domains. In the event that she does not encounter back pain, this general measure of self-efficacy would be a good predictor. However, should back pain arise, the generalized measure of self-efficacy may not effectively predict LTPA; while barrier self-efficacy would prevail. As such, assessing only general perceptions of self-efficacy may overestimate self-efficacy for key sub-domains of the behaviour in question.

To illustrate a potential manifestation of this issue, consider findings in 2 of the 6 regression analyses where exercise self-efficacy did not have an attenuating effect on the relationship between barrier self-efficacy and LTPA. In those instances, barrier self-efficacy exerted the greatest effect on LTPA. It is plausible that barrier efficacy came into stronger play in these two analyses because women were facing new or heightened

barriers. This explanation is partially supported by the open-ended barriers data in Study 2, where the percentage of pregnant women reporting physical limitations as a barrier increased at T2 and barrier self-efficacy was the significant predictor of LTPA in the subsequent 6 weeks. In sum, Studies 2 and 3 support Bandura's (1995, 1997) assertion that self-efficacy encompasses numerous sub-domains. Future studies should assess a variety of specific self-efficacy beliefs (e.g., goal setting, scheduling and planning self-efficacy) when examining LTPA to understand what beliefs influence generalized perceptions of exercise self-efficacy (Culos-Reed, Gyurcsik, & Brawley, 2001; McAuley & Mihalko, 1998) and when these beliefs become more or less influential.

Practical Implications for Future Intervention Studies

One of the overarching goals of the current dissertation was to understand how and why LTPA changes during the pre and post natal period in order to help guide future intervention research. The results of the 3 dissertation studies provide several important practical implications for guiding future interventions targeting LTPA among pre and postnatal women.

First, in accordance with Study 1 and Study 2, it appears that LTPA declines during pregnancy, beginning early in pregnancy and continuing until childbirth. Thus, interventions should be implemented early in pregnancy to address this decline. Second, Study 2 demonstrated that barriers reported early in pregnancy are not necessarily the same as barriers reported later in pregnancy. Therefore, interventions that focus on identifying and overcoming barriers need to be adapted as pregnancy progresses.

Another significant implication for future intervention research comes from the combined results of Studies 2 and 3. These two studies highlight the need for interventionists to not only promote confidence for engaging in task specific aspects of exercise (e.g., duration, intensity, frequency/week), but to also focus on promoting confidence to engage in self-regulatory skills needed to help manage self-directed independent exercise on a regular basis. In addition, the data from Studies 1 and 3 showed that LTPA increased following childbirth. While this finding that women are initiating LTPA in the postnatal period is promising, future postnatal intervention research should include strategies to help women maintain LTPA in the postnatal period and for the long-term (cf. Rothman, Baldwin, & Hertel, 2004).

There is the potential benefit of translating this research not only regarding when to implement interventions and what interventions should consists of, but also how interventions might be conducted. The open-ended elicitation procedure in Studies 2 and 3 resulted in the generation of a substantial number of LTPA barriers. Independent researchers were able to classify these barriers into 9 general themes. Moreover, the open-ended outcome expectations elicitation procedure in Study 3 resulted in the generation of over 2000 LTPA outcome expectations. Approximately 90% of the outcomes listed could be accounted for by 4 general themes. Together these results suggest that LTPA barriers and reasons for engaging in LTPA are more similar than they are dissimilar among pre and postnatal women, and this has important implications for future group based intervention studies. For example, when individuals perceive themselves to be more similar to other group members, group cohesion improves. High

levels of group cohesion are thought to encourage adherence and commitment to learning behaviour change skills (cf. Brawley, Rejeski, Angove, & Fox, 2003; Meichenbaum & Turk, 1987). Therefore, group based interventions should be considered as a possible avenue for conducting future physical activity intervention studies for this population.

Limitations

While the findings from the dissertation provide significant contributions to the literature, several limitations are notable. One limitation is that the study participants were self-selected. Therefore, the findings may not be representative of a sample of pre and postnatal women who are not motivated to take part in an exercise study. Also, while a conscious effect was made to recruit a diverse sample, the final sample was primarily comprised of white, married, educated, middle to upper-middle class women. Therefore, the results have limited generalizability.

A second limitation is that LTPA data were based on self-report. Although the reliability and validity of the MAQ has been tested in a variety of populations (Aaron et al., 1993; Aaron et al., 1995; Kriska & Casperson, 1997, Schulz et al., 1994), self-report measures may be subject to recall errors and other biases such as social desirability. In addition, the measure of physical activity concerned only physical activity participation that was carried out in one's leisure-time and did not include an assessment of occupational or household physical activity. Thus, the results cannot be generalized to overall levels of physical activity or energy expenditure.

Future Directions

The noted contributions to theory and practice and the limitations discussed above shed light on several areas for future research. One central focus of future research should be to examine other SCT constructs that could influence LTPA during pregnancy and in the postnatal period. For example, research should examine other forms of self-regulatory efficacy and environmental factors. While barrier self-efficacy represents one form of self-regulatory efficacy, there are other facets of self-regulatory efficacy that warrant future research attention (i.e., goal setting and scheduling; DuCharme & Brawley, 1995; Maddux and Lewis, 1995). Another logical area for future research is to understand how to alter the strength of self-efficacy beliefs. For example, it would be interesting to study the effects of written versus verbal social persuasion on increasing self-efficacy, and would be valuable in the development of future intervention studies.

According to SCT, behaviour is an interaction between the person and his or her environment (Bandura, 1997). Accordingly, future research should examine how environmental factors interact with the individual in understanding physical activity behaviour. For example, weather, transportation, and perceived neighbourhood safety are factors beyond the control of the individual that could deter LTPA despite existent/the presence of motivation or self-efficacy (Lox, Martin Ginis, & Petruzzello, 2006).

Conclusion

Engaging in regular LTPA is a complex and challenging behaviour. Being pregnant and becoming a parent presents further challenges to an already complex behaviour. The data demonstrated that LTPA decreased during pregnancy and increased

in the postnatal period. While these data represent the average LTPA trajectory, individual trajectories of LTPA varied substantially from the average growth curve. In examining self-efficacy, exercise and barrier self-efficacy are two modifiable constructs that were found to predict pre and postnatal women LTPA. Collectively, the results from the 3 dissertation studies represent initial steps towards understanding LTPA behaviour among pre and postnatal women, and provide information about when and how interventionists might best intervene to enhance pre and postnatal women's LTPA. Albeit, there are many opportunities for future research to further understand LTPA behaviour during the pre and postnatal periods. Continuous efforts to study pre and postnatal LTPA will increase our knowledge about the determinants and outcomes of LTPA among pre and postnatal women and improve our ability to effectively intervene.

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Appendix A

Overview: Data Collection Timeline and Measures

Appendix A.1 Study 2 Measurement Timeline

Appendix A.2 Study 3 Measurement Timeline

Appendix A.1: Study 2 Measurement Timeline

		Data Collection Time Points			
		Prenatal Week 18	Prenatal Week 24	Prenatal Week 30	Prenatal Week 36
Enter Study	Pre-natal Week 18	* 12-month MAQ ** Demographic 6-week MAQ Self-efficacy (exercise and barrier)	6-week MAQ Self-efficacy (exercise and barrier)	6-week MAQ Self-efficacy (exercise and barrier)	6-week MAQ Self-efficacy (exercise and barrier)
	Pre-natal Week 24		* 12-month MAQ ** Demographic 6-week MAQ Self-efficacy (exercise and barrier)	6-week MAQ Self-efficacy (exercise and barrier)	6-week MAQ Self-efficacy (exercise and barrier)
	Pre-natal Week 30			* 12-month MAQ ** Demographic 6-week MAQ Self-efficacy (exercise and barrier)	6-week MAQ Self-efficacy (exercise and barrier)
	Pre-natal Week 36				* 12-month MAQ ** Demographic 6-week MAQ Self-efficacy (exercise and barrier)

Note. MAQ = Modifiable Activity Questionnaire
*Data used for Study 1.
** Data used for Study 1 and Study2

Appendix A.2 – Study 3 Measurement Timeline

		Data Collection Time Points			
		Postnatal Week 12	Postnatal Week 18	Postnatal Week 24	Postnatal Week 30
Enter Study	Post-natal Week 12	* 12-month MAQ ** Demographic 6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations	6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations	6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations	6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations
	Post-natal Week 18		* 12-month MAQ ** Demographic 6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations	6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations	6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations
	Post-natal Week 24			* 12-month MAQ ** Demographic 6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations	6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations
	Post-natal Week 30				* 12-month MAQ ** Demographic 6-week MAQ Self-efficacy (exercise and barrier) Outcome expectations

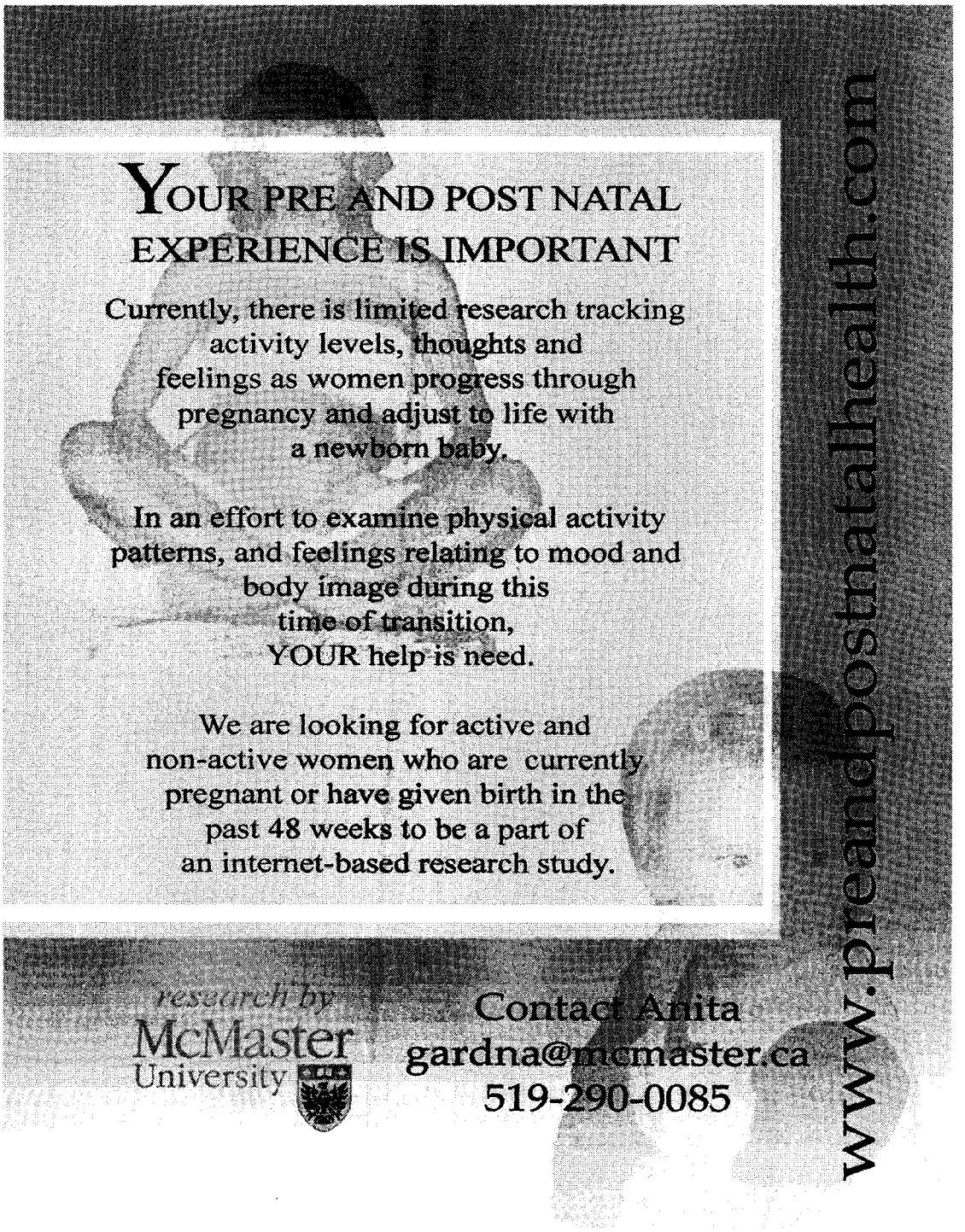
Note. MAQ = Modifiable Activity Questionnaire
*Data used for Study 1.
** Data used for Study 1 and Study 3

Appendix B

Recruitment Material

Appendix B.1	Recruitment Poster
Appendix B.2	Study Information Handout
Appendix B.3	Summary of Recruitment Presentation
Appendix B.4	Email Script: Presentation Follow Up

Appendix B.1 – Recruitment Poster



Appendix B.2 - Study Information Handout

Very little is known about pre and postnatal women's attitudes and beliefs about participating in physical activity. In an effort to examine physical activity patterns during this time of transition, your help is needed.

We are looking for women who are currently pregnant or have given birth in the last 42 weeks to be a part of a research study.

Purpose of the study: To examine pre and postnatal women's exercise patterns and exercise beliefs at various stages during pregnancy and in the first year after giving birth.

Participation in the study: If you volunteer to participate in this study, your involvement would span over the next several months depending on what pre/postnatal period you are in. It is our intention to follow up with you until your 42nd week postnatal. Specifically, as a participant in the study, you will be:

1. asked to set up a username and password for data collection purposes
2. asked to answer baseline questionnaires about: (this will take approximately 30 minutes of your time)
   - Your participation in and attitudes about physical activity
   - Your confidence for participating in physical activity
   - Barriers or obstacles to participating in physical activity
   - Your body satisfaction and general satisfaction with life
   - Demographic information such as height, weight, age, etc.
3. contacted via email or telephone once every six weeks until your 42nd week postnatal to answer follow up questions. Questions will be similar to the baseline questionnaires described above and will take approximately 15 - 20 minutes of your time to complete.

Note. All questionnaires will be administered online or over the phone according to participant preference.

Benefits. You will receive no direct benefits from participating in this study. However, you may find you become more aware of your physical activity patterns, which may lead you to initiate participation in regular physical activity or help you maintain your current level. Findings from the study will help researchers identify changes in physical activity patterns that may occur during pregnancy and after giving birth as well as important psychological factors that might affect these patterns. These findings may be useful for developing strategies to help promote physical activity among pregnant and postnatal women.

Confidentiality. Any information that is obtained during this study and that can be identified with you will remain confidential. Your responses to the questionnaires are completely private and will be kept in a secured electronic data base for a period of five years. Only the researchers will have access to this information. Your identity will never be revealed in any reports of this study.

Risks. There are no known physical risks associated with participating in the current study. However, it is difficult to predict how you will feel when completing some of the questionnaires (such as the one that focuses on body satisfaction). If answering any of the questions makes you feel uncomfortable, please feel free to leave those questions blank.

Compensation for participation. Participation in the study is voluntary and no payment will be given for participation. However, your name will be entered into a draw for every questionnaire package you complete. A draw for one prize, $250 cash, will be made at the conclusion of the study.

For more information contact Anita Cramp
(905) 525-9140, ext. 27624.
gardna@mcmaster.ca

Appendix B.3 - Recruitment Presentation Script

My name is Anita Cramp, and I am a PhD student at McMaster University. Over the next year I will be conducting a research study looking at physical activity among pre and postnatal women.

My purpose for being here today is to invite you to be a part of my research project. I will start by telling you about the study and what it involves.

The purpose of the study is to examine pre and postnatal women's exercise patterns and exercise beliefs at various stages during pregnancy and in the first year after giving birth.

If you volunteer to participate in this study, your involvement would span over the next several months depending on what pre/postnatal period you are in. It is my intention to follow up with you until your 42nd week postnatal. Specifically, as a participant in the study, you will be:

1. asked to set up a username and password for data collection purposes
2. asked to answer baseline questionnaires about: (this will take approximately 30 minutes of your time)
   - Your participation in and attitudes about physical activity
   - Your confidence for participating in physical activity
   - Barriers or obstacles to participating in physical activity
   - Your body satisfaction and general satisfaction with life
   - Demographic information such as height, weight, age, etc.
3. contacted via email or telephone once every six weeks until your 42nd week postnatal to answer follow up questions. Questions will be similar to the baseline questionnaires described above and will take approximately 15 - 20 minutes of your time to complete.

All questionnaires will be administered online or over the phone according to participant preference.

Although you will receive no direct benefits from participating in this study, you may become more aware of your physical activity patterns, which may lead you to initiate participation in regular physical activity or help you maintain your current level. Findings from the study will help researchers identify changes in physical activity patterns that may occur during pregnancy and after giving birth as well as important psychological factors that might affect these patterns. These findings may be useful for developing strategies to help promote physical activity among pregnant and postnatal women.

Any information that is obtained during this study and that can be identified with you will remain confidential. Your responses to the questionnaires are completely private and will be kept in a secured electronic data base for a period of five years. Only the researchers will have access to this information. Your identity will <u>never</u> be revealed in any reports of this study.

There are no known physical risks associated with participating in the current study. However, it is difficult to predict how you will feel when completing some of the questionnaires (such as the one that focuses on body satisfaction). If answering any of the questions makes you feel uncomfortable, please feel free to leave those questions blank.

Participation in the study is **voluntary** and no payment will be given for participation. However, your name will be entered into a draw for every questionnaire package you complete. A draw for one prize, $250 cash, will be made at the conclusion of the study.

Does anyone have questions?

If you are interested in participating or would like more information about the study, please write your name and contact information on this list and I will contact you in the weeks to confirm and initiate participation in the study.

Appendix B.4 - Email Script: Presentation Follow Up

Hi "INSERT NAME", this is *"INSERT RESEARCHER NAME"* from McMaster University, I spoke with about being in research study and I am emailing you to follow up.

As I mentioned when you provided me with your name and contact info, the purpose of this study is to examine pre and postnatal women's exercise patterns and exercise beliefs at various stages during pregnancy and in the first year after giving birth.

If you volunteer to participate in this study, your involvement would span over the next several months depending on what pre/postnatal period you are in. It is our intention to follow up with you until your 42nd week postnatal. Specifically, as a participant in the study, you will be:

1. asked to set up a username and password for data collection purposes
2. asked to answer baseline questionnaires about: (this will take approximately 30 minutes of your time)
   - Your participation in and attitudes about physical activity
   - Your confidence for participating in physical activity
   - Barriers or obstacles to participating in physical activity
   - Your body satisfaction and general satisfaction with life
   - Demographic information such as height, weight, age, etc.
3. contacted via email or telephone once every six weeks until your 42nd week postnatal to answer follow up questions. Questions will be similar to the baseline questionnaires described above and will take approximately 15 - 20 minutes of your time to complete.

As an incentive to participate, for every time you login in and complete the specified questionnaires your name will be entered into a draw to win $250 cash.

Here's how to get started:
Click on the website below and complete the login process.

WEBSITE: www.preandpostnatalhealth.com

If you forget your login and password you may contact me atgardna@mcmaster.ca.

Once you have completed this you will be directed to the study homepage to begin completing the study questionnaires.

If you have any questions please feel free to contact me at gardna@mcmaster.ca or at 905-525-9140 ext. 27624.

Thank you,
Anita Cramp

Appendix C

Study Material

Appendix C.1 – Letter of Consent

CONSENT TO PARTICIPATE IN RESEARCH

You are being invited to participate in a research study entitled "An examination of pre and post natal women's exercise patterns and exercise beliefs", carried out by Dr. Steve Bray as well as PhD student Anita Cramp (Department of Kinesiology, McMaster University). If you have any questions or concerns about the study, please feel free to contact Anita Cramp at (905) 525-9140, ext. 27624.

RATIONALE

Very little is known about pre and post natal women's attitudes and beliefs about participating in physical activity. This study is designed to provide information regarding pre and post natal physical activity participation.

PURPOSE

The purpose of this study is to examine exercise patterns and exercise beliefs during pregnancy and in the first year after giving birth.

PROCEDURE

If you volunteer to participate in this study, your involvement would span over the next several months depending on what pre/post natal period you are in. It is our intention to follow up with you until your 42nd week post natal. Specifically, as a participant in the study, you will be:

1. Asked to set up a username and password for data collection purposes
2. Asked to answer baseline questionnaires (which will take approximately 15–20 minutes of your time) about:

    - Your participation in and attitudes about physical activity
    - Your confidence for participating in physical activity
    - Barriers or obstacles to participating in physical activity
    - Your body satisfaction and general satisfaction with life
    - Demographic information such as height, weight, age, etc.

3. Contacted via email or telephone once every six weeks until your 42nd week post natal to answer follow up questions. Questions will be similar to the baseline questionnaires described above and will take approximately 10- 15 minutes of your time to complete.

POTENTIAL RISKS

There are no known physical risks associated with participating in the current study. However, it is difficult to predict how you will feel when completing some of the questionnaires (such as the one that focuses on body satisfaction). If answering any of the questions makes you feel uncomfortable, please feel free to leave those questions blank.

BENEFITS

You will receive no direct benefits from participating in this study. However, you may become more aware of your physical activity patterns and decide to initiate participation in regular

physical activity or help you maintain your current level. Findings from the study will help researchers identify changes in physical activity patterns that may occur during pregnancy and after giving birth as well as important psychological factors that might affect these patterns. These findings may be useful for developing strategies to help promote physical activity among pregnant and post natal women in the future.

CONFIDENTIALITY

Any information that is obtained during this study and that can be identified with you will remain confidential. Your responses to the questionnaires are completely private and will be kept in a secured electronic data base for a period of five years. Only the researchers will have access to this information. Your identity will never be revealed in any reports of this study.

STUDY WITHDRAWAL

You can decide whether to take part in this study or not. If you volunteer for this study you may withdraw at any time without penalty. You can choose to remove your data from the study at any time by contacting the study investigator. You may also refuse to answer any questions you don't want to answer while remaining in the study.

COMPENSATION FOR PARTICIPATION

Participation in the study in voluntary and no payment will be given for participation. However, your name will be entered into a draw for every questionnaire package you complete. A draw for one prize, $250 cash, will be made at the conclusion of the study.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because you are participating in this research study. This study has been reviewed and received ethics clearance through the McMaster Research Ethics Board (MREB). If you have any questions regarding your rights as a research participant, contact the Office of Research Services, McMaster University [Phone: (905) 329-2747].

SIGNATURE OF RESEARCH PARTICIPANT

I understand the information provided for the study "An examination of pre and post natal women's exercise patterns and exercise beliefs" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. **I UNDERSTAND THAT BY ANSWERING THE QUESTIONNAIRES, I AM CONSENTING TO PARTICIPATE IN THE STUDY.**

Appendix C.2 – Study 2 Demographic Questionnaire

1. The year you were born : _____
2. Your height in feet and inches: _____
3. Your weight in pounds: _____
4. How many children do you have that live at home? _____
5. If this is not your first pregnancy, what is the year that your oldest child was born? _____
6. Is your current pregnancy a multiple birth pregnancy (i.e., twins)?

   ☐ Yes ☐ No

   If yes, please indicate if you had twins, triplets, etc. _____
7. Marital status?

   ☐ married ☐ single ☐ separated

   ☐ divorced ☐ widow ☐ common law
8. How would you describe your ethnicity?

☐ White ☐ Chinese ☐ Black ☐ Latin American ☐ Southeast Asian

☐ South Asian ☐ West Asian ☐ Arab ☐ North American Indian, Metis, or Inuit

☐ Other

9. What best describes your yearly household income?

   ☐ less than $20,000
   ☐ $20, 001 – $39,999
   ☐ $40,000 – $59,999
   ☐ $60,000 – $79, 000
   ☐ $80,000 or greater

10. What best describes your employment?

☐ Stay at home
☐ Work part time
☐ Work full time
☐ Other, please indicate: _____

11. What is the highest level of educational training you have?

☐ some High School
☐ some University/College
☐ Post Graduate School
☐ High School diploma
☐ University degree/College diploma

12. What is your postal code? _____

13. Do you smoke?

☐ Yes
☐ No

14. Would you like a copy of the study results, when the study is completed?

☐ Yes
☐ No

Appendix C.3 – Study 2 Demographic Questionnaire

1. The year you were born: _____
2. Your height in feet and inches: _____
3. Your weight in pounds: _____
4. How many children do you have that live at home? _____
5. If this is not your first pregnancy, what is the year that your oldest child was born?

   _____

6. Type of most recent birth: ☐ Natural
   ☐ Caesarean
7. Was your pregnancy a multiple birth?
   ☐ Yes ☐ No
   If yes, please indicate if you had twins, triplets, etc. _____
8. Are you breastfeeding?
   ☐ Yes ☐ No
   ☐ Combination of both
9. Marital status?
   ☐ married ☐ single ☐ separated
   ☐ divorced ☐ widow ☐ common law
10. What best describes your yearly household income?
    ☐ less than $20,000
    ☐ $20, 001 – $39,999
    ☐ $40,000 – $59,999
    ☐ $60,000 – $79, 000
    ☐ $80,000 or greater

11. How would you describe your ethnicity?

☐ White ☐ Chinese ☐ Black ☐ Latin American ☐ Southeast Asian
☐ South Asian ☐ West Asian ☐ Arab ☐ North American Indian, Metis, or Inuit
☐ Other

12. What best describes your employment prior to maternity leave?

☐ Stay at home
☐ Work part time
☐ Work full time
☐ Other, please indicate your occupation? _____

13. What is the highest level of educational training you have?

☐ some High School
☐ some University/College
☐ Post Graduate School
☐ High School diploma
☐ University degree/College diploma

14. What is your postal code? _____

15. Do you smoke?

☐ Yes
☐ No

16. Would you like a copy of the study results, when the study is completed?

☐ Yes
☐ No

17. Did you experience any complications during your pregnancy such as preeclampsia or gestational diabetes?

☐ No
☐ Yes, Please list: _____

Appendix C.4 – 12-Month/6-Week
Modifiable Physical Activity Questionnaire (MAQ)

The following questionnaire was obtained from Kriska, A., & Casperson, C. eds (1997). A collection of physical activity questionnaires. *Medicine & Science in Sports & Exercise,* 29, S79-S82. It was modified to be administered online. For example, the online format allowed participants to check the activities provided in the list. All checked activities automatically showed up in the chart. In addition, the measure was modified to read "last month", "two months ago", "three months ago", etc., instead of using "Jan", "Feb', "Mar", etc, the columns The procedure for completing the 12-Month MAQ and 6-Week MAQ were identical, however the 6-Week MAQ chart was revised to read, "last week", "two weeks ago", "three weeks ago", etc. For brevity sake, only the 12-Month MAQ is presented.

Instructions: **Below is a list of activities. We are interested in knowing how often you engage in MODERATE to VIGOROUS intensity activities. This includes activities that use large muscle groups, that increases your heart rate, and that are at least as demanding as brisk walking. Click any activities you did in the past 12 MONTHS [6 MONTHS], in which your heart rate was elevated.**

Aerobics	Gymnastics	Swimming (Laps)
Band/Drill Team	Hiking	Tennis
Baseball	Ice Skating	Volleyball
Basketball	Roller Skating	Water Skiing
Bicycling	Running for Exercise	Weight Training (Competitive)
Bowling	Skateboarding	Wrestling
Cheerleading	Snow Skiing	Others:
Dance Class	Soccer	_____
Football	Softball	_____
Garden/Yard Work	Street Hockey	_____

List each activity that you checked above in the "Activity" box below.
Check the months you did each activity and then estimate the amount of time spent in each activity.

Activity	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Months per Year	Days Per Week	Minutes Per Day

Appendix C.5 – Exercise Self-efficacy Questionnaire

INSTRUCTIONS: The following is a list of behaviours associated with participation in exercise. Please consider each specific behaviour as it applies to you and **indicate how confident you are that you can complete each of the following behaviours regularly over the next 6 WEEKS using the scale below.**

0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
not at all confident					**somewhat confident**				**completely confident**	

1. Complete **30 minutes** of physical activity (e.g. cycling, brisk walking)**ONCE** a week for the next 6 WEEKS?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. Complete **30 minutes** of physical activity (e.g. cycling, brisk walking)**TWICE** a week for the next 6 WEEKS?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. Complete **30 minutes** of physical activity (e.g. cycling, brisk walking)**THREE** times a week for the next 6 WEEKS?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. Complete **30 minutes** of physical activity (e.g. cycling, brisk walking)**FOUR** times a week for the 6 WEEKS?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. Complete **30 minutes** of physical activity (e.g. cycling, brisk walking)**FIVE** times a week for the next 6 WEEKS?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Appendix C.6 – Barrier Self-efficacy Questionnaire

INSTURCTIONS. Barriers are defined as anything that may stop you from doing physical activity. Please list four barriers to physical activity relevant to you, which you anticipate will occur **in the next 6 WEEKS.** An example is provided.

EXAMPLE:

Barrier: Lack of sleep

How confident you are in overcoming this barrier in the next 6 WEEKS? Please check one:

☐ ☐ ☐ ☐ ☐ ☒ ☐ ☐ ☐ ☐ ☐

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

not at all confident — **somewhat confident** — **completely confident**

BARRIER #1: _____

How confident are you in overcoming this barrier in the next 6 WEEKS? Please check one:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

not at all confident — **somewhat confident** — **completely confident**

BARRIER #2: _____

How confident are you in overcoming this barrier in the next 6 WEEKS? Please check one:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

not at all confident — **somewhat confident** — **completely confident**

BARRIER #3: ___

How confident are you in overcoming this barrier in the next 6 WEEKS? Please check one:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

not at all confident — **somewhat confident** — **completely confident**

BARRIER #4: ___

How confident are you in overcoming this barrier in the next 6 WEEKS? Please check one:

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
not at all confident					**somewhat confident**				**completely confident**	

Appendix C.7 – Outcome Expectations Questionnaire

Instructions: Outcome expectations are defined as "things" you believe will occur as a result of engaging in physical activity.

1. Please list 2 outcome expectations **according to the categories provided** you expect to occur **if you were to engage** in physical activity. Please be very specific when you indicate what the outcome is.

2. Rate the LIKELIHOOD that the outcome will occur over the next 6 WEEKS using the following scale:

1	2	3	4	5	6	7
very unlikely		somewhat unlikely		somewhat likely		very likely

3. Next, rate how much you will VALUE attaining the outcome in the next 6 WEEKS using the following scale:

1	2	3	4	5	6	7
Little value			average value			very great value

PHYSICAL

(e.g., outcomes associated with your physical functioning or physical appearance, such as healthier heart)

PHYSICAL OUTCOME EXPECTATION #1: _____

i) What is the **LIKELIHOOD** that the outcome will occur **over the next 6 WEEKS** if you participate in 3 or more exercise session per week:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

ii) How much you will you **VALUE** attaining the outcome in the **next 6 WEEKS**:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

PHYSICAL OUTCOME EXPECTATION #2: _____

i) What is the **LIKELIHOOD** that the outcome will occur **over the next 6 WEEKS** if you participate in 3 or more exercise session per week:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

ii) How much you will you **VALUE** attaining the outcome in the **next 6 WEEKS**:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

PSYCHOLOGICAL

(e.g., outcomes associated with how you mentally feel such as reduced depression)

PSYCHOLOGICAL OUTCOME EXPECTATION #1_____

i) What is the **LIKELIHOOD** that the outcome will occur **over the next 6 WEEKS** if you participate in 3 or more exercise session per week:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

ii) How much you will you **VALUE** attaining the outcome in the **next 6 WEEKS**:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

PSYCHOLOGICAL OUTCOME EXPECTATION #2: _____

i) What is the **LIKELIHOOD** that the outcome will occur **over the next 6 WEEKS** if you participate in 3 or more exercise session per week:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

ii) How much you will you **VALUE** attaining the outcome in the **next 6 WEEKS**:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

SOCIAL

(e.g., outcomes associated with your social life such as making friends)

SOCIAL OUTCOME EXPECTATION #1: _____

i) What is the **LIKELIHOOD** that the outcome will occur **over the next 6 WEEKS** if you participate in 3 or more exercise session per week:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

ii) How much you will you **VALUE** attaining the outcome in the **next 6 WEEKS**:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

SOCIAL OUTCOME EXPECTATION #2: _____

i) What is the **LIKELIHOOD** that the outcome will occur **over the next 6 WEEKS** if you participate in 3 or more exercise session per week:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

ii) How much you will you **VALUE** attaining the outcome in the **next 6 WEEKS**:

☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7

Appendix D

Study Follow up Contact Emails

Appendix D.1 – Email script: Study Follow-up

Dear [*insert participant* name]

Thank you for participating in the study. According to my records, you are in the *[enter follow up period]*. Please visit the study website (www.preandpostnatalhealth.com) to complete the questionnaires. There are 2 questionnaires to complete:

1. A 6-week activity recall and,
2. A questionnaire pertaining to your confidence in exercising and overcoming barriers.

There will be a 7 day window to complete these questionnaires. I really appreciate you taking the time to be a part of the study. The information you provide is very valuable to me.

Have a great *[insert day of the week]*. Please feel free to contact me if you have any questions.

Sincerely,
Anita Cramp
PhD Candidate
McMaster University, Hamilton, ON
E: gardna@mcmaster.ca
www.preandpostnatalhealth.com

Appendix D.2 – Email script: Study Follow-up Reminder

Dear [*insert participant* name]

I hope all is well.

I am sending you this email to remind you that you are in a study follow up period. To complete the questionnaires please visit the study website at www.preandpostnatalhealth.com.

There are 2 questionnaires to complete. One of the questionnaires is a 6-week physical activity recall and the other is about your confidence to exercise.

Thank you for taking the time to be a part of the study. Let me know if you have any questions.

Sincerely,
Anita Cramp
PhD Candidate
McMaster University, Hamilton, ON
E: gardna@mcmaster.ca
www.preandpostnatalhealth.com

Appendix D.3 – Email script: Incomplete Data

Dear [*insert participant* name]

Thanks for taking the time to complete the online survey questionnaires. I really appreciate it.

I am not sure if you ran out of time but the *[insert name of measure]* has not been completed. If you log into the website (www.preandpostnatalhealth.com) again the missing questionnaire will be highlighted. The questionnaire is tied to the data you have already provided, so it is important that I have this information when it comes time to analyzing the data.

If you have any questions please do not hesitate to contact me.

Thanks again,
Anita Cramp
PhD Candidate
McMaster University, Hamilton, ON
E: gardna@mcmaster.ca
www.preandpostnatalhealth.com

Appendix D.4 – Study 2 Participant Flow

Table D.1

Summary	Total N	Carry over n	New n	Follow through n
Participants who completed T1	59			
1		-	-	7
1,2		-	-	7
1,2,3		-	-	13
1,2,3,4		-	-	24
1,3		-	-	3
1,4		-	-	0
1,2,4		-	-	3
1,3,4,		-	-	2
Total Participants who completed T2	86	-	-	-
Carry over from T1		47	-	-
New:			39	
2			-	8
2,3			-	7
2,3,4			-	19
2,4			-	5
Total Participants who completed T3	97	-	-	-
Carry over from T1		42	-	-
Carry over from T2		26	-	-
New:			29	
3			-	11
3,4			-	18
Total Participants who completed T4	106	-	-	-
Carry over from T1		29	-	-
Carry over from T2		26	-	-
Carry over from T3		18	-	-
New			33	-

Appendix D.5 – Study 3 Participant Flow

Table D.2

Summary	Total N	Carry over n	New n	Follow through n
Participants who completed T1	113			
1		-	-	31
1,2		-	-	14
1,2,3		-	-	9
1,2,3,4		-	-	30
1,3		-	-	11
1,4		-	-	2
1,2,4		-	-	11
1,3,4,		-	-	5
Total Participants who completed T2	113	-	-	-
Carry over from T1			64	-
New:			49	
2			-	11
2,3			-	10
2,3,4			-	23
2,4			-	5
Total Participants who completed T3	125	-	-	-
Carry over from T1		55	-	-
Carry over from T2			33	-
New:			37	
3			-	14
3,4			-	23
Total Participants who completed T4	130	-	-	-
Carry over from T1		48	-	-
Carry over from T2		28	-	-
Carry over from T3		23	-	-
New			31	-

Appendix E

Additional Measures Collected

Appendix E.1 List of Additional Measures Collected

Appendix E.1 - List of Additional Measures Collected

The following measures were also collected as part of Studies 2 and 3 at T1, T2, T3 and T4:

Theory of Planned Behaviour Variables:

- Attitudes
- Subjective Norm
- Perceived Behavioural Control
- Intentions

Scheduling Self-efficacy

Body Cathexis Scale

State Trait Anxiety Inventory

Life Satisfaction Scale

Participants weight

Committee Notes