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Effects of an In-bed Resistance Exercise Program for Hospitalized High Risk Pregnant Women on Postpartum Functional Ability and Psychosocial Health

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Abstract

Hospitalised high-risk pregnant women (HHRPW) report physiological deconditioning similar to non-pregnant bed-rested patients. The purpose of this pilot study was to evaluate the effectiveness of an in-bed resistance exercise program to reduce the side-effects of activity-restriction in HHRPW. It was hypothesized that HHRPW who exercised while in hospital would have better functional ability and a higher quality of life at two months postpartum compared to HHRPW with no exercise program. HHRPW were activity-restricted (1940 ±1405 steps/day) in hospital and reported high rates of anxiety and depression. Nine women were randomized to either a supervised in-bed exercise (n=5) or into a music only control group (n=4). HHRPW in the exercise group had improved mood states in hospital and significantly longer gestation (34.5 weeks vs 32.4 weeks; p<0.05). They also performed better on postpartum measures of aerobic functioning. An in-bed-exercise-program may be effective in reducing postpartum side-effects of activity-restriction in HHRPW.

Keywords

“High-risk Pregnancy, antenatal, bed-rest, strengthening exercise, post-delivery, functional ability, quality of life, randomized controlled trial”
Co-Authorship Statement (for future publication)

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Chapter 1: Review of the Literature

1.1 Introduction

The following chapter will begin by summarizing physical changes that occur with normal pregnancy. These changes include hormonal, respiratory, cardiovascular and skeletal modifications. Appropriate weight gain during pregnancy will be discussed as well as recommendations for physical activity during pregnancy. The psychosocial changes that may occur with pregnancy, including stress, anxiety and depression and the effects that these changes have on both the mother and fetus will also be discussed. The focus will then shift to high risk pregnancy, specifically women that require hospitalization prenatally. Since hospitalized pregnant women are very restricted in their activity levels, they will be compared to non-pregnant bed-rested patients. The efficacy of bed-rest in non-pregnant populations will be discussed including complications that may arise as a side-effect of bed-rest, most notably cardiovascular deconditioning, muscle atrophy and bone loss. The effect that bed-rest, or activity-restriction, has on hospitalized high risk pregnant women (HHRPW) will then be discussed, as well as potential interventions that may be used to minimize side-effects of hospitalized activity-restriction.

1.2 Physiological Adaptations in Pregnancy

Pregnancy poses a challenge to all body systems, most notably hormonal, respiratory, cardiovascular, and skeletal, accompanied by changes in body composition (Carlin & Alfirevic, 2008). Maternal physiological adaptations occur to accommodate fetal demands, increasing the availability of substrates and precursors for feto-placental metabolism and hormone production, improving transport capacity, increasing maternal-fetal exchange and increasing disposal of waste products from the fetus (Weissgerber & Wolfe, 2006). These progressive physiological adaptations are essential for the protection and development of the growing fetus as well as to prepare the mother for parturition (Carlin & Alfirevic, 2008).

1.2.1 Hormonal Adaptations in Pregnancy

Early human pregnancy initiates a cascade of events beginning with hormonal changes soon after fertilization that facilitate implantation and feto-placental development. Increased levels of human chorionic gonadotropin (hCG) ensure the perpetuation of the corpus luteum and
the maintenance of estrogen and progesterone concentrations, which facilitate further changes throughout pregnancy (Weissgerber & Wolfe, 2006). As pregnancy progresses, the placenta modulates the production and release of hormones such as progesterone, estrogen and hCG, ensuring the growth and development of the fetus (Weissgerber & Wolfe, 2006). The high volume of hormones from both the mother, fetus and placenta cause the maternal pituitary gland to grow to twice its pre-pregnancy size, and works to modulate further hormone production as well as prepare the maternal body for parturition and lactation (Bocking, 2001).

1.2.2 Respiratory Adaptations in Pregnancy

As pregnancy unfolds, the effects of progesterone causes a loosening of the ligaments in the chest, which allow the ribs to flare out as the uterus expands, thereby decreasing chest wall compliance to promote ventilation (Carlin & Alfirevic, 2008). As abdominal volume increases, the diaphragm is raised, but changes in ventilation seem to be due to increasing levels of progesterone rather than any changes in diaphragmatic function (Bocking, 2001). Women often experience the sensation of shortness of breath during late pregnancy, but this is most likely caused by the actions of progesterone on the chemoreceptors found in the brain, rather than any mechanical changes in lung capacity (Bocking, 2001). Progesterone may work to stimulate chemoreflex and nonchemoreflex drives to breathe, which in turn leads to increased rates of ventilation (Weissgerber & Wolfe, 2006). Accelerated ventilation is coupled with an increase in tidal volume (the amount of air displaced by the lungs in normal breathing) by 150 percent of pre-pregnancy levels by the end of the third trimester (Bocking, 2001). This greater diffusion and volume of maternal oxygen is available for the developing fetus (Bocking, 2001).

1.2.3 Cardiovascular Adaptations in Pregnancy

Maternal cardiovascular adaptations begin early in the first trimester. Significant increases in cardiac output can be seen by five weeks gestation (Weissgerber & Wolfe, 2006). Cardiac output rises in the first trimester by approximately 130% to 150% of pre-pregnancy levels and then plateaus by the end of the second trimester for the remainder of pregnancy. (Clark et al, 1989; Chapman et al, 1998). Changes in cardiac output occur due to a combination of maternal heart rate, stroke volume and vascular resistance (Chapman et al, 1998). Maternal heart rate increases up to 15 beats per minute (bpm) by the end of pregnancy (Bocking, 2001; Wilson et al, 1980). An increase in stroke volume, occurs predominantly in the second trimester.
The remaining adaptations in cardiac output occur due to endocrine changes which cause a decrease in systemic vascular resistance (Bocking, 2001). As a result of these endocrine changes blood pressure falls in early pregnancy, decreasing by approximately 10% of resting values as early as seven weeks gestation (Clapp et al, 1988).

Changes in cardiac output are accompanied by an increase in maternal blood flow. The uterine artery blood flow is significantly increased between 6 and 12 weeks of gestation, most likely due to the action of hormones released from the placenta into maternal circulation (Weissgerber & Wolfe, 2006). This increase in uterine blood flow results in a larger supply of oxygen and nutrients delivered to the developing fetus as well as better waste removal from the fetus via maternal renal filtration (Boking, 2001; Weissgerber & Wolfe, 2006).

Circulating blood volume increases in the maternal cardiovascular system as a result of both an increase in red blood cell production and plasma volume. Red blood cell production is elevated to increase the carrying capacity for oxygen and nutrients. Plasma volume is simultaneously increased, although plasma volume increases at a greater rate than red blood cell production which results in the physiological anemia of pregnancy (Bocking, 2001; Clark et al, 1989; Weissgerber & Wolfe, 2006). These changes in plasma volume, up to 150% of pre-pregnancy levels, are likely caused by elevated estrogen and progesterone (Bocking, 2001; Weissgerber & Wolfe, 2006).

If cardiovascular adaptations do not develop appropriately then both the mother and baby can become at risk for physiological pregnancy complications. Murphey and colleagues (1986) investigated the relationship of haemoglobin levels in the first and second trimesters to pregnancy outcomes. Results indicated that obstetric outcomes and birth weight were correlated with increases in plasma volume (Murphey et al, 1986). Circulating blood volume is vital for optimal fetal outcome. A failure of the maternal circulatory system to increase plasma volume could give rise to maternal hypertension and intrauterine growth restriction (Bocking, 2001).

Another example of a failure to adapt occurs when there is no reduction in vascular impedance. If uterine vascular impedance is too high during pregnancy the result can be preeclampsia, which poses a risk to both the mother and the fetus (Valensise et al, 2003).
1.2.4 Skeletal Adaptations in Pregnancy

During development the fetus requires approximately 30 to 35 grams of calcium, which is essential for the formation of the fetal skeletal system (Black et al, 2000). This calcium is obtained from the mother, the majority of which comes from maternal intestinal absorption of calcium (Kovacs, 2005). Intestinal absorption of calcium increases to two times pre-pregnancy volumes as early as 12 weeks of gestation (Kovacs, 2005). Current Dietary Reference Intakes (DRI) recommend daily calcium intake of 1000mg for women 19 to 50 years to maintain bone health during pregnancy and lactation (Oliveri et al, 2004). The gastrointestinal tract is only able to absorb a set amount of calcium so excess calcium intake above the DRI would have no benefit to fetal calcium uptake (Black et al, 2000). If a pregnant woman does not intake enough calcium fetal skeletal development may be affected or it may lead to a loss in maternal bone minerals in an attempt to compensate for the lack of dietary intake (Kovacs, 2005).

The volume of calcium absorbed by the maternal gastrointestinal tract is not sufficient for all fetal needs, therefore the remaining calcium needs is obtained from the breakdown of the maternal skeletal system (Black et al, 2000). In non-pregnant individuals bone density homeostasis is maintained by a balance of bone resorption and bone formation. During normal pregnancy there is a physiological change towards greater bone resorption than bone formation in the first and second trimester. This bone resorption generates a greater availability of calcium for utilization in the development of the fetal skeleton (Black et al, 2000). By third trimester this ratio changes to more bone formation than bone resorption, however, there is still an overall decrease in bone mineral density (BMD) in pregnancy (Black et al, 2000).

In the postpartum, infants still require a large amount of calcium for growth, which can be provided through maternal lactation. Women who exclusively breastfeed may lose up to 400 milligrams of calcium each day through breast milk (Kovacs, 2005). In the postpartum a greater proportion of calcium is taken from the maternal skeletal system than through maternal diet. The net decrease in BMD is related to the length of time spent breastfeeding (Moller et al, 2011). Studies report up to a 10% loss of skeletal minerals during 6 months of exclusive breastfeeding (Kovacs, 2005). The postpartum balance of skeletal minerals is usually fully restored within a few months after weaning therefore the loss of skeletal minerals should not have any long-term effects on the breastfeeding mother (Kovacs, 2005; Moller et al, 2011). In some cases, the
calcium balance may not have a chance to return to normal such as short intervals between pregnancies, low calcium intake during pregnancy, pregnancy in adolescents, multiple fetuses or bed-rest during pregnancy (Oliveri et al, 2004). If a normal net increase in bone formation does not occur, either during pregnancy or the postpartum, the mother may be at a greater risk of osteoporosis (Black et al, 2000).

1.3 Recommended Weight Gain during Pregnancy

The Institute of Medicine (IOM) updated their gestational weight gain guidelines based on pre-pregnancy body mass index (BMI) (See Table 1.1). These guidelines propose that there is an optimum range of weight that should be gained during pregnancy (Institute of Medicine, 2009). This weight gain is accumulated from a combination of sources including: blood volume, breast volume, uterus, placenta, amniotic fluid and fetus growth (Health Canada, 2011). To achieve the recommended weight gain during pregnancy, Health Canada advises an increase in maternal caloric intake of 100 kcal/day in the first trimester and 300 kcal/day in the second and third trimesters (Health Canada, 2011). There may be serious long term health implications for the offspring of mothers who do not gain enough weight during pregnancy as well as those who gain excessive gestational weight (Institute of Medicine, 2009).
Table 1.1 IOM Weight Gain Guidelines for Pregnancy (adapted from Institute of Medicine, 2009).

<table>
<thead>
<tr>
<th>Pre-pregnancy BMI</th>
<th>BMI (kg/m²) (WHO)</th>
<th>Total Weight Gain Range (lbs)</th>
<th>Rates of Weight Gain* 2nd and 3rd Trimester (Mean Range in lbs/wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
<td>28-40</td>
<td>1 (1-1.3)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>18.5 – 24.9</td>
<td>25-35</td>
<td>1 (0.8-1)</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0-29.9</td>
<td>15-25</td>
<td>0.6 (0.5-0.7)</td>
</tr>
<tr>
<td>Obese (includes all classes)</td>
<td>≥30.0</td>
<td>11-20</td>
<td>0.5 (0.4-0.6)</td>
</tr>
</tbody>
</table>

*Calculations assume a 0.5-2.0 kg (1.1-4.4 lbs) weight gain in the first trimester (based on Abrams et al., 1995; Carmichael et al., 1997; Siega-Riz et al., 1994). IOM: Institute of Medicine.

1.4 Recommendations for Exercise during Pregnancy

In the past women were instructed to rest during pregnancy, reducing exertion demands to conserve resources for their baby (Sprague, 2004). As research based guidelines for exercise during pregnancy are developed women are now encouraged, in normal low-risk pregnancies, to participate in exercise programs to complement healthy lifestyle choices (Canadian Society for Exercise Physiology, 2013). Most women tend to decrease their exercise intensity as gestation progresses, choosing to participate in more low to moderate intensity exercise options. Walking has been found to be the most preferred method of exercise, especially later in pregnancy (Mottola & Campbell, 2003).

1.4.1 Canadian Physical Activity Guidelines for Pregnancy

The PARmed-X for Pregnancy is the current Canadian physical activity guidelines (Canadian Society for Exercise Physiology, 2015). The document was created to improve
communication between health care and the fitness professional. The PARmed-X for pregnancy includes a checklist for the health care provider to determine general health status, status of the current pregnancy, activity habits during the past month and physical activity intentions. The pregnant woman also completes a pre-exercise health checklist. Based on the pre-exercise health checklist and patient history, the health care provider can recommend whether physical activity is recommended or contraindicated. If physical activity is recommended, the PARmed-X for pregnancy contains a section for the fitness professional to recommend the appropriate exercise prescription for both aerobic activity and muscle conditioning. Aerobic activity may be recommended 3 to 4 times per week for 15 to 30 minutes per session. Each session should be preceded by a 10 to 15-minute warm-up and followed by a 10 to 15-minute cool-down. Intensity can be monitored by target heart rate zones based on age and fitness, the Borg rating of perceived exertion scale (RPE) and the “talk test.” Muscle conditioning may be recommended during a healthy pregnancy, although there are several precautions listed for muscle conditioning exercise (Canadian Society for Exercise Physiology, 2015).

1.4.2 International Physical Activity Guidelines for Pregnancy

The American College of Obstetricians and Gynecologists (ACOG) recommends that, in the absence of medical or obstetric complications, pregnant women should participate in 20 - 30 minutes or more of moderate exercise per day on most, if not all, days of the week (American College of Obstetricians and Gynecologists, 2009). A physically active woman with a history of or at risk for preterm labour or fetal growth restriction should be advised to reduce her activity in the second and third trimesters. Participation in contact sports is highly discouraged as blunt trauma to the abdomen could result in health consequences for both the mother and the fetus (American College of Obstetricians and Gynecologists, 2009).

Current recommendations for pregnancy vary geographically. In 2014 researchers in the field of exercise and pregnancy came together to examine the recommendations from around the world (Evenson et al, 2014). Guidelines were examined from Australia, Canada, Denmark, France, Japan, Norway, Spain, United Kingdom, and the United States. The majority of the guidelines advised medical pre-screening prior to exercise, while most also listed both relative (risk of exercise may exceed the benefit) and absolute (exercise is not recommended) contraindications. Absolute and/or relative contraindications include anemia, persistent
bleeding, cardiovascular disease, cerclage or incompetent cervix, multiple gestation, preeclampsia, or pregnancy-induced hypertension, premature contractions or labor, premature rupture of membranes and thyroid disease (Evenson et al, 2014). The FITT (Frequency, Intensity, Time, and Type) principle was used in each of the guidelines as a way to prescribe the appropriate exercise for pregnant women (Evenson et al, 2014).

**Frequency:** The recommended frequency of exercise was approximately three exercise sessions per week, with a range of recommendations from two days to four days a week or on most, if not all, days of the week (Evenson et al, 2014, American College of Obstetricians and Gynecologists, 2009).

**Intensity:** Intensity was recommended within the range of low to moderate exercise intensity. High intensity exercise recommendations should be approached with caution as research is limited in this area with regards to maternal and fetal outcomes during and after vigorous activity. If a pregnant woman was previously highly active, she may participate in some vigorous activity as long as she is monitored by her physician and the intensity levels stay the same or lower than pre-pregnancy levels (Evenson et al, 2014).

**Time:** Duration of aerobic exercise recommendations varied between countries from a minimum recommendation of 15 minutes of aerobic exercise to a maximum recommendation of 60 minutes in duration. Higher intensity exercises should be shorter in duration, while low to moderate exercise can be sustained for longer (Evenson et al, 2014).

**Type:** Aerobic exercise is recommended as the primary form of exercise, but low intensity resistance exercise is also suggested, although the focus should be on maintaining muscle mass and endurance rather than increasing strength (Evenson et al, 2014).

A previously sedentary pregnant woman should be medically pre-screened, before beginning an exercise program. If no contraindications exist, she may begin an exercise program gradually and work up to the recommendations. It is advised to stop exercise and consult a physician if dizziness or presyncope occurs, dyspnea before exertion, vaginal bleeding, amniotic fluid leakage, excessive shortness of breath as well as any indication of abdominal or back pain.
Activities in the supine position (lying on the back) should be avoided because the enlarged uterus may obstruct blood flow and change cardiac output in this position. A seated position, standing or side-lying are recommended instead (Evenson et al, 2014).

1.4.3 Meeting the Physical Activity Guidelines in Pregnancy

Many women do not meet the minimum physical activity recommendations during pregnancy (Evenson et al, 2014). A sedentary pregnant woman can decrease sedentary behaviour throughout each day. Activity levels can be measured through wearable devices such as a pedometer to measure step counts. Tudor-Locke and Bassett (2004), developed a guideline for the number of daily step counts needed to achieve health benefits (Table 1.2). Mottola (2013) suggested a goal of 10,000 steps per day for pregnant women to promote health benefits in pregnancy. This goal was shown to be achievable in the Nutrition and Exercise Lifestyle Intervention Program (NELIP) which used a 40-minute structured walking program to increase physical activity levels to 10,000 step per day in overweight and obese pregnant women (Mottola et al, 2010).

Table 1.2 Daily Steps Counts for Health Benefits (Adapted from Tudor-Locke & Bassett, 2004)

<table>
<thead>
<tr>
<th>Activity Index</th>
<th>Daily Step Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary</td>
<td>&lt;5000 steps/day</td>
</tr>
<tr>
<td>Low Active</td>
<td>5000-7499 steps/day</td>
</tr>
<tr>
<td>Somewhat Active</td>
<td>7500-9999 steps/day</td>
</tr>
<tr>
<td>Active</td>
<td>≥10,000 steps/day</td>
</tr>
<tr>
<td>Highly Active</td>
<td>&gt;12,500 steps/day</td>
</tr>
</tbody>
</table>

1.5 Psychosocial Adaptations in Pregnancy

1.5.1 Stress and Anxiety in Pregnant Women

Stress and anxiety may accompany pregnancy. It is those women with high obstetrical risk that may have heightened stress and anxiety (Gorsuch & Key, 1974; Mercer & Ferketich, 1998; Norbeck & Tilden, 1983; Tilden, 1983). Responses to a stressful life event may include anxiety and depression and these responses vary according to perception of the event combined...
with feelings of being able to control the outcome (Mercer & Ferketich, 1998). Anxiety (an emotional response to an event viewed as a threat to well-being resulting in apprehension and uneasiness) may be heightened in situations where a pregnant woman feels like she has little control (Spielberger et al, 1983). Social support and high self-esteem (emotional evaluation of their own worth) may improve the capacity to handle a stressful situation, however studies examining women of high obstetrical risk have shown a deterioration in self-esteem and self-concept (the ability for a person to recognize their self as separate from others) in hospitalized pregnant women. This reduction in self-esteem and self-concept can reduce the ability of a pregnant woman to handle the stress of high obstetrical risk in hospital (Curry & Snell, 1985; Merkatz, 1978; White & Ritchie, 1984).

1.5.2 Antenatal Depression

The Diagnostic and Statistical Manual of Mental Disorders, 4th edition, text revision (DSM-IV-TR) defines a major depressive episode as a collection of symptoms that last for a minimum of two weeks, where at least one of the symptoms include a depressed mood or loss of interest or pleasure (American Psychiatric Association, 2000). Women suffering from antenatal depression, a form of clinical depression that affects women during pregnancy, experience a collection of symptoms that may include emotional distress, social isolation, and excessive concern over pregnancy outcome. These symptoms often result in feelings of guilt in the pregnant woman since pregnancy can be portrayed as a time of immense happiness and fulfillment (Bowen & Muhajarine, 2006; Radloff, 1977).

Antenatal depression is a growing concern among health care professionals due to deleterious effects on both mother and baby during pregnancy and in the postpartum period. Risk factors that have been associated with antenatal depression are history of depression, single marital status, marital difficulties, lack of social support, low socioeconomic status, intimate partner violence, recent stressful life events, substance abuse, history of previous abortions, unplanned pregnancy and anxiety about the fetus (Bowen & Muhajarine, 2006; Brittian et al, 2015) The prevalence of antenatal depression can be difficult to estimate. It is often undiagnosed since many of the symptoms may be associated with hormonal changes that occur during pregnancy (Bowen & Muhajarine, 2006). Estimates rate antenatal depression as one of the most common complications of pregnancy. Seven to twenty percent of pregnant women experience
antenatal depression at some point throughout their pregnancy (Bowen & Muhajarine, 2006; Brittain et al, 2015; Finley & Brizendine, 2015; Flynn et al, 2015). In a study by Geier and colleagues (2015) women were two to three times less likely to receive a diagnosis of depression in pregnancy and in the postpartum, and those that did receive a diagnosis were much less likely to receive treatment for their diagnosis than non-pregnant peers.

With proper diagnosis and treatment, the symptoms of antenatal depression may be mitigated and may prevent future onset of postpartum depression (Finley & Brizendine, 2015) however, current medications used in the treatment of depression may not be suitable in the treatment of a pregnant patient. A significant association has been found between pregnant women prescribed antidepressants and preeclampsia (Avalos et al, 2015). Alternative treatments can be used in the treatment of antenatal depression that do not require the use of antidepressant medication (Bowen & Muhajarine, 2006). Alternative treatments to medications can include supportive therapy, either individually or in a group setting, social support from family and friends, exercise programs, and adequate nutrition and sleep (Bowen & Muhajarine, 2006).

Exercise has been shown to be effective as a means of reducing symptoms of depression and anxiety. An acute exercise session with pregnant women may enhance mood (Polman et al, 2007), while a more chronic exercise program throughout pregnancy may play a role in enhancing mood stability (Poudevigne & O’Connor, 2005). A randomized controlled trial of an exercise program conducted three times per week with 80 pregnant women examined the effects of a moderate physical activity program on maternal health. Women who participated in the exercise program had a significantly improved perception of health status compared to a control group thereby improving maternal emotional well-being both during pregnancy and in the postpartum (Barakat et al, 2011).

1.5.3 The Effect of Maternal Stress and Depression on the Fetus

Researchers are now examining the effects of maternal antenatal and postpartum depression on the fetus. The fetus seems to respond to maternal mood states as evidenced by fetal heart rate tracings that show a decreased variability and altered response to stimulation when exposed to maternal anxiety and depression (Allister et al, 2001). Studies have indicated that poor maternal mental health may affect the growth pattern of the fetus in utero, reduce
gestational age at birth and put children at an increased risk of developmental problems (Brittain et al, 2015; Flynn et al, 2015; Giallo et al, 2015).

A birth cohort study of 726 women, with a depression prevalence of 21 percent, found a strong association between maternal antenatal depression and decreased infant weight-for-age and head-circumference-for-age-z-scores at birth (Brittain et al, 2015). One mechanism that may account for these adverse effects on fetal growth may be the increase in maternal concentrations of corticosteroids and catecholamines elevated with maternal stress and depression. These high concentrations may decrease placental blood flow causing a stress response in the fetus thereby altering fetal patterns of brain development and growth (Glover & O’Connor, 2002). Changes in brain development may have a long term effect into childhood. In a prospective cohort of 1085 mother-infant pairs, the children of mothers reporting high symptoms of depression were at least two times more likely to have emotional-behavioural problems than children of mothers with minimal symptoms (Giallo et al, 2015).

1.6 The Prescription of Bed-Rest in Medicine

Historically bed rest (BR) has been used by physicians to promote healing through rest in critically ill patients. Rest can reduce pain by preventing unnecessary movements, promote patient comfort, and allow the natural repair of damaged tissue (Brower, 2009). It was thought that BR could be used to conserve limited metabolic resources, which could be used towards healing the body from whatever ailment the patient was suffering (Bigelow & Stone, 2011). Short periods of four to six hours of BR after cardiac catheterization and liver biopsy can reduce bleeding complications (Brower, 2009).

Although acute BR may be beneficial in promoting healing, prolonged BR may cause further complications. Randomized controlled trials on the effect of chronic BR on disease have found no beneficial effect of BR on patients with rheumatoid arthritis, acute low back pain, uncomplicated myocardial infarction or high-risk pregnancy (Bigelow & Stone, 2011; Brower, 2009; Maloni, 2010). Due to the frequency of prescribed BR in pregnant populations the following section will describe the BR model in non-pregnant populations and how this coincides with results seen in hospitalized high risk pregnant women (HHRPW).
1.6.1 Complications Accompanying Bed-Rest in Non-Pregnant Individuals

Although in the short term, BR allows for rest and healing of the body, it can cause complications over a longer period of time (more than one week). BR has been investigated for some time by the National Aeronautics and Space Administration (NASA) as an alternative avenue to study the effects of reduced weight-bearing in space. These studies have examined the effects of BR and uncovered a range of side-effects for every system in the human body (Pavy-Le Traon et al, 2007). Complications of BR can include fatigue, headache, mood changes, low back pain, tenseness, difficulty concentrating, back muscle soreness, dry skin, cardiac atrophy, increased heart rate, blood coagulation, heartburn and reflux, constipation, reduced lung compliance, decreased cardiac output, decreased stroke volume, muscle atrophy, joint contracture, thromboembolic disease, skin ulcers, glucose intolerance, insulin resistance in skeletal muscle and increased concentrations of cholesterol and triglycerides in the blood (Brower, 2009; Dorfman et al, 2007; Hamburg et al, 2007 Sandler & Vernikos, 1986). BR may also shift sleep wake cycles altering diurnal rhythms (patterns of behaviour that synchronize with day and night). Patients who undergo BR have increased daytime sleep, although their nighttime sleep is decreased, resulting in an overall sleep time similar to those not on BR (Liang et al, 2014). These ailments can be multiplicative and directly impact the quality of life of the patient (Lenz et al, 1997). It is unknown whether physical changes that occur from BR in bone, muscle and metabolism are completely reversible (Sandler & Vernikos, 1986). Measures used to help counteract the effects of BR include resistance exercise, ambulation, neuromuscular electrical stimulation, and passive stretching of muscles (Brower, 2009).

1.6.2 Cardiovascular Adaptations to Bed Rest in Non-Pregnant Individuals

Cardiovascular deconditioning occurs with prolonged BR as evidenced by research studies which have reported cardiac atrophy, increased heart rate, blood coagulation, decreased cardiac output, and decreased stroke volume following BR (Brower, 2009; Convertino et al, 1997; Dorfman et al, 2007; Fourney et al, 1994; Levine et al, 1997). A BR study with 24 healthy young women who participated in 60 days of 6-degree head-down tilt BR showed a significant decrease in left and right ventricular mass after BR (Dorfman et al, 2007). There is also an increased risk of thromboembolic disease with BR, formation of blood clots that can travel throughout the body and cause damage to the heart and lungs, as prolonged compression of the
veins against the bed can cause venous stasis, damaging the vascular endothelium (Brower, 2009).

Another intervention examined 24 young healthy women who participated in a 56-day BR exercise program. Participants were divided into three groups. An exercise group (n=8), a control group (n=8), and a nutrition only group (n=8). Women in the control group (complete BR with no exercise) had a significantly higher heart rate, decreased stroke volume, and increased vascular resistance following BR. The exercise group (lower body negative pressure treadmill and flywheel resistance exercise) did not show any significant changes in these measures before and after BR. This indicates that resistance exercise may be an effective countermeasure to reduce the cardiovascular deconditioning of BR (Edgell et al, 2007).

1.6.3 Muscle Atrophy with Prolonged Bed Rest in Non-Pregnant Individuals

After 35 days of prolonged, BR De Boer and colleagues (2008) found a significant increase in muscle atrophy as well as a remodeling of muscle architecture in antigravity muscles, but no difference in muscle thickness in non-antigravity muscles. (De Boer et al, 2008). Measurements of muscle loss report that even in as little as 5 days of BR there is approximately a 2 to 3 percent reduction in the cross sectional area of both the calf and thigh muscles (Mulder et al, 2015). This loss in muscle volume occurs primarily from a decreased size of the muscle fibres within the muscle (Adams et al, 2003). Overall measurements of muscle mass are reported to be 1.5% to 2% lower after the first two weeks of BR, but the effect is even higher in weight bearing muscles required for locomotion (Brower, 2009).

Heightened amounts of circulating cortisol (hypercortisolemia) can further exacerbate the muscle atrophy caused by BR (Ferrando et al, 2006). Loss of skeletal muscle may be slowed by supplementing the patient with essential amino acids to promote muscle anabolism, however protein supplementation does not fully counteract the loss of muscle mass. Further measures are needed to counteract the multitude of side-effects that occur with BR, especially when accompanied with the high stress of a traumatic injury prior to hospitalization (Ferrando et al, 2006).
1.6.4 Exercise Programs to Reduce Side-Effects of Bed-Rest

Bed-rest studies with young healthy non-pregnant adults have found that resistance exercise programs can be used as a countermeasure to prevent the side-effects of muscle and bone deterioration accumulated during BR (Akima et al, 2001; Beller et al, 2011; Mulder et al, 2015; Shackelford et al, 2004). BMD increases in response to mechanical stress on the bone, however, when stressors are removed, such as with bed-rest, BMD decreases (Snow-Hater & Marcus, 1991). Exercise programs during BR may be able to maintain some of the mechanical stress on the bone and therefore may maintain BMD (Snow-Hater & Marcus, 1991).

A study by Akima and colleagues (2001) investigated the effects of resistance training during BR on muscle size in the lower limb. Fifteen healthy men were placed on twenty days of BR with 6-degree head-down tilt. Five participants in the exercise group performed two sessions of dynamic leg press action daily. These participants were compared to ten participants placed on the same BR protocol with no exercise program. The participants who completed the resistance exercise program were better able to retain the physiological cross sectional area of the knee flexor and extensor muscles. The results of the study indicate that lower body resistance exercise may be effective in preventing the deteriorating effects of muscle atrophy that can occur with prolonged BR (Akima et al, 2001).

Shackelford and colleagues (2004) used a supine maximal resistance exercise program during 17 weeks of horizontal BR as a countermeasure to reduce bone loss and muscle atrophy. Five men and four women completed the BR exercise program and were compared to 18 control subjects (13 men and 5 women) who participated in the BR program with no exercise. Participant BMD, bone mass, metabolic markers and calcium balance were measured before, during and after BR. The gastrocnemius and soleus muscle volumes decreased significantly in both groups, but the exercise group lost significantly less muscle volume than the control group (Shackelford et al, 2004). Calcium concentrations were significantly reduced in the BR only control group indicating a reduction in bone density. The exercise group was able to maintain calcium concentrations and minimize muscle atrophy caused by BR, indicating a preservation of muscle and bone, with a supine maximal resistance exercise program (Shackelford et al, 2004).

Another study with 27 volunteers completed an exercise program with a rowing ergometer during 5 weeks of 6-degree head-down-tilt BR (Krainski et al, 2014). Participants
were randomized to either the exercise program which consisted of rowing ergometry six days per week with supplemental strength training or a control group with no exercise. Sedentary BR patients (control group) significantly decreased muscle volume in both the quadriceps and plantar flexor muscles. The exercise program was able to reduce muscle atrophy, but was unable to fully prevent the atrophy in the antigravity muscles (Krainski et al, 2014). A further study also showed that muscle strength may be maintained with an exercise training program during 5 days of BR, however the exercise program was unable to prevent the BR induced bone resorption that occurred after 5 days of BR (Mulder et al, 2015).

A study with both an exercise and nutrition countermeasure investigated the effects of 60 days of BR on bone mineral density and muscle mass (Beller et al, 2011). Twelve healthy women of childbearing age were assigned to one of three groups: a resistance and endurance training exercise group, a high protein diet nutrition group, or a control group. The exercise countermeasure was able to reduce muscle loss compared to the control group while the nutrition countermeasure had similar changes in muscle loss as the control group (Beller et al, 2011). Lee and colleagues (2014) performed a similar study with twelve healthy non-pregnant women. Neither countermeasure was effective in preventing bone loss in either study. Even up to one-year post intervention regional differences in bone loss were still not completely restored (Beller et al, 2011). The results indicated that a combined resistance and aerobic exercise program protects against losses in strength, endurance and lower limb muscle mass in women, whereas a nutritional countermeasure only may not be effective in preventing these side-effects (Lee et al, 2014).

1.6.5 Recommendations for Rehabilitation after Bed-Rest

It is clear from the literature that prolonged BR has detrimental side-effects. Since the onset of BR complications such as muscle atrophy can occur as soon as 4 hours of BR, it is important to administer preventative measures such as an in-bed exercise program or shorts periods of ambulation if the patients are able (Kasper et al, 2002). The primary focus of any BR rehabilitation program should be the muscles of locomotion which are most directly affected in the prescription of BR (De Boer et al, 2008). Muscle cross sectional area, leg power, and peak VO\(_2\) may be maintained with a rigorous integrated resistance and aerobic exercise program with high compliance in healthy non-pregnant adults, but this may not be generalizable to other
populations (Ploutz-Snyder et al, 2014). After prolonged BR the patient will be experiencing bone, muscle and joint side-effects. It is vital that those suffering from side-effects are slowly introduced to weight bearing activities for short periods of time to rebuild the structural damage that has occurred without causing further injury and immobilization (Kasper et al, 2002).

1.7 Activity-Restriction in High Risk Hospitalized Pregnant Women (HHRPW)

Although bed-rest is usually no longer prescribed in the medical community, many physicians still prescribe restricted activity for high risk pregnancies (Biggio, 2013). The amount of activity prescribed varies according to physician as well as the reason for hospitalization (Maloni et al, 1993). Hospitalized activity-restriction is primarily used to reduce the risk of preterm labour and is often prescribed in women with high-risk obstetric problems (Bigelow & Stone, 2011; Maloni et al, 1993). The more risk factors associated with a pregnancy, such as previous miscarriage or multiple gestation, the more likely it is that activity-restriction will be recommended, (Maloni, 2010). Although there has been limited research to suggest that activity-restriction consistently yields better outcomes than no activity-restriction, it is often seen as the most conservative path to take when the status of the mother or baby is at risk (Maloni & Park, 2005). Hospitalizing the pregnant women puts the mother and fetus under constant clinical supervision and ensures that they will receive immediate medical care if needed. Activity-restriction is similar to BR in that it is often accompanied by a myriad of physical, psychological and psychosocial side-effects that may affect maternal quality of life (Sciscione, 2010).

1.7.1 The Prescription of Activity-Restriction in Pregnancy

As many as 25,000 Canadian women are activity-restricted to prevent preterm delivery every year (Sprague et al, 2008). See Table 1.3 for obstetric conditions requiring hospitalization.
Table 1.3 Obstetric conditions requiring hospitalization

<table>
<thead>
<tr>
<th>Obstetric Condition</th>
<th>Definition</th>
<th>Management</th>
</tr>
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<tbody>
<tr>
<td>Placenta Previa</td>
<td>An abnormally firm attachment of the placental villi to the maternal uterine wall that grows across the cervix, preventing vaginal delivery (Miller et al, 1997)</td>
<td>Hospitalization &amp; Physician Supervision</td>
</tr>
<tr>
<td>Placental Abruption</td>
<td>Premature separation of the placenta occurring in approximately 1% of all births. It is the leading cause of vaginal bleeding in the second half of pregnancy (Oyelse &amp; Ananth, 2006)</td>
<td>Hospitalization &amp; Physician Supervision</td>
</tr>
<tr>
<td>Preterm premature rupture of membranes (PPROM)</td>
<td>Rupture of the membranes before the onset of labour prior to 37 weeks gestation. (American College of Obstetricians and Gynecologists, 2007)</td>
<td></td>
</tr>
<tr>
<td>Incompetent cervix</td>
<td>Recurrent painless dilation of the cervix usually occurring midway through pregnancy resulting in preterm birth (Owen et al, 2003)</td>
<td>Hospitalization &amp; Physician Supervision</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>Elevated maternal blood pressure after 20 weeks gestation with proteinuria (American College of Obstetrics and Gynecology, 2014).</td>
<td>Immediate delivery</td>
</tr>
</tbody>
</table>
1.7.2 Cost of Hospitalization

Hospitalization for both the mother and her preterm infant (before 37 weeks gestation, Sosa et al, 2015) cost the healthcare system a massive amount of money each year. A Canadian Institute for Health Information (CIHI) survey estimated that a normal weight newborn cost the Canadian health care system approximately $1,000 while small for gestational age babies (<2500 grams) can cost substantially more with those under 750 grams can cost up to $117,000 (Lim et al, 2009). The smaller the baby, the more time spent in the Neonatal Intensive Care Unit (NICU) and the more resources are required for care. Preventing preterm birth and improving maternal child healthcare for high risk mothers and babies is paramount reducing costs to the healthcare system.

1.7.3 Activity Levels of Hospitalized High Risk Pregnant Women

Previous studies have observed the activity levels of hospitalized high risk pregnant women (HHRPW). These studies demonstrate that the degree of activity-restriction in this population is quite substantial. Maloni and Schneider (2002) reported that 141 hospitalized pregnant women spent an average of 22.4±0.94 hours per day in bed. This equates to only 1.6 hours per day spent outside of bed. This prompted further research in the field to use pedometers to record step counts to further investigate the level of restriction these women experience while in hospital.

A pilot study completed by Tomkins and colleagues (2007) examined dietary intake, capillary blood glucose and activity levels in HHRPW in the third trimester. Specifically, 20 women wore a pedometer 24 hours per day for 7 days while in hospital. In this study participants took an average of 1,579 ± 936 steps per day, compared to ambulatory pregnant women who walked an average of 6,495 ± 2,282 steps per day (Tomkins et al, 2007). Later studies with HHRPW reported pedometer step counts of 1504 ± 1,377 steps per day (Brandao et al, 2011) and 1329 ± 926 steps per day (Vanderspank et al, 2014). According to the Tudor-Locke and Bassett’s activity index ambulatory pregnant women were in the low active range while hospitalized pregnant woman were extremely sedentary (Tudor-Locke & Bassett, 2004) (See Table 1.2). This demonstrates that high risk pregnant women are indeed severely restricted in their activity levels while in hospital.
1.7.4 Efficacy of Managing HHRPW with Activity-Restriction

Activity-restriction during pregnancy is a controversial issue within the medical community. While some call the practice unethical (McCall et al, 2013) and call for further studies (Biggio, 2013), others continue to prescribe activity-restriction until an alternative treatment for high-risk pregnant women has been validated within evidence-based practice. Even though there is a critical need to establish a better standard of care for this population there has been limited research to suggest alternatives for the current practice of activity-restriction prescribed in this population (Sprague, 2004). The evidence that does exist suggests that the physical, psychosocial, and financial cost of activity-restriction may outweigh the benefits (Bigelow & Stone, 2013).

1.7.5 Physiological Symptoms of Activity-Restriction in Pregnant Women

Since the activity levels of HHRPW are so reduced, many women exhibit physiological side-effects similar to non-pregnant bed-rested individuals. These symptoms can include muscle atrophy, cardiovascular deconditioning, bone demineralization, and decreased weight gain (Brandao et al, 2011; Maloni, 2010; Maloni et al, 1993; Maloni & Schneider, 2002; Vanderspank et al, 2014). Current research on the topic does show that there are some severe side-effects which need further investigation to conceptualize the full effects of this prescription of activity-restriction (Maloni et al, 1993; Maloni, 2010).

A study by Maloni and colleagues (1993) examined the physical and psychosocial side-effects of 17 antepartum bed-rested women compared to 18 pregnant non-bed rested controls. Women were categorized into complete bed-rest (n=10), no skeletal weight bearing for two or more days, or partial bed-rest (n=7), no skeletal weight bearing for a period of less than two days (Maloni et al, 1993). Women on both types of bed-rest complained of postpartum deep muscle soreness, especially from the postural muscles in the back of the legs, which had a large reduction in use while in hospital. During their first week postpartum women previously on BR had more difficulty with simple mobility tasks, such as walking up stairs, as their legs were unable to bear their weight in ascending stairs. Those on complete bed-rest had more difficulty than those on partial bed-rest (Maloni et al, 1993).

A concern with activity-restricted pregnant patients is a lack of functional mobility in everyday tasks as they resume ambulation (Maloni et al, 1993). This is due in part to the loss of
muscle mass that occurs from disuse while in hospital. Maloni and Schneider (2002) investigated time needed to re-oxygenate the gastrocnemius muscle after plantar flexion exercise in HHRPW. Re-oxygenation was used as a marker of muscle efficiency. Sixty-five pregnant women on hospitalized bed-rest were recruited with a mean of 24.8 days (5 to 70 days) in hospital. During hospitalization the gastrocnemius muscle of HHRPW needed significantly more time to re-oxygenate after exercise compared to a control group of ambulatory pregnant women of similar gestational age. When these HHRPW returned home and resumed ambulation, re-oxygenation of weight bearing muscles significantly improved, but were still not completely recovered six weeks postpartum. Participants also reported postpartum soreness of weight bearing muscles and issues with mobility. The study concluded that women are discharged from prolonged hospitalization after childbirth without the resources to aid in recovering from the physiological deconditioning that occurs with prolonged hospitalization (Maloni & Schneider, 2002).

1.7.6 Bone Loss in HHRPW

Due to the nature of activity-restriction, in that patients are restricted from weight bearing activities for long periods of time, it is important to evaluate the effects on bone health. Women placed on antepartum bed-rest are six times more likely to lose more than 5% of their bone density in as little as 20 weeks (Promislow et al, 2004).

Bone status in fourteen HHRPW was recently investigated by Brandao and colleagues (2011). Bone status was compared in the left and right calcaneus bone using quantitative ultrasound. This population group had an average hospital stay of 16 days and took an average of 1504 ± 1377 steps per day. There were significant differences in bone stiffness index scores in HHRPW compared to similar control ambulatory pregnant women (Brandao et al, 2011). It seems that a reduction of weight bearing activities for as little as two to three weeks may have consequences on subsequent bone health, increasing the risk of potential future fractures.

Fracture risk was further investigated by Vanderspank and colleagues (2014) who investigated bone health in HHRPW. Fourteen HHRPW were recruited and urinary deoxypyridinoline (Dpd) excretion, a marker of bone resorption, was measured once per week while in hospital. Dpd excretion was higher in HHRPW than ambulatory control participants, indicating that HHRPW had more bone resorption while in hospital than their ambulatory counterparts. The longer a participant was activity-restricted, the higher the amount of Dpd
excreted (Vanderspank et al, 2014). Longer activity-restriction, coupled with more bone resorption, may lead to unintended health consequences such as an increased risk of fracture and future development of osteopenia and osteoporosis (Vanderspank et al, 2014).

1.7.7 Weight Loss in HHRPW

There may be serious long term health implications for the offspring of mothers who do not gain enough weight during pregnancy as well as those who gain excessive gestational weight. While much of the growing concern among researchers today is based around excessive gestational weight gain with an increasingly obesogenic environment, the concern for activity-restricted pregnant women is the lack of weight gain, or even weight loss, that occurs in hospital (Maloni et al, 1993). See Table 1.1 for IOM recommendations for appropriate weight gain during pregnancy.

In 1993, Maloni and colleagues observed a weight loss trend in 17 HHRPW. The finding that many HHRPW had an initial weight loss when admitted to hospital followed by a slower loss or slow weight gain was concerning (Maloni et al, 1993). Because of this weight loss, many HHRPW gained less weight overall than ambulatory pregnant women, and many failed to meet weight gain guidelines. This finding was further investigated in a subsequent study by Maloni and colleagues (2004) who followed 141 HHRPW with singleton pregnancies. Seventy-five percent of the sample of HHRPW either lost or failed to gain weight appropriately in the first week of hospitalization. This trend continued across hospitalization. Infant weight was also decreased. Seventy-five percent of babies were born below the national mean for their specific gestational age, race, and gender comparison group. The strongest predictor of infant weight gain was maternal weight gain, most likely resulting from maternal physiologic changes induced by bed-rest (Maloni et al, 2004).

Lower infant birth weights in HHRPW indicate that a lower maternal weight gain may be affecting infant growth patterns causing a higher risk of fetal growth restriction to an already high risk population. It is unknown whether the lower birth weights and shorter gestational age is due in part to the restricted activity levels of the mothers or simply because of the high risk nature of the pregnancies prescribed bed-rest. It is likely a combination of several factors that play a part in the early delivery and low birth weights of these high risk babies.
1.7.8 Preterm Labour and Birth

Babies born to mothers who had been placed on antenatal bed-rest had lower birth weights and gestational age at delivery often as a result of a preterm birth (Maloni et al, 2004; Maloni et al, 2006). Gestational age is established based on the start of the last menstrual period or through an ultrasound (McCarty-Singleton & Sciscione, 2014) and a preterm birth is defined as a birth before 37 weeks gestation (Sosa et al, 2015). Low birth weight (<2500 grams) may be caused by a preterm birth or by intrauterine growth restriction (Maloni, 1993). Increasing health care technology has provided medical teams with better equipment to care for this population, but the number of preterm babies in Canada has risen quite substantially over the last few decades. In Canada there were approximately 386,000 babies born in 2014. Of these babies there was an estimated 6% born with a low birth weight (Statistics Canada, 2014). The preterm birth weight in 1980 was approximately 6% of the population, but this number has risen to 8.1% in 2006 to 2007 (Lim et al, 2009). Although improved technology has allowed the healthcare system to better provide for preterm babies, increasing maternal age and technologies such as in vitro fertilization have elevated preterm births to higher than it has been historically (Lim et al, 2009).

During normal fetal growth and development organs and pathways are programmed, but this process may be disrupted by a preterm birth. Barker (2004) coined the term Developmental Origins of Health and Disease (DOHaD) in his investigations on the effect of various developmental factors on later disease risk (Barker, 2004). This theory outlines that there are critical periods in development. If a fetus is restricted by the uterine environment, genetic programming may be altered to anticipate similar restricted environments. If a previously restricted infant is no longer restricted after birth, there will be a mismatch between expectations and reality. This mismatch of genetic expectations in early development can have long-term consequences on future disease risk such as obesity, coronary heart disease and type 2 diabetes (Barker, 2012).

1.8 Psychosocial Side-Effects of Activity-Restriction in HHRPW

Activity-restriction can be accompanied by, not only physical, but also a myriad of psychosocial side-effects, both during pregnancy and the postpartum. Being identified as having
a high risk pregnancy and being treated in hospital for an emergent condition are likely to affect women psychosocially (Maloni, 2010). Some of the more common psychosocial side-effects can be depression, anxiety, stress, and boredom (Finley & Brizendine, 2015; Marques et al, 2015). During hospitalization the mother is under a great deal of stress, which may affect immunological and central nervous system development of the fetus (White & Ritchie, 1984). Hospitalization may also cause added stress to family members, who often have to take on added responsibilities while the pregnant mother is in hospital (Maloni & Ponder, 1997).

One of the most common psychosocial complications of pregnancy is depression (Da Costa et al, 2003), which can be compounded by the stress of a high-risk pregnancy. During hospitalization, the pregnant woman is often isolated from family, friends, and job environments and may have trouble coping with the added stress of a high risk pregnancy. Perinatal depression can also be a risk factor for postpartum depression (Radloff, 1977). It may be important to identify women with high perinatal depression, not only to improve her antepartum psychological state, but also in an effort to prevent postpartum depression.

The experiences of women deemed to have a high risk pregnancy differs greatly from low risk counterparts. Maloni and colleagues (1993) developed an Antepartum Hospital Stressors questionnaire and found that separation from family was reported as the most stressful part of hospitalization with a high risk pregnancy. Hospitalized women also reported higher boredom than their non-bed-rested counterparts (Maloni et al, 1993).

1.9 Exercise and the High Risk Pregnant Woman

A potential solution to the side-effects of activity-restriction may be to incorporate exercise into the routines of hospitalized pregnant women to reduce the physiological and psychosocial side-effects of activity-restriction in hospital. As early as 1992, research suggested that women with preterm labour might be able to participate in an exercise program with minimal risk of increasing uterine activity (Mayberry et al, 1992).

A recent retrospective study examined the effectiveness of an aquatic exercise program (AEP) conducted in a rural hospital in the southwest region of the United States with HHRPW (Sechrist et al, 2015). The study examined the medical records of 19 hospitalized pregnant women who participated in an AEP compared to 13 similar control women with no AEP. The
AEP was conducted by an occupational therapist 3 times per week for one hour sessions in a group setting. There was a significantly higher amniotic fluid index and a longer gestation in the women who participated in the AEP compared to those who did not (Sechrist et al, 2015). A prospective randomized controlled trial is needed to further investigate the benefits of an AEP for this population.

A prospective pilot exercise program developed in London, Canada by Brun and colleagues (2011) involved one bout of an in-bed exercise program using resistance bands as a form of resistance exercise for both lower and upper body. There was a total of 11 participants randomized to one of two groups, 6 in a bed-rest exercise group and 5 in a bed-rest music group which acted as a control. The control group and exercise group both listened to the same music. Those who participated in the exercise session showed no significant changes in maternal blood pressure or the number of uterine contractions compared to the control group. There were no difference in vaginal bleeding or delayed uterine contractions up to 2 days after the exercise program (Brun et al, 2011). This indicates that a bed-rest exercise program may be safe for HHRPW. A further case study by Brun and colleagues (2012) indicated that a more chronic bed-rest exercise program over several weeks may be feasible while maintaining the safety of both the pregnant woman and the fetuses (Brun et al, 2012).

Antepartum activity-restricted hospitalized women are expected to return home shortly after delivery to take on the responsibility of caring for a new infant, as well as other children and household responsibilities. After the birth of the baby clinical focus turns toward ensuring the health of the new infant, often overshadowing the rehabilitative needs of the mother (Maloni et al, 1993). Research has suggested that women be admitted to a rehabilitation program after childbirth to regain cardiovascular conditioning and functional ability (Maloni & Park, 2005). There were only a few pilot studies that used an intervention to try to reduce the side-effects of activity-restriction in hospitalized pregnant women, even though resistance exercise programs have been shown to be effective in non-pregnant populations (Akima et al, 2001; Mulder et al, 2015). Based on a thorough review of the literature, it is evident that further research is needed to reduce the side-effects found in HHRPW, both in hospital and the postpartum period.
Chapter 2: Purpose and Hypothesis

2.1 Purpose

The primary purpose of the current pilot study was to investigate whether an exercise program conducted in bed and given to hospitalized activity-restricted high-risk pregnant women would improve functional ability and overall quality of life in the postpartum period compared to a control group with no exercise program. The secondary purpose was to create a profile of HHRPW while in hospital.

2.2 Hypothesis

It is hypothesized that women who participate in a hospitalized antepartum bed-rest-exercise program using resistance bands will have better functional ability and a higher quality of life in the early postpartum (2 months postpartum) compared to a similar control group with no in-bed exercise program.
Chapter 3: Methods

3.1 Participants

Participants were recruited from the London Health Science Centre (LHSC) antenatal ward in London, Ontario between the dates of November 24, 2014 and August 31, 2015.

3.1.1 Inclusion Criteria

Hospitalized high-risk pregnant women (HHRPW) with gestational hypertension, preeclampsia (mild to moderate), intrauterine growth restriction, singletons, twins, triplets, shortened cervix, or threatened pre-term labour (not actively contracting) were recruited. Women had to be at least 28 weeks gestation and activity-restricted in hospital for at least 7 days prior to entry into the study.

3.1.2 Exclusion Criteria

Exclusion criteria included those with symptomatic placenta previa (bleeding), severe pre-eclampsia (immediate delivery), heart and renal disease, Type 1 diabetes, Type 2 diabetes, metabolic bone disease, hyper-or-hypo-thyroidism, Cushing disease, and anemia as well as conditions with short term hospital stays of less than 7 days, such as, but not limited to, infections. Women carrying more than 3 babies were also excluded.

3.2 Study Design

The present study was a pilot randomized controlled trial consisting of a parallel single center design (LHSC), and registered at ClinicalTrials.gov Identifier: NCT02239341. The study protocol was approved by the University of Western Ontario Health Science Research Ethics Board (Appendix A). Participants were recruited in collaboration with the antenatal nursing staff at LHSC. All participants were initially screened by a ward nurse for eligibility and then approached in person by the researcher in an interview setting. Each participant was presented with a letter of information and consent form (Appendix B) and written informed consent was obtained before baseline information was collected. Experimental design consisted of four parts: baseline measurements, interventions, birth measurements and postpartum follow-up. The timeline of the research study is outlined in Figure 3.1.
3.3 Baseline Measurements

After written consent was obtained each participant filled out baseline questionnaires (History and Activity Questionnaire, Psychosocial Profile Questionnaire, and EQ-5D; see below) which were used to create a profile of hospitalized activity-restricted pregnant women. The participant was then given a pedometer to track her daily step count for the next 7 days while concurrently filling out a 7-day food intake record (see below).
3.3.1 History and Activity Questionnaire (Appendix C)

The History and Activity questionnaire was developed by our research team for exercising pregnant women. (Campbell & Mottola, 2001). The modified questionnaire gathered information about health habits, level of activity-restriction at the time the questionnaires was administered, and previous activity level (including both pre-pregnancy activity levels as well as activity levels during each trimester of pregnancy).

3.3.2. Psychosocial Profile Questionnaire (Appendix D)

The Psychosocial Profile Questionnaire consisted of four individual questionnaires that made up a psychosocial profile of each participant.

A) Centre of Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977)

The CES-D was composed of 20 questions, of which 3 were scored in reverse order (4, 12, and 16). A 4-point scale (0,1,2,3) was used as the method of response where 0 indicated that they had felt that way “Rarely or none of the time”, 1 indicated “Some or a little of the time,” 2 indicated “Occasionally or a moderate amount of time”, and 3 indicated “Most or all of the time.” Scores on the scale ranged from 0 to 60, with higher scores indicating higher levels of depression. A score of ≥16 was used as an indicator of major depression (Marcus et al. 2003). An example question on the scale would be: “I felt that everything I did was an effort.”

B) State Anxiety Index (Short Version) (Spielberger, 1980)

A modified short version of the State Anxiety Index was used to assess maternal state anxiety. This short version was composed of 12 questions, of which 6 were scored in reverse order (1, 2, 6, 9, 11, and 12). The index used a 4-point scale (1,2,3,4) where 1 indicated “Not at all”, 2 indicated “Somewhat,” 3 indicated “Moderately so,” and 4 indicated “Very much so.” Scores on the index could range from 12 to 48 with higher scores indicating higher levels of anxiety. An example question on the state anxiety index was: “I am presently worrying about possible misfortunes.”

C) Antepartum Physical and Psychological Symptoms Report (Maloni et al, 1993)

The Antepartum Physical and Psychological Symptoms Report assessed both the physical and psychological symptoms related to antepartum hospital BR. The report was composed of
49 items; 42 items related to physiological symptoms and 7 items related to psychological symptoms (thinking or mood). Reported symptoms were those that were identified over the last 7 days, while in hospital. Responses were scored on a 4-point scale including “Not Applicable” where 1 indicated “Mild symptoms,” 2 indicated “Moderate symptoms,” and 3 indicated “Severe symptoms.” An example question from the symptoms report would be: “Have you had any muscle cramps over the past week?”

**D) Antepartum Hospital Stressors Inventory (AHSI) (White, 1981)**

The AHSI was developed to assess potential stressors affecting pregnant women while hospitalized. The inventory was composed of 49 items and was based on stressors over the last 7 days, while in hospital. The inventory was scored on a 5-point scale including “Not Applicable,” where 0 indicated “No stress,” 1 indicated “Very little stress,” 2 indicated “Some stress,” 3 indicated “A lot of stress,” and 4 indicated “A great deal of stress.” Responses were divided into 7 categories: Separation (7 items), Environment (9 items), Health Status (10 items), Communication with Professionals (7 items), Self-Image (8 items), Emotions (5 items), and Family Status (3 items). An example question would be: “Thinking about my baby’s health.”

**3.3.3. EQ-5D (Appendix E) (Gusi et al, 2010).**

The EuroQol-5 Dimensional Scale (EQ-5D) is a health related quality of life questionnaire which asked five questions related to mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The participant was asked to pick the sentence that best fit their level of functioning at that point in time. This questionnaire gave a perspective of the physical and psychological health at the time of administration.

**3.3.4. Pedometer Log. (Appendix F)**

Participants wore a pedometer (ACCUSPLIT AE120XL) secured to their waistband 24 hours a day for 7 days, except while showering. All physical activity was recorded in the comments section of the 7-day pedometer log (Tomkins et al, 2007). Participants were instructed to record the total number of steps from the pedometer before they went to bed each night and then reset the pedometer to zero.
3.3.5. Food Intake Record. (Appendix G)

All participants were given a 7-day food intake record to fill out concurrently with their 7-day pedometer log. Participants were instructed to keep the meal tickets delivered to them by hospital staff with each meal. Any extra food eaten was recorded in the food log, giving as much detail as possible including the time, place, food description, method of preparation and amount of each food item. Both the 7-day food intake record and the meal tickets were used in combination to assess the nutritional intake of each participant. Nutritional intake was analyzed using The Food Processor SQL version 10.11.0 (ESHA Research 2012: Nutrition Analysis Software).

3.4. Intervention

After baseline measurements were complete each woman was randomized to one of two groups using sealed opaque envelopes as per the method of allocation concealment in accordance with CONSORT 2010 guidelines (Schulz et al, 2010). Each participant was then presented with a second letter of information and consent, specific to her group (Appendix H; Appendix I).

3.4.1. Exercise Intervention (Appendix J)

The exercise intervention, specifically designed for HHRPW in a previous study, was conducted in bed (Brun et al, 2011). The exercise program consisted of a 30-minute intervention of 5-minutes of warm-up, 20 minutes of strengthening exercises using latex stretch bands, and 5 minutes of cool-down (Appendix J). The first exercise session for each participant was used to assess initial muscle strength. Difficulty level was adjusted by using different strength stretch bands as deemed appropriate by the researcher. Instrumental music (70-90 bpm) was played through earphones on an iPod throughout each exercise session. The Exercise-Induced Feeling Inventory (EFI) questionnaire (see below) was administered before and after each session to assess mood states pre and post exercise intervention.

Each woman in the exercise group was visited by the researcher five times per week. Heart rate was monitored at rest before exercise and throughout each exercise session via a polar heart rate monitor, which was strapped to the chest directly below the breasts for all exercise sessions. The first session of each week also included blood pressure measurements before and
after the exercise program was administered. Blood pressure was taken using a hospital blood pressure cuff.

3.4.2 Music Intervention (Control Group)

Participants randomized to the music group listened to the same music as the exercise group while in bed (70-90 bpm) for 30 minute sessions, 5 times per week. The EFI was also administered pre and post music intervention. Heart rate and blood pressure measurements were taken in the same manner as the exercise group. The music group acted as a control group for the exercise group.

3.4.3 Exercise Induced Feeling Inventory (Appendix K) (Gauvin & Rejeski 1993)

The Exercise Induced Feeling Inventory was a questionnaire used to assess mood states. It was administered daily pre and post intervention for both the exercise and music groups. The questionnaire was composed of 12 items divided into four distinct feeling states: revitalization, tranquility, positive engagement and physical exhaustion. It was scored on a 5-point scale where 0 indicated “Do Not Feel”, 1 indicated “Feel Slightly,” 2 indicated “Feel Moderately,” 3 indicated “Feel Strongly,” and 4 indicated “Feel Very Strongly.

3.5. Birth Information

Birth information was collected from hospital birth records within 48 hours of delivery. Information collected included: gestational age at birth, birth weight (grams), length (cm), head circumference (cm), sex of infant, type of delivery (vaginal or caesarean) and any complications that may have occurred during labour or parturition.

3.6. Postpartum Follow-Up

Participants were contacted via email or by phone at 2 weeks and 2 months postpartum. Each participant was invited to The Exercise and Pregnancy Lab at Western University for follow-up measures. The participants were also given the option of completing the follow-up measures in the participant’s home for convenience. Follow-up included a set of questionnaires designed for the postpartum mother (Breastfeeding Questionnaire, Postpartum Psychosocial Profile Questionnaire, and the Kaiser Physical Activity Survey). The Functional Mobility
Assessment Tool (FMAT) was also administered to assess functional ability in the early postpartum (see below).

3.6.1. Breastfeeding Questionnaire (Appendix M) (Labbok & Krasovek, 1990)

The breastfeeding questionnaire was a one-page questionnaire developed by Labbok and Krasovek (1990) to assess current breastfeeding status at the time of the questionnaire. The questionnaire differentiates between full and partial breastfeeding and specifies the frequency, duration, and intervals between breastfeeds. It also specifies other feedings other than breastfeeding.

3.6.2. Postpartum Psychosocial Profile Questionnaire: (Appendix N)

The Postpartum Psychosocial Profile Questionnaire consisted of three questionnaires used to develop a psychosocial profile of postpartum women with a previous high risk pregnancy in hospital.

A) **Centre of Epidemiological Studies Depression Scale** (same scale as used in baseline measurements; Radloff, 1977).

B) **State Anxiety Index** (same scale as used in baseline measurements; Spielberger, 1980).

C) **Postpartum Physical and Psychological Symptoms Report** (Maloni et al, 1993).

The Postpartum Physical and Psychological Symptoms Report was composed of 62 items related to postpartum symptoms, 35 physical symptoms, 7 psychological symptoms pertaining to thinking and mood, 13 items related to activities of daily living, and 7 items related to mobility. It was used as an indirect measure of cardiovascular deconditioning. An example question was: “Please tell me the day when you first resumed walking up stairs following delivery.”

3.6.3 Kaiser Physical Activity Survey (Appendix N)

The Kaiser physical activity survey consisted of 38 items divided into four categories: Household and Family Care Activities (11 items), Occupational Activities (8 items), Active Living Habits (4 items), and Participation in Sports and Exercise (15 items). Each question had a list of responses. Participants were instructed to pick the response that best fit their level of
activity over the past two weeks. This questionnaire was validated with pregnant women in 2006 by Schmidt and colleagues. (Schmidt et al, 2006).

### 3.6.4 Functional Mobility Assessment Tool (Appendix L) (Rikli & Jones, 2003)

To assess physical deconditioning in the early postpartum period the Functional Mobility Assessment Tool (FMAT), adapted from the Senior Fit Test, was used at the 2 week and 2-month follow-up visit. The FMAT consisted of 7 tests to assess muscular strength, aerobic endurance, flexibility and agility (Chair Stand Test, Arm Curl Test, 6-Minute Walk Test, 2-Minute Step Test, Chair Sit-And-Reach Test, Back Scratch Test, and 8-Foot-Up-And-Go Test, respectively).

### 3.7 Sample Size Calculation

The equation \( \frac{N}{\text{group}} = \frac{2(Z_{\alpha} + Z_{\beta})^2\sigma^2}{(\delta-M)^2} \) (Chow et al, 2003) was used to calculate the sample size needed for each group. \( Z_{\alpha} \) and \( Z_{\beta} \) were the normal z-scores for a power of 80% (\( \beta=0.2 \)) and a type I (\( \alpha \)) error rate of 5%, \( \sigma \) was the standard deviation (SD), \( \delta \) was the expected change and \( M \) was the clinically important difference.

The FMAT was tested previously on ambulatory postpartum women at 2 months. Ambulatory postpartum women (N=3) walked 480 ± 135m on the 6-minute walk test. It was hypothesized that there would be a 65% change (\( \delta = 168 \)) when antepartum hospitalized activity-restricted women were tested in the postpartum on the 6-min walk test. A clinically important difference would be seen one SD from the mean therefore \( M \) was set at 345m. Allowing for a 15% attrition rate, 15 women were needed in each group.

### 3.8 Statistical Analysis

Statistical analysis included student t-tests, which were used to detect differences between the groups as well as pre versus post intervention for each group (significance accepted at the \( p \leq 0.05 \)). Chi squared tests were used to analyze nominal data for physiological and psychosocial symptoms both in hospital and postpartum (significance accepted at the \( p \leq 0.05 \)).
Chapter 4: Results

4.1 Recruitment and Randomization of HHRPW

Of the 69 women who met the inclusion criteria 47 were not enrolled for the following reasons: 18 declined (no reason given), 16 decided there was too much of a time commitment, 8 did not want to commit to follow-up and 5 were discharged or gave birth before committing to the study. Twenty two women consented to participate in the intervention study. Of these women two were discharged before any baseline questionnaires could be administered. Five women completed partial baseline data, but delivered early and were not randomized. This left 15 women who were randomized to either the exercise intervention (n=7) or the music intervention (n=8). Two women randomized to the exercise intervention did not receive the allocated intervention because one did not want to exercise and the other delivered before initiation of the exercise program. One woman randomized to the music intervention did not participate due to early delivery and three women were discharged from the hospital before initiation of the intervention. Two women who received the exercise intervention and one woman who received the music intervention did not respond to attempts at follow-up post-delivery. Three women in the exercise group, one woman in the music group and two women who had not been able to receive an intervention agreed to participate in the postpartum functional ability follow-up testing (see Figure 4.1). Two women in the music group were able to respond via email to postpartum follow-up questionnaires, but were unable to complete the postpartum FMAT. Partial baseline data were collected for five women who were not randomized (refer to A in Figure 4.1), because they gave birth early, but birth information was recorded. Baseline data were collected from two women randomized to the exercise intervention. One gave birth before the intervention began, who also provided birth record information. The other woman only provided baseline information. (refer to B in Figure 4.1). Four women were allocated to the music group and did not initiate the intervention due to early birth (n=1) or being discharged (n=3), but all completed baseline data (n=4). Birth record information was collected and postpartum follow-up was completed for only two of the four women (refer to C in Figure 4.1).
Figure 4.1: Randomization flow diagram for HHRPW

Note: HHRPW: Hospitalized High Risk Pregnant Women, FMAT: Functional Mobility Assessment Tool. A, B, C refer to those whose data were analyzed, but received no intervention (n=11).
4.2 Baseline Data

4.2.1 Number of Participants Completing Study Components

Some women who consented to the study were unable to complete all components (as shown in Figure 4.1). Two women who signed consent were discharged before any baseline data was completed. This left a total of twenty HHRPW who completed all baseline questionnaires. Table 4.1 outlines the number and percentage of these 20 women who completed each component of the study.

Baseline data included all questionnaires administered at the start of the study (n=20) as well as the pedometer log (n=16) and 7-day food intake record (n=13) completed by each participant before randomization. Postpartum follow-up occurred at 2 weeks and 2 months postpartum and consisted of questionnaires as well as the FMAT.

Four women were able to participate in the music intervention and five women were able to participate in the exercise intervention. One woman in the music group and three women with no intervention were sent home before delivery and therefore, of the 20 women who completed questionnaires, birth data was only collected from 16 women. Postpartum follow-up questionnaires were collected from three women in the music group, three women in the exercise group, and two women with no intervention. Two of the women in the music group were unable to meet with the researcher to complete the FMAT follow-up, but were able to email their questionnaires, therefore the total number of participants completing the FMAT was six: music (n=1), exercise (n=3), no intervention (n=2). See Table 4.1.

Table 4.1 Number and percentage of twenty participants who signed consent and completed each study component

<table>
<thead>
<tr>
<th></th>
<th>Baseline Questionnaires</th>
<th>Pedometer Log</th>
<th>Food Record</th>
<th>Birth Questionnaires</th>
<th>Birth Data</th>
<th>Postpartum Follow-Up Questionnaires</th>
<th>Postpartum FMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>n = 20</td>
<td>n = 16</td>
<td>n = 13</td>
<td>n = 16</td>
<td>n = 16</td>
<td>n = 8</td>
<td>n = 6</td>
</tr>
<tr>
<td></td>
<td>(100%)</td>
<td>(80%)</td>
<td>(65%)</td>
<td>(85%)</td>
<td>(85%)</td>
<td>(40%)</td>
<td>(30%)</td>
</tr>
</tbody>
</table>
Note: FMAT: Functional mobility assessment tool (Rikli & Jones, 2003). Percentage is the number of women who completed each component divided by the twenty women who completed baseline questionnaires.

### 4.2.2 Reason for hospitalization

The 20 women who completed baseline information were hospitalized for a variety of reasons including preterm premature rupture of membranes (PPROM) (n=10), shortened cervix (n=6), placenta previa (n=1), fluid around the lungs of fetus (n=1), ventricular hemorrhage in fetal brain (n=1), and maternal hypertension (n=1). When stratified by intervention, of the four women randomized to the exercise group, two had PPROM, one had shortened cervix and one had placenta previa. Of the four women in the music group two had PPROM, one had a shortened cervix and one woman had a fetus with extra fluid around the lungs. Of the four women who received no intervention six had PPROM, three had a shortened cervix, one woman had a fetus with a ventricular hemorrhage in the brain, and one woman had hypertension.

Figure 4.2: Reason for hospitalization for the 20 women who completed baseline data stratified by group

Note: PPROM: Preterm Premature Rupture of Membrane. Exercise (n=5), Music (n=4), No Intervention (n=11)
4.2.3 Participant Characteristics

All HHRPW (n=20) for whom data was collected were an average age of 31.4±5.8 years with an average pre-pregnancy BMI of 23.9±4.7 kg/m². Women randomized to the music group (n=4) were 28.8±4.1 years old with a pre-pregnancy BMI of 24.7±2.7 kg/m². Women randomized to the exercise group (n=5) were 32.9±2.5 years old with a pre-pregnancy BMI of 22.4±1.8 kg/m². Women who were not randomized to a group (n=11) were 31.9±6.3 years old with a pre-pregnancy BMI of 24.3±5.8 kg/m² (See Table 4.2). There were no significant differences between groups.

Fifty percent of all HHRPW had sedentary occupations prior to hospitalization which equated to 25% in the music group, 60% in the exercise group and 55% of women with no intervention. No women in either the music or exercise group smoked whereas four women (36%) with no intervention smoked. No woman in either the music or exercise group reported alcohol consumption during pregnancy while two women (18%) with no intervention reported having consumed alcohol in the early stages of pregnancy before they were aware of being pregnant.

4.2.4 Activity Levels Prior to Hospitalization of HHRPW from the Activity History Questionnaire

The percentage of women who participated in each form of exercise for at least fifteen minute intervals, three or more times per week before pregnancy and for each trimester is depicted in Figure 4.3. Walking was found to be the most common form of exercise in all time periods. Overall activity was highest pre-pregnancy and declined during each stage of pregnancy. There were no differences between the groups in activity levels pre-pregnancy through each trimester of pregnancy, therefore data is presented for all HHRPW who reported participation in each exercise category.
Table 4.2: Summary of participant characteristics for all women and stratified by group

<table>
<thead>
<tr>
<th></th>
<th>All HHRPW (n=20)</th>
<th>Music Group (n= 4)</th>
<th>Exercise Group (n= 5)</th>
<th>No Intervention Group (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Age (years)</td>
<td>31.4±5.8</td>
<td>28.8±4.1</td>
<td>32.9±2.5</td>
<td>31.9±6.3</td>
</tr>
<tr>
<td>Pre-pregnancy Body Mass Index (kg/m²)</td>
<td>23.9±4.7</td>
<td>24.7±2.7</td>
<td>22.4±1.8</td>
<td>24.3±5.8</td>
</tr>
<tr>
<td>BMI Categories (n/%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>2(10%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>2(18%)</td>
</tr>
<tr>
<td>Normal-Weight</td>
<td>12(60%)</td>
<td>3(75%)</td>
<td>4(80%)</td>
<td>5(46%)</td>
</tr>
<tr>
<td>Overweight</td>
<td>3(15%)</td>
<td>1(25%)</td>
<td>1(20%)</td>
<td>1(9%)</td>
</tr>
<tr>
<td>Obese</td>
<td>3(15%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>3(27%)</td>
</tr>
<tr>
<td>Occupational Activity (n/%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary Job</td>
<td>10(50%)</td>
<td>1(25%)</td>
<td>3(60%)</td>
<td>6(55%)</td>
</tr>
<tr>
<td>Active Job</td>
<td>10(50%)</td>
<td>3(75%)</td>
<td>2(40%)</td>
<td>5(45%)</td>
</tr>
<tr>
<td>Smoking during Pregnancy (n/%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4(20%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>4(36%)</td>
</tr>
<tr>
<td>No</td>
<td>16(80%)</td>
<td>4(100%)</td>
<td>5(100%)</td>
<td>7(64%)</td>
</tr>
<tr>
<td>Alcohol during Pregnancy (n/%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2(10%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>2(18%)</td>
</tr>
<tr>
<td>No</td>
<td>18(90%)</td>
<td>4(100%)</td>
<td>5(100%)</td>
<td>9(82%)</td>
</tr>
</tbody>
</table>

Note: HHRPW: Hospitalized high risk pregnant women; Data presented as mean ± standard deviation unless otherwise stated; n=number of women.
Figure 4.3: Percentage of HHRPW participating in exercise pre-pregnancy and throughout each trimester of pregnancy before hospitalization.

Note: Active is defined as at least 15 minutes of activity 3 or more times per week (Canadian Society for Exercise Physiology, 2013) (n = 20). HHRPW: Hospitalized high risk pregnant women.

4.2.5 Baseline Average Daily Step Counts

Step counts for all HHRPW were much lower than the recommended 10,000 steps per day for active pregnant women (Mottola et al, 2010). There were no significant differences in the average seven-day baseline step counts between the music group (2045±395 steps/day), the exercise group (1525±627 steps/day) or no intervention (2156±844 steps/day). Step counts for all HHRPW (n=16), regardless of group, are depicted in Figure 4.4 categorized based on reason for hospitalization.
Figure: 4.4 Baseline average daily step counts (n=16) based on reason for hospitalization and compared to recommended step counts for active pregnant women.

Note: PPROM: Preterm premature rupture of membranes. 10000 steps are based on Tudor-Locke & Bassett (2004) recommendation for an active population and Mottola et al (2010) for a healthy active pregnancy. Data are presented as means with error bars one standard deviation from the mean. Four women did not complete the baseline average step count due to early delivery in hospital before baseline data could be completed therefore n=16.

4.2.6 HHRPW Nutritional Intake in Hospital from Seven-Day Food Records

HHRPW had an average daily energy intake of 2367.1±552.1 kcals per day. There were no differences between groups in terms of nutritional intake. A total of 102.9±21.8g of fat, 96.0±16.6g of protein, and 344.8±88.4g of carbohydrates were consumed daily on average by the HHRPW. This is made up by 19% fat, 18% protein and 64% carbohydrates. Table 4.4 outlines the average baseline macronutrient intake for each group.
Table 4.3: Average daily nutrition in hospital at baseline and stratified by group

<table>
<thead>
<tr>
<th></th>
<th>All HHRPW (n=13)</th>
<th>Music Group (n=3)</th>
<th>Exercise Group (n=5)</th>
<th>No Intervention (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Energy (kcal)</strong></td>
<td>2367.1±552.1</td>
<td>2562.9±646.8</td>
<td>2690.6±509.5</td>
<td>2628.2±525.2</td>
</tr>
<tr>
<td><strong>Fat (g)</strong></td>
<td>102.9±21.8</td>
<td>105.0±29.4</td>
<td>102.9±14.2</td>
<td>101.7±22.5</td>
</tr>
<tr>
<td>% Fat</td>
<td>19%</td>
<td>20%</td>
<td>19%</td>
<td>18%</td>
</tr>
<tr>
<td><strong>Protein (g)</strong></td>
<td>96.0±16.6</td>
<td>98.5±23.6</td>
<td>99.6±10.0</td>
<td>91.0±15.5</td>
</tr>
<tr>
<td>Protein (g/kg)</td>
<td>1.34±0.3</td>
<td>1.38±0.38</td>
<td>1.48±0.26</td>
<td>1.17±0.18</td>
</tr>
<tr>
<td>% Protein</td>
<td>18%</td>
<td>19%</td>
<td>18%</td>
<td>17%</td>
</tr>
<tr>
<td><strong>Carbohydrate (g)</strong></td>
<td>344.8±88.4</td>
<td>317.0±81.6</td>
<td>351.5±92.1</td>
<td>354.7±85.0</td>
</tr>
<tr>
<td>% Carbohydrate</td>
<td>63%</td>
<td>61%</td>
<td>63%</td>
<td>65%</td>
</tr>
<tr>
<td><strong>Fibre (g)</strong></td>
<td>26.1±7.3</td>
<td>26.7±6.0</td>
<td>24.1±5.1</td>
<td>27.6±9.3</td>
</tr>
</tbody>
</table>

Note: Data presented as mean ± standard deviation unless otherwise stated. One woman in the music group misplaced her food log therefore data was unable to be analyzed. Six women with no intervention were unable to complete food records due to early delivery or discharged before food record was complete. HHRPW: Hospitalized high risk pregnant women.

4.2.7 Physiological Symptoms of HHRPW Measured by the Antepartum Symptoms Report

Complaints experienced by at least 50% of HHRPW are presented in Table 4.4. There were no significant differences between groups in total number of physiological complaints at baseline in hospital. The most common complaints for all HHRPW were related to sleep changes (100%): waking up to go to the bathroom (95%), waking up in the night other than to go to the bathroom (75%), restless sleep (60%), difficulty getting to sleep (60%), and not being able to get
back to sleep after waking (55%). Other physiological complaints, not related to sleep, reported by at least fifty percent of the HHRPW included fatigue (90%), dry lips (80%), dry skin (75%), and back pain (70%).

Table 4.4 Frequency of physiological symptoms experienced by at least 50% of HHRPW at baseline.

<table>
<thead>
<tr>
<th>Physiological Symptoms</th>
<th>All HHRPW (n= 20) n (%)</th>
<th>Music Group (n=4) n (%)</th>
<th>Exercise Group (n= 5) n (%)</th>
<th>No Intervention (n=11) n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Changes</td>
<td>20 (100%)</td>
<td>4 (100%)</td>
<td>5 (100%)</td>
<td>11 (100%)</td>
</tr>
<tr>
<td>Wake Up to Go to Bathroom</td>
<td>19 (95%)</td>
<td>4 (100%)</td>
<td>5 (100%)</td>
<td>10 (91%)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>18 (90%)</td>
<td>2 (50%)</td>
<td>5 (100%)</td>
<td>11 (100%)</td>
</tr>
<tr>
<td>Waking up in night (not bathroom)</td>
<td>16 (80%)</td>
<td>4 (100%)</td>
<td>3 (60%)</td>
<td>9 (82%)</td>
</tr>
<tr>
<td>Dry Lips</td>
<td>16 (80%)</td>
<td>3 (75%)</td>
<td>4 (80%)</td>
<td>9 (82%)</td>
</tr>
<tr>
<td>Restless Sleep</td>
<td>15 (70%)</td>
<td>3 (75%)</td>
<td>3 (60%)</td>
<td>9 (82%)</td>
</tr>
<tr>
<td>Dry Skin</td>
<td>15 (75%)</td>
<td>3 (75%)</td>
<td>4 (80%)</td>
<td>8 (73%)</td>
</tr>
<tr>
<td>Back Hurt</td>
<td>14 (70%)</td>
<td>2 (50%)</td>
<td>4 (80%)</td>
<td>8 (73%)</td>
</tr>
<tr>
<td>Difficulty Getting to Sleep</td>
<td>12 (60%)</td>
<td>2 (50%)</td>
<td>3 (60%)</td>
<td>7 (64%)</td>
</tr>
<tr>
<td>Can`t go back to sleep after waking</td>
<td>11 (55%)</td>
<td>1 (25%)</td>
<td>3 (60%)</td>
<td>7 (64%)</td>
</tr>
<tr>
<td>Indigestion</td>
<td>10 (50%)</td>
<td>2 (50%)</td>
<td>2 (40%)</td>
<td>6 (55%)</td>
</tr>
<tr>
<td>Round Ligament Pain</td>
<td>10 (50%)</td>
<td>3 (75%)</td>
<td>3 (60%)</td>
<td>4 (36%)</td>
</tr>
</tbody>
</table>

Note: n=number of women who experienced that symptom in past seven days. HHRPW: Hospitalized high risk pregnant women.
4.2.8 Psychosocial Symptoms in Hospital as Measured by the Antepartum Symptoms Report

Boredom was the most common psychosocial complaint (90%) from HHRPW. Mood changes and tenseness were also reported by half of all HHRPW during hospitalization (see Table 4.5). There were no significant differences between groups for total number of psychosocial complaints in hospital.

Table 4.5 Frequency of psychosocial symptoms experienced by at least 50% of HHRPW

<table>
<thead>
<tr>
<th>Psychosocial Symptoms</th>
<th>All HHRPW (n = 20) n/%</th>
<th>Music Group (n= 4) n/%</th>
<th>Exercise Group (n= 5) n/%</th>
<th>No Intervention (n=11) n/%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boredom</td>
<td>18 (90%)</td>
<td>3 (75%)</td>
<td>4 (80%)</td>
<td>11 (100%)</td>
</tr>
<tr>
<td>Mood Changes</td>
<td>10 (50%)</td>
<td>1 (25%)</td>
<td>3 (60%)</td>
<td>6 (55%)</td>
</tr>
<tr>
<td>Tenseness</td>
<td>10 (50%)</td>
<td>1 (25%)</td>
<td>3 (60%)</td>
<td>6 (55%)</td>
</tr>
</tbody>
</table>

Note: n=number of women who experienced that symptom in past seven days. HHRPW: Hospitalized high risk pregnant women.

4.2.8.1 Depression in HHRPW as measured by the CES-D

Of the 20 women who completed baseline questionnaires in hospital, 8 women scored higher than 16 on the CES-D (see Figure 4.5). A score of 16 or higher on the CES-D identifies those at risk for clinical depression (Radloff, 1977). The music group had an average score of 10.2±7.6 (range of 3 to 21), with one woman (25%) at risk for clinical depression. The exercise group had an average score of 17.6±12.6 (range of 3 to 33), with three women (60%) at risk for clinical depression. Those with no intervention had an average of 12.6±6.8 (range of 2 to 22), with four women (36%) at risk for clinical depression. There were no significant differences in scores on the CES-D between groups.
Figure 4.5: Number of HHRPW at risk for clinical depression (score of 16 or higher).

Note: A score of 16 or higher on the CES-D indicates a risk for clinical depression (Radloff, 1977). HHRPW: Hospitalized high risk pregnant women.

4.2.8.2 Anxiety in HHRPW using the State Trait Anxiety Inventory

Scores on the STAI can range from 12 to 48. The sample of 20 HHRPW had an average score of 21.3±4.6 with a range of 14 to 31, the music group had an average score of 20.5±0.9 with a range 19 to 21, the exercise group had an average score of 20.6±5.6 with a range of 14 to 28 and no intervention had an average score of 21.9±4.8 with a range of 17 to 31. There were no significant differences at baseline between groups.

4.2.8.3 Hospital stressors in HHRPW as measured by the AHSI questionnaire

Separation was found to be the biggest contributing factor to stress in hospital, followed closely by health status and self-image (see Table 4.6). There were no significant differences between groups.
Table 4.6: Hospital stressors in HHRPW as measured by the AHSI

<table>
<thead>
<tr>
<th>AHSI Sub-Category</th>
<th>Possible Score Range</th>
<th>All HHRPW (n=20)</th>
<th>Music Group (n=4)</th>
<th>Exercise Group (n=5)</th>
<th>No Intervention (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separation</td>
<td>0 – 28</td>
<td>11.3 (1-22)</td>
<td>12.8 (3-21)</td>
<td>11.4 (9-16)</td>
<td>10.6(1-22)</td>
</tr>
<tr>
<td>Environment</td>
<td>0 – 36</td>
<td>6.5 (0-16)</td>
<td>5.8 (1-15)</td>
<td>5.8 (5-7)</td>
<td>7.1 (0-16)</td>
</tr>
<tr>
<td>Health Status</td>
<td>0 – 40</td>
<td>10.5 (3-24)</td>
<td>9.5 (3-18)</td>
<td>10.6 (5-14)</td>
<td>10.8 (5-24)</td>
</tr>
<tr>
<td>Communication</td>
<td>0 – 28</td>
<td>5.3 (0-12)</td>
<td>4.0 (0-12)</td>
<td>4.8 (0-8)</td>
<td>5.9 (3-12)</td>
</tr>
<tr>
<td>Self-Image</td>
<td>0 – 32</td>
<td>10.4 (4-14)</td>
<td>11.0 (4-14)</td>
<td>10.2 (7-13)</td>
<td>10.3 (8-13)</td>
</tr>
<tr>
<td>Emotions</td>
<td>0 – 20</td>
<td>5.2 (1-17)</td>
<td>4.0 (1-8)</td>
<td>5.8 (2-9)</td>
<td>5.4 (1-17)</td>
</tr>
<tr>
<td>Family Status</td>
<td>0 – 12</td>
<td>5.6 (1-10)</td>
<td>8.0 (5-10)</td>
<td>6.4 (2-10)</td>
<td>4.3 (1-9)</td>
</tr>
<tr>
<td>Total ASHI Score</td>
<td>0 - 196</td>
<td>54.7(19-103)</td>
<td>55(19-42)</td>
<td>55(40-63)</td>
<td>54(27-103)</td>
</tr>
</tbody>
</table>

Note: AHSI: Antepartum Hospital Stressors Inventory (White, 1981); Data presented as mean (range) unless otherwise stated.

4.2.8.4 Quality of Life at Baseline for HHRPW Measured by the EQ-5D

Sixty-five percent of all HHRPW who completed the EQ-5D had problems completing usual activities (n=13), 60% reported pain or discomfort (n=12), and 55% reported feelings of anxiety or depression (n=11). Although restricted in the amount of activity, as evidenced by the low step counts in hospital, only 15% of HHRPW reported problems with mobility (n=3) and no women had trouble maintaining self-care while in hospital (n=0) (see Table 4.7).
Table 4.7: Baseline health related quality of life as measured by the EQ-5D

<table>
<thead>
<tr>
<th></th>
<th>Mobility</th>
<th>Self-Care</th>
<th>Usual Activities</th>
<th>Pain/Discomfort</th>
<th>Anxiety/Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>All HHRPW (n=20)</td>
<td>3 (15%)</td>
<td>0 (0%)</td>
<td>13 (65%)</td>
<td>12 (60%)</td>
<td>11 (55%)</td>
</tr>
<tr>
<td>Music Group (n=4)</td>
<td>1 (25%)</td>
<td>0 (0%)</td>
<td>3 (60%)</td>
<td>1 (25%)</td>
<td>2 (50%)</td>
</tr>
<tr>
<td>Exercise Group (n=5)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>4 (80%)</td>
<td>3 (60%)</td>
<td>2 (40%)</td>
</tr>
<tr>
<td>No Intervention (n=11)</td>
<td>2 (18%)</td>
<td>0 (0%)</td>
<td>6 (55%)</td>
<td>8 (73%)</td>
<td>7 (64%)</td>
</tr>
</tbody>
</table>

Note: Data presented as n (%) where n = number of women who reported a problem with that dimension. EuroQOL five-dimension questionnaire (EQ-5D) (Gusi et al, 2010). HHRPW: Hospitalized high risk pregnant women.

4.3 Intervention

Five women participated in the exercise program (9.6±7.7 sessions; range of 5 to 25 sessions) and four women participated in the music only sessions (8.3±6.1 sessions; range of 3 to 18 sessions). There were no changes in blood pressure pre versus post intervention for either group. There were no changes in heart rate in the music only group (97.8±8.7 beats per minute (bpm) pre intervention, 95.8±6.9 bpm post intervention), however there was a significant increase in heart rate in the exercise group during exercise (82.0±6.5 bpm pre-intervention, 96.4±8.7 bpm post-intervention; p ≤ 0.05).

There were no significant differences in the music group pre versus post intervention in each of the four feeling states of the EFI. The participants in the exercise group had significant increases in positive engagement, revitalization, and tranquility and a significant decrease in physical exhaustion when feeling states were compared pre and post intervention (p ≤ 0.05) (see Figure 4.6).
Note: EFI: Exercise induced feeling inventory (Gauvin & Rejeski 1993). Data are presented as means with error bars one standard deviation from the mean. † = significant difference pre vs post intervention (p ≤ 0.05).

4.4 Birth data

Information regarding birth was collected within twenty-four hours of delivery from hospital birth records. Birth data were collected from 16 participants: Music (n=3), Exercise (n=5), No Intervention (n=8). One participant in the exercise group gave birth to twins for a total of six babies in the exercise group.

Participants from the music group (n=3) and those with no intervention (n=8) were not significantly different on any baseline or birth measure, therefore the two groups were pooled to form one larger control group (n=11) for all birth data. Babies whose mothers participated in the exercise program in hospital had a significantly longer gestational age at birth, 34.5±1.1 weeks, and a significantly longer body length, 46.4±2.7cm, than those in the control group, 32.4±2.5 weeks and 37.9±10.3cm (p ≤ 0.05). Those in the exercise group appeared to trend towards significance with a higher average birth weight and larger head circumference than the control group, although these were not significant upon analysis (p = 0.08; p = 0.06 respectively) (see Table 4.8).
Table 4.8 Birth data

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n= 11)</th>
<th>Exercise Group (n= 5)</th>
<th>Effect Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birth Weight (g)</strong></td>
<td>1923.9±530.7</td>
<td>2313.3±289.9</td>
<td>0.19 (Large)</td>
</tr>
<tr>
<td><strong>Length (cm)</strong></td>
<td>37.9±10.3</td>
<td>46.4±2.7*</td>
<td>0.29 (Large)</td>
</tr>
<tr>
<td><strong>Head Circumference (cm)</strong></td>
<td>29.3±3.1</td>
<td>31.2±1.7</td>
<td>0.21 (Large)</td>
</tr>
<tr>
<td><strong>Gestational Age at Birth (Weeks)</strong></td>
<td>32.4±2.5</td>
<td>34.5±1.1*</td>
<td>0.28 (Large)</td>
</tr>
<tr>
<td><strong>Number of Days Hospitalized at Birth</strong></td>
<td>20.7±13.5</td>
<td>52±28</td>
<td></td>
</tr>
<tr>
<td><strong>Method of Delivery</strong></td>
<td>Vaginal (n/%)</td>
<td>8/73</td>
<td>3/60</td>
</tr>
<tr>
<td></td>
<td>Caesarean (n/%)</td>
<td>3/27</td>
<td>2/40</td>
</tr>
</tbody>
</table>

Note: Data presented as mean (range) unless otherwise stated. * Significantly different from control (p ≤ 0.05). Sixteen women gave birth, but one woman in the exercise group gave birth to twins and therefore birth data are averaged between seventeen babies. Participants from the music group (n=3) and those with no intervention (n=8) were not significantly different on any baseline or birth measures and therefore were pooled to form one larger control group (n=11) for all birth data.

4.5 Postpartum Functional Follow-Up

Due to the nature of the high-risk pregnancies studied, it was difficult for the participants to attend follow-up visits. Two follow-up visits were performed at the Exercise and Pregnancy lab as planned, four visits were completed by travelling to the participant’s home, and two participants were able to email their questionnaires, but were unable to meet with the researcher to complete the functional ability testing. A total of three women in the exercise group, one woman in the music group, and two women with no intervention were able to complete the FMAT. Due to the low number of participants who completed the FMAT, the primary outcome of the study, those in the music group and those with no intervention were pooled to create one
control group which was then compared to the exercise group. Therefore, there was a total of five women in the control group and three women in the exercise group for all follow-up data.

4.5.1 Number of Days after Delivery HHRPW Completed Activities of Daily Living

There was no significant difference in the number of days to return to activities of daily living between the exercise and control group. On average, for all women bathing was resumed after 1.5 days, while activities such as walking upstairs (3.4 days), cooking (4.4 days), making the bed (6.7 days), and light housekeeping (6.6 days) were resumed by the end of the first week. Laundry (11.5 days), cleaning house (12.0 days), grocery shopping (7.6 days), walking for pleasure (12.7 days), and driving (10.6 days) were resumed in the second week. Trips outside the home (24.1 days) and heavy housekeeping (46.6) were resumed much later. Figure 4.7 outlines the average number of days taken to return to activities of daily living for each group.

Figure 4.7 Number of days taken to return to activities of daily living
4.5.2 Breastfeeding Status

Forty percent (2/5) of the women in the music group who completed a postpartum follow-up exclusively breastfed. Forty percent (2/5) partially breastfed while supplementing breastmilk with formula. Twenty percent (1/5) used formula as the primary form of sustenance.

Sixty-seven percent (2/3) of the women in the exercise group who completed a postpartum follow-up exclusively breastfed and thirty-three percent (1/3) partially breastfed, while supplementing with formula.

4.5.3 Postpartum Physical Activity as Measured by the Kaiser Physical Activity Survey

There were no significant differences between postpartum physical activity in the control group compared to the exercise group. (see Table 4.9).

Table 4.9 Results of the Kaiser Physical Activity Survey

<table>
<thead>
<tr>
<th>Total Activity</th>
<th>Control Group (n=5)</th>
<th>Exercise Group (n=3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighted Total Activity index</td>
<td>10.03</td>
<td>9.98</td>
</tr>
<tr>
<td>Household/caregiving</td>
<td>2.96</td>
<td>2.91</td>
</tr>
<tr>
<td>Occupational Index</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Active Living index</td>
<td>2.75</td>
<td>2.92</td>
</tr>
<tr>
<td>Sports/Exercise index</td>
<td>2.77</td>
<td>2.24</td>
</tr>
</tbody>
</table>

Note: the weighted activity index estimates that a greater amount of energy expenditure is attributable to household/caregiving activities as opposed to occupation and sport/exercise in early postpartum.

4.5.4 Postpartum Functional Mobility as Measured by the FMAT

Only one woman was able to complete any FMAT measures at 2 weeks postpartum therefore only results from 2 months postpartum are presented. There were no significant differences between the two groups in the postpartum on any of the FMAT measures at 2 months postpartum. Only 3 women in the exercise group and 3 women in the control group were able to complete the FMAT. Although there were no statistical differences there may be clinical
implications in the differences between groups. Those who participated in the exercise program in hospital had a 44% higher average number of stands in the chair stand test (Effect Size: 0.40, large), 32% more knee raises in the 2-minute step test (Effect Size: 0.56, large) and took 23% less time to complete the 8 foot up and go test at the two-month postpartum follow-up visit than the control group (see Table 4.10). Women in the control group did have a 25% higher average number of arm curls than the exercise group, but this was not significant. Only three women, one in the exercise group and two in the control group, were able to complete the 6 Minute Walk Test therefore percent difference between groups was not calculated.

Ambulatory pregnant women (APW), from a previous unpublished study in the Exercise and Pregnancy Laboratory, were compared to both groups of HHRPW (see Table 4.10). APW performed 35% better than the exercise group and 94% better than the control group on the chair stand test. APW performed 94% better than the exercise group and 55% better than the control group on the arm curl test. APW performed 16% better than the exercise group and 53% better than the control group on the 2-minute step test. APW were 4% faster than the exercise group and 28% faster than the music group on the 8 foot up and go test.

4.5.5 Postpartum Physiological Symptoms from the Postpartum Symptoms Report

Symptoms experienced by at least 50% of postpartum HHRPW are presented in Table 4.11. There were no significant differences between the two groups in number of physiological complaints in the postpartum. The most common physiological complaint for all postpartum HHRPW was fatigue (75%) followed by dry skin (63%), sore back (63%), headaches (63%), and decreased appetite (50%).
Table 4.10 Postpartum functional ability as measured by the FMAT

<table>
<thead>
<tr>
<th>Test</th>
<th>Control Group (n= 3)</th>
<th>Exercise Group (n= 3)</th>
<th>Ambulatory Pregnant Women (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chair Stand Test</strong> (stands in 30 sec)</td>
<td>12.0±2.2</td>
<td>17.3±4.0</td>
<td>23.3±0.6</td>
</tr>
<tr>
<td><strong>Arm Curl Test</strong> (curls in 30 sec)</td>
<td>21.3±3.4</td>
<td>17.0±4.3</td>
<td>33.0±4.6</td>
</tr>
<tr>
<td><strong>6 Minute Walk Test</strong> (m)</td>
<td>504±12</td>
<td>600</td>
<td>480±135</td>
</tr>
<tr>
<td><strong>2 Minute Step Test</strong> (steps)</td>
<td>71.3±5.2</td>
<td>94.3±13.3</td>
<td>109.0±6.4</td>
</tr>
<tr>
<td><strong>Chair Sit and Reach Test (cm)</strong></td>
<td>0.33±3.7</td>
<td>10.17±9.6</td>
<td>7.3±11</td>
</tr>
<tr>
<td><strong>Back Scratch Test</strong> (cm)</td>
<td>0.33±1.9</td>
<td>4.17±2.9</td>
<td>3.7±7.4</td>
</tr>
<tr>
<td><strong>8 Foot Up and Go Test</strong> (sec)</td>
<td>5.9±0.7</td>
<td>4.8±0.6</td>
<td>4.6±0.04</td>
</tr>
</tbody>
</table>

Note: FMAT: Functional mobility assessment tool (Rikli & Jones, 2003); Data presented as mean ± standard deviation unless otherwise stated. Data for ambulatory pregnant women were collected in a previous unpublished study in the Exercise and Pregnancy Laboratory. Only one woman in the exercise group was able to complete the 6-minute walk test therefore no standard deviation could be calculated.
Table 4.11 Frequency of physiological symptoms experienced by at least 50% of postpartum women

<table>
<thead>
<tr>
<th>Physiological Symptoms</th>
<th>Control Group (n= 5) n/%</th>
<th>Exercise Group (n= 3) n/%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td>4(80%)</td>
<td>2(67%)</td>
</tr>
<tr>
<td>Skin Dry</td>
<td>4(80%)</td>
<td>1(33%)</td>
</tr>
<tr>
<td>Back Sore</td>
<td>3(60%)</td>
<td>2(67%)</td>
</tr>
<tr>
<td>Headache</td>
<td>3(60%)</td>
<td>2(67%)</td>
</tr>
<tr>
<td>Decreased Appetite</td>
<td>2(40%)</td>
<td>2(67%)</td>
</tr>
</tbody>
</table>

4.6 Psychosocial Postpartum Follow-Up

Mood changes were the only psychosocial complaint reported by at least 50% of HHRPW in the postpartum follow-up. There were no significant difference between the two groups in number of postpartum psychosocial complaints reported. Sixty percent (3/5) of women in the control group and 67% (2/3) of women in the exercise group experienced mood changes in the postpartum.

4.6.1 Postpartum Depression

Of the eight women who completed the two-month follow-up, no women scored higher than sixteen on the CES-D. Average scores on the CES-D can be seen in Figure 4.8. The control group had an average score of 8.2±5.1 (range of 0 to 14) and the exercise group had an average score of 6.3±4.0 (range of 2 to 10) (Effect Size: 0.05, small). There were no significant differences in the control group or the exercise group between baseline and postpartum scores on the CES-D.

A total of twelve women were unable to complete follow-up (10 from the control group and 2 from the exercise group). Four women from the control group and two women from the exercise group who were at a risk for clinical depression at baseline were not able to be contacted for follow-up and therefore it is unknown whether their clinical risk was lowered in the postpartum.
Figure 4.8: Average score on CES-D at baseline compared to 2 month follow up

Note: A score of 16 or higher on the CES-D identifies those at risk for clinical depression (Radloff, 1977). Data are presented as means with error bars one standard deviation from the mean. Only baseline data from the 8 participants who completed follow-up were used for comparison. HHRPW: Hospitalized high risk pregnant women.

4.6.2 Postpartum anxiety

Postpartum anxiety in HHRPW was assessed using the State Trait Anxiety Inventory (STAI). There were no significant differences in anxiety between groups either at baseline or in the postpartum. Scores also did not significantly change from baseline to postpartum in either group. The sample of 8 HHRPW at follow-up had an average score of 17.9±3.0 with a range of 13 to 21, the control group (n=5) had an average score of 18.0±2.8 with a range 13 to 21, and the exercise group (n=3) had an average score of 17.7±3.4 with a range of 13 to 21 (Effect size: 0.0.
4.6.3 Postpartum Quality of Life

Postpartum quality of life was measured by the EQ-5D (Gusi et al., 2010). HHRPW reported no problems with mobility or self-care two months postpartum. One woman in the control group (20%) reported problems completing daily activities, while no one in the exercise group had problems in this area. No one in the control group were experiencing any pain/discomfort however two women in the exercise group (67%) were still experiencing some pain/discomfort at two months postpartum. Three women in the control group (60%) were having problems with anxiety/depression, while no one in the exercise group reported problems in this area (see Table 4.12).

Table 4.12 Health related quality of life as assessed by the five dimensions of the EQ-5D

<table>
<thead>
<tr>
<th></th>
<th>Mobility</th>
<th>Self-Care</th>
<th>Usual Activities</th>
<th>Pain/Discomfort</th>
<th>Anxiety/Depression</th>
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<td></td>
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<td>0(0%)</td>
<td>13(65%)</td>
<td>12(60%)</td>
<td>11(55%)</td>
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<tr>
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<td>0(0%)</td>
<td>1(5%)</td>
<td>2(10%)</td>
<td>3(15%)</td>
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<tr>
<td><strong>Control Group</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Baseline (n=15)</td>
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<td>0(0%)</td>
<td>9(60%)</td>
<td>9(60%)</td>
<td>9(60%)</td>
</tr>
<tr>
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<td>0(0%)</td>
<td>0(0%)</td>
<td>1(20%)</td>
<td>0(0%)</td>
<td>3(60%)</td>
</tr>
<tr>
<td><strong>Exercise Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (n=5)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>4(80%)</td>
<td>3(60%)</td>
<td>2(40%)</td>
</tr>
<tr>
<td>Follow-Up (n=3)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>2(67%)</td>
<td>0(0%)</td>
</tr>
</tbody>
</table>

Note: Data are presented as n (%) where n = number of women who reported problems in that dimension. EQ-5D: EuroQoL five-dimension questionnaire (Gusi et al, 2010). Not all women were able to complete follow-up.
4.7 Summary of Results

HHRPW were hospitalized for a variety of reasons, but all high risk pregnant women were activity-restricted in hospital, as measured by their low step counts. There were no significant differences between groups on all baseline data including participant characteristics, average step counts, depression, anxiety, hospital stressors and health related quality of life. Those who participated in the exercise intervention did have significant changes in feeling states pre versus post intervention and a significantly higher heart rate during exercise ($p \leq 0.05$), however blood pressure remained unchanged. There were no changes in feeling states, heart rate or blood pressure in the music group. At birth, those in the exercise group had a significantly longer gestation and babies were significantly longer than the control group ($p \leq 0.05$). There were no significant differences between birth weight, head circumference or number of days hospitalized at birth between the exercise and the control group. There were also no significant changes in the number of days taken to return to activities of daily living, postpartum physical activity, postpartum functional mobility, postpartum physiological symptoms, depression, anxiety or quality of life in the postpartum between the two groups.
Chapter 5: Discussion

The primary objective of the current study was to evaluate the effectiveness of an in-bed-exercise program for HHRPW on postpartum functional ability and psychosocial health after hospitalized activity restriction. The secondary objective was to create a profile of the physical and psychosocial health of HHRPW. It was hypothesized that HHRPW who participated in the in-bed-exercise program in hospital would have less physiological deconditioning as measured by the FMAT and better psychosocial health.

Health problems in the postpartum have been called a hidden morbidity, as the imminent needs of the infant often overshadow the needs of the mother (Albers, 2000). This is especially true of HHRPW, as these babies are often born early with a high risk of potential complications. After the birth of their baby/babies these mothers have the responsibility of caring for one or more high risk infant(s) as well as any other familial chores and have little energy to care for their own well-being. Maternal postpartum symptoms after antepartum bed-rest have been cited as unrecognized and untreated (Maloni & Park, 2005). An exercise program in hospital may assist in reducing these maternal antepartum symptoms and reduce the medical issues these women face.

The lack of activity in hospital, combined with the stress of a high risk pregnancy, leads to physical deconditioning with self-reported deconditioning in hospital and functional deconditioning as measured in the postpartum. Although there were no significant differences between groups on outcome measures on the FMAT the large effect sizes between the two measures of aerobic ability on the FMAT (chair stand test and 2-minute step test) indicate that there may be a clinically relevant difference between the two groups that health care providers may be able to use to evaluate the current standard of care in hospital. Women who completed the in-bed-exercise-program appeared to be less deconditioned at two months postpartum than those with no exercise program, which may reflect a better ability to return to daily life after hospitalization.

Upon examining the activity levels of HHRPW, daily step counts showed that these women were severely activity-restricted (1940±1405 steps per day) even less than those individuals with chronic illnesses who take approximately 3500 to 5500 steps per day (Tudor-Locke & Bassett, 2004). These low step counts are comparable to previous studies of HHRPW.
with measured step counts of 1579 ± 936 steps per day (Tomkins et al, 2007), and 1329 ± 926 steps per day (Vanderspank et al, 2014). Simple activities such as making a bed caused some HHRPW in the present study to become fatigued and out of breath. It is not surprising that the activity-restricted women in the present study reported similar physiological and psychosocial symptoms to that reported in the literature from non-pregnant bed-rested individuals: fatigue, headache, mood changes, low back pain, tenseness, difficulty concentrating, back muscle soreness, dry skin, heartburn and reflux, constipation (Brower, 2009; Dorfman et al, 2007; Hamburg et al, 2007; Sandler & Vernikos, 1986) and shifting sleep wake cycles with increased daytime sleep (Liang et al, 2014). These symptoms can be multiplicative and directly impact the quality of life of the individual (Lenz et al, 1997). The physiological deconditioning resulting from activity-restriction affected the ability of HHRPW to complete usual activities, lowering quality of life while in hospital.

The diagnosis of a high risk pregnancy combined with the stress of separation from family and support systems upon hospitalization created a compounded set of stressors. More than 50% of HHRPW reported feelings of boredom, mood changes and tenseness, which contributed towards their overall psychosocial health and well-being. In the current study separation from family was the biggest contributing factor towards stress in hospital with health status and self-image also contributing. This is consistent with previous studies that cite separation from family as a prominent stressor in hospital (Maloni et al, 1993; Pauze, 2004). Furthermore, the lack of normal familial support systems may serve to increase stress responses in situations where the mother and baby are at a high risk of health complications (Bowen & Muhajarine, 2006). Psychosocial support from family and friends may help to mitigate these psychosocial issues.

Antenatal depression has been a concern for researchers as depression rates seem to increase in pregnancy with estimates of 7% to 20% in ambulatory pregnant women (Bowen & Muhajarine, 2006; Brittain et al, 2015; Finley & Brizendine, 2015; Flynn et al, 2015). The prevalence of depression in the current sample of HHRPW was even higher (40%) than ambulatory pregnant women. These high rates of depression are in line with results from other studies of hospitalized pregnant women and may be a result of the high stress of potential pregnancy complications as well as separation from family. Some studies of hospitalized
pregnant women have reported depression rates as high 58% (Denis et al, 2012) and 44% (Brandon et al, 2008), while others report depression rates that are lower at 27% (Byatt et al, 2014), 25% (Adouard et al, 2005) and 18% (Thiagayson et al, 2013). The overall rates of depression in HHRPW are clinically relevant and a cause for concern in this population. There is conflicting research on whether depression rates remain high throughout hospitalization (Gourounti et al, 2015), or decrease as the time in hospital increases (Maloni et al, 2006). A decrease in depression rates across hospitalization may be due to a decreased risk of pregnancy complications as gestation increased. Separation from friends and family may further exacerbate feelings of isolation, increasing anxiety and depression in hospital, while intensifying physical discomforts. The longer gestational period found in the exercise group of the present study may be clinically relevant as it may decrease feelings of depression in this population group and should be investigated further.

Interventions used to reduce the physical side-effects of BR in non pregnant populations include resistance exercise, ambulation, neuromuscular electrical stimulation, and passive stretching of muscles (Brower, 2009). Current practices at LHSC for HHRPW include referral to a physiotherapist by nursing staff. Referrals are based on the clinical expertise of nursing staff with no specific criteria. Exercises prescribed by the physiotherapist included only upper body exercise conducted in bed with a light resistance band. The physiotherapist services are shared between departments, therefore time spent with HHRPW is limited. Exercises with a physiotherapist are usually demonstrated on an initial visit and resistance bands are left with the patient with a prescription for further exercise. Daily exercise is unsupervised and follow-up is completed as time allots, therefore many women do not continue with the exercise. Further evidenced based research on the benefits of in-hospital exercise for HHRPW is needed with more staff trained to facilitate such supervised exercise programs.

Psychosocial interventions to reduce psychosocial issues in hospital can include supportive therapy (either individually or in a group setting), social support from family and friends, exercise programs, and ensuring adequate nutrition and sleep (Bowen & Muhajarine, 2006). During the current study a student social worker facilitated a weekly support group for HHRPW, unrelated to the in-bed-exercise program. Some women from the current study participated in support sessions, however participation in the support group was inconsistent and
nursing staff reported that interventions such as these were difficult to have women attend long term. Further study is needed to determine the most effective way to reduce the psychosocial side effects of antenatal hospitalization.

Participation in an exercise program may be one way to help reduce both the physical and psychosocial side-effects of activity-restriction (Brun et al, 2011). The in-bed exercise program seemed to have a positive effect on mood in HHRPW while in hospital. In the current study HHRPW in the exercise group had significantly higher positive engagement, revitalization and tranquility with significantly less physical exhaustion immediately after completing exercise than the control group (p ≤ 0.05). Although the current study is the first of its kind to measure mood states in HHRPW before and after exercise, acute exercise sessions with ambulatory pregnant women have been shown to increase positive mood states in both studio-based and aqua-based exercise programs (Polman et al, 2007). These increases in positive mood with acute exercise are similar in strength to other psychosocial interventions used to enhance mood states (Polman et al, 2007).

5.1 Birth Outcomes in HHRPW

The risk of serious medical disability increases significantly with younger gestational age at birth (Moster et al, 2008). The more time the fetus has to grow and develop in the womb the lower the risk of both physical and psychological complications (Barker, 2012). Although all but one baby was born preterm, women who participated in the in-bed-exercise-program prolonged gestational age by an average of 2.1 weeks. Birth weight and head circumference appeared to trend towards significance, with a large effect size, which may have clinical relevance. The longer gestation of babies born to those in the exercise group compared to the control group may reflect the protective effects of exercise against preterm birth (Mette et al, 2008). Further research is needed to understand the mechanism of preterm birth to further develop techniques to reduce the incidence of early delivery.

The early delivery of infants in the current population is consistent with previous literature. Maloni (1993) reported that 65% of a sample of 17 HHRPW delivered before 37 weeks gestation. In a case controlled study of an in-bed-exercise program, the woman who participated in the in-bed exercise program was induced at 37 weeks gestation, compared to her matched control who gave birth at 33 weeks gestation (Brun et al, 2012). Due to the high-risk
nature of the pregnancies involved, it is expected that these hospitalized women will have early deliveries, however the significantly longer gestation of those in the exercise groups may demonstrate an added benefit of an in-hospital resistance exercise program.

5.2 Postpartum Recovery in HHRPW

Ambulatory pregnant women out-performed both groups of HHRPW on measures of functional ability indicating that HHRPW are still deconditioned at two months postpartum, with or without the exercise intervention. Most notably ambulatory pregnant women had a higher aerobic capacity and muscular endurance postpartum as evidenced by their performance on the 2-minute step test (16% better than the exercise group and 54% better than the control group). The difference in aerobic capacity between ambulatory pregnant women, HHRPW with an exercise intervention, and HHRPW with no exercise intervention may reflect a protective effect of exercise against the physiological deconditioning that occurs during activity-restriction in hospital. This is consistent with research on non-pregnant participants that shows that a resistance exercise program can be used as a countermeasure to prevent the side-effects of muscle and bone deterioration accumulated during BR (Akima et al, 2001; Beller et al, 2011; Mulder et al, 2015; Shackelford et al, 2004).

The current study appears to be novel in assessing functional ability in the postpartum after an exercise program in hospital. Maloni and colleagues (1993) reported that women who were hospitalized antenatally had problems with mobility, such as difficulty walking up stairs and buckling, within the first week after delivery, however the long term recovery was not measured. Women in the current study did not report these mobility problems, however there may be a recovery period in the very early postpartum (within the first few weeks of delivery) that needs further examination. In addition, it may not be feasible for women who have had a Caesarean Section to complete a functional ability test as early as 2 weeks postpartum.

5.3 Strength and Limitations

The RCT design of the current pilot study was a major strength. The study design allowed for comparison of physical and psychosocial health between those who participated in an exercise program in hospital and those who did not. Since all women in the study were hospitalized on the same ward of the hospital, the nursing staff became familiar with the study
which allowed easy access to potential new participants. The ongoing support from the nursing staff to ensure the success of the RCT was vital to the recruitment and ongoing participation of women in the study.

The individual exercise sessions were also a major strength. Sessions were often cancelled or postponed to accommodate medical appointments and in-hospital tests. The one-on-one sessions served as a strength of the study, allowing the researcher to meet with each participant more frequently, as exercise sessions could be rescheduled to fit around the medical and personal schedule of each hospitalized woman. All questionnaires had been previously validated with pregnant women therefore the validity of the questionnaires also increased the strength of the study.

The small sample size of the current pilot study was a limitation. The large number of participants who dropped out of the study was unexpected and therefore served as a major limitation. The sample size calculation anticipated a 30% drop-out rate however the actual dropout rate was closer to 70%. The majority of drop out was due to early delivery. Other reasons for drop-out varied as some of the women simply lived too far away and were unable to make the trip back into the lab for the follow-up visit; others felt they could not leave their baby even for one hour as their high risk baby needed so much extra care and attention. Although every attempt was made to accommodate the needs of these women, travel may be necessary to complete the follow-up by visiting each participant at home. Future studies should accommodate for this high drop out rate in their sample size calculation.

The self-reported nature of the questionnaires used to create a profile of pregnant women also served as a limitation. Participants may have a response bias and have been more likely to over report previous activity levels or present themselves in a more positive light in terms of psychosocial health.

5.4 Conclusions and Recommendations

HHRPW are activity-restricted in hospital, leaving this group of women with a wide range of physical and psychosocial side-effects. The stressors of a high risk pregnancy may lead to high depression and anxiety while in hospital. The physical deconditioning that occurs in hospital was consistent with that of non-pregnant bed-rested individuals and may affect
postpartum functional ability. HHRPW have not fully recovered from the side-effects of activityrestriction even up to two months postpartum. A focus on physical and psychosocial support for hospitalized pregnant women is needed to improve the quality of life of HHRPW while in hospital and in the postpartum.

5.5 Implications for Future Research

Future researchers can use the knowledge gained from the current pilot study to create exercise programs that can be implemented into clinical hospital settings for HHRPW. Using a larger sample size, researchers can examine how HHRPW women with different conditions respond to an in-bed-exercise-program. It may be beneficial for physicians to become actively involved in the recruitment process to encourage and inform women of the benefits of exercise on their health related quality of life.

In the current study women did not start the exercise program until at least 14 days after hospital admission. Physiological changes in muscle size and cardiovascular conditioning can deteriorate quickly without use and can take a significant period of time to rebuild (Brower 2009). In order to counteract the deconditioning that occurs with activity-restriction it may be beneficial to start an exercise program immediately after hospitalization.

Activity levels in the early postpartum were not measured, however activity is anticipated to be quite low as the care of a high risk infant consumes much of the time of the new mother. It may be beneficial for HHRPW to participate in a light exercise program in the early postpartum, as well as an antenatal exercise program. Future research should combine an in-bed-exercise program in-hospital with an early postpartum exercise program to improve maternal postpartum functional ability and quality of life.
References


Finley, P.R., & Brizendine, L. (2015). Enhancing our understanding of perinatal depression. CNS Spectrums. 20:9-10.


APPENDIX A

ETHICS APPROVAL (UWO and Lawson)
(2 pages)
Western University Health Science Research Ethics Board
HSREB Full Board Initial Approval Notice

Principal Investigator: Dr. Michelle Mattola
Department & Institution: Health Sciences/Kinesiology, Western University

HSREB File Number: 105699
Study Title: Effects of two in-hospital antepartum interventions on functional ability and quality of life in early postpartum women
Sponsor:

HSREB Initial Approval Date: November 04, 2014
HSREB Expiry Date: October 31, 2016

Documents Approved and/or Received for Information:

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The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review. If an Updated Approval Notice is required prior to the HSREB Expiry Date, the Principal Investigator is responsible for completing and submitting an HSREB Updated Approval Form in a timely fashion.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 3, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 000009010.

Ethics Officer, on behalf of Dr. Joseph Goss, HEC Chair

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<tr>
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</tr>
<tr>
<td><a href="mailto:eliasel@uwo.ca">eliasel@uwo.ca</a></td>
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This is an official document. Please retain the original in your files.
LAWRSON FINLAL APPROVAL NOTICE

LAWRSON APPROVAL NUMBER: R-14-436


PRINCIPAL INVESTIGATOR: Dr. Michelle Mottola

LAWRSON APPROVAL DATE: November 6, 2014

Health Sciences REB#: 105699

Please be advised that the above project was reviewed by the Clinical Research Impact Committee and Lawson Administration and the project:

Was Approved

Please provide your Lawson Approval Number (R#) to the appropriate contact(s) in supporting departments (eg. Lab Services, Diagnostic Imaging, etc.) to inform them that your study is starting. The Lawson Approval Number must be provided each time services are requested.

Dr. David Hill
V.P. Research
Lawson Health Research Institute

All future correspondence concerning this study should include the Lawson Approval Number and should be directed to Sherry Paiva, Research Approval Officer, Lawson Health Research Institute, 750 Baseline Road, East, Suite 300.

cc: Administration
APPENDIX B

Baseline Letter of Information and Consent (6 pages)
LETTER OF INFORMATION for PARTICIPANTS

Effects of two in-hospital antepartum interventions on functional ability and quality of life in early postpartum women.

Local Principal Investigator:
Dr. Michelle Mottola, PhD FACSM
School of Kinesiology

Local Study Investigators:
1. Dr. Michelle Mottola PhD, School of Kinesiology, UWO
2. Charity McCarthy, BSc, MSc Kinesiology, Exercise Physiology (Candidate), UWO
3. Dr. Maggie Sopper, PhD, Research Associate, School of Kinesiology, UWO
4. Dr. Barb deVrijer, MD, Maternal-Fetal Medicine, LHSC, Victoria Hospital

Invitation to Participate in Research
You are being invited to participate in this study about activity restriction in pregnancy. As an activity restricted pregnant woman in hospital, you are eligible to participate in this study and your participation is voluntary. Choosing not to participate will not have any negative consequences or affect the care that you receive at your primary health care clinic or place of delivery.

Why is this study being done?
Although activity restriction is commonly prescribed for women with a high-risk pregnancy, it may have an effect on your physical and psychological health. You are invited to participate in this study that will help us understand women’s experiences with activity restriction during pregnancy while hospitalized. The results of this study will allow us to design future studies for pregnant women to help mothers have the healthiest pregnancy possible.

How many participants will be in this study?
A total of 30 pregnant women will be participating in this study.

What will happen during the study?
We will be using two interventions to better understand women’s experiences with activity-restriction while hospitalized during pregnancy. You will be randomly assigned (like a flip of a coin) by a computer program to one of the two strategies. You have equal likelihood (50% chance) of being assigned to either of the two groups. Details of the group you have been allocated to will be provided after you are enrolled in the study. Due to the nature of the study the researcher will be unable to indicate what the other group entails. We will however provide a Debriefing Letter describing both interventions at the end of the study. Both strategies are safe for you and your baby/babies.
programs will require a time commitment of approximately 30 minutes 5 times per week until birth while you are hospitalized. You will also be asked to visit the Exercise and Pregnancy Lab at Western University 4 times after you give birth for follow up on your health. All women will continue to receive usual care and advice from their primary health care provider and he/she will be informed of your participation in the study. Study participation will begin at approximately 28 weeks of pregnancy and continue until the birth of your baby, with 4 follow up visits spread over the first year after birth.

Your participation involves the following:
Study measures will be conducted at the hospital until birth as outlined below. You will also be asked to visit the Exercise and Pregnancy Lab at Western University at 2 weeks, 2 months, 6 months and 1 year post-birth for further study measures to assess your health in the postpartum period.

✓ Study Measurements (specific information is below):

- The following information will be gathered during your first visit with the researcher while you are in hospital (see chart below for schedule):
  - You will be asked to complete questionnaires about your general health (History and Activity Questionnaire; Psychosocial Profile Questionnaire), and your mood and feelings (Edinburgh Prenatal Depression Scale; EQ-5D questionnaire). We will also ask about any supplements or medications you may be using. These questionnaires will take approximately 30 minutes to complete.
  - Blood pressure measurements, weight and height will be recorded each week as well as each of the 4 follow up visits.
  - We will ask you to wear a pedometer to record your activity for 7 days in a row while in hospital. You will also record your food intake for the same 7 days. This will take place at the beginning of the study.
  - Within 6 to 18 hours after delivery a member of our research staff will visit you and we will record the birth weight, length and head circumference from the birth records of your baby/babies, any complications which may have occurred during delivery, and your last known body weight.
  - At 4 times post-birth you will be invited to visit the Exercise and Pregnancy Lab for follow-up measurements regarding your health. This will occur at 2 weeks, 2 months, 6 months and 1 year after you have delivered. At each of these visits, you will complete the previously mentioned questionnaires as well as a questionnaire regarding your breastfeeding status and infant feeding practises. You will also be asked to complete a functional mobility assessment test at each of these postpartum visits. This will involve testing your ability to do physical tasks such as sitting, standing, and walking. Each of these visits will take about one hour to complete.

Blood pressure measurements:
We will use the same blood pressure cuff technique that your doctor uses while you are resting quietly in a chair. You will feel a slight pressure on your arm when the cuff is inflated.
We will be collecting the following information about you and your baby at the times specified:

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<td>Information about your activity level using a tracking device (pedometer) to be worn for 7 days.</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Day Food Intake Record (Same days as pedometer)</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height and Weight</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Heart Rate and Blood Pressure</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Functional Mobility Assessment Test (sitting, standing, walking)</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Breastfeeding Questionnaire</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Infant**

| Infant | Birth weight, length, sex, head circumference, complications from chart records | ✔ |

2 Weeks
Are there any risks to doing the study?
The risks involved in participating in this study are minimal. You may feel uneasy about answering some of the study questions about your mood. You do not need to answer questions that you do not want to answer. You can change your mind about participating in the study and withdraw (stop taking part) at any time.

Are there any benefits to doing the study?
Participating in this study may help you to learn more about health in pregnancy. What is learned as a result of this study may help us understand women’s experiences with activity restriction and being hospitalized during pregnancy.

Will I be paid to participate in the study?
You will not be paid to participate in this study.

Will there be any costs to me?
No. We will arrange for you to park free of charge at Western University for all follow up visits. Your participation in this research will not involve any additional costs to you or your health care insurer.

What You Need to Know About Signing the Consent Form
You do not waive any legal rights by signing the consent form. You will be given a copy of this letter of information and consent form once it is signed.

Other Information You Need to Know About Taking Part in This Study:
Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions, or withdraw from the study at any time with no effect on your future care. If you withdraw from the study at any time, we will still use your information collected up to that point. If your medical condition changes throughout the course of the study, or your physician determines that continuation in the study would impair your health or that of your baby/babies, you will be advised at that time to discontinue the study. We will still include information collected from you up until this time point and you will continue to receive ongoing medical care. If, during the course of this study, new information becomes available that may relate to your willingness to continue to participate, this information will be provided to you by the investigators. Participating in this study may result in you being asked if you would be willing to participate in future studies being conducted. You are under no obligation to do so. An alternative is not to participate in the study and continue on just as you do now. There is no guarantee of a personal benefit by participating in the study. Regardless of your decision to participate you would still receive continuing medical care.

Specific Things You Should Know About Confidentiality
Your confidentiality will be respected. The information collected will be used for this current research project only. Your records will be kept locked in a cabinet in a secure office. You will be given a unique identification number and will not be personally identified in any way. When the results of this study are published or presented to groups of other researchers or health care professionals, they will be
presented as group data, and your name will not be associated with any specific result without your consent to the disclosure. Data will be kept for a period of 15 years, at which time it will be destroyed.

We will try to ensure the confidentiality of your research–related records. Absolute confidentiality, however, cannot be guaranteed, as we may have to disclose certain information under certain laws. Representatives of the University of Western Ontario Health Sciences Research Ethics Board and representatives of Lawson Quality Assurance Education Program may require access to your study-related records or may need to follow-up with you to monitor the conduct of this research.

While we will do our best to protect your information there is no guarantee that we will be able to do so. The inclusion of your initials and your date of birth may allow someone to link the data and identify you.

How do I find out what was learned in this study?
We expect to have this study completed by approximately 2016. If you would like a brief summary of the results, please let us know how you would like it sent to you (on the consent form; page 6).

Contact Information
If you have any questions about this study or your treatment, please contact the principal study investigator at this site, Dr. Michelle Mottola (Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry; School of Kinesiology, Faculty of Health Sciences) of the University of Western Ontario.

If you have any questions about the conduct of this study or your rights as a research participant, you may contact the Office of Research Ethics.
CONSENT FORM

Effects of two in-hospital antepartum interventions on functional ability and quality of life in early postpartum women.

I have read the letter of information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

.................................................. ..................................................  
SIGNED SIGNED  

........................................................  ........................................................  
DATE DATE  

........................................................  ........................................................  
YOUR NAME (PLEASE PRINT) PRINTED NAME OF PERSON OBTAINING CONSENT
APPENDIX C

HISTORY & ACTIVITY HISTORY QUESTIONNAIRE
(to be completed while hospitalised)
(5 pages)
History Questionnaire

Subject ID:________  Date: ____/____/____

General Information:

What is your height? _________
What was your weight before pregnancy? ________
On your last visit to the doctor, what was your weight? _________

Medical Conditions / Diseases:
Have you had any medical conditions or diseases? (please list)

Before your pregnancy, did you have a regular menstrual cycle?

Health Habits
1. Have you ever smoked?
   Number of years smoked?
   Number smoked per day?

2. Do you consume alcohol?
   Number consumed per day?

Activity Habits [If you are activity-restricted now, please list activities BEFORE activity-restriction prescription]:
1. List regular fitness recreational activities:

   __________________________________________________________
   __________________________________________________________

   INTENSITY  FREQUENCY  TIME
   (times/week) (minutes/day)
   1-2 2-4 4+ 20 20-40 40+

   Heavy (rapid heart beat, sweating)  _____  _____  _____  _____  _____  _____
   Medium (not exhausting, sweating)  _____  _____  _____  _____  _____  _____
   Light (minimal effort, no sweating) _____  _____  _____  _____  _____  _____

2. Does your regular occupation (job/home) activity involve:
   YES  NO
   Heavy Lifting?  □  □
   Frequent walking/stair climbing?  □  □
   Occasional walking (<once/hr)?  □  □
   Prolonged standing?  □  □
   Mainly sitting?  □  □
Please read all of the following statements first and after reading them place a Y beside the one statement that best represented your exercise status during your pregnancy. PLEASE MARK ONLY ONE OF THE FIVE STATEMENTS.

1. _____ I did not engage in exercise in my leisure time and I did not think about starting.

2. _____ I did not engage in exercise in my leisure time, but I thought about starting.

3. _____ I engaged in some exercise in my leisure time but not on a regular basis.

4. _____ I engaged in regular exercise in my leisure time, but only began to do so within the last six months.

5. _____ I engaged in regular exercise in my leisure time and I have done so for longer than six months.

[TO BE COMPLETED IF YOU ARE ACTIVITY-RESTRICTED]:

Activity-Restriction Information

1. At what gestational age (weeks) were you prescribed activity restriction?

2. What is your activity restriction?

3. At what gestational age (weeks) were you hospitalized?

4. Why have you been hospitalized?

5. Are you currently taking any medication, including vitamins?

6. Since you've been in the hospital, describe what you do in a typical day.
Activity History Questionnaire

[If you are activity-restricted now, please list activities BEFORE activity-restriction prescription]

<table>
<thead>
<tr>
<th>trimester</th>
<th>Before Pregnancy</th>
<th>1st trimester</th>
<th>2nd trimester</th>
<th>3rd trimester</th>
</tr>
</thead>
</table>

1) Check **ALL** activities that were a part of your weekly routine:

- Walking for exercise (briskly)
- Swimming for exercise
- Jogging/Running
- Aerobics/Jazzercise
- Cycling for exercise
- Yoga
- Dance
- Calisthenics (sit-ups, push-ups)
- Weight training
- Cross country skiing (1 mile or more)
- Pre-natal fitness class
- Other (specify): __________

2) How many times per week did you exercise?:

- 0 times
- 1-2 times
- 3-4 times
- 5 or more
**[If you are activity-restricted now, please list activities BEFORE activity-restriction prescription]**

<table>
<thead>
<tr>
<th>trimester</th>
<th>Before Pregnancy</th>
<th>1st trimester</th>
<th>2nd trimester</th>
<th>3rd</th>
</tr>
</thead>
</table>

3) How long did you usually exercise?

- N/A (did not exercise)
- Less than 15 minutes
- 15-29 minutes
- 30-59 minutes
- 60 minutes or more

4) Generally, while exercising did you?

- Perspire and breathe rapidly
- Perspire and breathe above normal
- Breathe and perspire normally or only slightly above normal
- I did not exercise

5) Check **ALL** activities that you did as recreational activities:

- Bowling/Curling
- Leisure walking
- Cross country skiing (less than 1 mile)
- Ice skating
- Down hill skiing
- Racquet sports
- Golf
- Other (specify): ____________________
### If you are activity-restricted now, please list activities BEFORE activity-restriction prescription

<table>
<thead>
<tr>
<th>trimester</th>
<th>Before Pregnancy</th>
<th>1st trimester</th>
<th>2nd trimester</th>
<th>3rd</th>
</tr>
</thead>
</table>

6) How many times per week did you engage in the above recreational activities?

- 0 times
- 1-2 times
- 3-4 times
- 5 or more

7) How long did these activities last?

- N/A (did not exercise)
- Less than 15 minutes
- 15-29 minutes
- 30-59 minutes
- 60 minutes or more

8) Generally, while engaging in recreational activities, did you?

- N/A - no activities
- Perspire and breathe rapidly
- Perspire and breathe above normal
- Breathe and perspire normally or only slightly above normal
APPENDIX D

The Psychosocial Profile Questionnaire (PPQ) consists of:

a) Depression Scale CES-D – 1 page,
b) State Anxiety Index – 1 page,
c) Antepartum physical & psychological Symptoms Report (ASR) – 3 pages.
d) Antepartum Hospital Stressors Inventory (AHSI) – 7 pages, 2 pages of scoring sheet

(total 14 pages)
CENTRE OF EPIDEMIOLOGICAL STUDIES DEPRESSION SCALE (CES-D)

Subject ID: _____________    Date: ___/____/_____  

I am going to read you some sentences that say something about how people sometimes feel. Please listen to each sentence and tell me the number that best indicates how often you have felt this way in the past 7 days.

Have you felt this way:

0. Rarely or none of the time (less than one day)
1. Some or a little of the time (1 to 2 days)
2. Occasionally or a moderate amount of time (3 to 4 days)
3. Most or all of the time (5 to 7 days)

During the past seven days:

a) I was bothered by things that usually don't bother me. 0 1 2 3  
b) I did not feel like eating; my appetite was poor. 0 1 2 3  
c) I felt that I could not shake off the blues even with help from my family or friends. 0 1 2 3  
d) I felt that I was just as good as other people. 0 1 2 3  
e) I had trouble keeping my mind on what I was doing. 0 1 2 3  
f) I felt depressed. 0 1 2 3  
g) I felt that everything I did was an effort. 0 1 2 3  
h) I felt hopeless about the future. 0 1 2 3  
i) I thought my life had been a failure. 0 1 2 3  
j) I felt fearful. 0 1 2 3  
k) My sleep was restless. 0 1 2 3  
l) I was happy. 0 1 2 3  
m) I talked less than usual. 0 1 2 3  
n) I felt lonely. 0 1 2 3  
o) People were unfriendly. 0 1 2 3  
p) I enjoyed life. 0 1 2 3  
q) I had crying spells. 0 1 2 3  
r) I felt sad. 0 1 2 3  
s) I felt that people disliked me. 0 1 2 3  
t) I could not get "going". 0 1 2 3
STATE ANXIETY INDEX (SHORT VERSION)

Subject ID: _____________    Date:  ____/____/_____

Here’s a series of statements that people have used to describe themselves. Please listen to each statement and tell me how much it describes how you’ve been feeling over this past week. Just give the number of the category on this page that describes your feelings best.

1. not at all
2. somewhat
3. moderately so
4. very much so

a) I feel calm
b) I feel secure
c) I am regretful
d) I am presently worrying over possible misfortunes
e) I am anxious
f) I feel self-confident
g) I am jittery
h) I feel “high strung”
i) I am relaxed
j) I feel over-excited and “rattled”
k) I feel joyful
l) I feel pleasant
(Directions) I am going to go over a list of symptoms that pregnant women and women on bedrest sometimes have. Will you please tell me if you’ve had this symptom during the past week, and whether the symptom is mild (bothered you a little), moderate (bothered you), or severe (bothered you a lot).>

Scoring:

Phys Sx Severity 1 = mild 2 = moderate 3 = severe
0 = not applicable.

__sx1a__ Indigestion
__sx2a__ Reflux (Burping and bringing up fluid into your chest or throat)
__sx3a__ Nausea
__sx4a__ Decreased appetite
__sx5a__ Round Ligament Pain/discomfort
__sx6a__ Other parts of Abdomen hurt
__sx7a__ Hips hurt
__sx8a__ Back hurt
__sx9a__ Legs hurt
__sx10a__ External Ears hurt (pinna)
__sx11a__ Any Body part hurt not mentioned above- Specify __sx11a_sp__
__sx12a__ Other body part hurt - Specify __sx12a_sp__
__sx13a__ Rash on body anywhere __sx13a_sp__
__sx14a__ Skin drier than usual
__sx15a__ Lips drier than usual
__sx16a__ Skin sore
__sx17a__ Heels sore
__sx18a__ Muscle sore anywhere - specify __sx18a_sp__
__sx19a__ Knees sore
<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>sx20a</td>
<td>Pelvis/groin area hurts/sore</td>
</tr>
<tr>
<td>sx21a</td>
<td>Muscle cramps - Site _______________ sx21a_sp</td>
</tr>
<tr>
<td>sx22a</td>
<td>Earache</td>
</tr>
<tr>
<td>sx23a</td>
<td>Headache</td>
</tr>
<tr>
<td>sx24a</td>
<td>Visual problems</td>
</tr>
<tr>
<td>sx25a</td>
<td>Sleep changes 0. No 1. Yes If yes, ask below (if no, skip to Usual Bedtime)</td>
</tr>
<tr>
<td></td>
<td>Difficulty getting to sleep</td>
</tr>
<tr>
<td></td>
<td>Wake up to go to bathroom</td>
</tr>
<tr>
<td></td>
<td>Wake up in middle of night other than bathroom</td>
</tr>
<tr>
<td></td>
<td>Can’t get back to sleep after waking</td>
</tr>
<tr>
<td></td>
<td>Restless sleep</td>
</tr>
<tr>
<td></td>
<td>Falling asleep during the day without trying (doesn’t include napping)</td>
</tr>
<tr>
<td></td>
<td>Other sleep changes - specify ___</td>
</tr>
<tr>
<td></td>
<td>Usual bedtime sx26a</td>
</tr>
<tr>
<td></td>
<td>Usual waking time sx27a</td>
</tr>
<tr>
<td>sx28a</td>
<td>Shortness Of Breath on exertion (when do something strenuous)</td>
</tr>
<tr>
<td>sx29a</td>
<td>Elevated Blood sugar</td>
</tr>
<tr>
<td>sx30a</td>
<td>Gestational Diabetes 1. Diet controlled 2. Insulin controlled 3. Uncontrolled</td>
</tr>
<tr>
<td>sx31a</td>
<td>Dizziness</td>
</tr>
<tr>
<td>sx32a</td>
<td>Fainted/Faintness</td>
</tr>
<tr>
<td>sx33a</td>
<td>Fatigue</td>
</tr>
<tr>
<td>sx34a</td>
<td>Constipation</td>
</tr>
<tr>
<td>sx35a</td>
<td>Nasal congestion</td>
</tr>
</tbody>
</table>
SYMPTOM REPORT - ANTEPARTUM

Date

Subject No.

__sx36a__ Edema - Site __sx36a_sp__

__sx37a__ Hemorrhoids

__sx38a__ Any Other Physical Problems - Specify __sx38a_sp__

__sx39a__ Any Other - Specify __sx39a_sp__

<Nurse: (Directions) The following symptoms describe problems that some pregnant women have with their thinking or mood. I'm going to read through the list. Again, please tell me whether you've had this symptom during the past week, and if so, whether the symptom was mild (bothered you a little), moderate (bothered you), or severe (bothered you a lot).>

Symptom Severity

1 = mild
2 = moderate
3 = severe
0 = not applicable

__sx40a__ Difficulty concentrating

__sx41a__ Mood Changes

__sx42a__ Tenseness

__sx43a__ Boredom

__sx44a__ Unusual sensory experience (like hearing things, seeing things, smelling things)

__sx45a__ Nightmares

__sx46a__ Any Other Problems with Thinking or Mood - Specify __sx46a_sp__

Maternal weight __sta__

<Nurse: (Directions) Record any spontaneous patient statements regarding a) Weighing experience and b) standing experience

a) weighing pt. statements

b) Pt. statements about standing

>
AHSI
(ANTEPARTUM HOSPITAL STRESSORS INVENTORY)

SUBJECT ID: ________________________
DATE ____________________________

Instructions: (Hand response card to patient)

Women who are pregnant and are staying in hospital find they must cope with a number of new things. These things can be upsetting or stressful to them. We usually think of stress as something that makes it difficult for us to relax. Here is a list of experiences which pregnant women who have to stay in hospital might find stressful.

Please CHOOSE the response which best describes how each of these experiences affects you. (Read choices). Any questions?

Example:
Dropping a cake I've just baked.

1. Being less active than usual.
2. Wanting to be home to get ready for the baby.
3. Taking medication.
4. Thinking about my health.

Revised: 11/25/97
### AHSI
(ANTEPARTUM HOSPITAL STRESSORS INVENTORY)

**SUBJECT ID:**

**DATE**

1. Understanding explanations for tests.
   - no stress
   - very little stress
   - some stress
   - a lot of stress
   - a great deal of stress
   - does not apply to me

2. Sleeping alone.
   - no stress
   - very little stress
   - some stress
   - a lot of stress
   - a great deal of stress
   - does not apply to me

3. Being away from my work.
   - no stress
   - very little stress
   - some stress
   - a lot of stress
   - a great deal of stress
   - does not apply to me

4. Thinking about being a mother.
   - no stress
   - very little stress
   - some stress
   - a lot of stress
   - a great deal of stress
   - does not apply to me

5. Having tests done.
   - no stress
   - very little stress
   - some stress
   - a lot of stress
   - a great deal of stress
   - does not apply to me

6. Being away from home.
   - no stress
   - very little stress
   - some stress
   - a lot of stress
   - a great deal of stress
   - does not apply to me

7. Being asked about myself by other patients and their visitors.
   - no stress
   - very little stress
   - some stress
   - a lot of stress
   - a great deal of stress
   - does not apply to me

8. Trying to understand medical terms.
   - no stress
   - very little stress
   - some stress
   - a lot of stress
   - a great deal of stress
   - does not apply to me

---

Revised: 11/25/97

Page 2
<table>
<thead>
<tr>
<th>SUBJECT ID:</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Being given too much information about my condition.</td>
<td>no stress</td>
</tr>
<tr>
<td>14. Thinking about my baby's health.</td>
<td>no stress</td>
</tr>
<tr>
<td>15. Feeling worried.</td>
<td>no stress</td>
</tr>
<tr>
<td>16. Sleeping in a strange bed.</td>
<td>no stress</td>
</tr>
<tr>
<td>17. Being dependent on others.</td>
<td>no stress</td>
</tr>
<tr>
<td>18. Thinking about my partner doing my work.</td>
<td>no stress</td>
</tr>
<tr>
<td>19. Being away from my partner.</td>
<td>no stress</td>
</tr>
<tr>
<td>20. Lacking privacy.</td>
<td>no stress</td>
</tr>
</tbody>
</table>

Revised: 11/25/97

Page 3
<table>
<thead>
<tr>
<th>Subject ID:</th>
<th>Date</th>
<th>AHSI (Antepartum Hospital Stressors Inventory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21. Feeling scared.</td>
<td></td>
<td>no stress</td>
</tr>
<tr>
<td>22. Being away from my usual activities.</td>
<td></td>
<td>no stress</td>
</tr>
<tr>
<td>23. Thinking about the care of my children at home.</td>
<td></td>
<td>no stress</td>
</tr>
<tr>
<td>24. Feeling depressed.</td>
<td></td>
<td>no stress</td>
</tr>
<tr>
<td>25. Being bored from lack of activities.</td>
<td></td>
<td>no stress</td>
</tr>
<tr>
<td>26. Having hospital-prepared meals.</td>
<td></td>
<td>no stress</td>
</tr>
<tr>
<td>27. Wondering how long I'll be in hospital.</td>
<td></td>
<td>no stress</td>
</tr>
<tr>
<td>28. Hearing heart beats on monitors.</td>
<td></td>
<td>no stress</td>
</tr>
</tbody>
</table>

Revised: 11/25/97  
Page 4
<table>
<thead>
<tr>
<th>Subject ID:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>No Stress</th>
<th>Very Little Stress</th>
<th>Some Stress</th>
<th>A Lot of Stress</th>
<th>A Great Deal of Stress</th>
<th>Does Not Apply to Me</th>
</tr>
</thead>
<tbody>
<tr>
<td>29. Missing prenatal classes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Feeling angry.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31. Being dressed for bed all the time.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>32. Being isolated from my friends.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33. Being given too little information about my condition.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34. Thinking about extra expenses while I'm in hospital.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>35. Hearing the staff being noisy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Revised: 11/25/97
<table>
<thead>
<tr>
<th>Subject ID:</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AHSI</strong> (Antepartum Hospital Stressors Inventory)</td>
<td></td>
</tr>
<tr>
<td>36. Thinking about other patients' health.</td>
<td>no stress</td>
</tr>
<tr>
<td>37. Having nurses check my baby's heart rate.</td>
<td>no stress</td>
</tr>
<tr>
<td>38. Depending on staff to keep my room clean.</td>
<td>no stress</td>
</tr>
<tr>
<td>39. Hearing hospital noises.</td>
<td>no stress</td>
</tr>
<tr>
<td>40. Sharing a room with another patient.</td>
<td>no stress</td>
</tr>
<tr>
<td>41. Noticing staff are hurrying with my care.</td>
<td>no stress</td>
</tr>
<tr>
<td>42. Thinking about giving birth.</td>
<td>no stress</td>
</tr>
<tr>
<td>SUBJECT ID:</td>
<td>DATE</td>
</tr>
<tr>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>43. Needing a special diet.</td>
<td>no stress</td>
</tr>
<tr>
<td>44. Thinking about the results of tests.</td>
<td>no stress</td>
</tr>
<tr>
<td>45. Telling unfamiliar staff about myself.</td>
<td>no stress</td>
</tr>
<tr>
<td>46. Feeling lonely.</td>
<td>no stress</td>
</tr>
<tr>
<td>47. Being away from my family.</td>
<td>no stress</td>
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<td>49. Receiving different opinions or changing opinions from staff.</td>
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Antepartum Hospital Stressors Inventory (ASHI)

Scoring
Administered 2 weeks after admission to hospital and later again

49 items
women respond
0 = no stress;
1= very little stress;
2=some stress;
3= a lot a stress;
4= great deal of stress;
or does not apply to me- do not give a score for this! it is
"not applicable"

Responses are divided into 7 categories
1. Separation 7 items (6, 7, 10, 19, 22, 32, 47)
2. Environment 9 items (16, 20, 25, 28, 35, 38, 39, 40)
3. Health Status 10 items (3, 4, 9, 14, 27, 36, 37, 43, 44, 48)
4. Communication with professionals
   7 items, (5, 12, 13, 33, 41, 45, 49)
5. Self Image, 8 items (1, 2, 8, 11, 17, 29, 31, 42)
6. Emotions, 5 items (15, 21, 24, 30, 46)
7. Family Status, 3 items (18, 23, 34)

Scoring
For each item list the woman’s score.

List the number of items identified (may be less than the number of items in the category if someone scores an NA- does not apply to me)

Add up all scores in the category = Total Score

% Identified in Category = numbers of items identified divided by the total number of items in the category (For example, the separation category has 7 items. If a woman only gives a score for 6 items because one does not apply, her % identified would be 6/7 =85.7%)

Mean score for Category= total score divided by the number of items identified

Only categorical scores are given. To my knowledge categories scores have never been added up to give a total score for the entire tool.

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APPENDIX E

EQ-5D [EuroQol-5 dimensional scale] as a health survey for economic analyses (1 page)
EQ-5D Questionnaire
Unique ID ___________________________

By placing a tick in one box in each group below, please indicate which statement best describes your own health state today.
Do not tick more than one box in each group.

MOBILITY
I have no problems walking □
I have slight problems with walking □
I have moderate problems with walking □
I have severe problems with walking □
I am unable to walk □

SELF-CARE
I have no problems washing or dressing myself □
I have slight problems washing or dressing myself □
I have moderate problems washing or dressing myself □
I have severe problems washing or dressing myself □
I am unable to wash or dress myself □

USUAL ACTIVITIES (e.g. work, study, housework, family or leisure activities)
I have no problems doing my usual activities □
I have slight problems doing my usual activities □
I have moderate problems doing my usual activities □
I have severe problems doing my usual activities □
I am unable to my usual activities □

PAIN/DISCOMFORT
I have no pain or discomfort □
I have slight pain or discomfort □
I have moderate pain or discomfort □
I have severe pain or discomfort □
I have extreme pain or discomfort □

ANXIETY/DEPRESSION
I am not anxious or depressed □
I am slightly anxious or depressed □
I am moderately anxious or depressed □
I am severely anxious or depressed □
I am extremely anxious or depressed □
APPENDIX F

PEDOMETER LOG SHEET

(1 page)
# Pedometer Log

**Activity Restriction – University of Western Ontario**

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You can now reset the pedometer to zero. Please wear the pedometer to bed.

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You can now reset the pedometer to zero. Please wear the pedometer to bed.
APPENDIX G

7 DAY FOOD INTAKE RECORD
With explanations
(10 pages)
EXERCISE AND PREGNANCY LABORATORY

7-DAY FOOD RECORD

Unique ID: __________________Dates to record: ______________________

Checklist  Before you return your food record make sure you included:

☐ Spreads on toast, potatoes and vegetables
☐ Sugar and cream or creamers in beverages
☐ Salad dressings
☐ Syrups, sauces and gravies
☐ Condiments Ex. ketchup and soy sauce, etc.
☐ Candy and soft drinks
☐ Chips, nuts, and popcorn

Please keep a record of everything you eat and drink for 7 days. Keep track of everything you eat from the time you wake up in the morning until the time you go to bed at night. Do not forget to include all snacks and beverages.

If in doubt, leave too much information! Thank you!

Mail to:
Exercise and Pregnancy Lab, 3M Centre
The University of Western Ontario
London, ON  N6A 3K7

Or Fax:  (519) 661-2008
What do I need to include?

1. If you have a copy of your meal plan ticket you can attach it to the correct day and skip the next 5 steps. Please indicate on the meal ticket the proportion of each food item you ate so we can obtain an accurate measure of nutritional content.

2. List the food item and amount eaten.
   - Product Name – type of food eaten (ex. Mushroom soup)
   - Brand Name- different ingredients may be used (ex. Campbell’s vs. Lipton’s)
   - Characteristics:
     - Colour (ex. Green or yellow beans, white or brown bread, etc.)
     - Fat content ~ % fat (ex. Skim, 1%, 2% or homo milk)
       ~ leanness of meat (ex. Extra lean ground beef)
       ~ fat claims (ex. Light, low fat, etc.)
     - Freshness ~ Was it fresh, frozen, canned or dried?

3. Record the time and the place where the food was eaten.

4. For each item briefly describe how it was prepared:
   - Was your meat fried, baked, broiled or barbecued?
   - Were vegetables eaten raw, or were they boiled steamed or sautéed?
   - Did you trim the fat off of the chicken? Was it skinless?
   - Did you fry the food in butter, oil or margarine?

5. Please measure and describe the amount of food eaten as best as possible:
   - Give dimensions: ex. 2 slices of roast beef – 5” x 3” x ¼” thick
   - Give spoon or cup measurements: ex. ¾ cup peas with ½ tsp. butter
   - Give ounces (oz): ex. 4 oz. of salmon or a 6 oz. steak
   - Give metric units: ex. 250 ml of milk

6. For mixed dishes such as lasagna, casseroles and stews, record approximate amounts of the main ingredients.
   - Ex. Lasagna - Were there vegetables in it? What kind?
     - Or was it a meat and cheese lasagna?

How do I know what a serving size is?
To help identify serving sizes, the following guidelines may come in handy:

- Count the number of food items if practical.
  
  Ex. 20 grapes or 8 shrimps

- Use household measures to specify serving sizes.

  Ex.  1 cup (c) = 250 ml    1 tablespoon (tbsp) = 15 ml
       1 ounce (oz) = 30g     1 teaspoon (tsp) = 5 ml

- Use your hands to estimate serving sizes.

  - A palm is equal to 3 ounces (ex. 3 ounces of meat, fish or poultry).

  - A fist is equivalent to a 1-cup measure (ex. 1 cup of lettuce or yoghurt).

  - A thumb is equal to 2 tablespoons (ex. 2 tbsp. of peanut butter or cheese).

  - A thumb tip is equal to 1 teaspoon (ex. 1 tsp. of margarine).

  - 3 thumb tips are equal to 1 tablespoon (ex. 1 tbsp. of salad dressing).

- Other objects that may help to estimate serving sizes.

  - A deck of cards is approximately 3-4 oz. of meat.
  - A computer mouse is a serving of potato.
  - A baseball is equal to one cup or a serving of pasta.
  - A tennis ball is equal to a medium sized fruit.
  - A hockey puck is the serving size of a bagel.
  - A Ping-Pong ball is equal to 2 tablespoons.
  - A CD is the serving size of a pancake.
  - A chequebook is a 3-oz. fillet of fish.
  - A floppy disk is a slice of processed cheese.

  - A pair of dice is 2 tsp. of sugar.
  - A film canister is an ounce of nuts.
When filling out the daily food record, remember to write down everything that you eat and drink from the time you wake up until the time you go to sleep. Please accurately record as much information as possible. This will assist the Dietitian. Thank you!

7-Day Food Record  Day 1  Date: ______________________________

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When filling out the daily food record, remember to write down everything that you eat and drink from the time you wake up until the time you go to sleep. Please accurately record as much information as possible. This will assist the Dietitian. Thank you!

**Unique ID:** _____________________________

**7-Day Food Record**

**Day 2**

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When filling out the daily food record, remember to write down everything that you eat and drink from the time you wake up until the time you go to sleep. Please accurately record as much information as possible. This will assist the Dietitian. Thank you!

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7-Day Food Record    Day 3    Date: ______________________________

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**7-Day Food Record**  
**Day 4**

Unique ID: _________________________  
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7-Day Food Record  Day 5

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**7-Day Food Record  Day 6**  

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### 7-Day Food Record Day 7

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APPENDIX H

Exercise Group Letter of Information and Consent (5 pages)
LETTER OF INFORMATION for PARTICIPANTS IN INTERVENTION 2

Effects of two in-hospital antepartum interventions on functional ability and quality of life in early postpartum women.

Local Principal Investigator:
Dr. Michelle Mottola, PhD FACSM
Director, R. Samuel McLaughlin Foundation – Exercise & Pregnancy Lab

Local Study Investigators:
1. Dr. Michelle Mottola PhD, School of Kinesiology, UWO
2. Charity McCarthy, BSc, MSc Kinesiology, Exercise Physiology (Candidate), UWO
3. Dr. Maggie Sopper, PhD, Research Associate, School of Kinesiology, UWO
4. Dr. Barb deVrijer, MD, Maternal-Fetal Medicine, LHSC, Victoria Hospital

Invitation to Participate in Research
You are being invited to participate in this study about activity-restriction while hospitalized in pregnancy. As an activity-restricted pregnant woman in hospital, you are eligible to participate in this study. Your participation is voluntary. Choosing not to participate will not have any negative consequences or affect the care that you receive at your primary health care clinic or place of delivery.

Why is this study being done?
Although activity-restriction has been widely prescribed for high risk pregnancy, it may leave mothers with reduced cardiovascular and physical conditioning. This may make return to daily activities after birth, such as carrying a baby or walking up stairs, more difficult. You are invited to participate in this study which will investigate whether a low intensity muscle conditioning program performed while in hospital and lying in bed, can improve physical conditioning of high risk activity-restricted pregnant women. The results of this study will allow us to design future studies for pregnant women to help mothers have the healthiest pregnancy possible.

How many participants will be in this study?
A total of 30 pregnant women will be participating in this study.

What will happen during the study?
You have been randomly assigned (like a flip of a coin) by a computer program (equal probability - 50% chance) into Intervention 2 (Exercise; E).
Your participation involves the following:

If you agree to take part in the study, you will be participating in one of two protocols. Your protocol will involve a muscle conditioning program designed to counter the muscular and cardiovascular deconditioning while you are lying in bed that may occur during activity-restriction while you are in the hospital. Activities will include light stretching and muscle strengthening exercises using a theraband (rubber band with various tensions). You will be listening to music throughout each session while wearing head phones that we will provide.

For the first 7 days of your participation in this study you will be asked to wear a pedometer to measure your activity level. You will also be asked to fill out a 7 day food intake record at the same time that you wear the pedometer. This will be used to evaluate how your hospital stay compares to other pregnant women who are also activity-restricted.

If you agree to participate, you will meet with the researcher 4 to 5 times a week. The first visit each week will take approximately 70 minutes and each subsequent visit will last approximately 30 minutes. On the first visit of each week we will record your weight and blood pressure and then complete a light muscle conditioning program. The next three to four visits each week will consist only of the 30 minute exercise program. You will be wearing a polar heart rate monitor for each session so that we can monitor your heart rate. You will also complete a two minute questionnaire that asks you about your feelings, immediately before and after the 30 minute intervention. We will continue to visit you until you give birth. You will also be invited to visit us for follow up 4 times after birth at the Exercise and Pregnancy Lab on the Western University campus. These visits will occur at 2 weeks, 2 months, 6 months and 1 year post birth (approximately 1 hour). The follow up visits will be used to evaluate your physical ability by completing a Functional Mobility Assessment Tool which uses 7 tests to assess your muscular strength, aerobic endurance (heart and lung health), flexibility and agility (time to complete physical tasks). You will also fill out 3 questionnaires that you previously completed at the beginning of the study as well as a breastfeeding and infant feeding questionnaire. These questionnaires will ask questions about your mood, feelings and quality of life after an activity-restricted pregnancy while in hospital.

Are there any risks to doing the study?
The risks involved in participating in this study are minimal. You may have increased breathing and heart rate during the exercise sessions, which is a normal response to a mild intensity exercise. You may feel uneasy about answering some of the study questions about your mood, feelings or quality of life. You do not need to answer questions that you do not want to answer. You can change your mind about participating in the study and withdraw (stop taking part) at any time.

Are there any benefits to doing the study?
Participating in this study may help you to learn more about your health experience with an activity-restricted pregnancy in hospital. What is learned as a result of this study may help us understand
women’s experiences with activity-restriction during pregnancy, which can help all women to be healthy during pregnancy and perhaps improve the mother’s health after release from the hospital.

**Will I be paid to participate in the study?**
You will not be paid to participate in this study.

**Will there be any costs to me?**
No. We will arrange for you to park free of charge at Western when you visit us at 2 weeks, 2, 6 and 12 months post-delivery. Your participation in this research will not involve any additional costs to you or your health care insurer.

**What You Need to Know About Signing the Consent Form**
You do not waive any legal rights by signing the consent form. You will be given a copy of this letter of information and consent form once it is signed.

**Other Information You Need to Know About Taking Part in This Study:**
Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions, or withdraw from the study at any time with no effect on your future care. If you withdraw from the study at any time, we will still use your data compiled up to that point. If your medical condition changes throughout the course of the study, or your physician determines that continuation in the study would impair your health or that of your baby/babies, you will be advised at that time to discontinue the study. We will still include information collected from you up until this time point and you will continue to receive ongoing medical care. If, during the course of this study, new information becomes available that may relate to your willingness to continue to participate, this information will be provided to you by the investigators.

An alternative is not to participate in the study and continue on just as you do now. There is no guarantee of a personal benefit by participating in the study. Regardless of your decision to participate you would still receive continuing medical care.

**Specific Things You Should Know About Confidentiality**
Your confidentiality will be respected. The information collected will be used for this current research project only. Your records will be kept locked in a cabinet in a secure office. You will be given a unique identification number and will not be personally identified in any way. When the results of this study are published or presented to groups of other researchers or health care professionals, they will be presented as group data, and your name will not be associated with any specific result without your consent to the disclosure. Data will be kept for a period of 15 years, at which time it will be destroyed.

We will try to ensure the confidentiality of your research–related records. Absolute confidentiality, however, cannot be guaranteed, as we may have to disclose certain information under certain laws. Representatives of the University of Western Ontario Health Sciences Research Ethics Board and
representatives of Lawson Quality Assurance Education Program may require access to your study-related records or may need to follow-up with you to monitor the conduct of this research.

While we will do our best to protect your information there is no guarantee that we will be able to do so. The inclusion of your initials and your date of birth may allow someone to link the data and identify you.

Contact Information

If you have any questions about this study or your treatment, please contact the principal study investigator at this site, Dr. Michelle Mottola (Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry; School of Kinesiology, Faculty of Health Sciences) of the University of Western Ontario.

If you have any questions about the conduct of this study or your rights as a research participant, you may contact the Office of Research Ethics.
CONSENT FORM FOR PARTICIPATION IN INTERVENTION 2

Effects of two in-hospital antepartum interventions on functional ability and quality of life in early postpartum women.

I have read the letter of information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

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SIGNED DATE

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YOUR NAME (PLEASE PRINT)

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SIGNED DATE

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PRINTED NAME OF PERSON OBTAINING CONSENT
APPENDIX I

Music Group Letter of Information and Consent (5 pages)
LETTER OF INFORMATION for PARTICIPANTS IN INTERVENTION 1

Effects of two in-hospital antepartum interventions on functional ability and quality of life in early postpartum women.

Local Principal Investigator:
Dr. Michelle Mottola, PhD FACSM
Director, R. Samuel McLaughlin Foundation – Exercise & Pregnancy Lab

Local Study Investigators:
1. Dr. Michelle Mottola PhD, School of Kinesiology, UWO
2. Charity McCarthy, BSc, MSc Kinesiology, Exercise Physiology (Candidate), UWO
3. Dr. Maggie Sopper, PhD, Research Associate, School of Kinesiology, UWO
4. Dr. Barb DeVrijer, MD, Maternal-Fetal Medicine, LHSC, Victoria Hospital

Invitation to Participate in Research
You are being invited to participate in this study about activity restriction in pregnancy while hospitalized. As an activity-restricted pregnant woman, you are eligible to participate in this study. Your participation is voluntary. Choosing not to participate will not have any negative consequences or affect the care that you receive at your primary health care clinic or place of delivery.

Why is this study being done?
Although activity restriction been widely prescribed for high risk pregnancy, it may leave mothers with reduced cardiovascular and psychological health. This may make return to daily activities after birth more difficult. You are invited to participate in this study which will investigate whether listening to music in bed while you are in hospital can reduce stress and anxiety associated with activity-restriction. The results of this study will allow us to design future studies for pregnant women to help mothers have the healthiest pregnancy possible.

How many participants will be in this study?
A total of 30 pregnant women will be participating in this study.

What will happen during the study?
You have been randomly assigned (like a flip of a coin) by a computer program (equal probability - 50% chance) into Intervention 1 (Music; M).
Your participation involves the following:

If you agree to take part in the study, you will be participating in one of two protocols. Your protocol will involve listening to music while wearing head phones (that we will provide) in bed for 30 minutes, 4 to 5 times per week.

For the first 7 days of your participation in this study you will be asked to wear a pedometer to measure your activity level. You will also be asked to fill out a 7 day food intake record at the same time that you wear the pedometer. This will be used to evaluate how your experience compares with other pregnant women who are also activity-restricted in hospital.

If you agree to participate you will meet with the researcher four to five times a week. The first visit each week will take approximately 70 minutes and each subsequent visit will last approximately 30 minutes. On the first visit of each week we will record your weight and blood pressure and then you will listen to music for the next 30 minutes. The next three to four visits each week will consist only of the 30 minute music intervention. You will be wearing a polar heart rate monitor for each session to monitor your heart rate. You will also complete a two minute questionnaire that asks you about your feelings, immediately before and after the 30 minute intervention. We will continue to visit you until you give birth. You will also be invited to visit us for follow up 4 times after birth to assess your health at the Exercise and Pregnancy Lab on the Western University campus. These visits will occur at 2 weeks, 2 months, 6 months and 1 year post birth (approximately 1 hour). The follow up visits will be used to evaluate your physical ability by completing a Functional Mobility Assessment Tool which uses 7 tests to assess your muscular strength, aerobic endurance (heart and lung health), flexibility and agility (time to complete physical tasks). You will also fill out 3 questionnaires that you previously completed at the beginning of the study as well as a breastfeeding and infant feeding questionnaire. These questionnaires will ask questions about your mood, feelings and quality of life after being hospitalized with an activity restricted pregnancy.

Are there any risks to doing the study?
The risks involved in participating in this study are minimal. You may feel uneasy about answering some of the study questions about your mood, feelings or quality of life. You do not need to answer questions that you do not want to answer. You can change your mind about participating in the study and withdraw (stop taking part) at any time.

Are there any benefits to doing the study?
Participating in this study may help you to learn more about your health experience with an activity restricted pregnancy in hospital. What is learned as a result of this study may help us understand women’s experiences with activity restriction while hospitalized during pregnancy, which can help all women to be healthy during pregnancy and perhaps improve the mother’s health after release from the hospital.
Will I be paid to participate in the study?  
You will not be paid to participate in this study.

Will there be any costs to me?  
No. We will arrange for you to park free of charge at Western when you visit us at 2 weeks, 2, 6 and 12 months post-delivery. Your participation in this research will not involve any additional costs to you or your health care insurer.

What You Need to Know About Signing the Consent Form  
You do not waive any legal rights by signing the consent form. You will be given a copy of this letter of information and consent form once it is signed.

Other Information You Need to Know About Taking Part in This Study:  
Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions, or withdraw from the study at any time with no effect on your future care. If you withdraw from the study at any time, we will still use your data compiled up to that point. If your medical condition changes throughout the course of the study, or your physician determines that continuation in the study would impair your health or that of your baby/babies, you will be advised at that time to discontinue the study. We will still include information collected from you up until that point and you will continue to receive ongoing medical care. If, during the course of this study, new information becomes available that may relate to your willingness to continue to participate, this information will be provided to you by the investigators.

An alternative is not to participate in the study and continue on just as you do now. There is no guarantee of a personal benefit by participating in the study. Regardless of your decision to participate you would still receive continuing medical care.

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**Contact Information**

If you have any questions about this study or your treatment, please contact the principal study investigator at this site, Dr. Michelle Mottola (Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry; School of Kinesiology, Faculty of Health Sciences) of the University of Western Ontario.

If you have any questions about the conduct of this study or your rights as a research participant, you may contact the Office of Research Ethics.
CONSENT FORM FOR PARTICIPATION IN INTERVENTION 1

Effects of two in-hospital antepartum interventions on functional ability and quality of life in early postpartum women.

I have read the letter of information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

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SIGNED DATE

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PRINTED NAME OF PERSON OBTAINING CONSENT
APPENDIX J

EXERCISE PROTOCOL FOR EXERCISE GROUP
(4 pages)
Muscle Conditioning Activity-Restriction-Exercise

STRETCHING EXERCISES (5-minute warm-up)

Safe Stretching:

- Stretch slowly and smoothly without bouncing or jerking.
- Use gentle, continuous movement or stretch-and-hold for 10-30 seconds.
- Aim for a stretched, relaxed feeling, avoid pain, don’t hold your breath, and breathe in a natural rhythm.

1. **Ankle Circles** – While in a recumbent position, lift your right foot, rotate ankle slowly in a circular motion in one direction (left, 5x) and then repeat circling in the other direction (right, 5x). After having completed both directions, repeat same stretches with your left foot.

2. **Lying thigh/hip stretch** – While reclining in a side lying position, bend the top leg and hold the leg around the ankle or shin area with your hand. Gently tilt your pelvis under and gently move the leg backwards. Keep knee at 90 degree (no further) and do not arch back. Hold stretch for 30 seconds, and then repeat on other side.

3. **Outer thigh stretch** – While reclining in a comfortable side lying position, place the top leg in front of your body (knee bent at 90 degree). Hold for 30 seconds, and then repeat on the other side.

4. **Upper back/neck stretch** – In a recumbent recline position with proper posture, reach your arms in front of your body at chest height. The upper back and shoulders will be rounded. Hold the stretch for 30 seconds.

5. **Calf Stretch** – In a recumbent recline position with your legs outstretched, loop theraband or towel around ball of foot, and bring your toes towards you. Maintain stretch for 30 seconds and repeat on other side.

6. **Arm circles/Shoulder circles** – In a recumbent position, circle the arms in a backward motion slowly (15x). Repeat the exercise circling only the shoulders in a backward motion slowly (15x).

STRENGTHING EXERCISES (20 minutes)

Safe strength training:

- Always start with five minutes of light stretching at the start of each session.
- Use proper technique to protect your back and joints from undue stress.
- Breathe regularly when doing the exercises. Do not hold your breath.

**Lower Body:**

1. **Outer thigh strengthening** – Lie on your side and line up your shoulders, hips and ankles, bending the bottom leg 90 degrees. Raise the top leg about 30 cm, and then slowly lower it back down toward the bottom leg. The exercise can be performed with the top knee straight or bent. Repeat 15 times or until tension is felt in the outer thigh and buttocks. Repeat on the other leg.
2. **Inner thigh strengthening** – Lie on your right side in a comfortable position. Bend the top leg placing your foot on the bed. Keep the bottom leg straight and flex the toe. Lift the bottom leg up to 30 cm off the bed and then gently lower it. Repeat 15 times, and repeat with other leg.

3. **Knee extension** – Lying on your side, bend your top leg toward your belly. Then keeping your hip still straighten your leg (15x). Repeat on other leg.

4. **Knee to chest** – Lying straight on one side, bend top knee toward belly and then push it back down (15x). Repeat on other side.

**Upper Body**

1. **Biceps curls** – In a recumbent recline position with knees slightly bent, place theraband around your feet and holding on to the extremities of the theraband (one in each hand), bend arm at the elbow, bringing the hand to shoulder. Bring back arm to initial position (extension) and do same movement on the other side (unilateral). Repeat 15x on each side.

2. **Triceps extensions** – While in a recumbent recline position, with knees slightly bent and arms forward (at chest level) with 90-degree bend at the elbows, stabilizing the theraband with one hand, pull the theraband with the other hand until the elbow is extended (without locking the elbow). Gently return hand to initial position, repeat exercise 15 times and change sides.

3. **Upper back exercise** – In a recumbent recline position, with your knees slightly bent and arms forward (at chest level) with slight bend in elbows, stretch the theraband until hands are at shoulder level, gently squeezing both shoulder blades together. Gently return hand to initial position and repeat exercise 15 times.

4. **Chest press** – In a recumbent recline position, with theraband around your upper body (shoulder level) and the extremities of the theraband in each hand, slowly push both arms forward until elbows are completely extended (do not lock elbows) and repeat exercise 15 times.

5. **Shoulder shrugs** – In a recumbent recline position, elevate the shoulders and slowly lower them back to the initial position (15x).

**STRETCHING EXERCISES (5 minute cool-down)**

1. **Ankle circles** – While in a recumbent recline, lift your right foot, rotate ankle slowly in a circular motion in one direction (left, 5x) and then repeat circling in the other direction (right, 5x). After having completed both directions, repeat same stretches with your left foot.

2. **Lying thigh/hip stretch** – While reclining in a side lying position, bend the top leg and hold the leg around the ankle or shin area with your hand. Gently tilt your pelvis under and gently move the leg backwards. Keep the knee at 90 degree (no further) and do not arch back. Hold stretch for 30 seconds, and then repeat on the other side.
3. **Outer thigh stretch** – While reclining in a comfortable side-lying position, place the top leg in front of your body (knee bent at 90 degree). Hold for 30 seconds, and then repeat on the other side,

4. **Upper back/neck stretch** – In a recumbent recline position with proper posture, reach your arms in front of your body at chest height. The upper back and shoulders will be rounded. Hold the stretch for 30 seconds.

5. **Calf stretch** – In a recumbent recline position with your legs outstretched, loop therabands or towel around ball of foot, and bring your toes towards you. Maintain stretch for 30 seconds and repeat on other side,

6. **Arm circles/shoulders circles** – In a recumbent recline position, circle the arms in a backward motion slowly (15x). Repeat the exercise circling only the shoulders in a backward motion slowly (15x).
APPENDIX K

EXERCISE-INDUCED FEELING INVENTORY (EFI)
(1 page)
Exercise-Induced Feeling Inventory

Patient #: Date (d/m/y):

Instructions: Please use the following scale to indicate the extent to which each word below describes how you feel at this moment in time. Record your responses by filling in the appropriate circle next to each word.

<table>
<thead>
<tr>
<th></th>
<th>0 = Do Not Feel (DNF)</th>
<th>1 = Feel Slightly</th>
<th>2 = Feel Moderately</th>
<th>3 = Feel Strongly</th>
<th>4 = Feel Very Strongly (FVS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refreshed</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Calm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigued</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enthusiastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relaxed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energetic</td>
<td></td>
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<td></td>
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**PRE INTERVENTION:**

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<th>Scale</th>
<th>Scale</th>
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<td>2</td>
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<td>2</td>
<td>3</td>
<td>4 FVS</td>
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<tr>
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**POST INTERVENTION:**

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<td>4 FVS</td>
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APPENDIX L

FUNCTIONAL MOBILITY ASSESSMENT TOOL (Senior Fitness Test)
SUMMARY

In developing the SFT, we first identified the fitness parameters needed for functional mobility, then selected test items to assess these parameters. According to disability models, physical impairment (loss of strength, endurance, etc.) resulting from either pathology or disuse is the initial stage in the progression to disability. Physical impairment, in turn, leads to functional limitation (restriction in physical behaviors such as rising from a chair or climbing stairs), which eventually can lead to disability (loss of ability to take care of oneself).

Identifying the key physiological attributes associated with functional mobility is important in developing physical assessments and in planning exercise prevention/rehabilitation programs. Based on a literature review and feedback by expert judges, the following were identified as being key physiological parameters related to functional mobility in older adults:

- Muscular strength (lower- and upper-body)
- Aerobic endurance
- Flexibility (lower- and upper-body)
- Agility/dynamic balance
- Body mass index

After identifying the general components of functional fitness, the next step was to develop testing protocols to assess each fitness parameter. To meet the goals of the SFT, it was important that the test items

- be reliable and valid;
- be sensitive enough to detect expected changes in performance due to aging or to exercise intervention;
- be able to assess a wide range of performance levels, from borderline frail to highly fit;
- be easy to administer and score and have minimal requirements with respect to equipment, time, space, and training; and
- be socially acceptable and motivating to older people.

Following considerable trial-and-error pilot testing to develop protocols to meet the previously cited criteria, the following test items were selected for inclusion in the SFT battery:

- Chair stand test (lower-body strength)
- Arm curl test (upper-body strength)
- 6-minute walk test (aerobic endurance)
- 2-minute step test (an alternate measure of aerobic endurance)
- Chair sit-and-reach test (lower-body flexibility)
- Back scratch test (upper-body flexibility)
- 5-foot up-and-go test (agility/dynamic balance)
- Height and weight (body composition)

In the next chapter we will describe the procedures followed in assuring that these test items meet the standards of quality required for an effective test. Specifically, we will discuss the procedures used for establishing test validity and reliability and for developing norm-referenced and criterion-referenced performance standards for the SFT.
**CHAIR STAND TEST**

**Purpose:**
To assess lower-body strength needed for numerous tasks such as climbing stairs; walking; and getting out of a chair, tub, or car. Increased ability in performing this exercise may reduce the chance of falling.

**Description:**
Number of full stands from a seated position that can be completed in 30 seconds with arms folded across chest.

---

**ARM CURL TEST**

**Purpose:**
To assess upper-body strength needed for performing household and other activities involving lifting and carrying things such as groceries, suitcases, and grandchildren.

**Description:**
Number of biceps curls that can be completed in 30 seconds holding a hand weight—5 lbs (2.27 kg) for women, 8 lbs (3.63 kg) for men.
6-MINUTE WALK TEST

Purpose:
To assess aerobic endurance—important for walking distances, climbing stairs, shopping, sightseeing while on vacation, etc.

Description:
Number of yards (meters) that can be walked in 6 minutes around a 50-yard (45.72-meter) course.

2-MINUTE STEP TEST

Purpose:
Alternate aerobic endurance test for use when time, space limitations, or weather prohibits giving the 6-minute walk test.

Description:
Number of full steps completed in 2 minutes, raising each knee to a point midway between the patella (kneecap) and iliac crest (top hip bone). The score is the number of times the right knee reaches the required height.
**CHAIR SIT-AND-REACH TEST**

_Purpose:_
To assess lower-body flexibility, which is important for good posture, normal gait patterns, and various mobility tasks such as getting in and out of a bathtub or car.

_Description:_
From a sitting position at the front of a chair, with leg extended and hands reaching toward toes, the number of inches (centimeters) (plus or minus) between the extended fingers and the tip of the toe.

**BACK SCRATCH TEST**

_Purpose:_
To assess upper-body (shoulder) flexibility, which is important in tasks such as combing one's hair, putting on overhead garments, and reaching for a seat belt.

_Description:_
With one hand reaching over the shoulder and one up the middle of the back, the number of inches (centimeters) between the extended middle fingers (plus or minus).
8-FOOT UP-AND-GO TEST

Purpose:
To assess the agility/dynamic balance important in tasks that require quick maneuvering such as getting off a bus in time, getting up to attend to something in the kitchen, going to the bathroom, or answering the phone.

Description:
Number of seconds required to get up from a seated position, walk 8 feet (2.44 meters), turn, and return to seated position.

HEIGHT AND WEIGHT

Purpose:
To assess body weight relative to body height, because of the importance of weight management for functional mobility.

Description:
Involves measuring height and weight, then using a conversion table to determine body mass index.
APPENDIX M

BREASTFEEDING QUESTIONNAIRE (1 page)
Breastfeeding Questionnaire - Modified from Labbok and Krasovec (19)

BREASTFEEDING

<table>
<thead>
<tr>
<th>Full</th>
<th>Partial</th>
<th>Token</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusive</td>
<td>Almost Exclusive</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time Postpartum/ Age of Infant (weeks)</th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (How often)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration (How long)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervals (Between Breastfeeds)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Artificial Nipples &amp; Other Devices (Yes/No)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expression of Breastmilk (Yes/No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Type, Timing and Amount of Other Feedings

Describe Other Feedings

**DEFINITION OF TERMS AS FOLLOWS:**

**Exclusive:** No other liquid or solid is given to the infant

**Almost Exclusive:** Vitamins, minerals, water, juice, given infrequently in addition to breastfeeds

**High:** More than 80 percent of feeds are breastfeeds

**Medium:** 20-80 percent of feeds are breastfeeds

**Low:** Less than 20 percent of feeds are breastfeeds

**Token:** Breast used only for child/infant consoling or pacifying
APPENDIX N

POSTPARTUM PSYCHOSOCIAL PROFILE QUESTIONNAIRE (PPPQ)

(a and b - Same as Appendix D)

a) Depression Scale CES-D – 1 page,
b) State Anxiety Index – 1 page,
c) Postpartum Physical & Psychological Symptoms (PPPS) – 4 pages

(total 4 pages)
### Postpartum Symptom Report

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject No.</th>
<th>Postpartum Days Postpartum Pain</th>
<th>Physical Symptom</th>
<th>Severity</th>
<th>Scoring</th>
</tr>
</thead>
</table>

(Directions) I am going to go over a list of symptoms, similar to the ones I asked you about when you were pregnant. Pregnant women who have just delivered sometimes experience these symptoms. Will you please tell me if you've had this symptom during the past week and whether the symptom is mild (bothers you a little), moderate (bothers you), or severe (bothers you a lot)?

<table>
<thead>
<tr>
<th>Symptom Details</th>
<th>Severity</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigestion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflux (Burping &amp; bringing up fluid into your chest or throat)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased appetite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdomen hurt (no incision)</td>
<td></td>
<td></td>
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<tr>
<td>Abdominal incision hurt</td>
<td></td>
<td></td>
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<tr>
<td>Body part hurt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site body part 1. back 2. hips 3. legs 4. Other, please specify</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body part hurt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site body part 1. back 2. hips 3. legs 4. Other, please specify</td>
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<td></td>
</tr>
<tr>
<td>Rash body</td>
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<td></td>
</tr>
<tr>
<td>Skin dry</td>
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</tr>
<tr>
<td>Skin sore</td>
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<td></td>
</tr>
<tr>
<td>Muscle sore legs - upper</td>
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</tr>
<tr>
<td>Muscle sore legs - lower</td>
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<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>Muscle sore neck</td>
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</tr>
<tr>
<td>Muscle sore back</td>
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<tr>
<td>Heels sore</td>
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<tr>
<td>Muscle sore other, specify</td>
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</table>
SYMPTOM REPORT - POSTPARTUM
Page 2

_____ Date ____ Subject No.

Knees sore
Possible musc tear:
Site torn ________ 1. knee 2. gastroc 3.
Muscle cramps:
Site ________
Earache
Headache
Visual problems
Sleep changes (other than associated with infant care)
Shortness of Breath on exertion
Elevated Blood sugar
Dizziness
Fainting/Faintness
Fatigue
Constipation
Nasal congestion
Pedal Edema (swelling in your feet)
Other ________

<Nurse: (Directions) The following symptoms describe problems with your thinking or mood. I'm going to read through the list. Again, please tell me whether you've had this symptom during the past week, and if so, whether the symptom was mild (bothered you a little), moderate (bothered you), or severe (bothered you a lot).>

Symptom Severity 1 = mild 2 = moderate 3 = severe
0 = not appl.

Difficulty concentrating
Mood Changes
Tenseness
SYMPTOM REPORT - POSTPARTUM
Page 3

_/_/ ___ Date _____ Subject No.
_ ex39p ___ Boredom
_ ex40p ___ Unusual sensory experience
_ ex41p ___ Nightmares
_ ex42p ___ Other, please specify __________ex42p_sp

ACTIVITIES OF DAILY LIVING

< I'm going to read to you a list of activities that you might do as you begin to recuperate from having your baby. Please tell me the day when you first resumed this activity following delivery.>

Day

Bath/Shower __ ex51
Stairs __ ex52
Cooking __ ex53
Make Bed __ ex54
Laundry __ ex55
Lt. Housekeeping (Tidying) __ ex56
Cleaning House (Weekly cleaning) __ ex57
Hvy. Housecleaning (Seasonal, paint) __ ex58
Shopping, Grocery __ ex59
Shopping, other than grocery __ ex60
Walk (pleasure) __ ex61
Trip outside home (local, not shop) __ ex62
Drive __ ex63
SYMPTOM REPORT - POSTPARTUM

Page 4

_/_/_ _ Date _____ Subject No.

MOBILITY ASSESSMENT

<Nurse: (Directions) I'm going to read a list of different problems postpartum women sometimes have when walking around the house or outside. Please let me know if you are any of these problems with your walking.>

Scoring: 1 = yes 0 = no

__mobi1 Hesitate before walk
__mobi2 Support needed to walk
__mobi3 Knees Buckle
__mobi4 Support needed to sit
__mobi5 Doesn’t alternate foot when walk
__mobi6 Difficulty ascending stair
__mobi7 Difficulty descending stair
Appendix O

Kaiser Physical Activity Survey
(to be completed after delivery)
(7 pages)
Section I. Household and Family Care Activities
First, we want to know about your activities at home, not including activities you may do at your home or other people’s home for pay. During the past 2 weeks (2 weeks back from today), how much time did you spend…

1. Caring for a child or children under 2 years of age
   - None of less than 1 hour a week
   - Greater than 1 hour but less than 20 hours a week
   - Greater than 20 hours a week

2. Caring for a child or children between 2 and 5 years of age
   - None or less than 1 hour a week
   - Greater than 1 hour but less than 20 hours a week
   - Greater than 20 hours a week

3. Caring for a disabled child or elderly person (only count time actually spent in feeding, dressing, moving, etc)
   - None or less than 1 hour a week
   - Greater than 1 hour but less than 20 hours a week
   - Greater than 20 hours a week

4. Preparing meals or cleaning up from meals on weekdays?
   - None or less than ½ hour a day
   - Greater than ½ hour but less than an hour a day
   - Greater than 1 hour but less than 1½ hours a day
   - Greater than 1½ hours but less than 2 hours a day
   - Greater than 2 hours a day

5. Preparing meals or cleaning up from meals on weekends?
   - None or less than ½ hour a day
   - Greater than ½ hour but less than an hour a day
   - Greater than 1 hour but less than 1½ hours a day
   - Greater than 1½ hours but less than 2 hours a day
   - Greater than 2 hours a day

6. Doing major cleaning, such as shampooing carpets, waxing floors, or washing walls or windows?
   - Never or less than once a month
   - Once a month
   - 2-3 times a month
   - Once a week
   - More than once a week
7. Doing routine cleaning such as dusting, laundry, vacuuming, or changing linens?
   - Never or less than once a month
   - Once a month
   - 2-3 times a month
   - Once a week
   - More than once a week

8. Going grocery shopping or pushing a shopping cart?
   - Never or less than once a month
   - Once a month
   - 2-3 times a month
   - Once a week
   - More than once a week

9. Doing gardening or yard work, such as mowing lawn or raking leaves?
   - Never or less than once a month
   - Once a month
   - 2-3 times a month
   - Once a week
   - More than once a week

10. Doing heavy outdoor work, such as chopping wood, tilling soil, shoveling snow, or baling hay?
    - Never or less than once a month
    - Once a month
    - 2-3 times a month
    - Once a week
    - More than once a week

11. Doing major home decoration or repair, such as plumbing, tiling, painting, or building?
    - Never or less than once a month
    - Once a month
    - 2-3 times a month
    - Once a week
    - More than once a week
Section II. Occupational Activities

Now, some questions about your employment situation.

12. What is your occupation? (if more than one job, describe your occupation for the job with the most hours worked per week).

13. What is the name of your employer, business or company?

14. What kind of business or industry is this? (For example, hospital, newspaper publishing, mail order house, auto engine manufacturing, etc)

15. What are your most important specific activities or duties? (For example, selling cars, keeping account books, etc)
   a. ____________________________________________________________
   b. ____________________________________________________________
   c. ____________________________________________________________

16. Which best describes your current occupation:
   - Employee of private company, business or individual for wages, salary, or commissions
   - Employee of Federal government
   - Employee of state or local government
   - Self employed in own business, professional practice or farm
   - Working without pay in home, family business or farm

17. In comparison with other women your age, do you think your work is physically
   - Much lighter
   - Lighter
   - The same as
   - Heavier
   - Much heavier

18. After work, are you physically tired
   - Never
   - Seldom
   - Sometimes
   - Often
   - Always
19. When you are working at your current occupation, how often do you do each of the following:

a. Sit
   - Never
   - Seldom
   - Sometimes
   - Often
   - Always

b. Stand
   - Never
   - Seldom
   - Sometimes
   - Often
   - Always

c. Walk
   - Never
   - Seldom
   - Sometimes
   - Often
   - Always

d. Lift Heavy Loads
   - Never
   - Seldom
   - Sometimes
   - Often
   - Always

e. Sweat from exertion
   - Never
   - Seldom
   - Sometimes
   - Often
   - Always
Section III. Active Living Habits
This next section asks about the general level of physical activity involved in your daily routine during the past 2 weeks.

20. How many minutes a day do you usually walk and/or bicycle to and from work, school or errands?
   - Less than 5
   - Greater than 5 but less than 15
   - Greater than 15 but less than 30
   - Greater than 30 but less than 45
   - Greater than 45

21. Did you watch television?
   - Less than one hour a week
   - Greater than one hour a week but less than 1 hour a day
   - Greater than 1 hour a day but less than 2 hours a day
   - Greater than 2 hours a day but less than 4 hours a day
   - Greater than 4 hours a day

22. Did you walk for at least 15 minutes at a time…
   - Never or less than once a month
   - Once a month
   - 2-3 times a month
   - Once a week
   - More than once a week

23. Did you bike for at least 15 minutes at a time…
   - Never or less than once a month
   - Once a month
   - 2-3 times a month
   - Once a week
   - More than once a week

Section IV. Participation in Sports and Exercise
Finally, we want to ask about your participation in sports and exercise during the past 2 months.

24. In comparison with other women of your own age, do you think your recreational physical activity is…
   - Much less
   - Less
   - Same as
   - More
   - Much more

25. Did you play sports or exercise?
   - Never or less than once a month
   - Once a month
   - 2-3 times a month
   - Once a week
   - More than once a week
26. Did you sweat from exertion during sports or exercise?
   - Never or less than once a month
   - Once a month
   - 2-3 times a month
   - Once a week
   - More than once a week

[Provide a list of specific sports and exercises relevant to study population for reference in answering following questions]
   - Swimming
   - Running
   - Walking
   - Yoga
   - Weight training
   - Pilates
   - Stretching
   - Other Sports/Activities: ____________________________

27. During the past 2 months, did you participate in any of these activities or in any other similar activities not including in the list?
   - Yes
   - No

[If yes, please continue to the following questions]
28. Which sport or exercise did you do most frequently (Specify only one)
   ____________________________

29. How many weeks in this past 2 months did you do this activity
   - Less than 1
   - 1-3
   - 4-6
   - 7-9
   - Greater than 9

30. How many hours a week did you usually do this activity?
   - Less than 2
   - Greater than 1 but less than 2
   - Greater than 2 but less than 3
   - Greater than 3 but less than 4
   - Greater than 4

31. Did you do any other exercise or play any other sport in the past 2 months?
   - Yes
   - No

[If yes, please respond to the following questions]
32. What was the second most frequent sport of exercise you did? (Specify only one)
   ____________________________
33. How many weeks in the past 2 months did you do this activity?
   - Less than 1
   - 1-3
   - 4-6
   - 7-9
   - Greater than 9

34. How many hours a week did you usually do this activity?
   - Less than 2
   - Greater than 1 but less than 2
   - Greater than 2 but less than 3
   - Greater than 3 but less than 4
   - Greater than 4

35. Did you do any other exercise or play any other sport in this past 2 months?
   - Yes
   - No
   [If yes, please respond to the following questions]

36. What was the third most frequent sport or exercise you did? (Specify only one)

37. How many weeks in this past 2 months did you do this activity?
   - Less than 1
   - 1-3
   - 4-6
   - 7-9
   - Greater than 9

38. How many hours a week did you usually do this activity?
   - Less than 2
   - Greater than 1 but less than 2
   - Greater than 2 but less than 3
   - Greater than 3 but less than 4
   - Greater than 4
Curriculum Vitae

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Post-secondary Education and Degrees:
The University of Western Ontario
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