

**Routine Physical Activity and Healthy Pregnant Women's Self Reports of
Psychological Distress: A Literature Review**

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Abstract

Psychological distress is identified as a common experience during pregnancy, and a risk factor for negative maternal and fetal health outcomes. Physical activity contributes to physical and emotional health in non-pregnant subjects. The same may be true for pregnant women. The purpose of this project is to conduct a critical examination of the literature and provide recommendations to guide nurse practitioners in working with prenatal clients. The following question was designed to guide this process:

In healthy pregnant women, does physical activity at least three times weekly, as compared to remaining sedentary, decrease self reports of psychological distress?

For the purpose of this project, psychological distress is defined women's self reported feelings of anxiety, depressed mood, or concerns with body image. The studies included in the literature review were obtained from a series of online database searches. Research studies, literature reviews, or clinical practice guidelines published after 1999 and written in English were included. The final yield was nine studies and three clinical practice guidelines. The evidence suggests participation in physical activity decreases over the course of pregnancy, and that women who routinely participate in physical activity during pregnancy tend to feel more positive about body image and report less feelings of anxiety and depressed mood compared to women who do not regularly engage in physical activity. Due to the limited number of studies found on this topic and the design and methodology limitations of these studies, further research is warranted.

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ROUTINE PHYSICAL ACTIVITY AND SELF REPORTS
OF PSYCHOLOGICAL DISTRESS IN HEALTHY PREGNANT WOMEN:
A LITERATURE REVIEW

The purpose of this practice-based project is to conduct a critical examination and synthesis of knowledge in an area of concern to nurse practitioner practice. The result is a literature review and position paper that concludes with evidence-informed recommendations for nurse practitioners in primary care practice. The critical examination and synthesis of knowledge is designed to address the following clinically significant question:

In healthy pregnant women, does physical activity at least three times weekly, as compared to remaining sedentary, decrease self reports of psychological distress?

Literature Search Methodology

The research question was designed based on a method of inquiry in which a research question includes a specific population of interest ('P'), a proposed intervention ('I'), a comparison intervention ('C'), and a measurable outcome ('O'). The components of this 'PICO question' form the framework for a search process used to gather data in an attempt to answer the question and reduce uncertainty on the topic (Melnik & Fineout-Overholt, 2005). The PICO question of inquiry designed for this paper is comprised of the following components. The population of interest (P) is healthy pregnant women. The intervention of interest (I) is physical activity at least three times weekly during pregnancy, and the comparison of interest (C) is remaining sedentary during pregnancy. The measurable

outcome of interest (O) is decreased self reports of psychological distress. For the purposes of this review, psychological distress is defined as women's self reported feelings of anxiety, depressed mood, or concerns about body image. This paper is presented under the following headings: introduction; approach to the project; background and context; literature review; discussion; conclusion; and appendices.

Approach to the Project

This paper examines the relationship, as documented in the contemporary literature, between physical activity and healthy pregnant women's self reports of psychological distress. The appendices contain summaries of the studies and guidelines included in the literature review (see Appendices A, B, C, D, E, and F). Associations between physical activity and feelings of anxiety, depressed mood, and concerns about body image are addressed. Trends in physical activity during pregnancy are also investigated. Few prior investigations have addressed the relationship between physical activity and these aspects of psychological distress in pregnancy. This paper will review these investigations and synthesize the existing knowledge in order to propose evidence-informed recommendations for nurse practitioner clinical practice (see Appendices A, B, and C for complete analyses). Canadian (Appendix D), British (Appendix E), and American (Appendix F) recommendations on physical activity during pregnancy are also assessed to gain a clear understanding of current practice guidelines. Due to the scope and length limitations, this project concentrates only on American, British, and Canadian guidelines. Any follow up investigations would benefit from addressing guidelines from countries such as Australia,

New Zealand, Japan, and Scandinavia, where sound recommendations are also published.

The studies included in the literature review were obtained from a series of online database searches using components of the PICO question of inquiry as keywords. The databases included Medline Ovid, Medline Ebsco, the Cochrane database of systematic reviews, Health Sciences: a SAGE full-text collection, and Biomedical reference collection comprehensive. Studies published after the year 1999 were included in the literature review. This topic is addressed in the literature prior to the year 2000, however, due to scope and word length restrictions of the project only studies published in and subsequent to the year 2000 were included. Studies that did not directly address the research question or were written in languages other than English were excluded. Journal articles other than research studies or literature reviews were also excluded. The final yield was nine studies (See Appendices A, B, and C). Clinical practice guidelines for Canadian, British, and American Societies of Obstetricians and Gynaecologists were also retrieved (see Appendices D, E, and F for complete analyses).

Background and Context

Psychological Health During Pregnancy

The psychological health of women during pregnancy is a critical aspect of the overall health and well-being of pregnant women (Bowen & Muhajarine, 2006). Historically, much emphasis has been placed on the importance of physical maternal health during pregnancy. More recently, there has also been a growing recognition about the importance of maternal

psychological health during pregnancy (Davies, Wolfe, Mottola, & MacKinnon, 2003). Psychological distress is shown to be a common experience during pregnancy, and is identified as a risk factor for less than optimal maternal and fetal health outcomes such as inadequate maternal weight gain, low birth weight (Bennett, Einarson, Taddio, Koren, & Einarson, 2004a), preterm birth (Bennett et al., 2004a; Glynn, Hobel, Dunkel Schetter, & Sandman, 2008), lower levels of maternal-fetal attachment (Alhusen, 2008), and increased risk of postpartum depression (Bennett et al., 2004a; Bowen & Muhajarine, 2006). Despite growing awareness, it is noted that health care providers' detection of psychological distress during pregnancy remains low (Bennett et al., 2004a; Coleman, Carter, Morgan, & Schulkin, 2008). Additionally, the effectiveness of commonly prescribed treatment regimes, such as pharmacotherapy or psychotherapy, is frequently reported as being sub-optimal (Marcus & Flynn, 2007).

Physical Activity, Physiological Health, and Psychological Health

It has been well documented that routine participation in physical activity contributes to physical and emotional health (Centre for Disease Control and Prevention, 1999). A review of eleven trials found that pregnant women who engage in physical activity improved or maintained their physical fitness (Kramer & McDonald, 2008). Physical activity is recommended as an integral part of maternal and fetal health (American College of Obstetricians and Gynaecologists [ACOG], 1994; ACOG, 2002; Davies et al., 2003; Royal College of Obstetricians and Gynaecologists [RCOG], 2006), and in most cases is safe for both mother and fetus (ACOG, 1994; ACOG, 2002; RCOG, 2006).

Concerns associated with physical activity during pregnancy such as hyperthermia and the teratogenic effects in the first trimester of human pregnancy (ACOG, 1994; ACOG, 2004; Davies et al., 2003) or a shortened gestation (Kramer & McDonald, 2008) have not been supported in the literature (Davies et al., 2003; Kramer & McDonald, 2008). The contemporary literature agrees that maternal physiologic adaptations to pregnancy, such as raised minute ventilation and increased skin blood flow, aid in dissipating heat and thereby reducing the risk of hyperthermia (ACOG, 1994; RCOG, 2006). It is also agreed that women who engage in physical activity during pregnancy are not at increased risk of preterm labour. Their pregnancies are the same length as those who remain sedentary (Kramer & McDonald, 2008). According to ACOG (1994), "There has been no demonstrated increase in neural tube defects or other birth defects in infants of women who continue to perform even vigorous exercise during early pregnancy"(p. 1259).

In addition to the physiological benefits, physical activity also improves mental health and feelings of well-being (Callaghan, 2004). In non-pregnant women, physical activity has been shown to lessen the effects of psychological health issues such as depressed mood and feelings of anxiety (Poudevigne & O'Connor, 2006). It has also been shown to improve body image and self-esteem in non-pregnant subjects (Fox, 1999). The same may apply to pregnant women. As is argued in this paper, physical activity is an effective intervention that nurse practitioners can recommend to all healthy pregnant women as a way of helping to decrease self reports of anxiety, depressed mood, or decreased body image. There is an assumption that self reports of psychological distress reflect occurrence; therefore, a decrease in self reports of anxiety, depressed mood, or decreased body image is likely to reflect a

decrease in occurrence.

Relevance To The Practice of Nurse Practitioners in BC

In the province of British Columbia nurse practitioners manage the treatment of women with uncomplicated pregnancies well into the second trimester of pregnancy. Focusing on health promotion and disease prevention through primary, secondary, and tertiary levels of prevention is a cornerstone of nurse practitioner care. For example, implementing interventions such as education and counselling, immunizations, tobacco, drug, and/or alcohol cessation, screening for diseases and disorders, early diagnosing of diseases or disorders, and prescribing necessary treatments are components of the care that a nurse practitioner may provide to a pregnant woman (College of Registered Nurses of BC [CRNBC], no date). As I will argue in this review, routine physical activity during pregnancy can help to enhance the health and well-being of pregnant women by minimizing the occurrence and self reports of depressed mood, feelings of anxiety, or concerns about body image. The evidence supports nurse practitioners and other primary care providers discussing the psychological and physical benefits of routine physical activity during pregnancy with clients at every appropriate opportunity.

Depressed Mood and Feelings of Anxiety During Pregnancy

Pregnancy is a normal event in life. It is also a time requiring substantial adjustments for all involved. During a relatively short period of time, expectant mothers experience

significant psychological and physiological changes to body size and shape, hormones, emotions, relationships, and lifestyle (Varney, Kriebs & Gegor, 2004). Generally, pregnancy is a time of positive emotions for women; however, this is not true for all women. Feelings of anxiety (Andersson, Sundstrom-Poromaa, Wulff, Astrom, & Bixo, 2006; Radecki Breitkopf, Primeau, Levine, Olson, Wu, & Berenson, 2006), depressed mood (Andersson et al., 2006), and concerns about body image (Clark, Skouteris, Wertheim, Paxton, & Milgrom, 2009) are common and can have lasting negative effects for both the mother and baby (Misri and Kendrick, 2007). Furthermore, feelings of anxiety, depressed mood, or negative body image during pregnancy often go undetected by healthcare providers (Bowen and Muhajarine, 2006). The treatment regimes for these disorders during pregnancy are controversial and frequently sub-optimal (Koren, Matsui, Einarson, Knoppert, & Steiner, 2005), inaccessible to women due to lack of client or system resources, or are never initiated by the patient due to fetal health concerns (Marcus and Flynn, 2007; Misri and Kendrick, 2006). Further research of these issues is warranted to develop evidence-informed recommendations that inform nurse practitioners in primary care practice. The following is a general overview of these disorders.

Depression and anxiety are common and non-discriminant disorders that affect men and women of all socio-economic levels in every country of the world. The rates of depression in Canada and the United States are reported at 8.2% and 8.7% of the general population, respectively (Vasiliadis, Lesage, Adair, Wang, & Kessler, 2007). Bennett et al. report similar international rates ranging from 7%-13% (2004b). Women appear to be at increased vulnerability. Statistics Canada (2002) reports that Canadian women have higher

reported prevalence rates for depression than men: 5.9% of women were found to meet the criteria for major depressive episode compared to 3.7% of men. Women of lower socio-economic status are reported to be even more vulnerable (Bennett, et al., 2004b; Faisal-Cury & Rossi Menezes, 2007). Anxiety disorders are also seen at least twice as often in women as in men (Andersson et al., 2006). The reported lifetime prevalence of anxiety in women is as high as 30% (Andersson et al., 2006; Bowen, Bowen, Maslany, & Muhajarine, 2008). The literature reports that both anxiety and depression are prevalent in women of childbearing age (Andersson et al., 2006; Faisal-Cury & Rossi Menezes, 2007; Goebert, Morland, Frattarelli, Onoye, & Matsu, 2007) .

Causes

The causes of depression and anxiety remain unknown, however it is thought that a combination of biological factors, environmental and social factors, and a genetic predisposition are involved (Bennett et al., 2004a). In women, hormonal changes associated with the reproductive cycle may also play an integral role. As pregnancy is a period involving substantial hormonal changes, pregnant women are at increased risk (Misri and Kendrick, 2007).

Prevalence during pregnancy

The reported prevalence rates of depression and anxiety during pregnancy range considerably. A systematic review by Bennett et al. (2004b) reports prevalence rates of

depression in women from a variety of developed countries to be 7.4%, 12.8%, and 12.0% in the first, second, and third trimesters of pregnancy, respectively. The reported rates of depression during the second and third trimesters of pregnancy are nearly double the rate observed in the general female population. The authors point out that these rates may be conservative due to various limitations found in the studies included for analysis (Bennett et al., 2004b). Another study reported a prevalence rate of 19.6% based on a cross-sectional study of Brazilian women (Faisal Curry and Rossi Menezes, 2007), and Andersson et al. (2006) found that 14.5% of the participants in their Swedish population-based sample were experiencing minor depressive disorders. Further, Goebert et al. (2007) report a prevalence rate for probable major depression of 31% with an additional 5% at risk of having moderate depression. This was based on a study comparing Asian, Caucasian, and Native Hawaiian women in Hawaii.

Anxiety during pregnancy would appear to be as common as depression during pregnancy. Prevalence rates of anxiety are reported in the literature as 18.4% (Andersson et al., 2006), 39% (Adewuya, Ola, Aloba, and Mapayi, 2006), and 59.5% (Faisal-Cury and Rossi Menezes, 2007). Radecki Breitkopf et al. (2006) found that anxiety scores among women of lower socioeconomic status were lower in the postpartum period than during pregnancy. Comorbidity is also common. Andersson et al. (2006) report that 20.5 % of the women in their study suffered from both depression and anxiety. It is critical for healthcare providers to understand the prevalence of depression and anxiety during pregnancy due to the myriad of negative maternal and fetal outcomes associated with these disorders if left untreated.

Outcomes

The outcomes associated with depression and anxiety during pregnancy are significant to mother, fetus, and, neonate. In pregnant women these include: altered maternal-fetal attachment (Alhusen, 2008; Lindgren, 2001); decreased participation in health practices during pregnancy (Lindgren, 2001); increased maternal somatic symptoms; inadequate maternal weight gain; pre-eclampsia; substance use and addictions (including tobacco, drugs, and alcohol); increased risk of suicide (Bennett et al., 2004a); and increased risk of postpartum depression and/or psychosis (Bowen, & Muhajarine, 2006; Milgrom, Gemmil, Bilszta, Hayes, Bernett, Brooks et al., 2008). The outcomes associated with maternal depression during pregnancy on the fetus/neonate include: increased risk of pre-term birth (<37 weeks) and low birth-weight (<2500g) (Bennett et al., 2004a); less breast-feeding; lower health scores at birth; failure to thrive; increased admissions to the Neonatal Intensive Care Unit (Bowen, & Muhajarine, 2006); and, possible altered neurobehavioral functioning in the neonate (Bennett et al., 2004a).

Detection and treatment

Until the last decade, much emphasis has been placed on the detection and treatment of depression in the postpartum period whereas studies addressing depression during pregnancy have been noticeably lacking from the contemporary literature. Since the early 1990s, however, published studies have increased awareness of the issue and provided opportunity for enhanced prevention, detection, and treatment.

Detection of depression and anxiety in pregnant women has proven marginally

successful; as many as 50% of pregnant women who experience depression go unrecognized by their healthcare providers (Bennett et al., 2004a). This may be because many of the somatic symptoms associated with depression and anxiety during pregnancy are similar to common symptoms of pregnancy, and are therefore attributed to the pregnancy rather than a psychological origin (Bennett et al., 2004b). Such symptoms may include sleep and appetite disturbances, fatigue, emotional lability, physical aches and pains, or lack of interest in sex (BC Reproductive Care Program, 2003). Also, feelings of depression and anxiety may be negatively impacted by the progression of pregnancy. Without ongoing assessment throughout the course of the pregnancy depression and anxiety in pregnant women may be missed (Bennett et al., 2004a). Another reason why feelings of anxiety or depressed mood may go unrecognized is a lack of screening by care providers. A study by Coleman et al. (2008) found that only 20% of physician respondents screen for anxiety during pregnancy. The primary barrier identified for this lack of screening is perceived inadequate education about the disorder. Similarly, the same may be true regarding screening for depressed mood and body image concerns during pregnancy.

The current interventions for depressed mood and feelings of anxiety during pregnancy are similar to those for depression and anxiety in the general population: pharmacotherapy and psychotherapy (Bennett et al., 2004a; Bowen and Muhajarine, 2006; Misri and Kendrick, 2007). Psychotherapy has proven to be beneficial (Bowen & Muhajarine, 2006) but due to high costs, extensive need for resources, and lack of available therapists in most areas this option is often difficult for women to access or totally unavailable (Bennett et al., 2004a). Pharmacotherapy generally involves tricyclic

antidepressants (TCAs), selective serotonin re-uptake inhibitors (SSRIs) (Marcus & Flynn, 2007; Misri and Kendrick, 2007), serotonin norepinephrine reuptake inhibitors (SNRIs), or atypical antidepressants (Misri and Kendrick, 2007). There is a great deal of controversy regarding the use of antidepressants during pregnancy due to the potential of harm to the developing fetus (Marcus & Flynn, 2007; Misri and Kendrick, 2007). Both TCAs and SSRIs are proven to cross the placenta (Bennett et al., 2004a). For this reason, many healthcare providers and pregnant women have strong aversions to their use during pregnancy (Bennett et al., 2004a). Several complementary or adjunct therapies have also been investigated for treating depression and/or anxiety during pregnancy. Due to the concerns regarding lack of access to psychotherapy and possible side effects of pharmacotherapy, further investigation into complementary and adjunct therapies is warranted.

Body Image During Pregnancy

Another aspect of psychological distress reported by pregnant women is concern about body image (Clark et al., 2009). Thompson, Heinberg, Altabe, and Tanleff-Dunn define body image as "... one's internal representation of one's outer appearance, and includes cognitive, perceptual, and attitudinal components" (as cited in Clark et al., 2009, p. 28). During pregnancy women experience exceptional changes in their body size, shape, and composition over a relatively short period of time (Varney et al., 2004). These rapid physical changes may increase pregnant women's likelihood of experiencing negative body image. This is a concern because impaired body image during pregnancy is associated with maternal actions or issues that may impact negatively upon maternal and fetal health such as altered

eating behaviours, smoking, decreased participation in physical activity, and depression (Duncombe, Wertheim, Skouteris, Paxton, & Kelly, 2008).

The body image of pregnant women changes over the course of pregnancy (Goodwin, Astbury, & McMeeken, 2000; Boscaglia, Skouteris, and Wertheim, 2003). There is a lack of consensus in the literature as to whether these changes are generally in a positive or negative direction. Duncombe et al. (2008) report that the body image of the pregnant women in their study remained relatively stable across pregnancy, and that they were able to adjust to the rapid physical changes of pregnancy. These findings are consistent with those reported by Clark et al. (2009) and Boscaglia et al. (2003). Duncombe et al. (2008) also found that women with a positive body image at the beginning of pregnancy continued with a positive body image throughout the pregnancy while women with negative body image tended to remain concerned for the duration of the pregnancy. A study by Goodwin et al. (2000) and another by Smith and Michel (2006) found that body image for women in the control groups (no physical activity) moved in a negative direction from early pregnancy to late pregnancy. In contrast, positive changes in body image were noted for women in the physical activity group (Smith & Michel, 2006).

Although there is no absolute consensus regarding the nature of these changes, it is documented that some women experience negative changes to body image during pregnancy (Goodwin et al., 2000). These feelings may impact both the woman's and her baby's health. More research is necessary to investigate interventions that may help women to maintain or increase their positive body image during pregnancy.

*Association Between Physical Activity and Physical and
Psychological Health During Pregnancy*

Maternal participation in health practices, such as physical activity, healthy nutrition, maintaining good dental and personal hygiene, and abstaining from tobacco, drugs, and alcohol, have been associated with a reduced feelings of anxiety and depression and increased positive body image in pregnant women (Haas, Jackson, Fuentes-Afflick, Stewart, Dean, Barawsky, et al., 2005; Lindgren, 2001; Poudevigne & O'Connor, 2005; Poudevigne & O'Connor, 2006). Of these health practices, routine physical activity has the potential to benefit the participant both physically and psychologically (Davies et al., 2003). Physical activity also has reportedly no adverse effects, is inexpensive, and can be done in groups or individually depending on the social needs of the participant. It is feasible to argue that routine physical activity is an effective intervention for decreasing or preventing feelings of anxiety, depressed mood, or decreased body image in healthy pregnant women. Due to the lack of published studies on this topic and to the many design and methodology limitations of these studies (Poudevigne & O'Connor, 2006), more investigation is necessary.

Literature Review

Four themes related to physical activity and psychological distress during pregnancy emerged from the literature review: physical activity during pregnancy; the relationship between physical activity and self reports of depressed mood during pregnancy; the relationship between physical activity and self reported feelings of anxiety during pregnancy; and, the relationship between physical activity and self reports of concerns about body image

during pregnancy.

Physical Activity During Pregnancy

Three clinical practice guidelines included in this review speak to the topic of physical activity during pregnancy: the Canadian guidelines developed jointly by the Society of Obstetricians and Gynaecologists of Canada and the Canadian Society for Exercise Physiology (SOGC/CSEP) (Davies et al., 2003); the American guidelines developed by the American College of Obstetricians and Gynaecologists (ACOG) (1994, 2002); and the British guidelines developed by the Royal College of Obstetricians and Gynecologists (RCOG) (2006). The three guidelines concur that all healthy women should participate in routine physical activity throughout their entire pregnancy to maintain cardiorespiratory and muscular fitness.

Although the guidelines focus on the physiological benefits of physical activity during pregnancy, all three mention a psychological benefit as well: ACOG suggests routine physical activity may enhance women's overall feelings of well-being (1994, 2002); RCOG states that active women experience less stress, anxiety, and depression (2006); and SOGC/CSEP supports that women who do not engage in routine physical activity during pregnancy may develop concerns about body image (Davies et al., 2003).

The three guidelines agree that the beginning frequency for physical activity during pregnancy is at least three times weekly, and all encourage four to seven sessions per week as tolerated. The recommended duration per session is at least 30 minutes; previously sedentary women should begin with 15 minutes and build up to 30 minutes and more. The

recommended intensity of physical activity during pregnancy is at a moderate level (ACOG, 1994; Davies et al., 2003; RCOG, 2006).

To measure the level of intensity of physical activity, SOGC/CSEP (Davies et al., 2003) and RCOG (2006) recommend using the 'talk test', the Borg scale of perceived exertion, or modified heart rate zones for use in pregnancy. ACOG (1994) recommends pregnant women should modify the intensity based on how they feel. The 'talk test' implies a woman is exercising at an appropriate level if she is able to carry on a conversation during exercise. The level of intensity should be decreased if this is not possible (Davies et al., 2003; RCOG, 2006). The Borg scale of perceived exertion is another subjective way of measuring how one is feeling during activity. It is based on the individual's physical sensations of heart rate, respiration rate, and muscle fatigue. The scale ranges from 6-20, with 6 being very, very light perceived exertion and 20 being very, very hard perceived exertion (Borg as cited by CDC, 2009). A rating of 12-14 is identified as somewhat hard perceived exertion and is an appropriate level for most pregnant women (Davies et al., 2003; RCOG, 2006). Due to normal alterations of women's resting and maximal heart rates during pregnancy, conventional heart rate zones for aerobic exercise are not recommended for use in pregnant women (Davies et al., 2003; RCOG, 2006). Instead, SOGC/CSEP (Davies et al., 2003) and RCOG (2006) recommend following modified heart rate zones as outlined in their guidelines; women aged less than 20 years should aim for 140-155 beats per minute (bpm); women aged 20-29 should aim for 135-150 bpm; women aged 30-39 should aim for 130-145 bpm; and women aged 40 or greater should aim for 125-140 bpm (Davies et al., 2003; RCOG, 2006).

It is well documented that routine physical activity during pregnancy, defined as at least thirty minutes of moderate intensity activity three or more times weekly, contributes to physical health. The contribution to psychological health is also documented in the literature (Davies et al., 2003; RCOG, 2006). Despite this awareness, decreased participation in physical activity during pregnancy is common (Poudevigne & O'Connor, 2006). Five of the studies included in the literature review report on trends in physical activity during pregnancy.

Trends

In a prospective longitudinal study, Goodwin et al. (2000) used a self-report questionnaire to gather data on physical activity during pregnancy. They found that 80% of the 72 women in their convenience sample were exercising before pregnancy and at the beginning of the second trimester of pregnancy. Sixty percent maintained a consistent level of exercise throughout pregnancy, and 40% decreased their level of exercise. Limitations of this investigation included the lack of evidence for the validity of the exercise history questionnaire, a small sample size, and the possibility of recall error.

Data from 28 retrospective, non-experimental, or quasi-experimental studies included in a literature review by Poudevigne and O'Connor (2006) also determined that physical activity consistently decreases during pregnancy. The intensity, duration, and frequency of physical activity decreases from pre-pregnancy to the first trimester, and from the first to the third trimester. Limitations inherent to many of the studies included in the review are as follows: the use of physical activity measures with no documented evidence of their

reliability or validity; weak measures of physical activity, such as recall; lack of a clear definition of physical activity; lack of empirical testing, such as the maximum amount of oxygen an individual can use during intense exercise (VO₂ max), to confirm verbal reports (Quinn, 2008); and too few measures over time (Poudevigne & O'Connor, 2006).

Da Costa, Rippen, Dritsa, & Ring (2003) found similar results. The monthly frequency of physical activity decreased from the first to the third trimester. Interestingly, the monthly frequency of physical activity increased from pre-pregnancy to the first trimester. The duration of exercise sessions decreased from pre-pregnancy to the second trimester but increased slightly in the third trimester. Physical activity was assessed by asking participants to recall their participation in activities not associated with work (Da Costa et al., 2003). These results are limited due to the self-reporting of physical activity by the participants, no inclusion of a test of fitness to confirm verbal reports, and the use of a non-validated measure of physical activity.

Poudevigne and O'Connor (2005) used a 7-day diary, interviewer-administered 7-day physical activity recall, and a 3-day motion sensor recording to measure physical activity throughout the duration of their prospective investigation. The results from the pregnant participants were compared to an equal number of matched non-pregnant subjects. The results of the diary and recall showed that overall physical activity decreased over the course of the pregnancy with a slight increase at 24 weeks. The results of the motion sensor recording showed a significant decrease of motion in pregnant women: 23% from gestational weeks 12-36 compared with only a 5 % decrease in non-pregnant women (Poudevigne & O'Connor, 2005). Limitations are a small sample size of only 12 pregnant women and the

lack of generalizability of the results to those from socio-economic and ethnic backgrounds other than middle-class Caucasian women.

Schmidt, Pekow, Freedson, Markenson, and Chasan-Taber's (2006) cross sectional study of 233 prenatal care patients found that the median total energy expenditure was similar among women in the first and second trimesters and lower among women in the third trimester. While the other studies in this literature review address only physical activity in term of exercise-type activities, this study included household/caregiving, occupational, leisure, and sport/exercise in the definition of physical activity. Household/caregiving activity was found to be the largest contributor of total energy expenditure in each trimester. Sport/exercise activity contributed very little to the overall energy expenditures but increased from the first to the second trimester, and then decreased substantially in the third. These results are in general agreement with the previously mentioned studies (Da Costa et al., 2003; Goodwin et al., 2000; Poudevigne & O'Connor, 2005). A small sample size, recall bias, and the use of a non-validated physical activity measurement tool may influence these results.

Five studies addressed physical activity during pregnancy (see Appendices A, B, and C for complete analyses of these studies). The available evidence suggests that participation in physical activity decreases from the first to the third trimester of pregnancy. Additional research into this topic is warranted due to the design and methodology inadequacies of the existing studies.

Physical Activity and Depressed Mood During Pregnancy

Maternal participation in physical activity during low risk pregnancies has been reported as safe and beneficial to maternal physical and psychological health, and to fetal and neonatal health (Davies et al., 2003). Five of the nine studies included in the literature review address the relationship between depressed mood and physical activity during pregnancy. Limiting factors include the number of different tools used to evaluate depressive symptoms and their lack of validation for use with pregnant women.

Goodwin et al. (2000) found no significant difference for depression during pregnancy (mean score = 0.56 +/- 1.00 for exercisers vs. 0.61 +/- 1.24 for non-exercisers; p value not significant) when the exercise group was compared with the non-exercise group. The 28-item General Health Questionnaire (GHQ-28) was used to gain information about the subjects' mental state at 30 weeks' gestation. The authors report the GHQ-28 has not been validated for use with pregnant women (Goodwin et al., 2000). This lack of validation limits the reliability of this data. Additional limitations involve the data being reported only once during pregnancy and the lack of randomization of subjects into groups.

Alternatively, Poudevigne and O'Connor (2006) report on six studies whose evidence suggests that decreased aerobic exercise was associated with low mood, including increased symptoms of depression. Due to the lack of published research and design and methodology limitations found in the studies, these authors recommended additional research into this topic.

Da Costa et al. (2003) also found that pregnant women who were not exercising in the first and second trimesters reported significantly more symptoms of depression than their

exercising counterparts. The Lubin Depressive Adjective Checklist Form C (DACL) was used to assess symptoms of depression. No information was provided regarding the reliability or validity of this tool. In the first trimester, 33.1% of non-exercising pregnant women were considered depressed compared to 15.1% of exercising pregnant women ($p=0.02$). In the second trimester, 18.9% of non-exercising pregnant women were considered depressed compared to 5.7% of pregnant women who were exercising regularly ($p=0.02$). There were no group differences for the third trimester (Da Costa et al., 2003). A limitation of this study is the authors' failure to account for possible confounding factors in the relationship between physical activity and symptoms of depression.

Poudevigne and O'Connor (2005) also found associations between changes in physical activity and mood (including depression) during pregnancy using the 65-item Profile of Mood States (POMS) questionnaire. The authors report using this questionnaire due to the extensive evidence supporting its reliability and validity, including data from large samples of pregnant women. A strong test of the relationship was not possible due to the tiny magnitude of the changes. Additional limitations include a small sample size and recall bias.

In a large observational multi-ethnic cohort study, the prevalence of depressive symptoms increased over the course of pregnancy (Haas et al., 2005). In this study physical activity was measured by recall from the previous month, and depressive symptoms were screened for using the short-form Center for Epidemiologic Studies-Depression Scale (CES-D). Of the many demographic, medical, and obstetrical characteristics addressed in the study, a lack of exercise during pregnancy was consistently associated with depressive symptoms (Haas et al., 2005). Due to the observational nature of this study, it is not possible to identify

causal relationships. Recall bias may also interfere with these findings. This was a larger sample size than most of the studies reviewed, which may reduce bias.

Five studies addressed the relationship between physical activity and depressed mood during pregnancy (see Appendix C for complete analyses of these studies). The available evidence suggests that decreased physical activity during pregnancy is associated with increased depressive symptoms during pregnancy. More research is necessary due to the lack of published papers on the topic and the design and methodology inadequacies of the existing studies such as recall bias, small sample sizes, and the lack of accounting for confounding factors.

Physical Activity and Feelings of Anxiety During Pregnancy

As reported, feelings of anxiety during pregnancy appear to be as common, or even more common, than depressed mood (Adewuya et al., 2006; Andersson et al., 2006; Da Costa et al., 2003; Faisal-Cury and Rossi Menezes, 2007). Two of the nine studies included in this literature review specifically address the relationship between physical activity and feelings of anxiety during pregnancy.

Da Costa et al. (2003) used the state-trait anxiety inventory (STAI) to measure state anxiety of the participants. The scale was completed monthly beginning in the third month of pregnancy. The results indicate that anxiety was lower in every trimester for women who reported engaging in leisure time physical activity compared to non-exercising women. Based on the data, it is difficult to identify causal relationships. Also, small sample sizes and lack of generalizability of the results to non-Caucasian pregnant women limit the reliability

of these results.

Similarly, Goodwin et al. (2000) report that women in their non-exercise group scored higher on the 28-item General Health Questionnaire (GHQ-28) for anxiety than women in the exercise group (mean score = 6.22 ± 3.81 vs. 4.42 ± 2.58 ; $p = 0.03$). As previously mentioned, the GHQ-28 has not been validated for use during pregnancy which may limit the validity of the results. The lack of measures over time and the self selection of subjects into groups are also limiters.

In summary, the available evidence suggests that women who routinely participate in physical activity during pregnancy report less feelings of anxiety compared to women who do not regularly engage in physical activity (see Appendix C for complete analyses of the studies). Further research is warranted due to the limited number of papers found on this topic and the outlined design and methodology limitations of the available studies.

Physical Activity and Body Image During Pregnancy

It is well documented that women experience changes in body image during pregnancy (Chang, Chao, & Kenney, 2006; Clark et al., 2009; Duncombe et al., 2008). Although there is a lack of absolute consensus regarding the general trend of this change, it has been shown that negative body image during pregnancy may contribute to negative maternal health behaviors and depression (Clark et al., 2009). Four of the nine studies included in this literature review address the relationship between routine physical activity and body image during pregnancy.

Boscaglia, Skouteris, & Wertheim (2003) address changes in body satisfaction during

pregnancy using a 10-item version of the Body Cathexis Scale (test-retest reliability = 0.71; Cronbach's alpha = 0.85-0.88.). The results of high exercising and low exercising pregnant women were compared at 15-22 weeks' gestation and at 23-30 weeks' gestation. The results indicate that at 15-22 weeks' gestation, the high exercisers were significantly more satisfied with their bodies compared to the low exercisers, $t(69)=-2.89$; $p=0.005$; $d=0.69$. No other significant differences were found (Boscaglia et al., 2003). The authors report that while the majority of pregnant women in this study were able to adapt to their changing body without a negative shift in body image, women who regularly participated in physical activity adapted to these changes earlier in pregnancy (Boscaglia et al., 2003). These results may be limited by participant self-selection into groups and the recall method of data retrieval.

Similar results were found in a two-group quasi-experimental, pre-test/post-test study by Smith and Michel (2006). This study looked at the effects of aquatic exercises on discomforts in pregnancy, which included perception of body image (2006). Body image was measured using the 34-item Pregnancy Body Shape Questionnaire (PBSQ) (Cronbach's alpha=.86). Higher scores on this tool indicate lower body image. The body image scores of the non physical activity group were compared to those from the group participating in aquatic exercise three times weekly. The results indicate that there was no statistically significant difference between the groups for body image at the pretest (mean score = 65.5 +/- 23.6 (activity group) vs. 59.1 +/- 27.5 (non-activity group); $p=.03$). At the posttest, pregnant women who participated in the aquatic physical activity program reported significantly higher positive body image (lower scores) compared to the non physical activity group (mean score = (activity group) 56.0 +/- 23.7 vs. (non-activity group) 80.1 +/- 34.5,

$p=.03$) (Smith & Michel, 2006). Participant self-selection into groups and the small sample size may contribute to bias in this study. Also, there is a possible lack of generalizability of results to pregnant women who participate in physical activity other than aquatic exercises or who are less than 19 weeks gestation.

Goodwin et al. (2000) compared body image of exercising and non-exercising pregnant women. The Body Cathexis Scale was used to measure attitude about body image at 14-20 weeks' gestation and at 27-30 weeks' gestation. The results show no significant difference between the two groups. However, the scores for the non-exercising women became less positive over the course of pregnancy (34.67 vs. 33.78) while the scores for the exercising women became more positive (35.12 vs. 36.88) (Goodwin et al., 2000). These results may be limited by the self selection of subjects into groups, as well as the lack of clearly defined criteria for the exercise and non-exercise groups.

Marquez-Sterling, Perry, Kaplan, Halberstein, and Signorile (2000) also used the Body Cathexis Scale to examine the effects of routine physical activity on body image in 15 previously sedentary primigravidae. The results show no changes in the body image of the women in the non-physical activity group, indicating that their body image remained stable over the course of pregnancy. The women who participated in the three times weekly physical activity sessions showed an increase in positive body image over the course of pregnancy (Marquez-Sterling et al., 2000). These results may be limited by the small sample size and the lack of generalizability of the results to the general population.

Four studies addressed the relationship between routine physical activity and body image during pregnancy (see Appendix B for complete analyses of these studies). Based on

the available evidence, it can be argued that women who participate in routine physical activity during pregnancy are more likely to have a positive body image throughout the course of pregnancy compared to women who do not participate in physical activity. Due to the limited number of published articles on this topic and the design and methodology limitations of the available studies, additional research is warranted.

Discussion

Limitations or Biases in the Reviewed Literature

The evidence gathered for this review supports the argument that regular participation in physical activity during pregnancy is likely to decrease self reports of psychological distress, such as feelings of anxiety, depressed mood, or concerns about body image. The limited search time-line for this preliminary review and the subsequent possibility of missing seminal works on the topic will be best addressed in a follow up study to ensure all relevant contemporary literature is included. The findings of this review must also be interpreted with caution due to the lack of published studies found on this topic and the numerous limitations of the available studies. Small sample sizes, self-selection into groups, lack of experimental designs, too few measures over time, and use of recall to gather information may introduce confounding variables. Also, other factors may be unaccounted for and there is a frequent lack of empiric testing to confirm verbal accounts. Comparison of the findings between studies is difficult due to the inconsistent definitions of what constitutes physical activity and the varying methods of measuring levels of physical activity. The various types of measurement tools used in the different studies, some of which have no published evidence

of reliability or validity for use with pregnant women, also make comparison of the findings difficult. Further investigations using rigorous methods and validated measures that are appropriate for pregnant women would confirm or challenge these findings.

Based on the findings of this literature review, there is cautious support for an association between routine physical activity during pregnancy and pregnant women's experiences and self reports of psychological distress; however, there is insufficient evidence to provide reliable correlational evidence. It is unclear if pregnant women report less symptoms of psychological distress when they regularly participate in physical activity or if pregnant women participate in physical activity because they are experiencing fewer symptoms of psychological distress. Additional research using rigorous designs and validated measures that are relevant for pregnant women would verify any potential correlational relationships.

An interesting outcome of this review which warrants further investigation is a finding by Da Costa et al. (2003). The pregnant women in this study experienced psychological benefits of physical activity, even though many were exercising less frequently and at a lower intensity than is recommended by the Society of Obstetricians and Gynecologists and the Canadian Society for Exercise Physiology (Davies et al., 2003) and the Royal College of Obstetricians and Gynecologists (2006). As these recommendations focus primarily on the physical benefits of aerobic exercise during pregnancy and less on the psychological benefits, it is possible that a lower frequency and intensity of physical activity during pregnancy has similar protective benefits to psychological health than do the higher frequency and duration to physical health. More focussed research would shed light on the

optimal frequency and duration of aerobic exercise during pregnancy to achieve decreased self reports of psychological distress.

Relevance of Findings to the Clinical Practice of Nurse Practitioners

Despite the limitations or biases in the literature and the need for further investigations, the findings of these studies are valuable in the context of clinical practice. Nurse practitioners care for diverse populations with diverse health concerns. Providing evidence-informed treatments and recommendations is a necessity and expectation of the role. A substantial difficulty for NPs, and all health professionals, is wading through the masses of research and frequently conflicting information to gain an understanding of the optimal treatments and recommendations for each individual client. In this case, it is encouraging that the overall findings of the studies are consistent in stating that routine physical activity tends to decrease self reports of psychological distress in healthy pregnant women. It is also encouraging that self reports of psychological distress were not found to increase with routine physical activity during pregnancy. This knowledge, paired with the fact that physical activity during pregnancy benefits maternal physical health (Davies et al., 2003) and has shown no adverse effects to either mother or fetus (RCOG, 2006), presents a sound basis for effective clinical discussions between primary care providers and pregnant clients.

Conclusion

Contemporary literature reports that women's participation in physical activity is reduced during pregnancy (Poudevigne & O'Connor, 2006). For women who continue to

regularly participate in physical activity during pregnancy, trends show decreasing levels as the pregnancy progresses (Schmidt et al., 2006). Evidence supports that among healthy pregnant women, increased participation in physical activity is associated with a decrease in self reports of psychological distress (Boscaglia et al., 2003; Da Costa et al., 2003; Goodwin et al., 2000; and Poudevigne & O'Connor, 2006). The current recommendations encourage at least thirty minutes of moderate intensity physical activity three or more days every week throughout pregnancy (ACOG, 1994; Davies et al., 2003; RCOG, 2006); however, even low intensity physical activity during pregnancy is associated with decreased self reports of psychological distress (Da Costa et al., 2003). Pregnant women who routinely participate in physical activity are also more likely to report positive feelings about body image earlier in pregnancy (Boscaglia et al., 2003), and to maintain these positive feelings over the course of the pregnancy (Marquez-Sterling et al., 2000) compared to pregnant women who do not participate in regular physical activity. In addition to psychological health benefits, evidence also demonstrates that this intervention can improve maternal physical health and contribute to the prevention of pre-eclampsia, gestational diabetes, and excessive weight gain during pregnancy (RCOG, 2006).

Implications and Recommendations for Nurse Practitioner Clinical Practice

These findings have implications for nurse practitioners' clinical practice. Firstly, as levels of physical activity are shown to decrease during pregnancy, especially in the third trimester (Poudevigne & O'Connor, 2006), it is important for NPs to consider actions to encourage regular physical activity prior to and throughout pregnancy. Secondly, NPs must

consider the physical and psychological effects decreased physical activity has on maternal health, and monitor both appropriately throughout the gestational period. Thirdly, as the evidence from this review is inconclusive in terms of demonstrating causal relationships, it is necessary for NPs to consider that psychological distress may contribute to decreased physical activity during pregnancy just as decreased physical activity may contribute to self reports of psychological distress. It is useful for the NP to consider both possible associations when working with a prenatal client who is experiencing psychological distress and to plan the care accordingly.

When considering the implications of these findings for nurse practitioner clinical practice, the social context of women's lives also deserves full recognition. It is an area that is not well represented in the biomedical paradigm. Women's lived experiences are unique, and can greatly impact actions and choices. Pregnant women's social contexts have the potential to contribute to psychological distress, and may also facilitate or impede participation in physical activity during pregnancy. It is important for NPs to consider the greater determinants of health, which combine to create the social context within which pregnant women live, when planning and implementing care. Having a clear understanding of community services available to pregnant women, and ensuring adequate time to explore the client's lived experiences and social context may aid NPs when addressing psychological distress and physical activity during pregnancy.

Due to the dearth of available contemporary studies on this topic and the limitations of these studies, additional investigations using rigorous methods and validated measures relevant for pregnant women would be a beneficial contribution to NP clinical practice. NPs

could lead this research to ensure its relevance for their practices. Firstly, there is scope for NPs to pursue research that is congruent with, and which explores, the social, emotional, and spiritual contexts of women's lives, as well as the physical context. The literature review also reveals additional research topics with direct relevance to clinical practice that may be of interest to NPs. For example, an investigation into the reliability and validity of screening tools which have no such published evidence may be an area of interest. A follow up study to this preliminary review would be relevant to capture any seminal work not included due to the limited search time-line.

Based on the findings from this review, it is recommended that NPs discuss the physical and possible psychological benefits of routinely participating in physical activity during pregnancy with their pre-conception and prenatal clients at every appropriate opportunity. NPs routinely screen expectant clients for signs of physical illnesses, such as hypertension or urinary tract infections, using validated measures. In light of these findings, NPs may also choose to routinely screen for signs of psychological distress, such as feelings of anxiety, depressed mood, or concerns about body image, using validated screening tools. It is recommended that NPs encourage at least 30 minutes of moderate intensity physical activity three or more times weekly for all healthy, pregnant women, with a view to optimizing physical health and decreasing potential for self reports of psychological distress during the gestational period.

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Appendix A

Analysis of Research Study Addressing Physical Activity Patterns During Pregnancy

Author(s) & Date of Publication	Schmidt, M; Pekow, P; Freedson, P; Markenson, G; Chasan-Taber, L. 2006
Title	Physical activity patterns during pregnancy in a diverse population of women
Conceptual or Theoretical Framework	none given
Study Design	cross-sectional study
Major Variables Studied	a. total physical activity: household/caregiving; occupational; leisure; sports/exercise; transportation
Sample Description	233 prenatal care patients from first, second and third trimesters; all recruited from a tertiary care hospital in western Massachusetts; > 16 yrs < 40 yrs; uncomplicated pregnancies
Measurement Instruments for Each Variable	a. interviewers used standardized open-ended forms to record detailed descriptions of every activity performed by participants during a 24 hr period x 3 b. activity-specific intensity codes (Compendium of physical activities) assigned to each activity recorded in the recalls; in form of METs
Data Analysis Used	Statistical analysis performed using Statistical Analysis System version 9.1 - mean, median, and interquartile energy expenditure values calculated by activity type and intensity across trimesters and categories: age, race, education, income, parity, and pre-pregnancy BMI - statistical significance of differences in estimates across trimesters assessed with Kruskal-Wallis test of rank order differences. - logistic regression: ORs, 95% CI for high level of combined moderate /vigorous, total, and type-specific energy expenditure. - multivariate logistic regression used to statistically adjust for covariates found to be statistically significantly associated with high level of activity in unadjusted models at $p < 0.05$ - tests of trend: calculated by modeling ordinal subject characteristics as continuous variables. - effect modification by trimester evaluated in inspection of stratum-specific ORs and by evaluating significance of interaction terms via

	chi-square likelihood ratio tests
Study Findings	<ul style="list-style-type: none"> - activity intensity and type varied significantly across women in different trimesters - mean energy expenditure in moderate intensity activity was similar between women in the first and second trimesters, and approximately 45% lower among women in the third trimester. - mean household/caregiving energy expenditure: much higher among women in later pregnancy. - sports/exercise activity: very little contribution to total energy expenditure
Strengths and Weaknesses	<ul style="list-style-type: none"> - clearly written and organized. - clinical implications and future research outlined. - authors acknowledged the limitations of the study and emphasized the necessity of more rigorous research. - lit review good <ul style="list-style-type: none"> - nature and small sample size: may contribute to bias. - generalizability of results - no

Appendix B

Analysis of Research Studies Addressing Physical Activity Patterns and Body Image During Pregnancy

Author(s) & Date of Publication	Smith SA; Michel Y	Marquez-Sterling S; Perry A; Kaplan T; Halberstein R; Signorile J	Goodwin, A; Astbury, J; McMeeken, J.	Boscaglia, H; Skouteris, H; Wertheim, E.
	May-June 2006	January 2000	2000	2003
Title	A pilot study on the effects of aquatic exercises on discomforts of pregnancy	Physical and psychological changes with vigorous exercise in sedentary primigravidae	body image and psychological well-being in pregnancy. A comparison of exercisers and non-exercisers.	Changes in body image satisfaction during pregnancy: a comparison of high exercising and low exercising women
Conceptual or Theoretical Framework	Pender's Health Promotion Model (HPM), grounded in social cognitive theory.	none given	none given	none given
Study Design	a two-group, quasi-experimental, pretest/posttest	experimental - RCT	prospective longitudinal study	partial prospective approach
Major Variables Studied	a. body image b. participation in health-promoting behaviours c. level of physical discomfort d. mobility	a. physical characteristics: wt, ht, skin-fold measurements. b. body image c. aerobic fitness: HR, BP, lactates.	a. body image b. exercise activity over last 4 weeks: type, duration, perceived level of exertion, heart rate during activity c. psychological well-	a. body image

Sample Description	a convenience sample of 40 non-exercising pregnant women; at least 19 wks gestation; greater than 18 yrs; taller than or equal to 5ft; permission to participate from health care provider (HCP). Excluded: those with multiple pregnancies, hx of pre-term birth, placenta previa or gestational hypertension, or both. 60% of sample was African-American.	- subjects randomly assigned to either the Control or Exercise intervention group (C= 6; E=9) (5 d/ced) - recruited from radio and newspaper ads - all subjects: completed medical questionnaire, provided a fetal sonogram, classified as low risk, permission to participate by HCP, approved to participate by medical director of study, and had not exercised on a regular basis x 1 yr prior to conception	being: anxiety; dep. convenience sample of 72 volunteers recruited from a community and hospital based pre-natal classes. - nulliparous; 20-40 yrs; 14-20 wks pregnant; - healthy; no contraindications to exercise; BMI <30; read and write English.	71 healthy pregnant women; high socioeconomic status;
Measurement Instruments For Each Variable	a. Pregnancy Body Shape Questionnaire – Cronbach's alpha =.86 b. Pender's Health Promotion Lifestyle Profile (HPLP) – subscale reliabilities .70-.90; Cronbach's alpha =.92. c. Smith's Pregnancy Discomfort Index (SPDII)	a. Detecto balance scale, stadiometer attached to scale, Lange skin-fold caliper. b. Body Cathexis Scale c. Polar Vantage XL heart rate monitor, sphygmomanometer with cuff, 2300 Stat Glucose/L-Lactate Analyser	a. Body Cathexis Scale b. self-report exercise history questionnaire c. 28 item General Health Questionnaire(GHQ-28)	a. Body Cathexis Scale - test-retest reliability = 0.71; Cronbach's alpha = 0.85-0.88.

	<p>- reliability = .89 d. Timed Get Up and Go Test - reliability = .92-.96</p>				
Data Analysis Used	<p>Statistical analysis performed using SPSS version 12</p> <ul style="list-style-type: none"> - demographic and clinical characteristics evaluated at initiation of study and during post-testing. Distributional characteristics of outcome variables examined. Internal consistency estimates (Cronbach's alpha) evaluated for each instrument. Independent t-tests analysed for all instruments and sub-scales of the HPLP. Post-test scale and sub-scale scores evaluated by ANCOVA. alpha set at $< .05$. 	<p>Students t-test performed for independent samples to compare physical characteristics of subjects at beginning of study</p> <ul style="list-style-type: none"> - a repeated measures ANOVA performed to find significant differences in PWC150 time and lactate accumulation b/w groups before and after 15 wk program - a Students t-test for independent samples used to compare groups in pregnancy outcome measures and psychological variables. 	<p>- statistical analyses performed using Mac StatView Student data analysis prog.</p> <ul style="list-style-type: none"> - t-test and two-factor repeated measure analysis of variance (ANOVA) for analysis of parametric data. - for analysis of non-parametric variables chi-square test for categorical variables and Mann Whitney U for single items on the Body Cathexis Scale. - simple linear regression and a multiple regression anal. to predict relationships b/t independent variables and dependent variables. 	<ul style="list-style-type: none"> - analyses performed using SPSS for Windows, version 10.05. - two-tailed t-tests used to ensure no differences b/w exercisers and non-exercisers (groups differed on parity status). - mixed ANOVA conducted on body cathexis scores: group as bw subjects indep. variable, parity as blocking indep variable; time as within subjects indep variable ($P = 0.04$) - simple main effects analyses using t-tests bw and within groups ($\alpha = 0.01$ to reduce type 1 errors); effect sizes calculated (Cohen's d). 	
Study Findings	<p>Women who participated in the aquatic exercise program reported less</p>	<p>Exercising subjects experienced significant improvements in aerobic</p>	<p>- no significant difference in body cathexis scores between early preg (17</p>	<p>- at 15-22 wks gest. the high exercisers were significantly more</p>	

	<p>physical discomfort, improved mobility, and improved body image and health-promoting behaviours compared to the women who did not participate in the aquatic exercise program.</p>	<p>fitness, lactate hemodynamics, and psychological measures of health and well-being that were not observed in the non-exercising group. Recommendation: sedentary primigravidae with low risk pregnancies can participate in vigorous exercise programs when run by certified instructors in a supervised setting.</p>	<p>wks) and late preg (30 wks) - no significant difference in total body cathexis scores b/w the exercise and non-exercise groups however, scores for the non-exercise group became less positive over time while the scores for the exercisers remained relatively stable. - exercise group compared to the non-exercise group at late pregnancy: a significant difference was found for overall psychological well-being and for the subscales of anxiety and insomnia (4.70 +/- 4.68 for exercisers vs. 7.33 +/- 4.19 for non-exercisers; $p=0.04$). No significant difference was found for depression (0.56 +/- 1.00 for exercisers vs. 0.61 +/- 1.24 for non-exercisers; p NS).</p>	<p>satisfied with their bodies compares to low exercisers, $t(69)=-2.89$, $P=0.005$, $d=0.69$. No other significant differences found b/w groups. - high exercisers: significantly more satisfied with their bodies at 15-22 wks gest., and tended to be more satisfied at 23-30 wks gest., compared to 6 mo. pre-pregnancy - low exercisers: no significant difference in body image scores indicating that the body image of the non or low exercisers remained relatively stable from pre-pregnancy to late pregnancy.</p>
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Strengths and Weaknesses	<ul style="list-style-type: none"> - clearly written and organized. - clinical implications and future research outlined. - authors acknowledged the limitations of the study and emphasized the necessity of more rigorous research. - lit review good - participant self-selection of group assignments: may be a confounding variable and contribute to bias. - small sample size: may contribute to bias. ? generalizability - ext. validity? 	<ul style="list-style-type: none"> - limitations outlined by authors - groups randomly assigned : decreased bias - clearly written and organized - nature and size of sample: possible bias, decreased generalizability - large number of tests performed increased possibility of Type 1 error. 	<ul style="list-style-type: none"> - limitations outlined by authors - clearly written and well organized - self-selection of subjects - selection bias - lack of definition for exercise vs. non-exercise groups - lack of measurement points - GHQ only used in late pregnancy - GHQ not validated for use with pregnant women 	<ul style="list-style-type: none"> - self-selection into groups - small sample size.
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Appendix C

Analysis of Research Studies Addressing Physical Activity Patterns and Feelings of Anxiety and/or Depressed Mood During Pregnancy

Author(s) & Date of Publication	Da Costa, D; Rippen, N; Dritsa. M; Ring, A 2003	Poudevigne M; O'Connor P. August 2005	Haas JS; Jackson RA; Fuente-Afflick E; Stewart AL; Dean ML; Brawarsky P; Escobar GJ Jan 2005	Poudevigne M; O'Connor P. 2006
Title	Self-reported leisure-time physical activity (LTPA) during pregnancy and relationship to psychological well-being	Physical activity and mood during pregnancy	Changes in health status of women during and after pregnancy.	A review of physical activity patterns in pregnant women and their relationship to psychological health
Conceptual or Theoretical Framework	none given	none given	none given	none given
Study Design		two group quasi-experimental (longitudinal prospective approach)	non-experimental (observational cohort)	systematic review
Major Variables Studied	a. self reported LTPA patterns during each trimester of pregnancy b. depressive symptoms c. pregnancy-specific	a. physical activity patterns b. body weight c. mood	a. poor physical function b. poor vitality c. poor or fair health d. depressive symptoms	During pregnancy: a. physical activity changes b. mod changes c. relationship b/w physical activity and self-

	stressors and concerns d. state anxiety e. fluctuations in stress due to minor daily stressors			esteem; In general population: d. relationship b/w physical activity and mood
Sample Description	180 pregnant women; first trimester (8-14 wks); recruited from five OBGYN offices in Montreal area. 19-40 yrs, stable relationship; conceived naturally; read/understand English/French.	12 pregnant women aged 18-40; first trimester; uncomplicated pregnancy. Read and understand English. All were paid \$70 for their time. Recruited through newspaper ads, flyers at women clinics and OBGYN offices, and at maternity related businesses. The control group was made up of 12 race-matched non-pregnant, non-lactating women.	1809 pregnant women from 1 of 6 sites in the San Francisco area. These sites were chosen for a previous longitudinal cohort study (Project WISH) due to their socio-economic and ethnic diversity. All participants: received prenatal care at one of the six sites before 16 wks gestation; at least 18 yo; spoke English, Spanish or Cantonese; could be contacted by phone	samples of studies reviewed varied immensely: - size 18- >9000 - majority were convenience samples
Measurement Instruments For Each Variable	a. 3 structured interviews developed for study (1 for each trimester); includes assessment of LTPA in the previous month - specific activity; frequency/month; average duration/session b. Lubin depression adjective checklist - form C	a. diary of daily physical activities; 7-day physical activity recall; and the MTI accelerometer. b. double balance beam scale c. 65-item Profile of Mood States (POMS) questionnaire	Medical Outcome Study Short Form-36 (SF-36) a-c: a. physical function- 10 items b. vitality- 4 items c. self-rated health: excellent, very good, good, fair, poor. d. short-form Centre for	Generally, well validated measures not used in the reviewed studies: lack of precise, well-validated measures of physical activity, data gathered too infrequently;

	(DACL) c. Pregnancy Experiences Questionnaire (PEQ) d. state-trait anxiety inventory (STAI) e. Hassels Scale (revised)		Epidemiological Studies Depression Scale- 10 items	
Data Analysis Used	<ul style="list-style-type: none"> - descriptive stats: means, medians, standard deviation (SD) for all variables. - independent sample t-tests for continuous variables and chi-square for dichotomous variables for group differences on study variables for each trimester - daily energy expenditure est. for all the self-reported LTPA in which women reported having engaged in - expressed in kilocalories expended per kg of body weight per hour. The av. daily energy expenditure for the activity (Kcal/kg/day) was estimated by dividing by 30. 	<p>Statistical analysis performed using SPSS version 11.5</p> <ul style="list-style-type: none"> - assumptions for analysis of variance were tested; degrees of freedom were adjusted using the Huynh-Feldt adjustments when sphericity wasn't met. A box plot analysis was done for the variables. <p>Hypotheses 1&2 : Pearson correlations were computed; Hypothesis 3 tested with a mixed model ANOVA. Spearman correlations performed for hypothesis 4</p>	<p>3 sets of multivariate logistic regression models examined: health status prior to pregnancy, health status during pregnancy, and postpartum health status.</p>	<p>majority of studies reviewed used percentages or Pearson's r correlation to compare groups. Some used mean , standard deviation, and Cohen's d.</p> <ul style="list-style-type: none"> - No degrees of freedom or p-values given <p>Overall, the review failed to prove the credibility of the results identified from the included studies</p>

Study Findings	<ul style="list-style-type: none"> - prevalence of exercise behaviours: prior to pregnancy 40%; 1st and 2nd trimesters 29%, 3rd trimester 21%. - a significantly greater number of women who were not exercising in the first trimester were depressed (33.1%) compared to exercisers (15.1%). Similar in 2nd (18.9% vs. only 5.7%). No group differences were shown for the 3rd. - state anxiety was lower for exercisers in each trimester compared to non-exercisers 	evidence of the validity of the 7-day physical activity recall and the accelerometer as measures of physical activity in pregnancy; may be valid tools. Pregnant group may have had less fatigue, more energy, and more stable mood due to their above average physical activity although conclusions can't be drawn. More research is necessary	<p>Limitations in physical function, restrictions in vitality, and the prevalence of depressive symptoms increased over the course of pregnancy.</p> <p>Of the many demographic, medical, and obstetric characteristics examined, insufficient money for food and housing, and lack of exercise were strongly and consistently associated with poor health status on all indicators before, during, and after pregnancy.</p>	<ul style="list-style-type: none"> - physical activity is reduced during pregnancy; - available evidence suggests that inactivity is associated with worse mood; however, the literature was limited due design and methodology limitations of the existing studies - additional research is necessary
Strengths and Weaknesses	<ul style="list-style-type: none"> - limitations outlined by authors - clearly written and organized - nature and size of sample: possible bias, decreased generalizability - no test of cardiovascular fitness to confirm exercise adherence to reported 	<ul style="list-style-type: none"> - limitations outlined by authors - clearly written and well organized - small sample of self-selected participants; findings may not generalize to other samples; possible sample bias; Type II errors; recall 	<ul style="list-style-type: none"> - limitations outlined by authors - clearly written and well organized - observed relationships may not be causal - possible recall bias - no comparison group observed 	<ul style="list-style-type: none"> - limitations of studies discussed and the need for further, more rigorous, research outlined - majority of studies used were fairly recent - organization of report slightly confusing at times - failed to prove the credibility of the results

	exercise regimens - findings suggest association but no causal link	method may be unreliable		given from the included studies
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Appendix D

Analysis of SOGC/CSEP Clinical Practice Guidelines

source and date of publication	joint SOGC/CSEP Clinical Practice Guideline No 129, June 2003
title	Exercise in pregnancy and the postpartum period
scope and purpose	<p>Overall objective specifically described: Yes. To design Canadian guidelines advising obstetric care providers of the maternal, fetal, and neonatal implications of aerobic and strength-conditioning exercises in pregnancy.</p> <p>Clinical question specifically described: Yes. What are the relative merits of aerobic and strength conditioning in pregnancy and the postpartum period?</p> <p>Patients to whom the guidelines are mean to apply: Canadian women</p>
stake-holder involvement	<p>Guideline development group includes individuals from all relevant professional groups: reviewed by the Clinical Practice Obstetrics Committee and approved by the Executive and Council of the Society of Obstetricians and Gynaecologists of Canada, and approved by the Board of Directors of the Canadian Society for Exercise physiology.</p> <p>Patient's views and preferences sought: not mentioned in guidelines</p> <p>Target users of guidelines: Canadian women and their care providers</p> <p>Piloted among target users: not mentioned in guidelines</p>
rigour of development	<p>Systematic methods used to search for evidence: Yes.</p> <p>MEDLINE search from 1996-2002 for English language articles related to studies of maternal aerobic and strength conditioning in a previously sedentary population, maternal aerobic and strength conditioning in a previously active population, impact of aerobic and strength conditioning on early and late pregnancy outcomes, and impact of aerobic and strength conditioning on neonatal outcomes, as well as for review articles and meta-analyses related to exercise in pregnancy.</p> <p>Criteria for selecting evidence clearly described: Yes. See above.</p> <p>Methods used for formulating the recommendations clearly described: No.</p> <p>Health benefits, side effects, and risks considered in formulating the recommendations: Yes.</p> <p>Explicit link b/w the recommendations and the supporting</p>

	<p>evidence: Yes. the quality of evidence reported was described using the Evaluation of Evidence criteria outlined in the Report of the Canadian Task Force on the Periodic Health Exam. All recommendations are preceded by a discussion of the literature on the subject.</p> <p>Expert external reviewers prior to publication: No. The guidelines state that they were reviewed and approved by the Clinical Practice Obstetrics Committee, the Executive and Council of the Society of Obstetricians and Gynaecologists of Canada (which are later stated to be the same committee), and the Canadian Society for Exercise Physiology – sounds like external reviewers but then it is stated that these groups are also the sponsors of the guidelines. Also, two of the authors are listed as members of the reviewing committees.</p> <p>Procedure for updating the guideline is provided: no</p>
clarity and presentation	<p>Recommendations (specific and unambiguous): Yes.</p> <p>Various options for management presented: Yes. ie contraindications</p> <p>Key recommendations easily identifiable: Yes. In bold, offset, and numbered 1-6.</p> <p>Tools to support application of guideline: Yes. Borg's Rating of Perceived Exertion and resources clients and care providers can refer to.</p>
application	<p>Organizational barriers to applying recommendations discussed: No</p> <p>Cost implications of applying the recommendations considered: No</p> <p>Key review criteria for monitoring and/or audit purposes: No</p>
editorial independence	<p>Editorially independent from the funding body: No. The review committees are also the sponsors.</p> <p>Conflicts of interest recorded: no conflicts of interest of guideline development members was recorded in the guidelines</p>

Appendix E

Analysis of the RCOG Clinical Practice Guidelines

source and date of publication	RCOG Statement No. 4, January 2006
title	Exercise in pregnancy
scope and purpose	Overall objective specifically described: yes Clinical question specifically described: no question identified but objective clear Patients to whom the guidelines are mean to apply: pregnant women
stake-holder involvement	Guideline development group includes individuals from many relevant professional groups: physician from BC, Canada; physician consultant for the British Olympic Association; Community Development Officer; Chairman of Association of physiotherapists in Women's health; RCOG Consumer's Forum Patient's views and preferences sought: No; although Consumer's Forum consulted Target users of guidelines: women and their care providers Piloted among target users: No
rigour of development	Systematic methods used to search for evidence: Yes. Criteria for selecting evidence clearly described: Yes: databases; timelines; search words Methods used for formulating the recommendations clearly described: No Health benefits, side effects, and risks considered in formulating the recommendations: Yes Explicit link b/w the recommendations and the supporting evidence: Yes - evidence described but not rated Expert external reviewers prior to publication: yes Procedure for updating the guideline is provided: no
clarity and presentation	Recommendations (specific and unambiguous): yes Various options for management presented: yes Key recommendations easily identifiable: yes - numbered and bulleted Tools to support application of guideline: Yes. Borg's Rating of Perceived Exertion, modified heart rate target zones, and resources clients and care providers can refer to.
application	Organizational barriers to applying recommendations discussed: no Cost implications of applying the recommendations considered: no

	Key review criteria for monitoring and/or audit purposes: no
editorial independence	Editorially independent from the funding body: no Conflicts of interest recorded: not mentioned

Appendix F

Analysis of ACOG Clinical Practice Guidelines

source and date of publications	ACOG Technical Bulletin no. 189, February 1994 ACOG Committee Opinion No. 267, Jan. 2002
title	Exercise during pregnancy and the postpartum period
scope and purpose	Overall objective specifically described: yes Clinical question specifically described: no but intent clear Patients to whom the guidelines are mean to apply: pregnant women
stake-holder involvement	Guideline development group not mentioned Patient's views and preferences sought: not mentioned in guidelines Target users of guidelines: American women and their care providers Piloted among target users: not mentioned in guidelines
rigour of development	Systematic methods used to search for evidence: not provided Criteria for selecting evidence clearly described: no Methods used for formulating the recommendations clearly described: no Health benefits, side effects, and risks considered in formulating the recommendations: yes Explicit link b/w the recommendations and the supporting evidence: evidence explained; not rated Expert external reviewers prior to publication: not mentioned Procedure for updating the guideline is provided: no
clarity and presentation	Recommendations (specific and unambiguous): Yes. Various options for management presented: Yes. ie. contraindications Key recommendations easily identifiable: yes - bulleted Tools to support application of guideline: no
application	Organizational barriers to applying recommendations discussed: no Cost implications of applying the recommendations considered: no Key review criteria for monitoring and/or audit purposes: no
editorial independence	Editorially independent from the funding body: no Conflicts of interest recorded: no conflicts of interest of guideline development members was recorded in the guidelines