The effect of daily walking during pregnancy on neuromuscular pain in the third trimester

Efecto de la caminata diaria durante el embarazo sobre el dolor neuromuscular en el tercer trimestre

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How to cite in APA

Bobadilla-Agouborde, C., Soto-Rodríguez, F. J., Benito-Villena, R., Mozas-Moreno, J., Ribeiro Santos, P. C., & Amezcua-Prieto, C. (2025). The effect of daily walking during pregnancy on neuromuscular pain in the third trimester. *Retos*, *67*, 150–161. https://doi.org/10.47197/retos.v67.110153

Abstract

Objective: To describe the frequency of neuromusculoskeletal pain across each trimester of pregnancy and assess the impact of daily walking from the second trimester on the incidence, prevalence, and daily life impact of such pain in the third trimester.
Methods: A total of 192 pregnant women wearing pedometers from the beginning of the second trimester were analyzed. Daily walking activity, the frequency of back pain, pelvic girdle pain, and sciatic pain, as well as their impact on daily life, were measured. Women were categorized as physically active or inactive based on a threshold of 7000 steps/day.
Results: Back pain was the most commonly reported condition and had the greatest impact on daily life. No significant association was found between walking ≥7000 steps/day from the second trimester and the incidence or prevalence of pelvic girdle or sciatic pain in the third trimester. Additionally, no significant association was found with back pain prevalence, though the analysis suggested a possible trend in this direction.
Conclusions: Walking ≥7000 steps/day from the second trimester was not significantly associated with musculoskeletal pain outcomes in the third trimester. While physical activity is essential for overall health, further research is needed to determine how different walking patterns and intensities may contribute to musculoskeletal pain prevention and management during pregnancy.

Keywords

Back pain; pelvic girdle pain; physical activity; pregnancy; neuromusculoskeletal pain; sciatic pain; walking

Resumen

Objetivo: Describir la frecuencia del dolor neuromusculoesquelético en cada trimestre del embarazo y evaluar el impacto de caminar diariamente a partir del segundo trimestre en la incidencia, prevalencia e impacto en la vida diaria de dicho dolor en el tercer trimestre.
Métodos: Se analizaron 192 mujeres embarazadas que llevaban podómetros desde el inicio del segundo trimestre. Se midieron la actividad diaria de caminar, la frecuencia del dolor de espalda, dolor de cintura pélvica y dolor ciático, así como su impacto en la vida diaria. Las mujeres se clasificaron como físicamente activas o inactivas según un umbral de 7000 pasos/día.
Resultados: El dolor de espalda fue la afección notificada con mayor frecuencia y tuvo el mayor impacto en la vida diaria. No se encontró una asociación significativa entre caminar ≥7000 pasos/día a partir del segundo trimestre y la incidencia o prevalencia de dolor de cintura pélvica o ciático en el tercer trimestre. Además, no se encontró una asociación significativa con la prevalencia del dolor de espalda, aunque el análisis sugirió una posible tendencia en esta dirección.
Conclusiones: Caminar ≥7000 pasos/día a partir del segundo trimestre no se asoció significativamente con resultados de dolor musculoesquelético en el tercer trimestre. Si bien la actividad física es esencial para la salud general, se necesitan más investigaciones para determinar cómo los diferentes patrones e intensidades de caminata pueden contribuir a la prevención y el manejo del dolor musculoesquelético durante el embarazo.

Palabras clave

Dolor de espalda; dolor pélvico; actividad física; embarazo; dolor neuromusculoesquelético; dolor ciático; caminar

Introduction

During pregnancy, anatomical and physiological changes require continuous adaptations of the musculoskeletal system. From a biomechanical perspective, uterine and fetal growth lead to increased body weight and an anterior shift of the center of gravity, altering postural alignment (Bresolin et al., 2024). Hormonally, elevated progesterone and relaxin levels contribute to increased joint laxity and fluid retention (Fiat et al., 2022; Kesikburun et al., 2018). These physiological adaptations may lead to atypical postural patterns and altered morphofunctional conditions, potentially increasing the risk of neuromusculoskeletal pain. (Quesada Salazar, 2021). Neuromusculoskeletal pain refers to acute or chronic pain affecting bones, muscles, ligaments, tendons, or nerves (El-Tallawy et al., 2021). This type of pain can arise from cumulative stress due to repetitive trauma, from a single exertion exceeding tissue physiological limits (Mueller & Maluf, 2002), or from sedentary behavior (Dzakpasu et al., 2021). It is frequently linked to movement restrictions, loss of strength, and impaired physical function, significantly impacting daily activities (Hodges & Tucker, 2011; Mueller & Maluf, 2002).

The most common neuromusculoskeletal pain during pregnancy mainly affects the lumbopelvic region. In a study in which 255 participants were consulted, 91% reported having experienced this type of pain during their current pregnancy (Al-Sayegh et al., 2012). Similarly, another study involving 184 women between 37 and 42 weeks of pregnancy identified lower back pain (70.7%) and back pain (43.5%) as the most prevalent musculoskeletal complaints during pregnancy (Kesikburun et al., 2018). Although pelvic girdle pain is less common, it is also relevant, as evidence suggests that it significantly affects quality of life during pregnancy, postpartum, and even in subsequent pregnancies (Sward et al., 2023). It has been reported that women may experience other types of pain during pregnancy, along with associated consequences. In this regard, Hall et al. (Hall et al., 2016) found that 22.1% of pregnant women suffer from sciatic pain, with 79.3% seeking help for their condition. Additionally, several studies have shown that neuromusculoskeletal pain negatively impacts quality of life, a repercussion that can persist even a year after childbirth (Davenport et al., 2019; Igwesi-Chidobe et al., 2021). On the other hand, better overall physical fitness and cardiorespiratory fitness during pregnancy have been associated with lower levels of general body pain, lower back pain, and sciatic pain, as well as reduced pain-related disability, suggesting a potential protective role (American College of Obstetricians and Gynecologists, 2020; Marín-Jiménez et al., 2019).

Physical activity has well-documented positive effects on the health and well-being of pregnant women, promoting lifestyle changes that lead to long-term benefits (Dipietro et al., 2019; Mottola et al., 2018; Nascimento et al., 2012). Beyond its general health benefits, engaging in physical activity during pregnancy has been shown to play a relevant role in reducing the intensity of musculoskeletal pain. In this regard, various forms of exercise, including Pilates, aerobic training, strength exercises, and yoga, have demonstrated significant benefits in reducing discomfort and pain, as well as improving functional capacity. (Kinser et al., 2017; Sánchez-Polán et al., 2023). Generally, all women without contraindications are recommended to engage in regular physical activity during pregnancy and postpartum, equivalent to a minimum of 150 minutes of moderate-intensity aerobic activity per week (Bull et al., 2020). Thus, receiving physical activity recommendations has led 40.5% of women to choose to remain active during pregnancy (Rial-Vázquez et al., 2023). However, despite these recommendations, most pregnant women opt not to exercise, thus reducing their physical activity levels, including household and occupational activities (Nascimento et al., 2015). Reasons for this reduction in physical activity among women include discomfort during exercise, fear of harming the fetus, and history of miscarriages or infertility treatments. Furthermore, sociodemographic factors such as a lower level of education, lower income, and a greater number of children contribute to this decrease in physical activity (Nascimento et al., 2015).

Physical activity can either be classified as structured or incidental. Structured physical activity or exercise is planned, purposeful activity undertaken to promote health and fitness benefits (Strath et al., 2013). Incidental physical activity is not planned and usually is the result of daily activities at work, at home, or during transport (Strath et al., 2013). Daily walking is classified as an incidental physical activity and has been reported as the physical activity most frequently practiced during pregnancy (up to 82.2% of pregnant women) (Nascimento et al., 2015). Along these lines, it has been estimated that 150 minutes/week of moderate-intensity aerobic physical activity equals walking 7000-8000 steps/day (Tudor-Locke et al., 2011).

Despite the well-documented benefits of physical activity in managing neuromusculoskeletal pain during pregnancy, to our knowledge, no study has yet examined the association between walking—as a form of daily incidental physical activity—and the presence of neuromusculoskeletal pain. Therefore, this study aims to (i) describe the frequency of neuromusculoskeletal pain across each trimester of pregnancy, and (ii) assess the impact of daily walking, beginning in the second trimester (T2), on the incidence, prevalence, and impact on daily life of neuromusculoskeletal pain during the third trimester (T3).

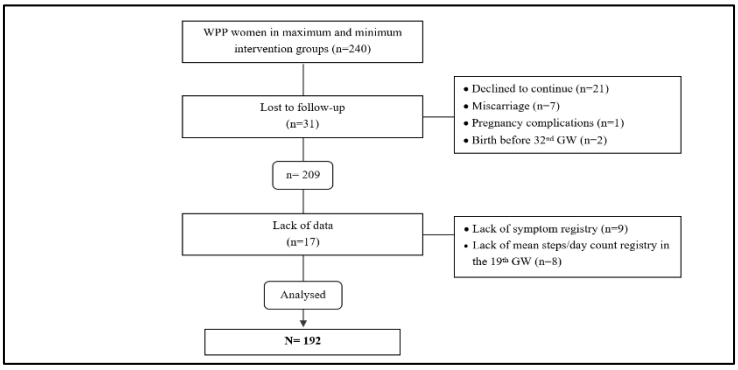
Method

Study Desing

A secondary analysis was performed using data from pregnant women participating in the Walking_Preg Project (WPP) study. Data were utilized from women who used pedometers and were part of the intervention groups of the study. Since the women in the WPP control group did not use pedometers, it was not possible to include their data in the analysis. The full study protocol of this randomized controlled trial (RCT) was previously published (Amezcua-Prieto et al., 2020) and summarizes essential methodological information.

Women were recruited during their first ultrasound, performed in the 12th gestational week (GW), at the Maternal and Child unit of the Virgen de las Nieves University Hospital in Granada, Spain. Considering that the analysis was only conducted on participants who wore a pedometer in the main study, 240 women from the total sample of the WPP study were selected for potential inclusion in the current study. However, due to pregnancy complications or incomplete data on symptom registry or daily steps, a total sample of 192 pregnant women was analyzed (Figure 1).

Figure 1. Flow chart



The recruitment period was carried out from June 2019 to December 2020, and the follow-up period continued until December 2021. During the medical check-up at 12 GW, women were informed about the study. Those who expressed their intention to participate were scheduled for further consultation with a member of the hospital's research team.

Participants

The participants included in this study were pregnant women aged 18 to 49 years, with low-risk pregnancies, treated in the Gynecology and Obstetrics Unit of the hospital. They were physically inactive (<5 days/week of moderate-to-vigorous physical activity, at least 30 minutes; equivalent to <7000 steps/day), had access to a mobile phone and email, and had no intellectual deficits or difficulties understanding the language. All participants were asked to sign the informed consent and pedometer loan form.

Procedure

Participants were followed up through three interviews conducted at 12, 20, and 32 GW, during which they were asked about the frequency of neuromusculoskeletal pain in the back and pelvic girdle, sciatic pain, and the impact of these symptoms on daily life over the past month using the Pregnancy Symptom Inventory questionnaire (Foxcroft et al., 2013). This questionnaire has been adapted and validated for

use with Spanish-speaking pregnant women (Oviedo-Caro et al., 2017). The Spanish version demonstrated good psychometric properties, with test-retest reliability showing Kappa coefficients ranging from 0.576 to 0.869 ($p<0.001$) and Pearson's correlation coefficients ranging from 0.619 to 0.943 ($p<0.001$), indicating strong consistency and agreement. During the interviews at 20 and 32 GW (T2 and T3, respectively), the average steps per day in the week prior to the interview were recorded using a Xiaomi® Mi Band 2 pedometer.

Outcome variables

- Daily walking: average of steps/day in the week prior to the interview, measured through the pedometer. This variable was collected at 20 and 32 GW.
- Frequency of the presence of neuromusculoskeletal pain: The types of neuromusculoskeletal pain evaluated were back pain, pelvic girdle pain, and sciatic pain. The frequency of them was recorded using a Likert scale from 0 to 3 (0=never; 1=rarely; 2=sometimes; 3=often). Pain was considered present if women responded 'sometimes' or 'often.' This variable was obtained from the Pregnancy Symptom Inventory questionnaire.
- Prevalence of neuromuscular pain: Reported as the percentage of neuromusculoskeletal pain in each body region studied for each trimester. Prevalence was calculated as the number of women suffering from neuromusculoskeletal pain in a given segment divided by the total sample size and multiplied by 100.
- Incidence of neuromusculoskeletal pain: It was calculated for each form of neuromusculoskeletal pain and for each trimester of pregnancy as follows:
- Incidence in T2 (T2 - first trimester (T1)): cases of neuromusculoskeletal pain at 20 GW that were not present at 12 GW / (total sample size) x 100.
- Incidence in T3 (T3 - T2): cases of neuromusculoskeletal pain at 32 GW that were not present at 20 GW / (total sample size) x 100.
- Global incidence (T3 - T1): cases of neuromusculoskeletal pain at 32 GW that were not present at 12 GW / (total sample size) x 100.
- Impact of neuromusculoskeletal pain on daily life in each trimester: Recorded using a Likert scale from 0 to 2 (0 = not limited at all; 1 = limited a little; 2 = limited a lot). A negative impact of pain on daily life was considered when women responded 'limited a lot'. This variable was obtained from the Pregnancy Symptom Inventory questionnaire.

Data analysis

Data analysis was performed using IBM® SPSS® Statistics 28. Central tendency and dispersion measurements were calculated for the continuous quantitative variables. For qualitative variables, absolute and relative frequencies were determined. The normality of the studied variables was assessed using histograms and Q-Q plots, as well as statistically with a Kolmogorov-Smirnov test. The use of this test allowed for the verification of assumptions required for the application of parametric tests, such as the t-test.

For statistical hypothesis testing, an α error of 5% and a 95% confidence interval were considered. Frequencies were calculated to determine the baseline characteristics of the participants, the prevalence and incidence of neuromusculoskeletal pain, as well as its impact on daily life. t-tests and chi-squared tests were utilized to compare the baseline characteristics of participants who walked fewer than 7000 steps/day and those who walked 7000 or more.

The prevalence and daily-life impact of neuromusculoskeletal pain were calculated for each trimester of pregnancy. The prevalence of pain (T3 vs T2; T2 vs T1) and daily-life impact (T3 vs T1) were compared using McNemar's test. This test was selected because the data consists of paired observations from the same group of individuals at different time points.

The incidence of pain in T2 during pregnancy corresponds to the appearance of new cases in T2 that did not present pain in T1 (T2-T1). For T3, two incidences were calculated: one corresponding to the appearance of new cases in T3 that did not present pain in T2 (T3-T2), and another corresponding to the

overall incidence, which is the appearance of new cases in T3 that did not present pain in T1 (T3-T1). The incidences of pain at T3 compared to T2 were analysed using McNemar's test.

A binomial logistic regression model adjusted for age, body mass index (BMI) before pregnancy, previous pregnancies, social class, and tobacco use in the second trimester of pregnancy was used to measure the association between walking ≥7000 steps/day (daily walking) and neuromusculoskeletal pain. The use of this test is based on its ability to explore the association between variables with binary categorical characteristics, allowing for the assessment of the likelihood of a particular outcome (pain presence or absence) based on predictor variables.

Participants with incomplete data in the main variables were excluded from the analysis, considering that their distribution is random.

Results

Characteristics of the sample

The baseline characteristics of the participants are described in Table 1. The mean age was 31 years, 50% of the women were nulliparous, and 11% were smokers. The pre-pregnancy mean BMI was 26.26 kg/m^2 (SD 5.64 kg/m^2). According to BMI classification, 51.6% of the women had a healthy weight, 1.6% were underweight, 24.5% were overweight, and 22.4% had obesity. No statistically significant differences were found in the baseline characteristics between women who walked <7000 steps/day and those who walked ≥7000 steps/day in T2.

Table 1. Characteristics of the participants

	Total n=192	<7000 steps/day in the second trimester n=126	≥7000 steps/day in the second trimester n=66	p value[1]
Mean steps/day in the second trimester; Mean (SD)	6.017 (3.441)	4.188 (1.561)	9.510 (3.351)	<0.001
Age; Mean (SD)	31.88 (4.64)	31.48 (4.79)	32.65 (4.28)	0.099
Pre-pregnancy BMI; Mean (SD)	26.26 (5.64)	26.7 (6.19)	25.2 (4.27)	0.071
Pre-pregnancy BMI; n (%)				0.175
≤18.4 (underweight)	3 (1.6)	3 (2.4)	-	
18.5-24.9 (healthy weight)	99 (51.6)	61 (48.4)	38 (57.6)	
25-29.9 (overweight)	47 (24.5)	29 (23.0)	18 (27.3)	
≥30 (obesity)	43 (22.4)	33 (26.2)	10 (15.2)	
Previous children; n (%)				0.098
0 (nulliparity)	96 (50)	58 (46.0)	38 (57.6)	
1	69 (35.9)	47 (37.3)	22 (33.3)	
≥2 (multiparity)	27 (14.0)	21 (16.7)	6 (9.1)	
Social class; n (%)				0.476
I (the higest)	31 (16.1)	17 (13.5)	14 (21.2)	
II	28 (14.6)	17 (13.5)	11 (16.7)	
III	40 (20.8)	28 (22.2)	12 (18.2)	
IV	70 (36.5)	50 (39.7)	20 (30.3)	
V (the lowest)	23 (12.0)	14 (11.1)	9 (13.6)	
Smokers; n (%)	21 (11.0)	15 (11.9)	6 (9.1)	0.526

SD: standard deviation; BMI: Body Mass Index; p value[1]: T-test for continuous quantitative variables and Chi square for discrete quantitative variables.

Prevalence of neuromusculoskeletal pain and its daily life impact

As shown in Table 2, the prevalence of neuromusculoskeletal pain increased across all trimesters for the back and pelvic girdle regions. In the sciatic region, a significant increase was observed only during the first two trimesters.

Back pain was the most prevalent form of neuromusculoskeletal pain in each trimester (T1= 38.0%, T2= 51.0%, and T3= 60.9%), and it had the greatest impact on daily life (T1= 4.7%, T2= 13.0%, and T3= 19.3%). Neuromusculoskeletal pain consistently demonstrated a significant impact on daily life across all studied regions.

Table 2. Prevalence of neuromusculoskeletal pain in each trimester of pregnancy and its daily life impact

	T1		T2		T3				
Pain	Prevalence	DLI	Prevalence	DLI	Prevalence	DLI	p value[1]	p value[2]	p value[3]
Back; n (%)	73 (38.0)	9 (4.7)	98 (51.0)	25 (13.0)	117 (60.9)	37 (19.3)	0.003	0.023	<0.001
Girdle; n (%)	34 (17.7)	6 (3.1)	60 (31.3)	15 (7.8)	89 (46.4)	25 (13.0)	<0.001	0.001	0.001
Sciatic; n (%)	28 (14.6)	2 (1.0)	60 (31.3)	21 (10.9)	77 (40.1)	25 (13.0)	<0.001	0.053	<0.001

T1: first trimester of pregnancy; T2: second trimester of pregnancy; T3: third trimester of pregnancy; DLI: Daily life Impact; p value1 (Prevalence T2 vs T1): McNemar's test; p value2 (Prevalence T3 vs T2): McNemar's test; p value3 (daily life impact in T3 vs T1): McNemar's test.

Incidence of neuromusculoskeletal pain

The incidence of back pain (45.4%), pelvic girdle pain (44.2%), and sciatic pain (43.2%) throughout pregnancy was similar. Specifically, 24% of pregnant women reported the onset of back pain in T2, and 26% experienced new cases of pelvic girdle pain in T3 (Table 3). No statistically significant differences were found in the incidence of these pain forms between the second and third trimesters of pregnancy.

Table 3. Incidence of neuromusculoskeletal pain

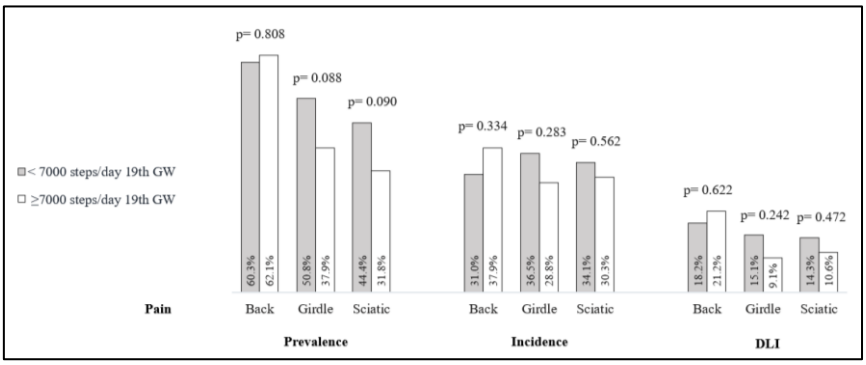
	Global	T2	T3	
Pain	Incidence T3-T1	Incidence T2-T1	Incidence T3-T2	p value[1]
Back; n (%)	87 (45.4)	46 (24.0)	41 (21.4)	0.668
Girdle; n (%)	85 (44.2)	35 (18.2)	50 (26.0)	0.128
Sciatic; n (%)	83 (43.2)	40 (20.8)	43 (22.4)	0.826

T1: first trimester of pregnancy; T2: second trimester of pregnancy; T3: third trimester of pregnancy; p value1 (incidence in T3 vs T2): McNemar's test.

Prevalence and incidence of neuromusculoskeletal pain in T2, according daily walking, and its impact on daily life

At T3, there were no significant differences in the prevalence, incidence, or impact on daily activities of neuromusculoskeletal pain between pregnant women who walked <7000 steps/day and those who walked ≥7000 steps/day (p>0.05) at the 19th GW. Back pain was consistently the most frequently reported and had the greatest impact on daily life for both groups. Among women who walked <7000 steps/day, 50.8% experienced pelvic girdle pain, compared to 37.9% in the ≥7000 steps/day group (p=0.08). Sciatic pain was reported by 44.4% of women who walked <7000 steps/day and by 31.8% of those who walked ≥7000 steps/day (p=0.09) (Figure 2).

Figure 2. Prevalence and incidence of neuromusculoskeletal pain and its impact in daily life in T3 according to 19th GW walking activity (<7000 or ≥7000 steps/day)



Prevalence (T3): Total cases with neuromusculoskeletal pain in the third trimester of pregnancy; Incidence (T3-T1): Appearance of new cases that did not have neuromusculoskeletal pain in T1 but presented neuromusculoskeletal pain in T3; DLI (T3): daily life impact in the T3 of pregnancy; p value: Chi square for categorical variables.
GW: Gestational Week.

Impact of daily walking starting from the T2 of pregnancy on the incidence and prevalence of neuromusculoskeletal pain during T3

No association was found between walking ≥7000 steps/day in T2 and the incidence or prevalence of pelvic girdle pain (aOR incidence= 0.88, 95% CI 0.42–1.82; aOR prevalence= 1.41, 95% CI 0.73–2.73) or sciatic pain (aOR incidence= 0.93, 95% CI 0.43–1.98; aOR prevalence= 1.50, 95% CI 0.77–2.91). A trend

was observed suggesting that greater daily walking was associated with a lower prevalence of back pain in the third trimester (aOR= 0.47; 95% CI 0.22–1.02) but was not associated with less back pain incidence (aOR= 0,78; 95% CI 0,40–1,52) (Table 4).

Table 4. Impact of daily walking starting from the T2 of pregnancy on the incidence and prevalence of neuromusculoskeletal pain during T3

	Pain in T3	Back		Girdle		Sciatic	
Mean steps/day at 19th GW		cOR (CI 95%)	aOR[1] (CI 95%)	cOR (CI 95%)	aOR[1] (CI 95%)	cOR (CI 95%)	aOR[1] (CI 95%)
<7000 steps/day		1	Reference	1	Reference	1	Reference
≥7000 steps/day	Prevalence	1.07 (0.58 -1.99)	0.78 (0.40 –1.52)	0.59 (0.32 –1.08)	1.41 (0.73 –2.73)	0.58 (0.31 –1.09)	1.50 (0.77 –2.91)
	Incidence	1.67 (0.82 –3.40)	0.47 (0.22 –1.02)	0.97 (0.49 –1.92)	0.88 (0.42 –1.82)	1.02 (0.50 –2.09)	0.93 (0.43 –1.98)

T3: third trimester of pregnancy; cOR: crude Odds ratio; aOR1: adjusted Odds ratio, logistic regression analysis, estimates adjusted for age, parity, social class, smoking and BMI.

Discussion

The main findings of this study indicate that the prevalence of back pain, pelvic girdle pain, and sciatic pain significantly increases during pregnancy, whereas no significant differences were observed in incidence across trimesters. Back pain was the most frequently reported neuromusculoskeletal condition and had a significant impact on daily life, particularly in T3. Furthermore, walking ≥7000 steps/day from T2 of pregnancy was not significantly associated with a reduction in the incidence of back pain in T3.

The findings of this research are largely consistent with previous literature. For instance, a study by Gjestland et al. (2013) reported a prevalence of low back pain of 52.1% and pelvic girdle pain of 51.7% in the third trimester, aligning with our results. They also found that engaging in structured physical activity (exercise) 1 to 2 days per week in mid-pregnancy was associated with a lower prevalence of low back pain (aOR= 0.80, 95% CI 0.66–0.97). Moreover, a greater frequency of structured physical activity (≥3 times per week) was linked to a lower prevalence of pelvic girdle pain (aOR= 0.76, 95% CI 0.61–0.96) (Gjestland et al., 2013). Despite this, our study did not find a significant association between walking ≥7000 steps/day and back pain. Nonetheless, the statistical analysis suggests a trend towards this association (aOR = 0.47, 95% CI 0.22–1.02). This could be explained by the fact that walking, as an incidental physical activity, lacks the structure and control inherent to prescribed exercise programs. Unlike structured physical activity, which allows for better regulation of frequency, intensity, duration, and progression (Piercy et al., 2018), daily walking is self-paced and varies among individuals. This variability may limit its potential to produce consistent benefits in managing neuromusculoskeletal pain (Bassett et al., 2017). Furthermore, incidental walking may not consistently provide the mechanical stimulus needed to elicit significant musculoskeletal adaptations, as its intensity and progression are not systematically regulated. In line with this, a recent meta-analysis reported that engaging in physical activity during pregnancy at low and moderate intensities can be effective in reducing pain intensity (Sánchez-Polán et al., 2023). Additionally, another meta-analysis of RCTs found that structured physical activity could reduce low back pain during pregnancy by 9%, though it may not have the same effect on pelvic girdle pain (Shiri et al., 2018).

Although walking may have some influence on low back pain, its effects may differ depending on the type and origin of musculoskeletal pain. In this regard, we found no association between walking and sciatic pain, which could be explained by physiological factors. This type of pain is often related to nerve root compression (Takahashi et al., 2003; Vroomen et al., 2000), mechanical irritation (Park et al., 2020), and venous congestion (Berthelot et al., 2022). Moreover, it has been suggested that moderate to vigorous physical activity may have a protective effect against this type of pain (Shiri et al., 2016), possibly due to its influence on muscle function, lumbopelvic stability, and vascular dynamics. However, since the walking assessed in this study was incidental, its pace, intensity, and duration were not regulated. These characteristics may have limited its impact on the underlying mechanisms of sciatic pain, reducing its ability to induce adaptive changes that improve the biomechanical and physiological conditions contributing to this type of pain (Mueller & Maluf, 2002).

The increase in low back and pelvic girdle pain during pregnancy found in this study could be attributed to joint and ligament laxity caused by elevated levels of estrogen and progesterone. These hormonal changes, together with weight gain, can cause anatomical alterations such as separation of the pelvic joint, increased compensatory lumbar lordosis, and relaxation of the anterior abdominal muscles (Ceprnja et al., 2021; Weis et al., 2018). Such changes, combined with alterations in the center of gravity,

can exert stresses that exceed the physiological limits of the joints, increasing tension, for example of the paraspinal muscles, resulting in low back pain (Igwesi-Chidobe et al., 2021).

In our study, we observed that back pain negatively impacts daily activities as pregnancy advances. These findings are consistent with those from other studies, which indicate that lower back pain is one of the most frequently reported symptoms with a significant impact on daily life, affecting 13.8% to 58.9% of pregnant women and ranking behind other pregnancy symptoms such as urinary tract manifestations and poor sleep quality (Marín-Jiménez et al., 2021; Özyürek & Özgül, 2021).

The daily life repercussions stemming from neuromusculoskeletal pain can directly affect the quality of life of pregnant women in all its dimensions. Various studies suggest that musculoskeletal pain negatively impacts quality of life (Baskan et al., 2016; Husky et al., 2018; Machino et al., 2021; Rodríguez-Romero et al., 2014), and many authors find it reasonable to assume that this association may also be present in pregnant women (Davenport et al., 2019; Husky et al., 2018; Igwesi-Chidobe et al., 2021; Oviedo-Caro et al., 2021; Rivera Díaz & Lopera Rivera, 2012). It has been demonstrated that the presence of low back pain during pregnancy is the primary factor explaining the negative change in the physical component of quality of life (Oviedo-Caro et al., 2021).

Despite the popular notion that walking more than 10000 steps per day is associated with better health, the origin of this goal remains unclear. It likely derives from the trade name of a pedometer sold in 1965 by the Yamasa Clock and Instrument Company in Japan, called Manpo-kei, which translates to "10000 steps meter" (Lee et al., 2012). For our study, we chose the threshold of 7000 steps/day based on Tudor-Locke's estimation, which equates to 150 minutes of moderate-intensity aerobic physical activity (Tudor-Locke et al., 2011).

This study has several limitations that should be acknowledged. First, as a secondary analysis derived from the original WPP randomized controlled trial (n=270), participant selection was restricted to those who wore pedometers, corresponding to women randomly assigned to intervention groups 1 and 2 (n=240), thus excluding the control group (n=30). Additionally, 20% (n=48) of these participants were excluded due to pregnancy-related issues and lack of data recording during interviews. This loss to follow-up may have reduced the statistical power to analyze the association between walking and back pain, pelvic girdle pain, and sciatica.

Second, although the original study followed an experimental design, this analysis adopts an observational approach. As a result, it is not possible to establish causal inferences regarding the relationship between step count and musculoskeletal pain. Additionally, only participants with complete data were included in the analysis, which may have introduced selection bias and affected the generalizability of the findings.

Another important limitation concerns the assessment of physical activity. While step count was objectively measured using a pedometer, this method does not provide information on walking intensity, duration in sustained bouts, or specific biomechanical characteristics. These factors may influence the relationship between physical activity and musculoskeletal pain, as they determine the mechanical load and physiological adaptations associated with walking (Bassett et al., 2017). However, step count remains a useful parameter for classifying women as physically active or inactive (Tudor-Locke et al., 2011).

Despite these limitations, this study has certain strengths. The use of pedometers for the objective measurement of step count (Corder et al., 2007) ensures accuracy in tracking daily walking patterns. Specifically, the Xiaomi Mi Band 2, recognized for its reliability in step measurement (Pino-Ortega et al., 2021; Xie et al., 2018), provided a cost-effective and accessible method for monitoring physical activity throughout the day. In addition to its accuracy, the affordability of this device makes it a practical tool for encouraging higher levels of physical activity among pregnant women (El-Amrawy & Nounou, 2015).

Conclusions

In this study, walking ≥7000 steps/day from the second trimester of pregnancy was not significantly associated with a reduced prevalence of back pain in the third trimester, although the analysis suggested

a possible trend in this direction. However, no association was observed with the prevalence or incidence of pelvic girdle pain or sciatic pain. These findings highlight the complexity of the relationship between physical activity and musculoskeletal pain during pregnancy and suggest that factors such as walking intensity, duration, and biomechanical characteristics may play a role.

Health promotion strategies should continue to emphasize the importance of physical activity throughout a woman's life cycle, with particular attention during pregnancy. Future research should further explore how different patterns and intensities of physical activity may contribute to the prevention and management of musculoskeletal pain in this population.

Acknowledgements

This work is part of the doctoral thesis project of the first author entitled "Efecto de la actividad física durante el embarazo en el dolor neuromusculoesquelético y en los resultados obstétricos y perinatales", conducted within the Doctoral Program in Clinical Medicine and Public Health at the Universidad de Granada.

Financing

This research was funded by FIBAO (Fundación para la Investigación Biosanitaria de Andalucia Oriental—Alejandro Otero) PI-0350-2018.

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