PHYSICAL ACTIVITY AND PAIN DURING PREGNANCY

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ABSTRACT

Low back and pelvic girdle pain are prevalent during pregnancy, impacting about 50% of pregnant women. Previous studies conducted on the general population have suggested that physical activity has been associated with reductions in pain levels.

PURPOSE: To determine if pregnant women with higher levels of physical activity experience less low back and pelvic girdle pain than women who are less physically active during pregnancy.

METHODS: Pregnant women (n=24, 31.6 ± 4.2 years) were recruited between 28- and 32-weeks gestation. Participants reported their weekly physical activity, responded to subjective pain surveys, and underwent a battery of objective pain testing. Spearman's-rho was used to assess correlations between physical activity scores and each subject's individual pain measure.

RESULTS: Tests for correlation between physical activity scores during pregnancy and pain domain measures were not significant ($p>0.05$), so no relationship could be determined between physical activity levels and low back/pelvic girdle pain based on this study.

CONCLUSION: This study was not able to identify a significant correlation between physical activity levels and low back/pelvic girdle pain during pregnancy.

1 INTRODUCTION

Low back pain (LBP) and pelvic girdle pain (PGP) affect roughly 50% of women during pregnancy, beginning between gestational weeks 12 and 24 (Gutke et al., 2015). Gestational weeks are used to measure the age of a pregnancy, with counting beginning on the first day of the woman's last menstrual period before conception (Jukic et al., 2012). A change in a woman's center of gravity during pregnancy may cause increased lordosis of the lumbar spine, which is an inward curve that visually presents as a swayback posture that places increased pressure on the spine and may cause pain (Kawabe et al., 2022; "Physical Activity and Exercise During Pregnancy and the Postpartum Period: ACOG Committee Opinion, Number 804," 2020). While issues with low back and pelvic girdle pain are often resolved postpartum, 43% of women report persistent PGP 6 months postpartum, and 20% of women report persistent pain 3 years postpartum (Gutke et al., 2015). It is important to find ways to alleviate LBP and PGP during and after pregnancy, as this may improve the quality of life for affected women.

Low back pain, which is described as pain felt below the 12th rib and above the gluteal folds, is a widespread issue affecting 60-85% of the general population at some point in their lives (Krismer et al., 2007). About 85% of LBP cases are non-specific, meaning they cannot be explained by a pathology (van den Berg et al., 2018). Specific LBP accounts for roughly 5-10% of all LBP cases and may be initiated by trauma, psychological factors, or disease (Krismer et al., 2007). PGP is less widespread in the general population, as it is most common during pregnancy (Ando & Ohashi, 2009). PGP is pain or discomfort in the pelvic area of the musculoskeletal system (Engeset et al., 2014), either in the area of the pubic symphysis or between the posterior iliac crest and gluteal folds (Weis et al., 2018). The areas affected by low back pain and pelvic girdle pain are highlighted in FIGURE 1. Both LBP and PGP can be measured either subjectively or objectively. Objective measurement techniques, such as the Straight Leg Raise test for low back pathology, are performed by the principal investigator to physically test for pain in the participant. Subjective measurement techniques, such as self-reported pain ratings through questionnaires including the numeric rating scale and the Oswestry Disability Index (Chiarotto et al., 2019) are most common.

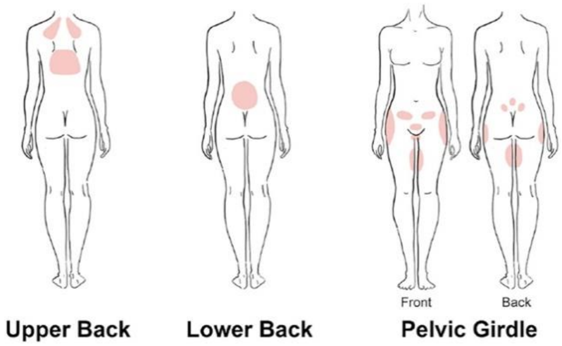

FIGURE 1: *Areas of low back pain and pelvic girdle pain (Dunn et al., 2019).*

Physical activity (PA) refers to movement initiated by muscle contractions, thereby expending energy beyond what is required in a resting state (Fletcher et al., 2018). According to the 2008 Physical Activity Guidelines for Americans, PA must include either 150 minutes of moderate intensity or 75 minutes of vigorous PA per week (Fletcher et al., 2018). PA has a multitude of health benefits for the general population, especially in cases of LBP; PA is often prescribed as a method of prevention or relief due to its analgesic, or pain relieving, effects (Hodges & Smeets, 2015). A proposed mechanism is that PA contributes to the relief of pain by releasing catecholamines, which suppress the activity of the pain response in the spinal cord, thereby improving overall motor control (Hodges & Smeets, 2015). This concept is demonstrated by a proposed U-shape relationship between LBP and PA, which shows that pain is highest at the lowest activity levels, then decreases as PA approaches a moderate level, and then increases again as PA becomes increasingly intense (Heneweer et al., 2009). This relationship reflects the concept that the recommended 150 minutes of moderate intensity PA per week may reduce LBP.

PA during pregnancy presents many of the same benefits as for the general population, including improved cardiovascular health, reduced musculoskeletal pain, and the maintenance of a healthy body weight (Melzer et al., 2010). However, many pregnant women assume a more sedentary lifestyle, with less than 38% of women meeting the American College of Obstetricians and Gynecologists PA guidelines of 20-30 minutes of moderate activity on most days per week, or a cumulative total of 150 minutes per week (Walters et al., 2021). With some precautions, PA has been found to be safe and beneficial for the mother and fetus. As previously mentioned, a change in the woman's center of gravity may result in a balance shift and increased risk of falling during activities that challenge balance. Precautions should also be taken to avoid supine positions, in which a woman is lying on her back facing up. In a supine position, the enlarged size of the uterus places increased pressure on the aorta and vena cava of the heart, potentially impeding venous return of blood to the heart and ultimately resulting in low blood pressure ("Physical Activity and Exercise During Pregnancy and the Postpartum Period: ACOG Committee Opinion, Number 804," 2020). In addition, it was found that women who are given a safe, approved exercise routine and fitness counseling experience reduced LBP and are more likely to adhere to PA guidelines than women who do not receive such guidance (Ozdemir et al., 2015). This trend suggests that a lack of education regarding the safety of exercise during pregnancy may be contributing, in part, to physical inactivity during pregnancy. For this reason, participants in this study are provided with educational materials at the conclusion of the study, with safe exercises to perform during and after pregnancy which may help with low back and pelvic girdle pain. Continued education regarding the safety of exercise during pregnancy, as well as professionals deeming certain exercises safe for the mother and fetus, may result in less hesitation to exercise and allow women to benefit from reduced pain.

PA levels typically decrease during pregnancy, and LBP and PGP increases (Ha et al., 2019; Walters et al., 2021). The nature of this relationship is unclear, so this topic requires more investigation to determine if there is a strong correlation between PA levels and pain during pregnancy. The objective of this study is to use subjective measures of pain to determine if women with higher levels of PA during pregnancy experience less pain and lower disability scores than women who are less physically active during pregnancy. If a correlation is found, there is potential to reduce future cases of LBP and PGP by educating women on the safety and importance of PA during pregnancy.

2 METHODS

STUDY DESIGN AND PARTICIPANTS

The study was an observational study conducted through the Department of Kinesiology and Health, Rutgers University, New Brunswick, New Jersey. The study was approved by the Rutgers University Institutional Review Board (PRO2021000624) and took place from November 2021 through September 2022. Participants were recruited from the New Brunswick, New Jersey area through posting fliers in women's health clinics, fitness centers, Rutgers University buildings, and on social media. Interested participants were contacted by the principal investigator and screened for eligibility over the phone. Participants were eligible if they were less than 28 weeks pregnant at the time of the screening in preparation for participation starting at 28 weeks pregnant. Participants also needed to be between the ages of 18 and 40 years, understand the study procedures, agree to adhere to the study requirements for 2 weeks, and agree to attend 3 sessions, each spaced one week apart from each other.

The exclusion criteria were: severe back pain or back surgery prior to pregnancy, a diagnosed sleep disorder, a contraindication to participating in moderate exercise (severe anemia, cardiac dysrhythmia, chronic bronchitis, uncontrolled Diabetes Mellitus, uncontrolled hypertension, heart disease, restrictive lung disease, etc.), a multiple-pregnancy in which there is more than one fetus, low body weight (BMI<18) or extreme obesity (BMI>40) prior to becoming pregnant, or pregnancy complications (premature labor, placenta previa, poor fetal growth, premature rupture of membranes, preeclampsia, uterine growth retardation, incompetent cervix, persistent vaginal bleeding, anemia, or gestational diabetes).

Forty-six participants expressed interest in this study; thirty-four participants were screened based on eligibility, twenty-five consented to participate, and one dropped out after the initial consent. Twenty-four participants were included in this analysis (see FIGURE 2 for Consort Flow Diagram). Participants had a mean age of 32.2 ± 4.1 years, and a mean pre-pregnancy BMI of 23.2 ± 6.0 (TABLE 1).

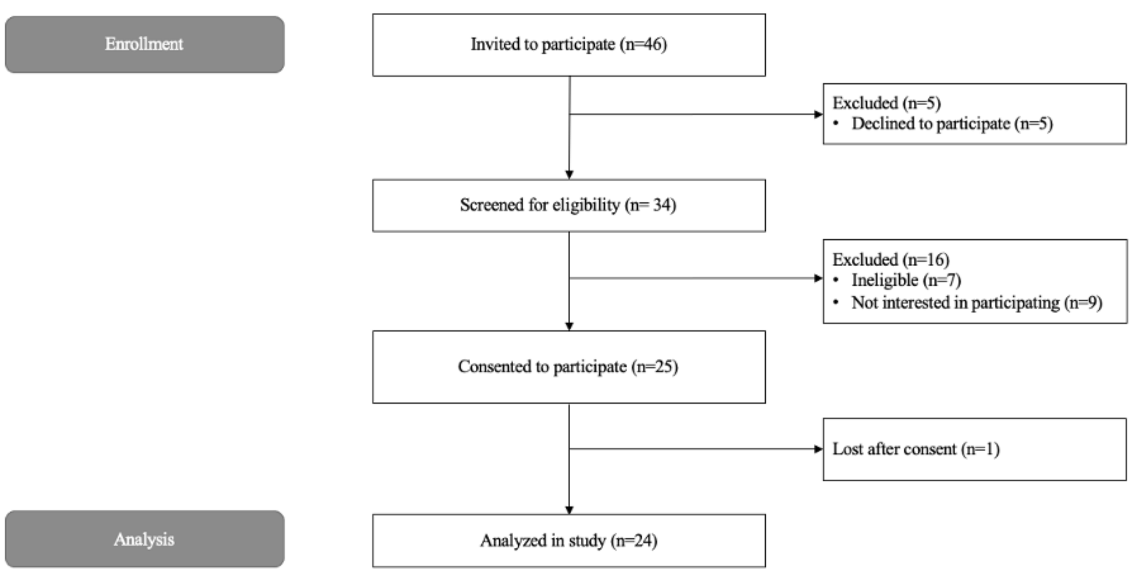

FIGURE 2: *Consort flow diagram displaying participant enrollment and exclusion.*

Variable	M±SD or f
Age (years)	31.6 ± 4.2
Pre-Pregnancy BMI (kg/m2)	24.2 ± 3.6
Parity	
Nulliparous	16
Multiparous	12
Race	
American Indian or Alaska Native	1
Black or African-American	1
Caucasian	20
Hispanic/Latinx	6
Education	
Grade 12 or GED	0
1-3 years after high school or technical school	2
4 years or more (college graduate)	11
Advanced degree	14
Prefer not to answer	1
Household Income	
<$25,000	1
$25,000-34,999	0
$35,000-49,999	0
$50,000-74,999	4
$75,000-99,999	2
$100,000-149,999	6
$150,000-199,999	8
>$200,000	2
Prefer not to answer	5
Employment	
Full time	16
Part time	3
Hourly	2
Not employed	7
Marital Status	
Married	22
Divorced	0
Widowed	0
Separated	1
Never married	1
Living with partner	2
Prefer not to answer	2

TABLE 1: *Demographic information for the 24 participants.*

Eligible participants were required to receive medical clearance prior to their first visit. Once clearance was obtained, participants were scheduled to begin between 28-32 weeks gestation. Participants underwent an informed consent process at the beginning of their first visit.

MEASURES

After consenting to participate in the study at their first visit, participants completed questionnaires regarding pain and physical activity. Pain was assessed using the Numeric Pain Scale (NPS) (Hawker et al., 2011), Oswestry Disability Index (ODI) (Fairbank & Pynsent, 2000), Pelvic Girdle Questionnaire (PGQ) (Stuge et al., 2011), and the Fear Avoidance Beliefs Questionnaire (FABQ) (Grotle et al., 2012). For NPS-best and NPS-worst, the participant was asked to state their best and worst pain levels on a scale of 0-10, with 0 being no pain and 10 being the worst pain possible. The ODI questionnaire inquired about pain intensity during various lifestyle activities with scores ranging from 0-50, higher scores reflecting more low back disability. In the PGQ, participants rated the extent to which pain interfered with their life, with 0 being no interference and 3 being considerable interference due to PGP. Their scores in various categories were summed and ranged from 0-100, with higher scores reflecting more disability. The FABQ assessed participants' perception of pain during PA by asking the extent to with they agree or disagree with 5 statements. This score summarizes the patient's fear-avoidance beliefs about PA and ranges from 0-50, with higher scores reflecting more avoidance beliefs. A follow up question inquired about pain management techniques including medication, physical therapy, chiropractic care, use of marijuana, alcohol, or other holistic measure.

Participants also completed the Pregnancy Physical Activity Questionnaire (PPAQ), in which they recorded the type, duration, and frequency of their PA over the past trimester (Papazian et al., 2020). The PPAQ provides an estimation of weekly metabolic equivalent (MET)/minutes and splits it into multiple domains including total activity, exercise activity, leisure activity, and work-related activity. METs are used to quantify the energy cost of an activity, which is calculated by taking the quotient of two values: the relative oxygen cost of a physical activity and the consumption of oxygen by the body at rest. Weekly metabolic minutes for each participant are estimated based on these domains and summed, with more metabolic minutes representing greater PA levels.

PROCEDURES

Next, the principal investigator and a licensed physical therapist conducted a physical screen. Baseline vitals (heart rate, blood pressure and oxygen saturation) and anthropometrics (height and weight) were obtained, a posture assessment was performed to check the alignment of the spine, and then a battery of pain provocative tests was conducted to obtain objective pain measures, with positive results signaling the presence of some pain or pathology and negative results signifying the absence of pathology in this area. The Straight Leg Raise Test (SLR) tests for low back pathology (Scaia et al., 2012); if positive, the Bowstring Test is performed to isolate the sciatic nerve and determine whether the nerve is contributing to the low back pathology (Berthelot et al., 2021). The Slump Test then places the participant in a flexed position to test for neuromeningeal tension, which is tension of the nerve roots of the spinal cord. If this test is positive, this suggests that LBP may be originating from pressure on the nerves and possible meningeal inflammation (Berthelot et al., 2021). Then four additional tests are performed to test for pelvic girdle pain: The Posterior Pelvic Pain Provocation Test (PPPP) (Albert et al., 2000), the Flexion Abduction External Rotation Test (FABER) (Cook et al., 2007), the Compression Test (Cook et al., 2007), and the Distraction Test (Cook et al., 2007). These tests were chosen to be performed together because they are commonly used in physical therapy due to their high validity and reliability when determining LBP and PGP. They also have the ability to differentiate between LBP and PGP, which allows for comparison between these objective results and the results of the subjective pain surveys, which inquired about each type of pain separately (Cook et al., 2007).

STATISTICAL ANALYSIS

The data was analyzed using an SPSS software. Descriptive statistics (mean and standard deviations for demographic characteristics and pain surveys and frequencies for objective pain measures [SLR Test, Slump Test, PPPP Test, FABER, Compression Test, and Distraction Test]) were conducted and are presented in TABLES 1 AND 2 and FIGURE 3. Tests of normality were conducted for all variables, and Spearman's-rho was used to assess correlations (FIGURE 4) between PA scores (PPAQ) and each subjective pain measure (NPS, ODI, PGQ, FABQ); the significance was set to $p<0.05$. A power analysis was conducted as part of the primary study to approximate a sample size of 48 participants total, and this secondary analysis was conducted at the halfway point with the first 24 participants.

3 RESULTS

The PPAQ had a mean of 750.26 ± 365.4 MET/min. The ODI had a mean score of 11.67 ± 9.04 out of a maximum score of 50 which reflects the worst pain. Using existing thresholds outlined in the ODI, seven out of the twenty-four participants were categorized as having moderate low back disability which may interfere with activities of daily living, due to their score falling between 15 and 24. The PGQ had a mean score of 16.04 ± 15.98 out of a maximum score of 100. The FABQ had a mean of score of 7.58 ± 6.52 out of a maximum score of 50 (TABLE 2).

Out of the total twenty-four participants, twenty-two participants (91.7%) had a negative SLR Test, twenty-two participants (91.7%) had a negative FABER Test, eighteen participants (75%) had a negative PPPP Test, nineteen participants (79.2%) had a negative compression test, twenty-one participants (87.5%) had a negative distraction test, and twenty-three participants (95.8%) had a negative Slump test (FIGURE 3).

The correlations between pregnancy PA scores (PPAQ) and pain and disability measures (NPS-best, NPS-worst, ODI, PGQ, and FABQ) were not significant ($p>0.05$, FIGURE 4). There was a positive trend between PPAQ and NPS-best and NPS-worst, which suggests that general pain ratings increased as PA minutes increased. There was also a positive trend between PPAQ and ODI and FABQ scores, which suggests that LBP increased as weekly PA minutes increased. There was a negative trend between PPAQ and the PGQ, suggesting that PGP decreased as weekly PA minutes increased. The direction of the trend between PA minutes and LBP scores was opposite of the direction of the trend between PA minutes and PGP; however, none of these trends were significant.

Surveys	Mean	Standard Deviation
Pregnancy Physical Activity Questionnaire	750.26	365.40
Oswestry Disability Index	11.67	9.04
Pelvic Girdle Questionnaire	16.04	6.52
Fear Avoidance Beliefs Questionnaire	7.58	6.52

TABLE 2: *Descriptive statistic for subjective surveys.*

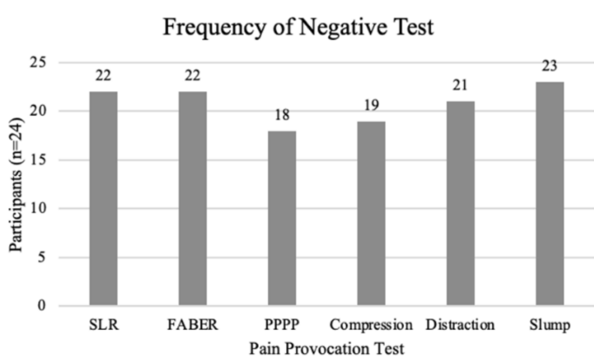

FIGURE 3: *Frequency of negative results on each objective pain provocation test.*

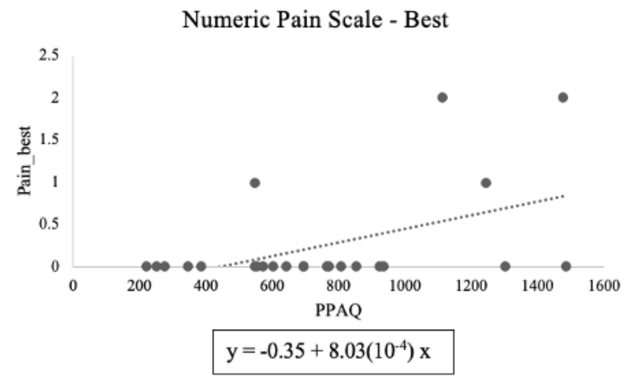

FIGURE 4A: *No correlation between NPS-Best pain and weekly physical activity minutes (r (24) = 0.343, p = 0.10).*

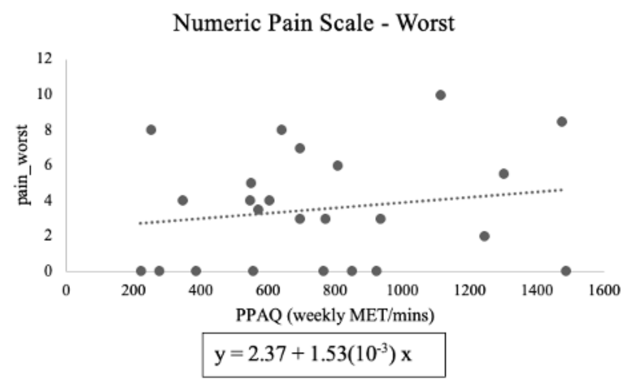

FIGURE 4B: *No correlation between NPS-Worst pain and weekly physical activity minutes (r (24) = 0.111, p= 0.6).*

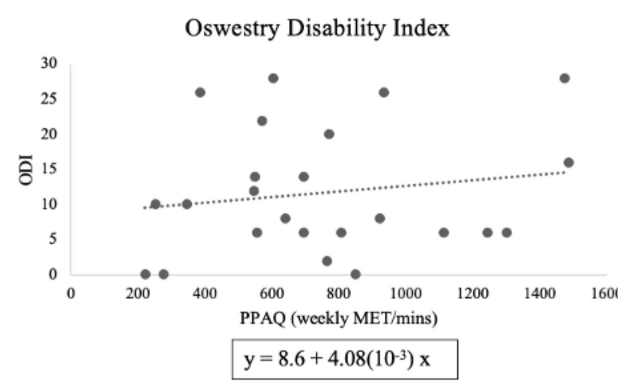

FIGURE 4C: *No correlation between ODI pain scores and weekly physical activity minutes (r (24) = 0.92, p = 0.67).*

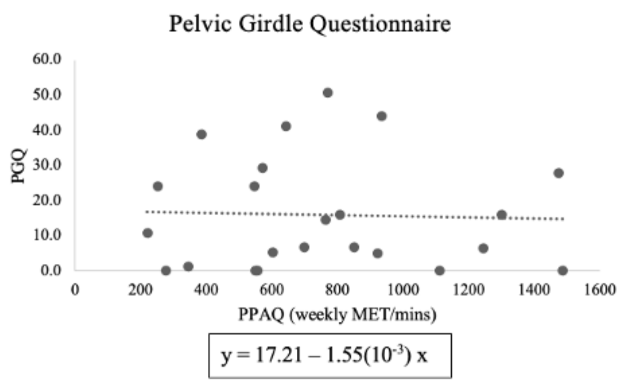

FIGURE 4D: *No correlation between ODI pain scores and weekly physical activity minutes (r (24) = 0.92, p = 0.67).*

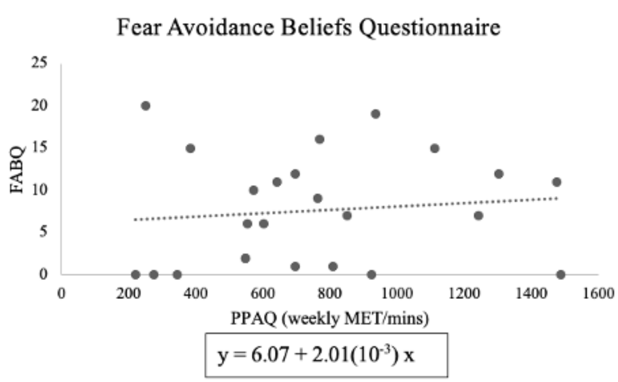

FIGURE 4E: *No correlation between FABQ scores and weekly physical activity minutes (r (24) = 0.195, p = 0.36).*

4 DISCUSSION

The objective of this study was to determine whether women with higher levels of PA experience less LBP and PGP, because such a discovery would have the potential to improve quality of life during pregnancy. However, an analysis of subjective pain levels compared to cumulative PA per week did not yield significant results.

This lack of a correlation was an unexpected result, as past studies conducted on the general population found higher levels of PA to be associated with pain relief (Hodges & Smeets, 2015). This was expected to translate to the pregnant population, since another study found that women who were given fitness counseling during pregnancy had less LBP (Ozdemir et al., 2015). The unexpected result found in this study may be due to the physical changes that occur during pregnancy that differ from the general population. Pregnancy causes a forward shift in a woman's center of gravity, resulting in altered posture (Kawabe et al., 2022). Women who scored higher on the PPAQ likely spend more time on their feet throughout the day, and this altered posture may put additional pressure on their low back, resulting in pain (Kawabe et al., 2022). This reasoning is consistent with the positive trendlines seen in FIGURES 3 A, B, C, AND E, which demonstrated that subjective pain scores increased as PPAQ scores increased.

This study also included a battery of objective pain assessments which were analyzed in conjunction with the subjective pain reports from the five questionnaires. One study investigating PGP specifically found that subjective reports of LPB and PGP lack diagnostic value, since women may be unable to distinguish between LBP and PGP (Ando & Ohashi, 2009). The PPPP test can make this distinction, which emphasizes the value of using the results of objective pain provocation tests when interpreting subjective pain reports. As shown in FIGURE 3, there was a high frequency of negative results on each objective pain test, despite patients reporting pain subjectively. The fact that participants reported pain but did not physically test positive for pain is consistent with the fact that subjective reports have limited diagnostic value, and this may have contributed to the lack of a correlation found in this statistical analysis. This discrepancy between subjective reports and objective tests may also be due to the time of day at which pain provocation tests were performed. It has been found that pregnant women experience higher levels of pain towards the evening compared to the morning (Eggen et al.). When women complete subjective surveys, this high level of pain may be what they report. However, since most objective testing took place in the morning or afternoon when women tend to experience less pain, the pain provocation tests may have failed to reflect pain that exists in the evening, contributing to the unexpected result of this study.

A strength of this study was the use of both objective and subjective measures to score LBP and PGP. This study used a variety of subjective pain tests, one specifically focusing on overall pain at its best and worst, one focusing on LBP, one focusing on PGP, and one focusing on fear and avoidance behaviors due to pain. This range of pain questionnaires gave a comprehensive view of subjective pain reports. The data from the objective pain tests was collected to be analyzed later as a component of the primary study, so it was not included in the statistical analysis of this secondary study. However, the raw data from these objective tests gave additional context and aided in the interpretation of the results of this analysis.

A limitation of this study was its subjective collection of cumulative PA data, rather than objective isolation of structured exercise. The study was designed this way to accommodate participants with physically active occupations such as a nursing. Since these women get most of their PA at work rather than through designated exercise, only inquiring about structured exercise minutes would not have properly reflected their activity levels. However, women who perform designated exercise with the goal of improving muscular fitness may strengthen the musculature in the back, therefore creating a better support structure to combat the natural postural changes during pregnancy. Therefore, structured exercise may be an important measure to include. Women with such varying training statuses are also likely to have varying perceptions of pain, which is another factor which may have contributed to these unexpected results. In addition, this analysis was a secondary analysis, stemming from a study comparing active women who meet the American College of Obstetricians and Gynecologists' guideline of 150 minutes/week of PA to sedentary women who engage in less than 90 minutes/week of PA. Women who reported weekly PA minutes between 90 and 150 were not included, since they did not fall within either group. Therefore, this analysis did not have a continuous sample, which is a limitation of the study. Finally, this analysis was conducted at the halfway point of the main study. The final sample will include approximately 48 participants, which may show a more accurate representation of relationships between PA and LBP/PGP.

5 CONCLUSION

The aim of this study was to identify a correlation between PA levels and LBP/PGP during pregnancy. However, this secondary analysis was not able to identify a significant correlation between these factors. Future studies should focus on structured exercise, rather than cumulative PA. The term PA refers to movement due to the contraction of skeletal muscles, which requires expenditure of energy above what is required at rest (Fletcher et al., 2018). The term exercise differs, as it refers to a planned sequence of activities with the primary goal of improving cardiorespiratory and muscular fitness (Fletcher et al., 2018). Future studies should emphasize this distinction and look for a correlation between time spent performing structured exercise and LBP/PGP during pregnancy. It may be found that women who exercise with the aim of improving muscle strength and endurance may experience more pain relief, and if so, women may be encouraged to perform more structured exercise regardless of their general physical activity status. Additionally, future studies should look to find significance behind the trends identified in this paper, such as the positive trend between PA and LBP, and the negative trend between PA and PGP. This paper determined that variations in pain throughout the day may have caused a discrepancy between objective pain and subjective pain reports, so future studies should control for the time of day for more accurate results. Additional research regarding this topic has the potential to provide women with supported ways to reduce their experience of chronic pain during pregnancy and improve their quality of life during this time■

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