Research Report

The Impact of Symptom Type and Frequency on Activity Level During Pregnancy

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ABSTRACT

Objective: The primary research question for this study was: Do symptoms during pregnancy relate to the amount of physical activity undertaken by women at heightened risk for preeclampsia?

Study Design: This is a secondary data analysis of prospective data collected from a randomized intervention study.

Background: Physical activity during pregnancy reduces health risks, yet the majority of pregnant women are sedentary. Physical symptoms during pregnancy may be a barrier to activity. Given the ubiquity of symptoms in pregnancy, we identified a need for more information regarding the link between symptoms and physical activity.

Methods and Measures: The original study looked at the impact of 2 exercise routines on the incidence of preeclampsia: walking (n = 64) and stretching (n = 60). Our primary analysis evaluated the connection between self-reported symptoms and physical activity as measured by steps per day.

Results: Most of the commonly reported exercise-associated symptoms (breathlessness, chest pain, leg cramping, muscle pain, and abdominal pain) were not significant predictors of physical activity. However, women who experienced multiple symptoms during pregnancy exercised less. Greater maternal weight and nonwhite race were also associated with fewer steps per day. Women also significantly reduced their level of activity around 28-week gestation and continued to decrease activity until delivery.

Conclusions: These findings suggest the need for anticipatory prenatal guidance regarding symptoms and the safety of exercise with these symptoms. Health care providers may need to offer additional encouragement or interventions for women who are extremely obese and for those from racial minorities to increase physical activity during pregnancy.

Key Words: exercise, prenatal, trimester, walking

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INTRODUCTION

The American College of Obstetricians and Gynecologists[1] recommends that pregnant women (without complications that prohibit exercise) engage in at least 30 minutes of moderate-intensity exercise on most days of the week. Research findings indicate a protective effect of physical activity during pregnancy on the risk of developing preeclampsia and on the risk of developing gestational diabetes.[2–7] However, in spite of the evidence and these recommendations, the majority of pregnant women are sedentary, and women who were active before pregnancy tend to reduce their activity level during pregnancy.[8–12]

Various studies have explored self-reported barriers to exercise during pregnancy[9,13–18] and have found various factors that discourage exercise, including physical complaints and tiredness. Evenson et al,[15] using data from a survey of 1535 pregnant women, classified roughly 85% of the primary barriers to exercise as "intrapersonal" and then separated these into health related (52% overall) and not health related (33% overall). The most common health-related reported barriers were lack of energy or being tired,

pain/discomfort with activity, and medical complications. The most common non–health-related barrier was being too busy/lack of time. These authors also analyzed focus groups with 58 women regarding exercise during pregnancy and again found that physical complaints (tiredness, lack of sleep, shortness of breath, musculoskeletal problems, etc) were among the most common reported barriers to exercise.[15] Similarly, Duncombe et al[9] reported that the main barriers to exercise reported by their 158 participants were feeling tired or unwell, being too busy, and that exercise was uncomfortable, especially toward the end of pregnancy.

The findings regarding physical complaints as a barrier to exercise present a challenge for health care providers, given the many physical changes and symptoms that women experience during pregnancy. In their study of symptoms and mental health during pregnancy, Kamysheva et al[19] found that women reported a mean of 13.75 different physical symptoms, with the most common being fatigue (94.9%), increased urination (88.3%), nausea (85.6%), tender breasts (81.4%), headache (76.3%), vaginal discharge (75.8%), flatulence (74.8%), constipation (67%), appetite increase (66.8%), insomnia (64.2%), shortness of breath (61.4%), backache (61.4%), and heartburn (53%).

Given the wide variety and ubiquity of physical symptoms during pregnancy and the existing reports of symptoms as a barrier to exercise, we identified a need to generate further information regarding the link between specific symptoms and physical activity. Most of the studies that have been completed to date rely on retrospective recall of symptoms and the amount and level of physical exercise.[4,5,10,20] Using data from a large study, we have prospective daily records of both activity level and symptoms for sedentary women with a history of preeclampsia from early second trimester through the end of pregnancy. The purposes of this study were to explore the impact of physical symptoms on exercise in this population and to identify specific complaints that appear to have the greatest impact on activity level. Greater understanding of symptoms that impact exercise adherence and the level of symptom impact may enable practitioners to tailor interventions to help women manage symptoms to avoid a decline in physical activity. The specific research questions that this study addressed were as follows:

1. Are daily physical symptoms associated with the number of total steps taken daily as assessed by a pedometer for sedentary pregnant women with a history of preeclampsia?
2. If symptoms are associated with daily total steps in the study population, which physical symptoms (such as leg cramps, leg swelling, abdominal discomfort, breathlessness) have the strongest association with steps taken?

METHODS AND MEASURES

This study presents a secondary analysis of data obtained from a randomized comparative intervention study that included sedentary pregnant women at heightened risk for preeclampsia based on prior medical history. The original study took place between November 2001 and July 2006, and the study sample involved 124 pregnant women. They were recruited through 9 prenatal clinics in 2 heath care systems in Washtenaw County, Michigan. Women were eligible to participate in the original study if they were (1) diagnosed with preeclampsia during their most recent pregnancy, (2) at less than 14-week gestation at enrollment, (3) had a lower than average cardiovascular fitness level (peak oxygen consumption $\leq$ the 50th percentile of women in their age group), and (4) led a sedentary lifestyle (an estimated energy expenditure for daily physical activity during the index pregnancy of less than 840 kcal/wk). Women were excluded from the study if any of the following were present: (1) diagnosed chronic hypertension or pregestational diabetes at recruitment, (2) medical or physical condition prohibiting daily regular exercise, (3) recommendation of primary provider to not participate, or (4) inability to communicate sufficiently to participate in the exercise program because of language or mental status. All participants signed written informed consent documents, and the study was approved by the applicable institutional review boards. The approval for the present study was obtained from the University of North Carolina at Chapel Hill institutional review board.

The primary purpose of the original study was to look at the impact of 2 different exercise routines on the incidence of preeclampsia. Women were randomized into 2 groups: a walking group (n = 64) and a stretching exercise group (n = 60). Women in the walking group were supposed to walk at moderate intensity (55%-69% of maximum heart rate and rating of perceived exhaustion of 12 or 13, using the Borg Rating of Perceived Exertion Scale[21]) for 40 minutes. The women in the stretching group were asked to follow a 40-minute videotaped stretching exercise sequence, which was designed to keep their heart rate within 10% of their resting heart rate and did not include aerobic or muscle-resistance exercises. Both groups were asked to engage in their assigned activity 5 times per week from 18-week gestation until the birth of the baby. A complete description of the original study has been previously published.[22] The study found a significant difference in the overall

number of exercise sessions completed, heart rate, and blood pressure between groups, but not in amount of weight gained.[11]

For this study, we were interested in the impact that physical symptoms had on the women's overall activity level, as indicated by the number of steps that women in both conditions took during the day. All the participants wore pedometers (DigiWalker SW200, Tokei Keiki Co, LTD, Tokyo, Japan) from the time they woke up in the morning until the time they went to bed at night, thus capturing the total steps taken. Women were asked to record in a logbook the number of steps taken each day, any physical symptoms experienced each day, and whether or not they attributed the symptoms to the pregnancy. Participants shared all the data from the logbooks with study team members, during weekly laboratory visits. Study staff recorded the symptom data by using 7 categories that represented the 6 most commonly reported symptoms from our pilot data (breathlessness, muscle soreness, leg cramps, leg swelling, abdominal discomfort, and chest pain) and an "other symptoms" category (unpublished pilot data). Of the 124 original study participants, 115 (62/64 in the walking group and 53/60 in the stretching group) provided complete data for this study.

Demographic Data

We considered several demographic variables as potential confounders for activity level, including age, race/ethnicity, education, hours worked per week, and body mass index. The first 4 variables were collected at baseline by using a questionnaire, and body size was recorded both at baseline and at the weekly laboratory visits during the study period. The women ranged in age from 19 to 43 years, and the large majority of participants were white. The only variable on which the 2 groups differed significantly was hours worked per week, with a mean of 26 h/wk for the walkers and 20 h/wk for the stretchers ($P = .032$). A summary of these variables for the women in the study by group is included in Table 1.

Table 1. Characteristics of Study Participants

	Walkers (n = 62)	Stretchers (n = 53)	P[a]
Age, y			
Range	19-42	23-43	.8315
Mean	31	31	
Median	31.4	31.5	
Race/ethnicity, %			
White	88	86	.483
Nonwhite	12	14	
Body mass index			
Range	17.5-50.4	20.3-49.9	.6994
Mean	26.8	27.1	
Median	29.9	29.8	
Years of education, %			
≤12	18	10	.126
13–16	62	62	
>17	20	28	
Hours worked per week			
Range	0–55	0–49.9	.032
Mean	26	20	
Median	26.9	19.1	

[a]Wilcoxon rank sum test was applied for age, body mass index, and hours worked per week. Pearson χ^2 test was applied for race/ethnicity and education.

Statistical Analysis

Our primary analysis evaluated the connection between physical symptoms (eg, leg cramps, leg swelling, abdominal discomfort, breathlessness) and the physical activity level of the women in the study between 16 and 40 gestational weeks. Physical activity was measured by the number of steps taken per day by each participant. Recorded step values greater than or equal to 40 000 were excluded from all analyses, as we deemed these values to be highly implausible (a very active person might take 30 000 steps in a day[23]). Under this criterion, only 2 observations were excluded from the analysis: a value of 58 562 and a value of 43 737.

Binary indicator variables were created to represent each of the physical symptoms of interest: breathlessness, muscle soreness, leg cramps, leg swelling, abdominal discomfort, chest pain, and other symptoms. A summary variable for symptoms was defined (any symptom) and indicates whether any of the previously mentioned symptoms occurred in a given day.

The control variables included in the analyses were weight (kg), height (m), maternal age, gestational age, hours worked outside of the home per week, randomized group (walking vs stretching), race/ethnicity (white versus all others), gravidity (primigravid versus not), and education level (high school or less, some college, completed college). To evaluate gestational age, a binary indicator variable was created for each gestational week. The indicator variable was set equal to "1" for the given week and "0" otherwise. All other variables were treated as continuous.

We employed statistical techniques for repeated measurements data to model our data with the total number of steps taken by each subject per day (STEPS) as the primary outcome variable of interest. A separate linear mixed-effects model[24] was fit to each of the symptom variables to evaluate the separate effect of each. Correlation between the daily step counts was modeled using a compound symmetric

covariance structure. All models included the variable STEPS as the outcome variable (approximately normally distributed), an explanatory symptom variable, and control variables (education, weight, maternal age, etc). Interactions between symptoms and both gestational age and treatment group, and between race and treatment group, were considered in each model, and likelihood-ratio tests were used to evaluate the effectiveness of such terms. After interaction was considered, a backwards selection method was used with a 0.05 α level, to select a reduced model.

RESULTS

As expected, the women randomized to the walking group reported more steps per day than women in the stretching exercise group ($P < .0001$, Table 2). In fact, the difference in the mean number of steps taken per day by group is roughly equivalent to the number of steps that would be expected in an average walking exercise session, or approximately 2500 steps.

Using the statistical model, we looked at each symptom separately and found that breathlessness, chest pain, leg cramping, muscle pain, and abdominal pain were not significant predictors of the number of steps taken. None of the interaction terms were deemed significant in any of these models, either. However, we found that leg swelling, "other symptoms," and "any symptom" were all related to the number of steps taken in a given day. In addition, in all the models, gestational age, race/ethnicity, maternal weight, and randomized group were predictors of the number of steps taken. The only exception was the leg-swelling model, which retained gestational weeks, maternal weight, and group, but did not retain race/ethnicity.

The estimates in Table 3 are obtained from the model in which all symptom variables were dropped from the model and race/ethnicity, maternal weight, group, and gestational age were the only predictors. In this model, race/ethnicity appears to be an important factor in predicting steps, with white women on average taking 1190 (95% CI: −7.9, 2387.2) more steps daily than nonwhite women. Another predictor of total steps taken appears to be maternal weight, which was recorded upon the participants' first prenatal clinical visit. It appears that for every additional kilogram (2.2 lbs) in weight, a participant walked about 23 (−43.4, −1.5) fewer steps per day. Thus, women who are overweight are expected to take fewer steps than women who are not. It also appears that wom en randomized to the stretching group, after controlling for all the other variables, took about 3725 (2907, 4543) fewer steps than those women randomized to the walking group. As mentioned earlier, a difference by randomized group was expected, given that the stretching exercise did not include any walking exercise. The difference between the 2 groups is consistent with what we would anticipate given the group assignment.

Table 2. Overall Steps per Day by Group[a]

Number of Steps per Day	Minimum	Median	Mean	Maximum	Standard Deviation
Walkers	88	7597	7932	30 132	3697
Stretchers	0	4962	5446	25 429	2924

[a]t test ($t = 16.095$; $P < .0001$).

Table 3. Basic Model

Variable	Model Estimate	95% Confidence Interval
Race/ethnicity (nonwhite is reference)	1189.7	−7.9, 2387.2
Weight, kg	−22.5[a]	−43.4, −1.5
Group (Walkers are reference)	−3724.7[a]	−4542.8, −2906.6

[a]Statistically significant at the α level of .05.

Lastly, gestational age seems to be a significant predictor of steps, with women taking the most steps around weeks 21 and 22. They started to take fewer steps beginning at week 24 and even fewer steps until delivery. According to model estimates, women are taking around 200 (−124.2, 515.1) more steps in weeks 20, 21, and 22 than at week 19. Women start taking fewer steps at around week 23, taking around 50 (−278.4, 355.0) more steps than at week 19. Women then start taking significantly fewer steps beginning in week 27, taking about 500 (−830.2, −180.7) fewer steps than in week 19. Number of steps continues to decline steadily until delivery, with women taking around 1500 (−2758.0, −212.4) fewer steps in week 40 than in week 19. As estimates were obtained for each gestational week, model estimates are not presented in this article.

Estimates from Table 4 were obtained from 3 different models, one model for each symptom. As each of these 3 models produced extremely similar estimates for gestational age, maternal weight, and group to those in Table 3, they are not presented in this article. One of these models, leg swelling, did not retain race/ethnicity as a significant predictor, while all the other models did.

We found different step estimates for women in the walking and stretching groups because of significant interaction terms between group and the respective symptom. Walkers who experienced "any symptom" walked about 141 (−361.2, 79) fewer steps than walkers without symptoms (not significant at .05). Stretchers who experienced "any symptoms" took about 294 (69.9, 517.8) more steps during the day than stretchers not experiencing "any symptoms"

Table 4. Models With Symptom Predictors

Variable	Parameter Estimate	95% Confidence Interval
Any symptom[a]		
Walkers	−141.1	−361.2, 79.0
Stretchers	293.8[b]	69.9, 517.8
Other symptoms[a]		
Walkers	−347.3[b]	−636.5, −58.0
Stretchers	110.81	−180.7, 402.3
Leg swelling[c]		
Walkers and stretchers	518.0[b]	153.6, 882.4

[a]Estimates adjusted for maternal weight, group, gestational week, and race/ethnicity.
[b]Statistically significant at the α level of .05.
[c]Estimates adjusted for maternal weight, group, and gestational week.

(significant at .05). Women in the walking group who reported "other symptoms" took about 347 (−636.5, −58.0) fewer steps than walkers who did not experience "other symptoms" (significant at .05), while women in the stretching group who reported "other symptoms" took 111 (−180.7, 402.3) more steps than stretchers who did not experience other symptoms (not significant at .05).

Finally, women in both the walking and stretching groups who reported leg swelling as a symptom took significantly more steps per day, approximately 518 (153.6, 882.4), than those who did not experience leg swelling.

COMMENTS

The women randomized to the walking group in this study took significantly more steps per day on average (M = 7952) than women randomized to the stretching group (M = 5445). To put these numbers into context, a recent study by Bassett and colleagues[23] reported that Americans take an average of 5117 steps per day, with men taking significantly more steps per day on average (5340 steps) than women (4912 steps). In an earlier study, Thompson et al[25] used a classification system that labeled 0 to 6000 steps per day as inactive, 6000 to 9999 steps per day as somewhat active, and 10 000 or more steps per day as regularly active. Using this classification, Americans in general and members of the stretching group in our study would be considered inactive. However, the walking intervention was successful in encouraging some of the previously sedentary women to become somewhat active, using this ranking system.

For the general public, research indicates that walking more steps each day is correlated with a reduced risk of developing metabolic syndrome (a potential precursor to diabetes) and with reduction in a number of risk factors for cardiovascular disease, including waist circumference, higher high-density lipoprotein cholesterol level, and lower levels of triglycerides.[25] Sisson and colleagues[26] found that the odds of having metabolic syndrome were 10% lower for each additional 1000 steps taken per day. On the basis of these and similar findings, most public health care organizations suggest that Americans aim to walk at least 10 000 steps per day. For pregnant women, physical inactivity during pregnancy is associated with a greater risk of developing preeclampsia and gestational diabetes and of experiencing excessive weight gain.[2–4,6,27,28]

A significant predictor of total steps taken in our study was maternal weight. We found that for every additional kilogram (2.2 lbs) in weight, our participants walked about 23 (−43.4, −1.5) fewer steps. Thus, women who were overweight took fewer steps than women who were not. Other studies with nonpregnant populations have also found that people with lower body mass index take more steps per day than people with higher body mass index.[23,25,29] Another recent study with pregnant women also found significantly higher activity levels in normal-weight women (n = 175) than in obese women (n = 163).[30] In the current study, although the difference in steps is statistically significant, a difference of 23 steps per day per kilogram of additional weight is expected to have limited clinical relevance for most patients. However, providers may need to provide additional encouragement to extremely obese women to engage in physical activity.

We also found that in every model, participants started to walk significantly less at week 27 (than at week 19) and walked fewer steps until delivery. This finding is consistent with information from the American College of Obstetricians and Gynecologists,[1] indicating that it is normal for women to find it difficult to do exercises they had previously completed with ease during the third trimester. This finding is also consistent with our previous report that both groups exercised significantly less frequently ($P < .0001$) as the pregnancy progressed,[31] as well as with reports from other research teams. For example, Renault et al[30] recently reported that they found significantly higher activity at midpregnancy for both normal weight and obese women than at either end of the pregnancy. Poudevigne and O'Connor[32] reported that activity level (accelerometer counts) peaked around 24-week gestation in a small sample of pregnant women and then fell off considerably by 28-week gestation.

In the basic model, race was also an important predictor of physical activity level. White women were found to take on average 1194 more steps per day than women who are of other race/ethnicity.

This finding is consistent with the findings of Evenson and Wen[33] in their analysis of data from 1280 pregnant women in the National Health and Nutrition Examination Survey from 1999 to 2006. They found that moderate or vigorous leisure activity, measured as hours per week by self-report, was significantly higher for non-Hispanic white women; the odds of meeting recommendations for physical activity were also significantly higher for non-Hispanic white women than for women from other racial/ethnic groups.[33]

Individual symptoms, as potential barriers to physical activity during pregnancy, were not statistically associated with the number of steps that women took per day during pregnancy. The one exception was the reported symptom of leg swelling, with women who reported leg swelling taking about 518 more steps per day than women who did not report leg swelling. Given that these values were recorded on the same day (steps and symptoms), we interpret this finding as indicating that women who walked more in a given day were more likely to experience leg swelling during that day. If this hypothesis is true, then women who experience leg swelling associated with exercise may be more reluctant to engage in exercise on ensuing days. In an earlier study,[28] we found that women randomized to the walking group were less adherent overall to their exercise condition than women in the stretching group. The experience of leg swelling may be one of the factors involved in the decision to adhere to the exercise routine. If that is the case, providers may be able to counsel women about leg swelling and its management, as well as provide greater anticipatory guidance around this symptom as it pertains to general physical activity.

We also found that "any symptoms" and "other symptoms" were important predictors of steps taken per day. Both of these analyses indicated that walkers were reporting significantly more symptoms than stretchers, and that, for walkers, experiencing "other symptoms" or "any symptoms" was associated with less physical activity (significant for "other" and not significant at .05 for "any"). These results suggest that women in the walking group who experienced a combination of symptoms related to physical activity did decrease their level of exercise. For women in the stretching group who were not walking for exercise, reducing their steps per day when they experienced "any" or "other" symptoms may have been a challenge, given that the steps were probably related to activities of daily living (chores, errands, etc). From our data, we are unable to infer the relative timing within a day of symptoms versus exercise. It may be that women in the stretching group experienced more symptoms when they engaged in more walking. This inability to specify timing is a limitation of this work and points to a need for further research to elucidate causality.

Another limitation of this investigation is that we were unable to include a measure of depression in our analyses, which other groups have suggested may be linked to physical activity during pregnancy.[32,34] A third limitation is that we did not have reliability data regarding the entries into the logbooks by participants. A fourth limitation is the lack of more detailed information regarding the "other symptom" category. We intend to address this last limitation in a future study by giving women more guidance regarding labeling and categorizing any symptoms that they experience during pregnancy. Finally, the lack of reliability/validity testing for our data-gathering tool is an additional limitation for this study.

CONCLUSIONS

We found that for women in the walking group, experiencing "other symptoms" was significantly associated with a lower level of physical activity as measured by pedometer (and "any symptom" was close but not significant at .05). We also found that maternal weight and race/ethnicity were both associated with level of activity, with greater weight and race other than white being associated with taking fewer steps per day. Finally, we found that the pregnant women in our study started to significantly reduce their level of activity around 28-week gestation, and that activity level then continued to decline until delivery. Our findings suggest the possibility for targeted interventions and anticipatory guidance for women about exercise during pregnancy. Providers may need to offer additional encouragement and/or programs for women who are extremely obese and for women of minority racial/ethnic groups to increase their physical activity during pregnancy.

In addition, providers need to offer anticipatory guidance to all women regarding symptoms that they are likely to experience during pregnancy, the safety of exercise in conjunction with these symptoms, and the potential ability of specific exercises to alleviate some symptoms. Kamysheva et al[19] stated that "given the proportion of women who found that pregnancy-related symptoms substantially affected their lives, further preparation of pregnant women for coping with these symptoms may be indicated." Finally, providers may also need to place more focus on the importance and benefits of continuing activity throughout pregnancy and offer women ideas for incorporating exercise into their daily lives. Evenson et al[15] discussed the need to adapt physical activity to the physical changes that women experience during pregnancy and suggested a lifestyle approach that would incorporate

physical activity throughout the day as a possible means of addressing the heightened fatigue that women experience during pregnancy, especially during later pregnancy.

Pregnancy offers a unique opportunity to help women from all socioeconomic groups increase their understanding of the benefits of regular physical activity. It is also a time to help women establish patterns of regular activity, given the frequency of their contact with a health care provider. Future research is needed to test the efficacy of interventions designed to help women reduce and/or cope with pregnancy-related symptoms to maximize their physical activity, thus likely improving their current and future health status and pregnancy outcomes. ❍

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