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# PREDICTORS OF PAIN SEVERITY AND DEPRESSION IN PATIENTS WITH LOW BACK PAIN: PILOT STUDY

**Kostiantyn V. Volanskyi, Gennadii S. Moskovko, Kateryna V. Ksenchyna, Alla G. Kapitun, Oleksandr A. Nazarchuk, Dmytro V. Dmytriiev**

National Pirogov Memorial Medical University, Vinnytsya, Vinnytsia, Ukraine

***Abstract***

**Introduction.** Low back pain is one of the leading causes of disability worldwide and a significant burden on healthcare systems. Despite numerous studies, the mechanisms behind the relationship between clinical, structural, and psychoemotional factors influencing pain intensity and depressive symptoms remain poorly understood.
**Materials and methods.** The study included 32 patients (17 men, 15 women) aged 22-72 years with pain lasting more than 3 months. All participants underwent clinical examinations, MRI to assess intervertebral herniation, and completed the Visual Analogue Pain Scale (VAS) and the PHQ-9 questionnaire to screen for depression. Patients were divided into groups with (n = 18) and without (n = 14) radicular syndrome. Multiple linear regression analysis was used to identify predictors of pain intensity and depression levels.
**Results.** Multiple regression analysis showed that the level of depressive symptoms (β = -1.71; p = 0.009) and the presence of radicular syndrome (β = -1.18; p = 0.036) were significantly associated with pain intensity. The presence of an intervertebral hernia showed a tendency to increase pain (β = 2.34; p = 0.055). Regarding depression, the presence of a hernia was the only significant factor associated with increased depressive symptoms (β = 10.64; p = 0.007). Comparing groups with and without radicular syndrome did not reveal statistically significant differences in the average pain level.
**Conclusions.** The intensity of low back pain is influenced by a complex interplay of factors, including psychoemotional state and the presence of radicular syndrome, rather than only structural spine changes. These findings highlight the importance of a multidimensional and individualized approach to managing patients with chronic low back pain, considering both clinical and psychoemotional aspects.

***Keywords:*** **low back pain, predictive factors, depression, hernia, radiculopathy**

## INTRODUCTION

Low back pain is one of the leading causes of disability worldwide and represents a significant burden on health systems. Current epidemiological studies estimate the point prevalence of low back pain to be around 7.5%, while the lifetime prevalence is over 80%. Low back pain also accounts for approximately 4% of all emergency department visits [1]. Globally, the number of years lived with disability due to low back pain increased by 54% between 1990 and 2015, largely due to population growth and aging, with the greatest increase in low- and middle-income countries [2]. Among adults, the main risk factors for low back pain include physical activity, smoking, obesity, mental disorders, and low socioeconomic status. An important component of clinical assessment is also the determination of the impact of pain on patients' daily activities, the presence of temporary disability, and the subjective perception of the connection of pain with professional activities [3]. The etiology of low back pain is multifactorial. One of the leading causes is considered to be intervertebral disc degeneration, which, according to the literature, is associated with approximately 26-42% of cases of low back pain [4, 5]. At the same time, in a significant proportion of patients, the clear structural source of pain remains unclear, which complicates the prediction of the course of the disease and the selection of optimal treatment tactics. It is estimated that in approximately 90% of individuals with low back pain, it is impossible to unambiguously identify a specific anatomical structure as the source of the pain syndrome [6]. In clinical practice,

the timely detection of so-called «red flags» is extremely important – these are signs that may indicate the presence of a serious underlying pathology and require specific or urgent treatment. These include non-mechanical pain with progressive increase, especially at rest or at night, pronounced neurological deficit with impaired function of the pelvic organs, paresthesias in the perineum, significant injuries, unexplained weight loss, history of cancer, fever, and deterioration of the general condition. Additional factors of increased clinical risk are the age of onset of symptoms less than 20 or more than 55 years, the presence of structural deformations of the spine, intravenous drug use, and long-term use of corticosteroids. At the same time, the course of low back pain is largely determined not only by biomedical but also by psychosocial factors. The so-called «yellow flags», which include depression, anxiety, chronic stress, inadequate perceptions of pain, fear of movement, and avoidance of activity, are associated with an increased risk of chronicity of the pain syndrome. Factors related to professional activity and working conditions also play an important role. «Blue flags» include high physical activity, high demands with limited control over the work process, insufficient social support, and low motivation to return to work. In addition, «black flags», reflecting the peculiarities of the organization of medical care, employer policies, and the social insurance system, can further complicate the recovery process and contribute to prolonged disability [7, 8].

In addition to spinal pathology, sources of pain in the lower back or lower extremities can be lesions of the intervertebral disc, facet joints, sacroiliac joint, as well as peripheral nerves. At the same time, the role of peripheral nerve entrapment as a cause of pain has long been underestimated against the background of the dominance of spinal concepts of the origin of pain syndrome, despite the fact that peripheral nerves were among the first anatomical structures studied in the history of pain medicine [9].

In general, comorbidity of chronic pain and depression occurs in more than 60% of patients. Depression in the context of chronic pain is associated with decreased psychological well-being, limitation of daily activities, deterioration of social interactions and overall quality of life. In addition, the presence of depressive symptoms can negatively affect compliance with the treatment regimen and the effectiveness of therapeutic interventions, which emphasizes the need for a multidimensional and individualized approach to the management of these patients [10].

Thus, chronic low back pain is often accompanied by various psychiatric disorders, in particular depression and anxiety, which significantly affect the course of the disease. It has been established that pain and psychoemotional disorders have a two-way relationship: persistent pain increases the risk of developing depressive and anxiety symptoms, while the presence of psychological distress can increase the perception of pain and its intensity. Such an interaction creates a vicious circle that worsens the functional capacity of patients, increases the risk of chronicity of pain syndrome and reduces quality of life. Additionally, the patient's psycho-emotional state can influence the level of activity, motivation for rehabilitation and the ability to effectively cope with daily stresses, which makes the assessment of mental health a key aspect of the comprehensive management of patients with low back pain [11].

Thus, the modern approach to the assessment of low back pain is based on a biopsychosocial model, which involves a comprehensive analysis of clinical, psychological and socio-economic factors. Such an approach is of key importance for predicting the course of the disease, preventing the chronicity of pain and choosing an individualized treatment strategy [12, 13].

## AIM

The aim of our study was to evaluate clinical, psychoemotional and structural factors associated with the intensity of low back pain and the level of depressive symptoms in patients with low back pain, using multivariate regression analysis.

## MATERIALS AND METHODS

### *Participant Characteristics*

Our study included 32 participants, 17 of whom were male and 15 were female. The age of the study participants ranged from 22 to 72 years. The median age was 42 years (95% CI: 38.99-46.01). The relative standard deviation was 30.45%, reflecting moderate age variability in the sample. The D'Agostino-Pearson test confirmed the normality of the age distribution (P = 0.228), which allows the use of parametric statistical analysis methods for further comparison. All participants provided written consent to participate in the study. The inclusion criteria for the study were age over 18 years, presence of back pain, duration of symptoms longer than 3 months, absence of spinal surgeries and injuries, and availability of MRI results to assess the presence of hernia (Table 1).

All study participants were divided into two groups depending on the presence of radicular pain syndrome. Group 1 included patients with radicular pain (n = 18), while group 2 consisted of individuals without signs of radicular syndrome (n = 14). Group 1 was dominated by women, who made up 56.6% of the sample, while the proportion of men was 44.4%. In contrast, group 2 was dominated by men (71.4%), and women made up 28.6% of the participants. The mean age of participants in group 1 was 42.36 years (95% CI: 34.74-49.98), while in group 2 it was 44.43 years (95% CI: 36.38-52.48). Comparative analysis using a paired t-test did not reveal any statistically significant differences between the groups by age (t = -0.375; DF = 13; p = 0.714), indicating that they were comparable in age.

*Table 1*

**Respondents Characteristics**

| № | Characteristics | Data |
|---|---|---|
| 1. | Gender<br>*male*<br>*female* | <br>17<br>15 |
| 2. | Age | 43,2 ± 13,2 years |
| 3. | Average height | 172,88 ± 8,68 cm |
| 4. | Average weight | 76,44 ±17,67 kg |
| 5. | Radicular syndrome<br>*yes*<br>*no* | <br>18<br>14 |
| 6. | Hernia<br>*yes*<br>*no* | <br>26<br>6 |
| 7. | Obesity<br>*yes*<br>*no* | <br>8<br>24 |
| 8. | Highly intensive physical activity<br>*current*<br>*past*<br>*no* | <br>12<br>10<br>10 |

The mean height of participants in group 1 was 170.07 ± 7.58 cm (95% CI: 165.69-174.45), while in group 2 it was 173.00 ± 7.44 cm (95% CI: 168.70-177.30). The detected mean difference between the groups (–2.93 cm) was not statistically significant (t = -0.926; DF = 13; p = 0.371).

The average body weight of participants in group 1 was 74.0 ± 17.13 kg (95% CI: 64.11-83.89), and in group 2, 77.0 ± 15.38 kg (95% CI: 68.12-85.88). Comparative analysis also did not reveal a statistically significant difference between the groups in this indicator (mean difference 3.0 kg; t = 0.460; DF = 13; p = 0.653).

Thus, the formed groups were comparable in terms of basic anthropometric and demographic characteristics, which allows us to correctly assess the impact of radicular pain syndrome on further studied indicators.

***Interviewing method***

The intensity of low back pain we assessed using a visual analogue scale (VAS), where 0 points corresponded to the complete absence of pain, and 10 points to the most pronounced, unbearable pain. The use of the VAS allows for a quantitative assessment of the subjective intensity of pain and is a generally accepted tool in clinical and scientific research [14]. Additionally, detailed information was collected on the nature of pain complaints, their localization, and duration, which was necessary for the correct clinical interpretation of the pain syndrome and for reducing the risk of misinterpretation of its etiology.

In parallel, all participants completed the PHQ-9 (Patient Health Questionnaire-9) questionnaire, a validated short tool for screening and quantitative assessment of the severity of depressive symptoms. The questionnaire consists of 9 items that reflect the main diagnostic criteria for depression and assess symptoms over the past two weeks. Each item is rated on a four-point scale (0-3 points), and the total score ranges from 0 to 27 points. The PHQ-9 is easy to use, has high sensitivity and specificity, and is widely used in clinical practice and scientific research [15].

***Statistical analysis***

Statistical analysis of data was performed using descriptive and inferential statistics. Quantitative indicators were preliminarily checked for compliance with normal distribution using the Shapiro-Wilk test. Under normal distribution, data were presented as mean and standard deviation (M ± SD) and t-test was used for comparison. Under non-normal distribution, non-parametric Wilcoxon signed-rank test was used. Categorical variables were presented as absolute and relative frequencies (%).

To assess independent predictors of pain intensity and severity of depressive symptoms, multiple linear regression analysis was used with the introduction of variables into the model. Clinical and demographic variables, in particular pain intensity, depression indicators, presence of radicular syndrome, gender and presence of hernia, were included in the regression models.

The adequacy of regression models was assessed by the coefficient of determination ($R^2$), adjusted coefficient of determination ($R^2$ adjusted), F-test and standard deviation of residuals. The significance of individual predictors was determined by Student's t-test with the calculation of regression coefficients (β), standard errors, and partial correlation coefficients (r_partial). The level of statistical significance was set at $p < 0.05$. All statistical tests were two-sided.

## RESULTS

In order to determine the factors associated with pain intensity as the dependent variable, a multiple linear regression was performed. Table 2 shows the results of the multiple regression analysis of factors associated with pain intensity. It was found that the level of depressive symptoms according to the PHQ-9 scale had a statistically significant negative relationship with the dependent variable (β = -1.71; p = 0.009), as well as the presence of radicular syndrome (β = -1.18; p = 0.036). Gender did not demonstrate a statistically significant effect on pain intensity (p = 0.355). The presence of a hernia was positively associated with pain level, but this relationship only tended to be statistically significant (β = 2.34; p = 0.055). Overall, the regression model was characterized by marginal statistical significance (F = 2.51; p = 0.066), indicating moderate explanatory power of the model (Table 2).

Table 2 presents the results of the multiple regression analysis of factors associated with the level of depression. Among the studied independent variables, the presence of a hernia was the only factor that demonstrated a statistically significant positive relationship with the level of depression (β = 10.64; p = 0.007), indicating a significant increase in the depression index in patients with hernias.

*Table 2*

**Multiregression Analysis of the Dependent Variable of Pain on the Studied Factors**

| Independent variables | Coefficient | Std. Error | rpartial | t | P |
|---|---|---|---|---|---|
| (Constant) | 5,4508 | | | | |
| phq9 | -1,7073 | 0,6083 | -0,4752 | -2,807 | 0,0092 |
| Radicular syndrome | -1,1800 | 0,5357 | -0,3903 | -2,203 | 0,0363 |
| gender | -0,4508 | 0,4786 | -0,1784 | -0,942 | 0,3546 |
| hernia | 2,3369 | 1,1633 | 0,3606 | 2,009 | 0,0547 |
| **F-ratio = 2,5062; P= 0,066** | | | | | |

Radicular syndrome, pain intensity, and gender did not have a statistically significant effect on the dependent variable (p > 0.05 for all), although pain showed a tendency to a positive association. Overall, the regression model was characterized by marginal statistical significance (F = 2.49; p = 0.067), indicating a moderate explanatory power of the model and the possible role of other factors not included in the analysis (Table 3).

*Table 3*

**Multiple Regression Analysis of the Dependent Variable of Depression on the Studied Factors**

| Independent variables | Coefficient | Std. Error | rpartial | t | P |
|---|---|---|---|---|---|
| (Constant) | -2,0045 | | | | |
| radicular syndrome | -0,9671 | 1,7718 | -0,1045 | -0,546 | 0,5897 |
| pain | 2,2238 | 1,8091 | 0,2302 | 1,229 | 0,2296 |
| gender | -0,2193 | 1,6749 | -0,02519 | -0,131 | 0,8968 |
| hernia | 10,6355 | 3,6781 | 0,4863 | 2,892 | 0,0075 |
| **F-ratio= 2,4936; P= 0,067** | | | | | |

After conducting the multiple regression analysis, the next step of our study was to compare the mean pain intensity according to the VAS results in the group of patients with and without radicular syndrome. For group 2 (n = 14), the values ranged from 4 to 7, the mean was 5.71 ± 1.33 (95% CI 4.95-6.48). For group 1 (n = 18), the values ranged from 4 to 9, the mean was 5.33 ± 1.53 (95% CI 4.57-6.10). The data distribution was not normal (D'Agostino-Pearson test, P = 0.0056). For group 2, the median of the variable was 6.0 (95% CI: 4.0-7.0; interquartile range: 4-7), for group 1 it was 5.0 (95% CI: 4.0-6.0; interquartile range: 4-6). Paired samples were used for comparison because the data distribution was not normal. The results of the nonparametric Wilcoxon signed-rank test showed that the difference between the groups was not statistically significant (P = 0.376) (Figure 1).

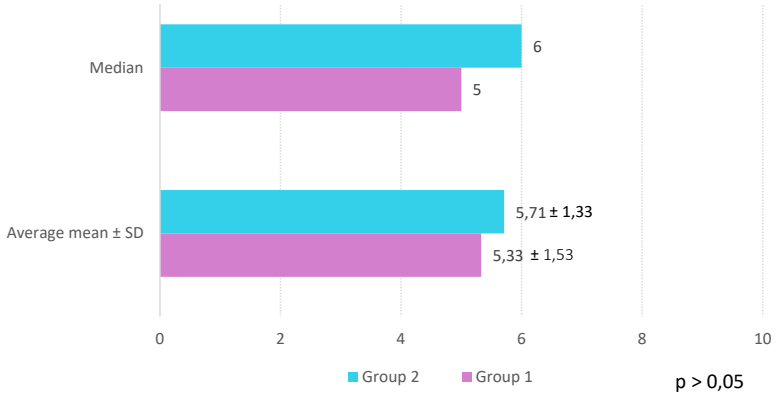


**Figure 1. Comparative values of the intensity of pain in the lower back with and without radicular syndrome.**

## DISCUSSION

The results of our study emphasize the complexity and multifactorial nature of low back pain. The associations found between depressive symptoms, the presence of radicular syndrome, and pain intensity are consistent with the concept of the biopsychosocial model, which assumes the interaction of physiological, psychological, and social factors in the formation of the pain syndrome. Despite the small sample size, our data demonstrate that the psychoemotional state of patients, in particular the level of depression, may play a key role in the perception and chronicity of pain. In our study, a multiple regression analysis was conducted to examine factors potentially associated with pain intensity in patients with spinal diseases. The model demonstrated moderate explanatory power ($R^2 = 0.27$), indicating the existence of other unaccounted factors that may affect the severity of the pain syndrome.

A systematic review by *Hincapié et al., 2025* shows that mean patient age (30-50 years), increased body mass index, cardiovascular risk factors in women, smoking, and high cumulative occupational exposure to the lumbar spine due to forward bending and manual handling of materials are associated with the development of lumbar disc herniation with radiculopathy [16].

In our study, among the predictors studied, depressive symptoms according to the PHQ-9 and the presence of radicular syndrome were statistically significantly associated with pain intensity. These results are consistent with previous data that emphasize the importance of the patient's psychoemotional state in the formation of pain perception.

In a similar study, a group of Korean researchers, *Park et al., 2018* found that the prevalence of depression was significantly higher in individuals with low back pain (20.3%) than in individuals without it (4.5%). According to the results of multivariate logistic regression analysis, the presence of depression was significantly associated with low back pain (adjusted odds ratio [aOR]: 3.93, $P < 0.001$) [17].

In addition, another study, *Wong et al., 2022* described that among working-age adults and the elderly, anxiety and depression are closely associated with chronic nonspecific low back pain. Psychological distress, in particular anxiety and depression, is associated with persistent or debilitating muscle and back pain in individuals of all ages. Longitudinal studies show that older adults with high baseline depressive symptoms have a doubled risk of developing persistent pain 4 years later, and depression is significantly associated with disabling back pain in patients over 70 years of age [18].

Our results also confirm that high levels of emotional distress increase the risk of chronic pain and disability, with depression being the strongest predictor.

At the same time, the predictive role of depression in maintaining chronic pain, according to longitudinal studies by *Otero-Ketterer et al., 2022,* is less pronounced compared to cross-sectional studies [19]. An interesting observation in our sample was the negative association of depressive symptoms with pain intensity, which may indicate the influence of compensatory mechanisms or the specificity of the clinical context. The presence of intervertebral hernia showed a tendency to be associated with increased pain intensity, but statistical significance was not reached ($p = 0.055$). This is consistent with clinical observations that disc herniation is often accompanied by pain, but its severity may depend on additional factors, such as inflammatory response or individual sensitivity.

Comparison of groups with and without radicular syndrome showed that the difference in pain intensity was not statistically significant, which emphasizes the complex and multifactorial nature of the pain syndrome, which is determined not only by morphological changes, but also by psychoemotional factors.

The main limitations of the study include the small sample of patients and the lack of control for additional factors that could affect pain intensity (e.g., lifting heavy objects, taking medications). For example, *Zaina et al., 2023* mention risk factors for lumbar disc-related radiculopathy, such as acute trauma, heavy lifting, twisting, bending, driving, smoking, pregnancy, diabetes, body mass index, hypertension, hypercholesterolemia, and family history [20].

## CONCLUSIONS

Multiple regression analysis revealed that depressive symptoms and the presence of radicular syndrome are significantly associated with pain intensity in patients with spinal diseases. In contrast, the patient's gender does not influence pain levels. The presence of an intervertebral hernia shows a tendency to increase pain, and comparing groups of patients with and without radicular syndrome did not reveal statistically significant differences. The findings highlight the multifactorial nature of pain syndrome and the necessity of a comprehensive approach to its assessment, incorporating both clinical and psychoemotional factors.

***Prospects for further research***. Further research should focus on clarifying the causal relationships between psychoemotional factors and pain intensity in patients with spinal disorders. Longitudinal studies with larger samples are needed to evaluate dynamic changes in pain perception and to assess the effectiveness of integrated biopsychosocial treatment strategies.

## COMPLIANCE WITH ETHICAL REQUIREMENTS

The study was performed in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the National Pirogov Memorial Medical University, Vinnytsya.

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Authors declare the absence of any conflicts of interest and own financial interest that might be construed to influence the results or interpretation of the manuscript.

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## ATHOUR CONTRIBUTIONS

Volanskyi K. V.[B, D]
Moskovko G. V.[A, E]
Ksenchyna K. V.[C, D]
Kapitun A. G.[B, D]
Nazarchuk O. A.[E, F]
Dmytriiev D. V.[A, F]

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## *Резюме*

**ПРЕДИКТОРИ ТЯЖКОСТІ БОЛЮ ТА ДЕПРЕСІЇ У ПАЦІЄНТІВ ІЗ ХРОНІЧНИМ БОЛЕМ У ПОПЕРЕКУ: ПІЛОТНЕ ДОСЛІДЖЕННЯ**

**Костянтин В. Волянський, Геннадій С. Московко, Катерина В. Ксенчина, Алла Г. Капітун, Олександр А. Назарчук, Дмитро В. Дмитрієв**

Вінницький національний медичний університет імені М. І. Пирогова, м. Вінниця, Україна

**Вступ.** Біль у попереку є однією з провідних причин інвалідності в усьому світі та значним навантаженням на системи охорони здоров'я. Незважаючи на численні дослідження, механізми взаємозв'язку між клінічними, структурними та психоемоційними факторами, що впливають на інтенсивність болю та депресивні симптоми, залишаються недостатньо вивченими.

**Матеріали та методи.** У дослідженні взяли участь 32 пацієнти (17 чоловіків, 15 жінок) віком від 22 до 72 років з болем тривалістю понад 3 місяці. Усі учасники пройшли клінічні обстеження, МРТ для оцінки міжхребцевої грижі та заповнили Візуальну аналогову шкалу болю (ВАШ) та опитувальник PHQ-9 для скринінгу депресії. Пацієнти були розділені на групи з (n = 18) та без (n = 14) корінцевого синдрому. Для визначення предикторів інтенсивності болю та рівня депресії було використано множинний лінійний регресійний аналіз.

**Результати.** Мультирегресійний аналіз показав, що рівень депресивних симптомів (β = –1,71; p = 0,009) та наявність корінцевого синдрому (β = –1,18; p = 0,036) були суттєво пов'язані з інтенсивністю болю. Наявність міжхребцевої грижі демонструвала тенденцію до посилення болю (β = 2,34; p = 0,055). Щодо депресії, наявність грижі була єдиним значущим фактором, пов'язаним зі збільшенням депресивних симптомів (β = 10,10,64; p = 0,007). Порівняння груп з корінцевим синдромом та без нього не виявило статистично значущих відмінностей у середньому рівні болю.

**Висновки.** На інтенсивність болю в попереку впливає складна взаємодія факторів, включаючи психоемоційний стан та наявність корінцевого синдрому, а не лише структурні зміни хребта. Ці результати підкреслюють важливість багатовимірного та індивідуалізованого підходу до лікування пацієнтів із хронічним болем у попереку, враховуючи як клінічні, так і психоемоційні аспекти.


***Ключові слова:*** **біль у попереку, прогностичні фактори, депресія, грижа, радикулопатія**

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