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Original Article

Associated factors of nonspecific low back pain in occupational health settings

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Abstract

***Background & Aims*:** Non-specific low back pain (NSLBP) is one of the most prevalent musculoskeletal issues, significantly impacting workers' quality of life and occupational productivity. This multifactorial condition arises from a combination of occupational, lifestyle, and individual factors. This study aimed to investigate the prevalence and associated factors of NSLBP among workers.

***Materials & Methods*:** This cross-sectional study was conducted on 406 participants, including 202 workers with NSLBP and 204 without. Demographic and occupational questionnaires, along with the Work Ability Index and Job-Related Physical Demands scales, were completed by all participants. Data were analyzed using descriptive and inferential statistical methods.

***Results*:** Significant associations were identified between longer weekly working hours ($p < 0.001$), lack of physical activity ($p = 0.001$), and exposure to occupational hazards ($p < 0.05$) and NSLBP. Workers exposed to these factors were at a higher risk of developing NSLBP.

***Conclusion*:** NSLBP is significantly associated with a combination of individual and occupational factors. The findings highlight the necessity of preventive interventions, including ergonomic workplace improvements, reduced weekly working hours, and the promotion of regular physical activity. These results can inform occupational health policies and enhance workers' quality of life. However, the study's limitations, including its cross-sectional design and relatively small sample size, should be considered when interpreting the findings.

***Keywords*:** Ergonomics, Low back pain, Occupational groups, Occupational health

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Introduction

Non-specific low back pain (NSLBP) is one of the most prevalent musculoskeletal disorders globally, significantly impacting individual health and occupational productivity. Over 80% of individuals experience back pain at least once in their lifetime,

making it a leading cause of healthcare visits and long-term disability (1). Unlike pain caused by specific pathologies, NSLBP is characterized as chronic or persistent pain without an identifiable underlying condition, profoundly affecting quality of life and workplace functionality (1, 2). The economic burden of NSLBP—resulting from increased healthcare expenditures and lost workplace efficiency—further underscores its significance as a public health concern (3).

Several factors contribute to NSLBP, broadly categorized into individual, occupational, and psychosocial determinants. Individual factors such as age, gender, and physical activity levels influence susceptibility to NSLBP. For example, aging is associated with muscle deterioration and reduced flexibility, increasing the risk, particularly in individuals over 50 years old (4-6). Gender-specific physiological differences also play a role, with women being more susceptible due to hormonal and anatomical variations (7, 8).

Occupational factors are critical contributors to NSLBP. Jobs involving repetitive movements, prolonged sitting or standing, and physically demanding tasks impose excessive strain on the spine and associated musculature (9, 10). Additionally, sedentary work environments significantly increase the likelihood of NSLBP, highlighting the importance of ergonomic workplace practices (11).

Psychosocial factors, such as workplace stress and job dissatisfaction, exacerbate NSLBP by inducing muscular tension and amplifying pain perception (12). Employees experiencing high levels of stress are more likely to develop chronic pain, underlining the interplay between psychological strain and musculoskeletal health (13).

Physical activity plays a preventive role against NSLBP. Regular exercise enhances core strength, spinal flexibility, and overall resilience to physical stressors (14, 15). Conversely, sedentary behavior weakens muscles and increases vulnerability to back pain (16).

While numerous studies have explored the prevalence and risk factors of NSLBP, few have comprehensively assessed these factors in a workforce setting using tools such as the Work Ability Index and Job-Related Physical Demands scales. This study bridges that gap by examining the interplay between occupational and individual factors in NSLBP among workers, providing a nuanced understanding that can inform targeted interventions. By identifying key risk factors, the findings will contribute to the development of evidence-based strategies to reduce NSLBP prevalence and its impact on occupational health.

Materials & Methods

Study Design

This cross-sectional study was conducted in 2023 and included 406 workers, comprising 202 individuals diagnosed with NSLBP and 204 without NSLBP. Participants were recruited based on inclusion criteria requiring at least 1 year of occupational experience and referral to an occupational medicine center in 2023. Exclusion criteria included spinal tumors, infections, acute spinal injuries, systemic inflammatory disorders, or recent spinal surgeries.

The diagnosis of NSLBP was made based on clinical evaluations conducted by occupational medicine specialists. This assessment included a detailed history and physical examination to identify pain lasting at least 12 weeks, localized between the lower rib margins and the gluteal folds, without an identifiable underlying pathology such as herniated discs, fractures, or systemic diseases. Workers without NSLBP were confirmed as asymptomatic through similar clinical evaluations, ensuring they had no history of persistent or recurrent low back pain in the past year.

The sample size was determined based on a preliminary estimate of NSLBP prevalence among workers, aiming to achieve sufficient statistical power (80%) to detect significant associations with a 95% confidence level. Using this calculation, a minimum sample size of 400 participants was estimated. Due to practical constraints, convenience sampling was employed for participant recruitment, which may introduce selection bias and limit the generalizability of findings to broader worker populations. This limitation

was acknowledged, and efforts were made to minimize bias by including a diverse group of workers from various industries and occupational backgrounds. Sampling continued until the target sample size was reached.

Data Collection

Participants completed a structured checklist that included demographic and occupational information such as age, gender, body mass index (BMI), education level, smoking status, physical activity, and underlying medical conditions (e.g., cardiovascular, endocrine, respiratory, renal, and gastrointestinal diseases). Objective measurements of height and weight were taken to calculate BMI. Occupational factors, including job type (blue-collar vs. white-collar) and working hours, were determined based on occupational health assessments. Participants were categorized into two distinct groups based on their work environment and job nature:

- Blue-collar workers: Individuals engaged in physically demanding, manual labor roles, typically in industrial, manufacturing, and construction sectors. These workers were exposed to various occupational hazards, including physical strain, machinery, chemicals, and environmental stressors. Their tasks often required hands-on involvement in manual work or production processes.
- White-collar workers: Individuals primarily working in office-based roles, involving administrative, managerial, or professional tasks. These workers generally had fewer physical demands in their job functions, focusing more on mental labor, problem-solving, and organizational tasks.

Exposure to occupational hazards and work ability was assessed using validated questionnaires:

- The Job-Related Physical Demands (JRPD) Questionnaire (17): This tool evaluates the intensity of exposure to occupational physical demands through 38 items assessing repetitive, improper, or heavy physical activities. Responses are categorized into four levels based on frequency and duration: Level 1: Less than 5 hours per week or never, Level 2: Less than 2 hours per day, Level 3: 2–4 hours per day, and Level 4: more than 4 hours per day. The total score ranges from 38 to 152, with higher scores indicating greater exposure to physically demanding and potentially harmful occupational activities.

For this study, scores of 43 and above were categorized as indicating significant exposure to occupational hazards. This cutoff point was selected based on Youden's Index, which optimizes the balance between sensitivity and specificity in differentiating between workers at risk and those not at risk for NSLBP. The choice was further informed by previous studies that validated this threshold for identifying meaningful exposure levels linked to musculoskeletal disorders, ensuring its applicability in occupational settings (18, 19). The JRPD questionnaire has demonstrated high reliability and validity, particularly in populations with low back pain (19).

- The Work Ability Index (WAI): This questionnaire measures work capacity relative to job demands, health status, and psychological resources. It consists of seven components, with a total score ranging from 7 to 49. Higher scores indicate better work ability, and results are categorized into four levels: poor (7–27), moderate (28–36), good (37–43), and excellent (44–49)

These cutoffs are widely recognized and were established through extensive validation studies involving diverse occupational groups. They provide a standardized assessment of workers' capacity to perform their jobs and help identify individuals at risk of reduced work ability (20). The WAI is extensively used in occupational health research and has been validated in various populations, including workers experiencing musculoskeletal issues.

Data Analysis

Descriptive statistics were used to summarize the data. Group comparisons for categorical variables were conducted using chi-square tests, while independent t-tests were used for continuous variables. Logistic regression analysis was performed to identify significant

predictors of NSLBP, adjusting for potential confounders. Statistical significance was set at $p < 0.05$. All analyses were performed using SPSS software, version 24.

Results

Participant Characteristics

This study included 406 workers, divided equally into a group with NSLBP (n = 202) and a group without NSLBP (n = 204). The majority of participants were male (68.2%), while females comprised 31.7% of the sample. Regarding job type, approximately 36% worked in physically demanding (blue-collar) jobs, while 64% held administrative (white-collar) positions. Most participants (90.6%) had only one job, while 9.4% reported holding a second job. Educational levels varied among participants: 23.8% had less than a high school diploma, 36% held a high school diploma, 11.3% had an associate degree, 21.4% had a bachelor's degree, and 7.3% held a master's or doctorate. Underlying health conditions were reported by only 5.5% of participants. Physical activity was observed in 61% of participants, while 39% reported low or no physical activity. A smoking history was reported by 22.6% of participants. Work ability was categorized as follows: excellent in 81% of participants, good in 16%, moderate in 3%, with no participants reporting poor work ability. Exposure to hazardous occupational activities was reported as: severe in 33%, moderate in 65%, and mild in 2% of participants. The mean participant age was 38.09 years (SD = 8.1), and the mean job tenure was 14.69 years (SD = 7.6). Daily work hours averaged 8.85 (SD = 1.8), while weekly work hours averaged 53.52 (SD = 12.8). The mean body mass index (BMI) was 25.90 kg/m² (SD = 2.8). Smoking consumption averaged 1.60 pack-years (SD = 3.7). The mean hazardous activity exposure score was 60.13 (SD = 20.5), while the mean work ability score was 46.60 (SD = 3.9).

Table 1 compares variables between the NSLBP and control groups. Participants with NSLBP had a higher prevalence of blue-collar jobs (53% vs. 19%, $p < 0.001$), lower physical activity levels (48% vs. 74%, $p < 0.001$), and greater exposure to hazardous activities (72.64 vs. 47.62, $p < 0.001$). Smoking was also more prevalent among NSLBP participants (36% vs. 10%, $p < 0.001$). Work ability scores were lower in the NSLBP group (45.56 vs. 47.65, $p < 0.001$).

Table 1. Comparison of study variables in groups with and without non-specific back pain (NSLBP)

Variable		NSLBP positive N = 202	NSLBP negative N = 204	*P* value	Odds ratio (95% CI)
		Number (percentage)			
Gender	Men	130 (64%)	147 (73%)	0.17	0.6 (0.3-1.2)
	Women	72 (36%)	57 (27%)		
Job	Blue collar	107 (53%)	39 (19%)	0.000	4.8 (2.5-9.0)
	White collar	95 (47%)	165 (81%)		
Having a second job	No	170 (84%)	198 (97%)	0.002	0.1 (0.04–0.5)
	Yes	32 (16%)	6 (3%)		
Education level	Undergraduate	49 (24%)	48 (24%)	0.67	
	Diploma	75 (37%)	71 (35%)		
	Associate degree	18 (9%)	28 (14%)		
	Bachelor degree	42 (21%)	45 (22%)		

Variable		NSLBP positive N = 202	NSLBP negative N = 204	*P* value	Odds ratio (95% CI)
	Master's degree/Ph.D	18 (9%)	12 (5%)		
Having an underlying disease	No	180 (89%)	204 (100%)	0.001	0.8 (0.83-0.95)
	Yes	22 (11%)	0 (0%)		
Physical activity	No	105 (52%)	54 (26%)	0.000	3.08 (1.7-5.5)
	Yes	97 (48%)	150 (74%)		
Smoking history	No	130 (64%)	184 (90%)	0.000	0.19 (0.09-0.42)
	Yes	72 (36%)	20 (10%)		
Work ability index	Poor	0	0	0.001	-
	Moderate	12 (6%)	0		
	Good	47 (23%)	19 (9%)		
	Excellent	143 (71%)	185 (91%)		
Exposure to harmful work activities	Mild	2 (1%)	6 (3%)	0.000	-
	Moderate	77 (38%)	187 (92%)		
	Severe	123 (61%)	11 (5%)		
Exposure to harmful work activities	No	6 (3%)	47 (23%)	0.000	0.1 (0.03–0.35)
	Yes	196 (97%)	157 (77%)		
		Mean (standard deviation)			
Age (years)		39.72 (8.2)	36.46 (7.8)	0.005	-
Work experience (years)		17.21 (8.2)	12.17 (6.1)	0.000	-
Working hours per day		8.96 (1.6)	8.74 (1.9)	0.39	-
Working hours per week		59.87 (12.2)	47.17 (9.9)	0.000	-
Body mass index (kg/m^2)		26.01 (2.8)	25.79 (2.8)	0.59	-
Amount of smoking (pack/year)		2.74 (4.7)	0.45 (1.7)	0.000	-
Exposure to harmful work activities(score)		72.64 (20.4)	47.62 (10.7)	0.000	-
Work ability index (score)		45.56 (4.5)	47.65 (2.9)	0.000	-

Logistic Regression Analysis

Logistic regression identified physical activity, weekly working hours, and hazardous activity exposure as significant predictors of NSLBP. Physical activity was protective (OR = 0.286, $p = 0.003$), while increased weekly working hours (OR = 0.911, $p < 0.001$) and

hazardous activity exposure (OR = 5.218, p = 0.021) were associated with a higher risk of NSLBP (Table 2). These findings underscore the multifactorial nature of NSLBP and the substantial impact of occupational and lifestyle factors.

Table 2. Logistic regression analysis

Variable	OR (95% CI)	*P* value
Job type	0.420 (0.171-1.047)	0.063
Second job	1.429 (0.271-7.541)	0.674
Smoking	1.255 (0.224-7.034)	0.796
Physical activity	0.286 (0.124–0.660)	0.003
Age	1.031 (0.956-1.112)	0.432
Job experience	0.927 (0.848-1.012)	0.091
Weekly work hours	0.911 (0.875–0.948)	< 0.001
Hazardous activity exposure	5.218 (1.288–21.131)	0.021

This study investigated the factors associated with NSLBP among workers, highlighting the significance of occupational, lifestyle, and physical activity-related risk factors. Our findings provide evidence that longer weekly working hours, lack of consistent physical activity, and exposure to hazardous occupational activities are significant contributors to NSLBP.

One notable finding was the lack of a significant association between daily working hours and NSLBP, despite a strong relationship with weekly working hours. This suggests that the cumulative burden of extended weekly hours, rather than daily shifts, plays a more critical role in fatigue and physical strain. Participants with NSLBP worked an average of nearly 60 hours per week, significantly exceeding the control group's average of 47 hours. This aligns with prior research (21, 22) indicating that prolonged weekly work schedules may exacerbate musculoskeletal strain and limit recovery time. Policies aimed at reducing weekly working hours, particularly to under 50 hours, could help mitigate this risk.

Physical activity emerged as a protective factor against NSLBP, with inactive participants being approximately three times more likely to develop NSLBP. Regular exercise, particularly flexibility and core-strengthening exercises, has been shown to improve spinal stability and resilience to physical stressors (23, 24). The protective effect aligns with Dean et al.'s findings that physically active individuals are less likely to develop back pain compared to sedentary individual (25). Worksite interventions promoting physical activity through ergonomic training and structured exercise programs could be effective in reducing NSLBP prevalence among workers.

Although smoking was more prevalent in the NSLBP group, with an odds ratio of 1.25, its contribution was not statistically significant in the adjusted model. This may indicate that the influence of smoking on NSLBP is indirect, potentially mediated by other occupational or health-related factors. Further research is needed to elucidate the mechanisms linking smoking and musculoskeletal health.

Our findings also revealed that exposure to hazardous occupational activities was strongly associated with NSLBP (OR = 5.21). This aligns with previous studies emphasizing the relationship between

physical occupational stressors and NSLBP (26). Workers exposed to repetitive motions, heavy lifting, or improper postures were at significantly higher risk, emphasizing the need for workplace ergonomic assessments. Specific interventions such as optimizing task design, providing lifting aids, and conducting regular ergonomic training sessions could reduce exposure to these risk factors.

Interestingly, psychosocial factors, although not directly measured in this study, warrant further consideration. Stress, job dissatisfaction, and negative perceptions about pain can amplify musculoskeletal symptoms. Future research should incorporate validated psychosocial measures to provide a more comprehensive understanding of their interaction with physical and occupational factors in NSLBP development.

Although aging has been associated with increased NSLBP risk in prior studies (27), our logistic regression analysis found no significant association after adjusting for confounders. This discrepancy may be due to the greater influence of weekly working hours, physical activity levels, and exposure to hazardous occupational activities in our study population.

Regarding job type, blue-collar workers exhibited a higher NSLBP prevalence than white-collar workers, consistent with Oakman et al.'s findings that physical job demands double the risk of NSLBP (26). However, the association did not remain significant in the logistic regression model, possibly due to the overriding impact of other occupational factors.

This study benefits from the use of validated tools, such as the JRPD and WAI, to comprehensively assess occupational and lifestyle factors. However, several limitations must be acknowledged. First, the cross-sectional design precludes causal inferences, limiting the ability to establish temporal relationships between risk factors and NSLBP. Longitudinal studies are needed to validate these findings and assess long-term outcomes. Second, the reliance on self-reported data may introduce reporting bias, particularly for variables like physical activity and smoking history. Objective measures could strengthen the reliability of future research. Finally, the use of convenience sampling and a relatively small sample size may limit generalizability, underscoring the need for larger, more representative samples in future studies.

Conclusion

This study identified critical occupational, lifestyle, and activity-related risk factors for NSLBP among workers. Tailored interventions are essential to address these factors effectively. Recommendations include reducing weekly working hours to under 50 hours, promoting regular flexibility and strength exercises, and implementing ergonomic improvements to minimize hazardous occupational exposures. Additionally, workplace wellness programs should integrate physical activity initiatives and stress management strategies to address the multifactorial nature of NSLBP. These targeted measures can enhance worker well-being, productivity, and quality of life.

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Authors' Contributions

Mashallah Aghilinejad and Negin Kassiri designed the study. Mostafa Farhadi and Mohammadreza Ganjedanesh collected data. Mashallah Aghilinejad, Negin Kassiri and Amir Bahrami Ahmadi supervised the data collection. Amir Bahrami Ahmadi, Mohammad Eslami and Mostafa Farhadi analyzed the data. Negin Kassiri, Mohammadreza Ganjedanesh and Mohammad Eslami wrote the article. All authors revised and approved the paper.

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Data Availability

All the data obtained from this study are included in the text of the article.

Conflict of Interest

The authors have no conflicts of interest associated with the material presented in this paper.

Ethical Statement

All participants provided informed consent, and their data were anonymized to maintain confidentiality. The study adhered to the principles of the Declaration of Helsinki. Ethical approval was obtained from Iran University of Medical Sciences (IR.IUMS.FMD.REC.1402.199).

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