The association between selected characteristics and low back pain in pregnant women

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ABSTRACT

Pregnancy is a highly taxing period for a woman's body, associated with a number of psychological, anatomical, hormonal, and biomechanical changes that significantly affect her well-being and functioning in everyday life. One of the common afflictions significantly reducing the quality of life in pregnancy is low back pain (LBP), located in the area between the last pairs of ribs and the gluteal folds. The aim of the study was to evaluate the influence of selected factors on the occurrence of LBP in pregnant women.

The study included 100 pregnant women, whose mean age was 29.29 ±4.96 years. It was carried out on the basis of our original questionnaire, a standardized questionnaire (the Revised Oswestry Disability Index) that assesses disability as a result of pain complaints, and a standardized numerical rating scale (NRS) for pain. The survey was made available in an online version on social networks. Analysis of the obtained survey results was carried out using R software. Statistical analyses began by

assessing the normality of the data distribution, which was carried out using the Anderson–Darling (AD) test. To calculate statistical significance for quantitative data with a distribution deviating from normal, the Mann–Whitney U-test was used. To assess the significance of qualitative data, the statistical Fisher test was used. The threshold for statistical significance was p < 0.05. The study showed that the place of residence, age, education, occupational activity, trimester of pregnancy, and the woman's body mass index (BMI) before pregnancy did not affect the occurrence of LBP during pregnancy. Statistical analysis indicated that pregnancy affects the occurrence of LBP in women who previously did not experience this type of pain. In addition, it was indicated that there was a significant correlation between the subjective assessment of pain and the degree of disability. The largest percentage of pregnant women experienced moderate (38%) and low (35%) disability.

Keywords: spine; pain; risk factors; pregnancy.

INTRODUCTION

Low back pain (LBP) is a very commonly reported health problem among the pregnant population which affects between 56–75% of pregnant women [1, 2, 3]. The majority of women report the onset of symptoms between 5–7 months of pregnancy. In many cases, the intensity of LBP in pregnant women and the duration leads to disability, which contributes to a significant reduction in the quality of daily life and an increased risk of falls [3, 4]. Factors affecting the occurrence of LBP during pregnancy include the presence of pain symptoms prior to pregnancy, the number of pregnancies, the nature of one's occupation, previous spinal injuries, and background. Pregnancy is also a time of intense hormonal, anatomical, vascular, and biochemical changes in a woman's body [1, 5].

The first anatomical and physiological changes occur as early as the first weeks of pregnancy, peaking during the period of impending delivery [6]. Problems with the musculoskeletal system are associated with the modification of the posture adopted by the pregnant woman. There is an increase in the weight of the woman's body, which results in a significant burden on the female body, a shift in the center of gravity, an overload of the axial skeleton, and extensive changes in the muscular system [1, 5, 7]. Weight gain is a physiological phenomenon during pregnancy and is the most important element influencing the

appearance of dysfunctions in the musculoskeletal system that lead to LBP. In general, the weight gain of a healthy pregnant woman throughout pregnancy, from the beginning of pregnancy to delivery, should be between 11.5–16 kg. The weight gain, mainly due to the weight of the baby, the increased volume of body fluids, the enlarging uterus and the placenta, induces an alignment of the pelvis in a forward tilt position through a change in posture, a contracture of the muscles responsible for bending the hip joints, and a shift of the center of gravity in a downward and forward direction by about 2 cm [1]. In order to maintain the balance that has been disturbed by the increased lumbar lordosis, the pregnant woman's body compensates for the shifted center of gravity by increasing the thoracic kyphosis, which is further aggravated by the enlargement of breasts during pregnancy. Mechanical changes due to weight gain also affect the pathological increase in tension in the short paraspinal muscles in the lumbosacral area. The appearance and function of the thorax during pregnancy also undergo numerous modifications. There is a significant increase in the lateral dimension and circumference of the thorax, and the position of the most important respiratory muscle also changes. The diaphragm undergoes a relatively slight upward shift, resulting in a reduction in total lung capacity of about 5%. With the development of pregnancy and a gradual increase in fluid volume that leads to compression within the soft tissues, the

muscular and ligamentous structures are stretched, which adversely affects the stabilizing functions performed by these structures [7].

Muscles, tendons, and ligaments during pregnancy are significantly affected by all the hormonal and biochemical changes characteristic of this period. An increase in the body's concentration of hormones such as progesterone and relaxin adversely affects the musculoskeletal system by causing joint flaccidity [6]. The most noticeable changes in the abdominal fascia occur at the beginning of the third trimester of pregnancy (from sixth to seventh month). These changes include elongation of the rectus abdominis muscle up to 15 cm. The stretching of this structure may, in some cases, lead to the tearing of particularly sensitive structures such as the linea alba, deep inguinal ring, and umbilical ring [6, 7]. As a result of ongoing anatomical and hormonal changes in a pregnant woman's body, muscle imbalances involving regions of the trunk, pelvis, and lower extremities occur. These changes are referred to as the lower junction syndrome, which is characterized by a decrease in the tension of the abdominal muscles, the muscles responsible for hip extension and the contracture of the muscles that flex the hip joint and straighten the lumbar spine. There is also an undeniable impact on the change in muscle tension and the consequent development of LBP, as well as the outward displacement of the hip spines and the relocation and stiffening of the pelvis. The result is a contracture of the iliac and lumbar muscles, which causes increased tension in the region of the pubic bone. The resulting muscle imbalance leads to gait abnormalities resulting from the loss of physiological rocking motion of the pelvis and mobility abnormalities in the lower spine segments.

The aim of the study was to evaluate the influence of demographic factors, trimester of pregnancy, type of occupation, and the level of disability on the incidence of LBP in pregnant women. In addition, changes in pain before and during pregnancy were assessed.

MATERIALS AND METHODS

The study group consisted of 100 pregnant women aged between 18–43 years (mean age 29.29 ±4.96 years). The study included pregnant women with no history of lumbar spine surgery or diagnosed conditions that could cause LBP. The study was conducted using the authors' questionnaire, which was made available online in social networks during the period between 7 October 2022 and 7 November 2022. Prior to taking the survey, each participant was given a full explanation of the nature and purpose of the study and was assured that the responses obtained would be completely anonymous and used for research purposes only. The research did not require the opinion of the Bioethics Committee (ref. RPW/6154/2022P).

The survey consisted of a 43-question questionnaire that included general personal data, original questions concerning LBP, the standardized Revised Oswestry Low Back Pain Disability Index questionnaire, and the numerical rating scale (NRS). The personal data included age, education level, and place of

residence (Tab. 1). Our original questions focused on gathering information on the issue of LBP in pregnant women, the frequency of its occurrence in the pregnant population, data that will help to identify potential risk factors influencing the onset of LBP during pregnancy, and determining the relationship between the occurrence of pain and the level of disability. The Revised Oswestry Low Back Pain Disability Index questionnaire included 10 questions about: pain intensity, caring, lifting, walking, sitting, standing, sleeping, social life, travel, and change in pain intensity. The scoring of the questionnaire was strictly defined, with 0–5 points possible for each question, depending on the answer given. The minimum number of points possible in the final score was 0, and the maximum was 50. Scores in the range of 0–4 were interpreted as no disability, 5–14 as mild disability, 15–24 as moderate disability, 25–34 as severe disability, and scores above 34 as total disability. The questionnaire also used the NRS to subjectively rate the severity of pain. The women rated the intensity of their pain 0–10, with 0 denoting no pain at all and 10 the worst pain they could ever imagine.

Statistical calculations were performed using R, a program designed for statistical analysis and visualization of results. Statistical analyses began with the evaluation of the distribution of data, which was performed using the Anderson–Darling (AD) test. Statistical analyses of quantitative data with non-normal distribution were calculated using the Mann–Whitney U-test. Qualitative data were calculated using the Fisher test of statistics. Correlations were performed using the rho-Spearman correlation test. The threshold for statistical significance was set at $p < 0.05$. Cronbach α was used for the assessment of reliability and consistency of the Food and Drug Administration (FDA) test. Cronbach α value (>0.70) was adopted to mean high reliability of the test.

RESULTS

Table 1 shows characteritics of the study group of pregnant women.

TABLE 1. Characteristics of the study group of pregnant women

Variable	Subgroup	n	%
Trimester of pregnancy	I	20	20
	II	32	32
	III	48	48
Place of residence	village	25	25
	city of up to 50,000 residents	12	12
	city of 50,000–150,000 residents	19	19
	city of 150,000–500,000 residents	18	18
	city of more than 500,000 residents	26	26
Education	vocational school/ junior high school	4	4
	high school	20	20
	university	76	76

n – subgroup size

Tables 2 and 3 present an assessment of the influence of place of residence, education, and age on the occurrence of LBP when pregnant women completed the questionnaire. The analysis showed that in the group of women with LBP, the highest percentage of respondents lived in cities with more than 500,000 inhabitants (27%) and had a university degree (77%). On the other hand, the fewest pregnant women with pain problems lived in cities with up to 50,000 inhabitants (11%). In the study group, there was not a single woman with a junior high school education who suffered from LBP.

In the group of pregnant women with no LBP, the largest number of women lived in rural areas (27%) and the smallest number lived in towns with a population 50–150 thousand (13%). Among women without LBP, higher education predominated (75%), and the smallest percentage were women with a vocational school/ junior high school education (4%). The mean age of the women who experienced pain during pregnancy was 29.39 ±5.24 years, whereas the mean age of the women without prenatal back pain was 29.16 ±6.47 years. There were no statistically significant differences between the groups.

TABLE 2. Place of residence and education vs. the occurrence of low back pain in pregnant women

Variable		Low back pain		p-value
		yes (n = 56)	no (n = 44)	
Place of residence	village	13 (23%)	12 (27%)	0.70
	city of up to 50,000 inhabitants	6 (11%)	6 (13%)	
	city of 50,000–150,000 inhabitants	13 (23%)	6 (13%)	
	city of 150,000–500,000 inhabitants	9 (16%)	9 (22%)	
	city of more than 500,000 inhabitants	15 (27%)	11 (25%)	
Education	university	43 (77%)	33 (75%)	0.63
	high school	12 (21%)	8 (18%)	
	vocational	1 (2%)	2 (4%)	
	junior high school	0 (0%)	1 (3%)	

n – subgroup size; p-value – level of statistical significance

TABLE 3. Age vs. the occurrence of low back pain (LBP)

Age	M	Me	SD	p-value
LBP	29.39	29.50	5.24	0.93
No LBP	29.16	28.00	4.67	

M – arithmetic mean; Me – median; SD – standard deviation; p-value – statistical significance level

Table 4 shows the assessment of the effect of body mass index (BMI) before pregnancy on the occurrence of LBP during pregnancy. In the group of respondents with LBP, the mean pre-pregnancy BMI was 24.92, while in the group with no LBP, the mean BMI was 24.07. There was no statistically significant difference between the groups.

TABLE 4. Pre-pregnancy body mass index (BMI) vs. low back pain (LBP) in pregnant women

BMI	M	Me	SD	p-value
LBP	24.92	23.37	5.06	0.41
No LBP	24.07	2.68	5.05	

M – arithmetic mean; Me – median; SD – standard deviation; p-value – statistical significance level

Table 5 shows the incidence of LBP in the individual trimesters of pregnancy. Statistical analysis showed that in the group of women with LBP, more than half were in the third trimester of pregnancy, while the fewest were in the first trimester. In the group of women who did not have LBP at the time of completing the questionnaire, the largest number were in the third trimester, while the smallest number were in the first trimester. A detailed statistical analysis of the respondents' answers did not show any statistically significant results.

TABLE 5. Low back pain in the individual trimesters of pregnancy

Trimester of pregnancy	Low back pain		p-value
	yes (n = 56)	no (n = 44)	
First	10 (18%)	10 (23%)	0.45
Second	16 (29%)	16 (36%)	
Third	30 (53%)	18 (41%)	

n – size of the distinguished subgroup; p-value – level of statistical significance

Subsequent statistical analyses focused on the relationship between the type of work performed and the incidence of LBP at the time the questionnaire was completed by the pregnant women. In the group of pregnant women with LBP, half of them had an office job, while the smallest percentage were respondents who were not employed. In the group of women with no LBP, the largest number of pregnant women had an office job and the smallest number were not employed. Detailed data are shown in Table 6. The intergroup analysis did not reveal any significant statistical differences.

Table 7, on the other hand, shows an assessment of the relationship between the characteristics of the work performed and the occurrence of LBP in pregnant women. In the group of respondents with LBP at the time of the survey, the largest group was made up of women who worked 8–12 h a week (80%), had 6–10 years' work experience (45%), and an office job (65%). The smallest group of respondents were those who worked more than 12 h a week, had more than 10 years' work experience and with a standing working position. Among the pregnant women with no LBP, the largest number also worked 8–12 h, had 6–10 years' work experience, and had an office job. On the other hand, the smallest percentage of respondents without LBP sensations were women who worked more than 12 h a day (3%), had more than 10 years' work experience (21%), and mixed working positions (19%). Detailed data are shown in Table 7. Statistical analysis revealed no differences that could be considered significant at p < 0.05.

TABLE 6. Type of occupation vs. the occurrence of low back pain in pregnant women

Type of occupation	Low back pain		p-value
	yes (n = 56)	no (n = 44)	
Physical	13 (23%)	7 (16%)	
Office	28 (50%)	23 (52%)	0.82
Mixed	8 (14%)	8 (18%)	
Unemployed	7 (13%)	6 (14%)	

n – subgroup size; p-value – level of statistical significance

TABLE 7. Work characteristics vs. the occurrence of low back pain in pregnant women

Variable		Low back pain		p-value
		yes (n = 56)	no (n = 44)	
Number of working hours in a day	less than 8 h	9 (18%)	13 (34%)	0.17
	8–12 h	39 (80%)	24 (63%)	
	over 12 h	1 (2%)	1 (3%)	
Seniority	up to 5 years	15 (31%)	14 (37%)	0.85
	6–10 years	22 (45%)	16 (42%)	
	more than 10 years	12 (24%)	8 (21%)	
Position at work	standing	7 (14%)	8 (21%)	0.78
	sitting	32 (65%)	23 (60%)	
	mixed	10 (21%)	7 (19%)	

n – size of the distinguished subgroup; p-value – level of statistical significance

Table 8 shows the relationship between pregnancy and the onset of LBP. The analysis performed showed that more than 90% of the women experienced LBP before and during pregnancy, while 75% of the women did not experience LBP before pregnancy but did experience it during pregnancy. The p-value was statistically significant (p = 0.01).

TABLE 8. Incidence of low back pain (LBP) during and before pregnancy

| LBP during pregnancy	LBP before pregnancy		p-value
	yes (n = 49)	no (n = 51)	
Yes	46 (94%)	38 (75%)	0.01
No	3 (6%)	13 (25%)	

n – size of the distinguished subgroup; p-value – level of statistical significance

In the study group, according to the Revised Oswestry Disability Index questionnaire, the largest percentage of respondents (38%) had moderate disability, while the smallest (3%) had severe disability, as shown in Table 9. Among the respondents, the highest pain level scored on the NRS was 8, while the lowest was 0. The average NRS score for the entire study group was 4.13 (±2.33). Figure 1 shows the correlation between the NRS and the Revised Oswestry Disability Index. The correlation

was considered positive as it reached the threshold of statistical significance (p < 0.001). As the numerical value of the NRS increases, so do the values of the Revised Oswestry Disability Index scale.

TABLE 9. Percentage distribution of disability according to the questionnaire filled in by the pregnant women

Disability level	%
Low disability	35
Intermediate disability	38
No disability	24
Severe disability	3
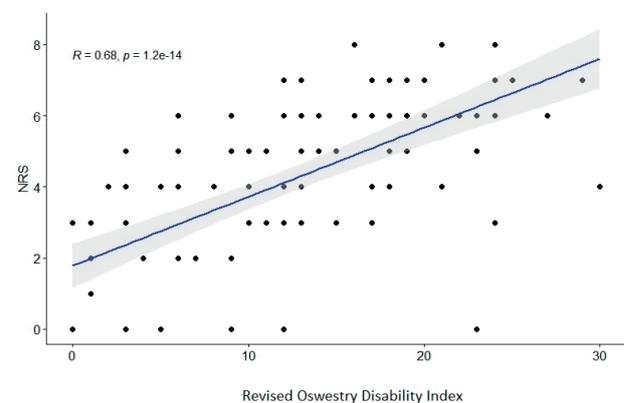
FIGURE 1. Correlation between the results on the numerical rating scale (NRS) and the Revised Oswestry Disability Index scale

DISCUSSION

Low back pain during pregnancy is a prevalent and challenging issue, with varying prevalence rates reported across studies [8]. The multifactorial nature and lack of clear understanding of the mechanisms underlying LBP in pregnant women necessitate a comprehensive examination of this phenomenon. Scientific literature indicates a correlation between pregnancy and the onset of LBP episodes [8, 9 10], which can significantly impact quality of life and lead to disability.

Our study, in line with previous research by Bryndal et al., demonstrated a positive association between pregnancy and the occurrence of LBP [8]. Similarly, Sencan et al. found that pregnancy contributes to a predisposition to LBP [10]. Wang et al. also supported this finding by identifying pregnancy as a causal factor in LBP [9].

In our investigation into the influence of various factors on LBP in pregnant women, statistical analysis revealed that factors such as maternal age, education, place of residence, pre-pregnancy BMI, trimester of pregnancy, and work activity were not significant risk factors for LBP. However, a strong correlation was observed between subjective assessment of LBP and disability. The relationship between these factors and LBP remains contentious, with no consensus among researchers. Studies

such as Tuncer and Tuncer's 2021 research and Yetişgin et al. findings regarding maternal age, BMI, and place of residence offer differing perspectives [11, 12]. Alkaf et al. similarly did not find significant risks associated with various factors, contrasting with Nazari et al. identification of maternal age, gestational age, and pre-pregnancy BMI as significant factors influencing LBP during pregnancy [13, 14]. The Tuncer and Tuncer's study group had a very similar mean age of respondents (29.98 ±5.23 years) compared to the results obtained in our study (29.29 ±4.96 years) [11]. The lack of statistical significance between the age variable and LBP was also not demonstrated by Kristiansson et al. [15]. Yetişgin et al. came to similar conclusions regarding maternal age, as well as BMI and place of residence. They evaluated 83 pregnant women who completed a paper version of the questionnaire in the first 72 h after delivery. They showed a single association, although not confirmed in our study – the authors claimed that the level of education, especially secondary and university education, predisposes to LBP during the antenatal period [12].

Our results are in full agreement with those of Alkaf et al. who did not find a significant association between LBP episodes and age (groups of under 20, 20–35, over 35), education, trimester of pregnancy, and BMI (24.98 kg/m² before pregnancy in the group with LBP and 25.00 kg/m² during pregnancy without LBP) [13]. Other conclusions were reached by Nazari et al., who showed that maternal age, gestational age, and pre-pregnancy BMI were the most important factors influencing the occurrence of LBP during pregnancy. The authors, who included 515 first-time mothers in their study group, came to a rather surprising conclusion that the incidence of LBP increases with the age of the pregnant woman. This is a rather surprising result, given that the majority of studies it was young age that predisposed to LBP. Nazari et al. explained their findings by pain tolerance, which gradually decreases with age in women. The present study also shows an association between high BMI, advanced prenatal age, and LBP in pregnancy [14]. Ramezanpour et al. also found an association between older maternal age and an increasing risk of LBP during pregnancy. They based their findings on a progressive decrease in body flexibility with age [16]. The association between high BMI and LBP was also confirmed by Mogren and Pohjanen cross-sectional study on a group of 1114 women who completed questionnaires about their pregnancy up to 24 h after delivery. Statistical analysis showed a significance between high BMI and LBP, which is not supported by the findings of our study [17]. Because body weight is closely tied to nutritional habits and physical activity, lifestyle changes that promote weight loss may help reduce the incidence of low back and pelvic pain during pregnancy.

Another source that comprehensively analyzes the factors that may affect pregnant women's quality of life through the occurrence of LBP is the article by Manyozo et al., which analyzed 404 questionnaires completed by pregnant women. The authors referred to the variable of educational level, which is the same as the result of their own study. In both studies, the variable of the respondent's level of education was not significantly correlated with the onset of LBP. The researchers also found that women in the second and third trimesters of pregnancy were significantly more likely to experience LBP than women in the first trimester [18]. This is likely due to the fact that, in the second trimester, as the abdomen enlarges, the body's center of gravity shifts forward. During this stage, back pain tends to become more frequent and more intense. In the third trimester – particularly in the weeks leading up to delivery – back pain is usually at its peak. This results from the substantial strain placed on the spine by the growing abdomen, the altered center of gravity, and the overall weight gain during pregnancy.

The researchers identified maternal age as a factor correlating with LBP in pregnancy, showing that younger pregnant women had a significantly higher risk of LBP than older women [18].

Very similar results were found in a detailed analysis of 404 questionnaires in the study by Wang et al. where the risk of LBP decreased with the age of the pregnant woman. The highest percentage of respondents reporting LBP was in the under-20 age group. When looking at the prevalence of LBP among pregnant women, there was no correlation with gestational age [9]. In their study, Kovacs et al. also confirm that the demographic variable of age contributes to the occurrence of LBP in the pregnant population. After analyzing the responses of 1158 Hispanic pregnant women, the authors concluded that the risk of LBP decreases with maternal age. Among other relevant variables, the authors mention the level of education (university education) and current occupational status (unemployment), which are responsible for a significant likelihood of LBP [19]. In the study by Bryndal et al., age and the level of education significantly correlated with LBP. There was also a higher risk of LBP in the group of younger women (p < 0.001) compared to a group of older women. According to the researchers, this correlation between age and pain is due to a low level of education, which also remains a significant variable influencing the onset of LBP [8]. Many pregnant women who experience back pain consider it a normal part of pregnancy and therefore do not take specific steps to address it. However, this condition can lead to functional limitations, reduced quality of life, and even temporary disability.

That study, which included 1510 pregnant women, also showed that the level of disability in the study group, as assessed by the Oswestry Disability Index questionnaire, significantly correlated with LBP (p < 0.001) [8]. This significance was also confirmed in our study (p < 0.001). Similar conclusions were reached by Mohseni-Bandpei et al. in 2009, who in their study showed a relationship between the visual analogue scale (VAS) of pain and the level of disability assessed by the Oswestry Disability Index questionnaire. The research was large-scale, as evidenced by the participation of 18 research centers in Iran. Its findings partially concur with the results of our study, showing that the type of occupation, level of education, and BMI are involved in the onset of LBP in pregnant women. In our study, occupation was divided according to its type (physical, office, mixed, and no employment), while Mohseni-Bandpei et al. analyzed the effects of work divided into unemployed and employed women [20]. Working conditions and the physical demands of a job can contribute to back pain

during pregnancy. Exposure to chemical agents in the workplace, prolonged standing or walking, lifting heavy objects, or working in shifts may all have a negative impact on pregnancy. Heavy physical labor, night shifts, and work involving exposure to harmful agents such as radiation or toxic substances are considered inadvisable during pregnancy.

Mohseni-Bandpei et al., obtained results, contrary to their own work, from which they concluded that young age and living in urban areas favor the development of LBP in pregnant women. As an explanation for the lower frequency of pain symptoms in women living in rural areas, they cited increased physical activity resulting from the characteristics of rural life compared to women living in urban areas. The authors admitted the limitations of insufficient differentiation between LBP and pelvic pain [20]. A study that also supports the statistical significance that occurs between the VAS and the level of disability is the Berber and Satılmış study on 400 pregnant women. Their results showed a strong correlation between the VAS and the Oswestry Disability Index. The study also assessed the subjective level of pain both in terms of its average intensity ($p < 0.001$) and the pain sensations experienced at the time of completing the questionnaire ($p < 0.01$) [3]. Another article supporting a correlation between the severity of pain complaints and the degree of disability is a study by Korovessis et al. who included a group of 167 women in their study. The respondents subjectively assessed their condition twice (3 months before and 3 months after delivery), and the results obtained during pregnancy ($p = 0.002$) are consistent with the results of our study [21]. In conclusion, as the overall number of scientific sources analyzing the correlation between subjective pain scores and disability is limited, further research is needed to reliably assess the above topic.

CONCLUSIONS

Pregnancy places a significant strain on a woman's body, particularly on the musculoskeletal system. Various factors, including postural changes, can lead to pain of varying intensity and location, increasing the level of disability. In addition, given the large discrepancy regarding the impact of individual risk factors on the occurrence of LBP in pregnant women, the mechanisms leading to the dysfunction manifested by LBP should be further investigated.

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