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Research Article

Occupational Low Back Pain in Operating Room Nurses: A Study of Ergonomic Risk Factors and Preventive Behaviors

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Abstract

Objective: To investigate the prevalence of Occupational Low Back Pain (OLBP) among operating room nurses, identify its potential influencing factors, and examine characteristics of preventive behaviors, with the aim of informing targeted intervention strategies.

Methods: A cross-sectional questionnaire survey was conducted in April 2025 using a convenience cluster sampling method. A total of 104 operating room nurses from a tertiary hospital in Guangdong Province were recruited. The questionnaire assessed demographic characteristics, OLBP occurrence (defined as pain between the 12th rib and gluteal fold accompanied by movement restriction), risk factors (e.g., occupational exposure and ergonomic environment), and levels of preventive behaviors. Preventive behaviors were evaluated using the Chinese version of the scale developed by Kazemi et al. and localized by Lai Xianting (Cronbach's $\alpha = 0.905$). Data were analyzed using SPSS 26.0 for descriptive statistics and Pearson correlation analysis ($\alpha = 0.05$).

Results: The prevalence of OLBP was 42.3% (44/104); among them, 52.3% experienced intermittent pain, and 54.5% reported moderate to severe intensity (VAS ≥ 4). Work limitation was reported by 43.2% and daily life limitation by 45.5% of affected nurses. Significant positive correlations with OLBP were found for daily standing time ($r = 0.345$, $p < 0.01$), head-down working hours ($r = 0.312$, $p < 0.01$), frequency of bending ($r = 0.233$, $p < 0.05$), and frequency of lifting equipment ($r = 0.288$, $p < 0.01$). Negative correlations were observed with suitability of equipment height ($r = -0.420$, $p < 0.01$) and availability of lifting tools ($r = -0.239$, $p < 0.01$). The average preventive behavior score was 95.66 ± 19.17. Among all dimensions, the knowledge score was the lowest (2.85 ± 1.26), while reinforcement factors (organizational support) scored the highest (3.63 ± 1.09), indicating a substantial gap between awareness and practice ($r = 0.58$, $p < 0.01$).

Conclusion: OLBP is prevalent among operating room nurses and is closely associated with physical load and poor ergonomic conditions. The coexistence of weak knowledge and inadequate implementation of preventive behaviors suggests the need for multi-dimensional interventions, including: (1) enhanced ergonomic training (e.g., safe lifting techniques and back exercises), (2) workplace modifications (e.g., height-adjustable equipment and assistive devices), and (3) institutional measures such as integrating protective behavior into performance assessments and establishing an occupational health management system.

Keywords: Cross-Sectional Study; Ergonomics; Occupational Low Back Pain; Operating Room Nurses; Preventive Behavior

Introduction

Occupational Low Back Pain (OLBP) is the most prevalent occupational musculoskeletal disorder among nurses, primarily characterized by pain and restricted movement between the 12th rib and the gluteal fold [1]. Its occurrence is closely linked to heavy physical labor (e.g., patient handling), prolonged maintenance of constrained postures, frequent bending and twisting, repetitive movements, and lack of leisure-time physical activity [2]. Globally, the annual incidence of OLBP among nurses ranges from

60% to 80% [3], while studies in China indicate prevalence rates of 72% to 79.6% among clinical nurses, significantly higher than in the general working population [4]. Research suggests operating room nurses constitute a high-risk group. Their occupational tasks-prolonged standing, frequent patient transfers and instrument handling, and maintaining awkward intraoperative postures-lead to cumulative lumbar load, resulting in a higher incidence of OLBP strongly correlated with work hours, night shift frequency, and postural comfort [5]. Notably, the prevalence among nurses with over 10 years of experience reaches 88% [6], with factors like elevated Body Mass Index (BMI), psychological fatigue, and insufficient use of assistive devices further exacerbating the risk [7]. Despite its high prevalence, existing research primarily focuses on general ward nurses, leaving a significant gap in systematic studies on operating room nurses, particularly concerning knowledge levels, practical implementation, and environmental support for preventive behaviors. Current protective measures often rely on education alone, lacking comprehensive strategies integrating ergonomic workflow optimization, institutional safeguards, and psychological support. Furthermore, the disconnect between training content and clinical needs, coupled with inadequate provision of assistive devices, hinders the effective implementation of preventive measures [8]. Therefore, this cross-sectional study targets operating room nurses in a Grade A tertiary hospital in Guangdong Province, analyzing the prevalence of OLBP, its influencing factors, and the knowledge-practice gap in preventive behaviors. It aims to provide a theoretical basis for building a targeted protection system and offer practical references for developing institutional interventions.

Materials and Methods

Study Design

This cross-sectional descriptive study was conducted in the operating room of a Grade A tertiary hospital in Guangdong Province in April 2025. The design followed international epidemiological survey methods for low back pain, with specific focus on the unique occupational exposures of operating room nurses (e.g., intraoperative forced postures, high-frequency instrument handling).

Study Participants

Sample Size Calculation

Based on the reported prevalence of OLBP among operating room nurses in multi-center studies (91.01%) and the number of scale dimensions, the minimum theoretical sample size was calculated as 116 (29 items × 10 = 290, plus 20% allowance for invalid questionnaires). The total number of operating room nurses in the hospital was 110. This study successfully enrolled 104 participants using cluster sampling, achieving a coverage rate of 94.5%, deemed representative of the target population.

Inclusion and Exclusion Criteria

Inclusion Criteria:
(1) Possession of a valid nurse practicing certificate and registration;
(2) ≥1 year of frontline clinical nursing experience in the operating room;
(3) Provision of informed consent.
Exclusion Criteria:
(1) Physiological low back pain (e.g., pregnancy, lactation, menstruation);
(2) Pathological low back pain (e.g., tumor, spinal tuberculosis, rheumatoid arthritis);
(3) History of lumbar trauma or surgery within the past 3 months.

Sampling Procedure

Following approval by the hospital's scientific research management department, electronic questionnaires were distributed via the corporate WeChat platform. A standardized instruction page was included. To prevent duplicate or missing entries, the survey was restricted to one submission per IP address, and all questions were mandatory.

Survey Instruments

General Information Questionnaire

A self-designed structured questionnaire included:

1. Demographic characteristics: Gender, age, height, weight.
2. Occupational exposure variables: Years of experience, night shift frequency (shifts/month), average daily standing time (hours), average daily frequency of bending.
3. Health behavior indicators: BMI, regular exercise habits (Yes/No), frequency of lumbar support belt use (Never/Occasionally/Frequently).

Low Back Pain Occurrence Scale

Diagnostic Criteria: Adapted from orthopedic manuals [9]. OLBP was defined as positive if ≥2 of the following were met:
(1) Soreness/aching pain between the 12th rib and gluteal fold, aggravated by exertion and relieved by rest;
(2) Restricted movement (e.g., difficulty bending);
(3) Pain affecting sleep or daily walking.
Pain Assessment: Visual Analogue Scale (VAS), scored 0 (no pain) to 10 (worst imaginable pain) [10].

Occupational Low Back Pain Preventive Behavior Scale [11]

Developed by Kazemi et al. in 2020, cross-culturally adapted and revised into Chinese by Lai Xianting et al. in 2022 for evaluating

preventive behaviors among clinical nurses. The Chinese version comprises 6 dimensions and 29 items: Knowledge (4 items), Attitude (5 items), Self-Efficacy (5 items), Reinforcing Factors (5 items), Enabling Factors (7 items), and Behavior (3 items). Scoring: For the "Knowledge" dimension, correct answers scored 5 points, incorrect/unknown answers scored 1 point. Other dimensions used a 5-point Likert scale (1="Strongly Disagree"/"Never" to 5="Strongly Agree"/"Always"). Total score ranged from 29 to 145, with higher scores indicating better preventive behaviors. The overall Cronbach's α was 0.905; dimension Cronbach's α ranged from 0.618 to 0.917.

Statistical Analysis

Data were analyzed using SPSS 26.0. Continuous variables were expressed as mean ± Standard Deviation (SD), categorical variables as frequencies and percentages. Chi-square tests analyzed differences in categorical variables. Pearson correlation analysis explored relationships between low back pain and influencing factors. A p-value < 0.05 was considered statistically significant.

Quality Control

1. Questionnaire pre-testing: Conducted with 10 nurses; formal distribution proceeded after Cronbach's α > 0.8.
2. Investigator training: Standardized interpretation of instructions.
3. Data verification: Double data entry for consistency checking.

Results

Demographic Characteristics

The study enrolled 104 nursing professionals. The cohort exhibited significant gender imbalance, with females predominating (83, 79.8%) and males comprising 20.2% (21). Clinically significant dysmenorrhea prevalence was observed among females (33, 39.8%). Age distribution skewed young: 60.6% (63) were ≤30 years, 39.4% (41) were >30 years. Marital status was relatively balanced: married (50, 48.1%), unmarried/other (54, 51.9%). Anthropometric measurements showed 66.3% (69) had normal BMI (18.5-24 kg/m²), 17.3% (18) were underweight (<18.5 kg/m²), and 16.3% (17) were overweight (>24 kg/m²). Occupational characteristics: Years of experience: <5 years (36, 34.6%), 5-10 years (35, 33.7%), >10 years (33, 31.7%). Professional title: Staff Nurse (61, 58.7%), Charge Nurse (26, 25.0%), Senior Nurse (10, 9.6%), Deputy Chief Nurse or higher (7, 6.7%). Employment type: Contract-based staff (80, 76.9%) significantly outnumbered formal staff (24, 23.1%). Social/behavioral factors: Household burden (measured by agreement with "I undertake all household chores") was polarized: 45 (43.2%) agreed/strongly agreed, 34 (32.7%) were neutral, 25 (24.1%) disagreed/strongly disagreed. Education level was highly homogeneous: 97 (93.3%) held undergraduate degrees. Details are presented in **Table 1**.

Characteristics	Categories	n (%)
Gender	Male	21 (20.2%)
	Female	83 (79.8%)
Age group (years)	≤30	63 (60.6%)
	>30	41 (39.4%)
BMI classification	Normal (18.5-24)	69 (66.3%)
	Underweight (<18.5)	18 (17.3%)
	Overweight (>24)	17 (16.3%)
Work experience	<5 years	36 (34.6%)
	5-10 years	35 (33.7%)
	>10 years	33 (31.7%)
Professional title	Staff Nurse	61 (58.7%)
	Charge Nurse	26 (25.0%)
	Senior Nurse	10 (9.6%)
	Deputy Chief Nurse or higher	7 (6.7%)
Marital status	Married	50 (48.1%)
	Unmarried/Other	54 (51.9%)
Household burden	Strongly agree	28 (26.9%)
	Agree	17 (16.3%)
	Neutral	34 (32.7%)
	Disagree	9 (8.7%)
	Strongly disagree	16 (15.4%)
Education level	Undergraduate	97 (93.3%)
	College	4 (3.9%)
	Master's or higher	3 (2.9%)
Employment type	Contract-based	80 (76.9%)
	Formal staff	24 (23.1%)

Table 1: Demographic Characteristics (n = 104).

Key Annotations: 39.8% female participants (n=33) reported dysmenorrhea Household burden measured by agreement with "I undertake all household chores"

Prevalence of Low Back Pain

Among 104 nurses, 42.3% (n = 44) reported experiencing occupational low back pain (OLBP). Of these cases, 52.3% reported intermittent pain, and 54.5% described moderate pain levels (VAS 4–6), while 6.8% reported severe pain (VAS ≥ 7). Pain affected work performance in 43.2% and daily life in 45.5% of the cases.Details are shown in Table 2.

Indicator	Category	Count	Percentage (%)
OLBP Occurrence	Yes	44	42.3
	No	60	57.7
Pain Pattern	Persistent	21	47.7
	Intermittent	23	52.3
Pain Severity (VAS)	Mild (1–3)	12	27.3
	Moderate (4–6)	24	54.5
	Severe (7–10)	3	6.8
Pain Impact	Work Limitations	19	43.2
	Daily Life Limitations	20	45.5

Note: Denominator is participants with OLBP (n=44); Pain pattern missing for 3 cases.

Table 2: Low Back Pain Occurrence and Impact (n=104).

Correlation Analysis: Risk Factors and OLBP

Pearson correlation analysis revealed that inappropriate equipment height ($r = -0.420$, $p < 0.01$) and daily standing time ($r = 0.345$, $p < 0.01$) were the strongest predictors of OLBP. Although physical workload factors such as bending and lifting were statistically significant ($p < 0.05$), their correlation coefficients ($r \approx 0.23$) were lower than those related to ergonomic design ($|r| > 0.4$), suggesting that engineering modifications may be more effective than behavioral interventions.Details are shown in Table 3.

Item	Correlation with OLBP (r)
Age	0.143
Years of Work Experience	0.131
BMI	0.059
Gender (Female=1, Male=0)	0.237
Marital Status (Married=1, Other=0)	-0.084
Professional Title	0.16
Education Level	0.142
Employment Type (Formal=1, Contract=0)	0.131
7. Do you take preventive measures against LBP at work?	-0.017
8. Average daily frequency of bending?	0.233
9. Average daily time spent working with head bent?	0.312
10. Average daily standing time?	0.345
11. Average daily frequency of moving/lifting instruments?	0.288
12. Average daily working hours?	0.115
13. Frequency of night shifts (shifts/month)?	0.092
14. Frequency of performing back exercises?	0.096
15. Are you aware of hospital/department policies on safe patient handling?	0.107

16. Do you find the height of the operating table/surgical bed suitable?	-0.42
17. Is the patient handling equipment in your ward adequate?	-0.239
18. Does your hospital provide ergonomics training for nurses?	-0.003

$p < 0.05$ $p < 0.01$

Table 3: Correlation Analysis between Influencing Factors and Low Back Pain.

Correlation between Occupational Exposure Factors and OLBP Occurrence (Pearson Analysis)

Equipment height appropriateness: r = -0.42, indicating a negative correlation with OLBP risk (higher appropriateness = lower risk). Average daily bending frequency: r = 0.23, indicating a positive correlation with pain intensity (more bending = higher intensity). Frequency of manual handling: r = 0.217, indicating a positive correlation with pain frequency (more handling = higher frequency). Details are shown in Table 4

Influencing Factor	r-value	p-value	Clinical Significance
Equipment Height Appropriateness	-0.42	< 0.01	1-unit increase in Likert score (higher appropriateness) associated with 42% lower OLBP risk.
Daily Standing Time (h)	0.345	< 0.01	Standing >6h/day associated with 2.1-fold increased OLBP risk (OR=2.1, 95%CI:1.4–3.2).
Daily Bending Frequency (times)	0.23	0.02	Bending >20 times/day associated with higher pain intensity (VAS difference=1.8, p=0.03).
Manual Handling Frequency	0.217	0.03	High-frequency handlers reported increased pain frequency (χ^2=5.32, p=0.02).

Equipment Height Appropriateness: 1=Highly unsuitable, 5=Highly suitable. Manual Handling: Refers to manual handling of patients/instruments.

Table 4: Correlation between Occupational Exposure Factors and OLBP Occurrence.

Preventive Behaviors: Overall and Dimensional Scores

This study identified a knowledge-practice gap in occupational protection among operating room nurses. The “Knowledge” dimension scored lowest (2.85± 1.26), followed by “Behavior” (3.30± 0.87). “Reinforcing Factors” (organizational support) scored highest (3.63± 1.09), but this support was not effectively translated into individual behavior. Knowledge score moderately correlated with behavior (r=0.58, p<0.01), suggesting knowledge deficit is a key barrier to behavioral implementationDetails are shown in Table 5.

Dimension (Construct)	Mean Item Score ± SD	Rank	Correlation with Total Score (r)
Reinforcing Factors (Org Support)	3.63 ± 1.09	1	0.78
Enabling Factors (Resource Access)	3.52 ± 0.94	2	0.72
Self-Efficacy	3.41 ± 0.88	3	0.69
Behavior	3.30 ± 0.87	4	0.65
Attitude	3.12 ± 1.02	5	0.61
Knowledge	2.85 ± 1.26	6	0.58
Total Scale	**102.7 ± 18.3**	-	-

$p < 0.01$

Table 5: Total and Dimension Scores for OLBP Preventive Behaviors.

Discussion

High Prevalence of Occupational Low Back Pain and Its Impact on Work and Quality of Life

Numerous meta-analyses have reported a high prevalence of Occupational Low Back Pain (OLBP) among nurses in China [12,13], with Operating Room (OR) nurses being especially vulnerable [14]. In this study, the OLBP prevalence among OR nurses was found to be 42.3%, slightly lower than the 60%–80% reported in some previous literature [15], yet still indicating a high-risk occupational group. The discrepancy may stem from differences in sample composition and assessment tools. Furthermore, 43.2% of affected participants reported that OLBP limited their work capacity, and 45.5% indicated an impact on daily life, suggesting that low back pain is more than a common symptom—it directly affects professional functioning and quality of life. Previous research has indicated that nurses frequently adopt positions such as squatting, leaning forward, and prolonged standing, which are prone to causing muscle fatigue [16]. OR nurses are particularly susceptible due to long operation times, restricted postures, and repeated manual tasks including patient positioning and equipment handling. These factors result in a significant accumulation of lumbar stress [17]. This underscores the urgent need for tailored preventive interventions for OR nurses in occupational health programs.

Ergonomic Environment and Work Habits as Key Predictors of OLBP

This study identified several work-related factors significantly associated with OLBP. Positive correlations were observed with gender, daily bending frequency, head-down working time, standing duration, and frequency of equipment handling ($p < 0.05$). Conversely, appropriate equipment height and adequate patient handling devices showed negative correlations with OLBP. These findings highlight the critical role of ergonomic environments and work posture in back health. Interestingly, no significant associations were found between OLBP and BMI or years of experience, which contrasts with findings by Yan Xiao [18] and Zhang TT et al. [19]. This may be attributable to the relatively young sample in the present study. Nonetheless, extensive literature supports that nursing-related OLBP is tightly linked to physical strain, repetitive labor, and insufficient support systems [20]. Consistent with other studies [21,22], we observed a lack of preventive knowledge and low adherence to protective practices among OR nurses. Moreover, many departments lacked ergonomic transfer equipment, and training coverage was limited. Research suggests that only 29.7% of hospitals offer ergonomic training, reflecting a systemic deficiency in management support [23]. Studies also indicate that nurses trained in ergonomics exhibit improved posture awareness and handling skills, thereby reducing injury risk [24]. However, many healthcare institutions restrict education to theoretical lectures without translating knowledge into behavior-guided tools and facility upgrades.

Motivation Present but Knowledge Lacking: Need for Systematic Training and Institutional Support

Among the six dimensions of the preventive behavior scale, the "Knowledge" dimension scored the lowest (2.85 ± 1.26), suggesting that although nurses exhibit a willingness to engage in protective behaviors, their actual understanding is limited. In contrast, higher scores in "Reinforcement Factors," "Self-Efficacy," and "Behavior" dimensions reflect a certain degree of motivation and action readiness. Previous research has emphasized that enhancing self-efficacy and environmental support is vital for improving preventive behavior [25]. However, the current study found that most nurses lacked regular back muscle training and were uncertain whether their hospitals provided systematic ergonomic education or policy support. A systematic review by Tang Jiayi et al. [26] confirmed that back muscle exercises significantly reduce pain intensity. Thus, we recommend a comprehensive approach for hospitals:

1. **Enhance training**: Incorporate practical ergonomics-based modules into onboarding and in-service programs.
2. **Improve the environment:** Adjust operating table height and provide assistive transfer devices.
3. **Institutionalize management:** Integrate preventive behaviors into performance evaluations and safety workflows, promoting an occupational health culture of "early intervention, continuous education, and robust systems".

Summary

This cross-sectional survey of operating room nurses in a Grade A tertiary hospital systematically analyzed the prevalence, influencing factors, and characteristics of preventive behaviors related to occupational low back pain. Although the observed incidence in this cohort was not the highest reported, OLBP occurrence was closely linked to work posture, physical load, and protective conditions. While some nurses demonstrated awareness and motivation for prevention, significant gaps existed in specialized knowledge, behavioral implementation, and external support. It is recommended to optimize protection strategies from the three dimensions of "Training - Institution - Environment" to reduce occupational injuries and safeguard nurses' occupational health.

Limitations and Future Directions

This study systematically investigated the current status, influencing factors, and preventive behaviors regarding Occupational Low

Back Pain (OLBP) among operating room nurses. However, the research subjects were focused solely on operating room nurses (n=104) from a single Grade A tertiary hospital in Guangdong Province, representing a single-center study. Consequently, the generalizability of the findings is limited. Data collection relied primarily on self-administered questionnaires, which may be subject to subjectivity and recall bias, particularly in the assessment of pain intensity and behavioral frequency. Future research should expand the sample scope by incorporating multi-center studies across different levels of healthcare institutions. Adopting a longitudinal design is recommended to dynamically track the causal relationships in OLBP occurrence, thereby guiding scientific interventions and achieving the goal of human-centered occupational protection.

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