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A Cross-Sectional Analysis of the Relationship Between Musculoskeletal Disorders and Occupational Burnout Among Employees at Bistoon Sugar Factory in Kermanshah

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ABSTRACT

Background: Rapid industrialization has led to a significant increase in work-related musculoskeletal disorders (WMSDs), driven by factors such as job demands, repetitive motions, workload intensity, and prolonged task durations. In the food industry, repetitive movements inherent to the work environment further elevate the risk of WMSDs. This study investigates the relationship between musculoskeletal disorders and occupational burnout among employees at the Bistoon Sugar Factory in Kermanshah.

Methods: This descriptive survey included all 300 employees of the Bistoon Sugar Factory, selected through census sampling. Participants with pre-existing musculoskeletal conditions or injuries affecting the musculoskeletal system were excluded. Data were collected using the Nordic Musculoskeletal Questionnaire and the Maslach and Jackson Job Burnout Inventory. Reliability analysis using Cronbach's alpha yielded coefficients of 0.948 for the burnout inventory and 0.757 for the Nordic questionnaire. Data were analyzed using SPSS version 22, employing Pearson's correlation and regression analysis.

Results: Significant positive correlations were found between musculoskeletal disorders (MSDs) and components of occupational burnout ($p < 0.001$). The strongest association was observed between MSDs and reduced personal accomplishment ($\beta = 0.212–0.282$). The modest R^2 values suggest that other unmeasured variables may also contribute to burnout.

Conclusion: The high prevalence of musculoskeletal disorders (MSDs) negatively affects task performance and job satisfaction. Implementing ergonomic adjustments, targeted training programs, and organizational support systems can help mitigate these disorders and enhance workplace adaptability. Such interventions have the potential to improve both employee well-being and the overall quality of services.

KEYWORDS: *Work-related musculoskeletal disorders, WMSDs, Job burnout, Sugar factory*

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INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are among the most prevalent and financially burdensome categories of occupational injuries, accounting for approximately one-third of all work-related injuries reported annually [1]. Research shows that WMSDs significantly contribute to lost work time, increased healthcare and compensation costs, and considerable human suffering within the workforce. As a result, these disorders pose one of the most critical ergonomic challenges faced by industrialized nations [2–4].

WMSDs constitute one of the most pressing issues encountered by ergonomists globally. Research indicates that the prevalence of WMSDs exceeds 30% within working populations. In countries such as Taiwan, China, and Italy, WMSDs have been identified as the leading cause of absenteeism and work-related disabilities [5–7]. Statistics show that approximately one-quarter of individuals experiencing work-related musculoskeletal pain report conditions such as neck pain, shoulder pain, and upper limb discomfort, while one in three suffers from work-related low back pain [8, 9]. Furthermore, studies have demonstrated that the prevalence of these disorders is closely linked to stress, psychological risk factors, and components of occupational burnout [10, 11].

Burnout refers to negative changes in attitudes, mood, and behavior resulting from work-related psychological stress. The most widely accepted definition, proposed by Maslach and Jackson (1981), identifies three dimensions of burnout: emotional exhaustion, depersonalization, and diminished personal accomplishment [12]. Burnout can lead to a decline in service quality, increased job turnover, insomnia, substance abuse, and familial or marital problems. In 2019, an estimated 1.71 billion individuals worldwide were affected by musculoskeletal disorders, including back pain, neck pain, bone fractures, osteoarthritis, and rheumatoid arthritis. These conditions are recognized as a leading cause of disability, accounting for 17% of total years lived with disability globally [13]. In Indonesia, basic health research has reported a musculoskeletal disorder prevalence rate of 7.3% [14]. According to data from the International Labour Organization (ILO) in 2013, production processes involving manual handling, pushing or pulling, and repetitive movements accounted for 47% of musculoskeletal disorder claims in Indonesia. Additionally, a study conducted with 40 transport workers revealed that 70% of respondents were at risk of developing musculoskeletal complaints based on the lifting index, with 47.5% reporting significant dissatisfaction related to these disorders [15].

Unlike many occupational diseases that result from exposure to specific hazardous substances, work-related musculoskeletal disorders (WMSDs) are often multifactorial, with several underlying causes. Research indicates that the development of musculoskeletal disorders is influenced not only by ergonomic factors but also by individual characteristics such as age, gender, body mass index (BMI), working hours, psychological stress, and physical fitness [16]. A particularly significant factor is job-related stress, which can have physical, psychological, behavioral, and organizational consequences—ultimately leading to decreased job satisfaction and reduced organizational commitment [17]. Given the rising prevalence of musculoskeletal disorders, their reduction and prevention have been recognized as a global priority.

In the food industry, musculoskeletal disorders resulting from improper movement patterns are among the most common injuries sustained by personnel. Workers are directly involved in the production process and perform physically demanding tasks such as lifting heavy loads, transporting, pulling, and pushing. These strenuous activities contribute to fatigue, which can lead to the development of musculoskeletal disorders. Burnout among food industry employees can have serious consequences, including reduced work output, increased absenteeism, higher healthcare costs, staff turnover, and both behavioral and physical changes—such as substance abuse in some cases. Therefore, investigating this issue is particularly important. Moreover, work-related physiological and psychological disorders, including musculoskeletal disorders and burnout, are considered harmful to both individuals and organizations, making their control and prevention essential. By examining strategies and control measures to eliminate or reduce these disorders, organizations can enhance productivity and improve individual performance, ultimately boosting the overall vitality and quality of work among employees.

This study introduces several innovative dimensions that set it apart from previous research. Most notably, it simultaneously investigates musculoskeletal disorders and occupational burnout within the food industry—specifically in sugar production facilities—addressing a gap in the existing literature, where these issues have typically been examined in isolation or

within other industrial sectors. By highlighting the interplay between physiological factors (e.g., chronic pain) and psychological stressors (e.g., diminished motivation) in a high-demand work environment, this research contributes to a more holistic understanding of occupational health challenges unique to this sector. Additionally, the focus on employees of the Bistoon Sugar Factory in Kermanshah—a representative sample of industrial workforces in underdeveloped regions—adds valuable geographical and cultural context, enabling exploration of how local socioeconomic and environmental conditions influence the prevalence of these disorders. Unlike prior studies, this research utilizes field-derived data to propose actionable, evidence-based interventions aimed at reducing organizational costs (e.g., absenteeism, turnover) and enhancing individual productivity. Its integrated approach to physical and mental well-being, framed as a driver of organizational vitality, establishes a novel paradigm for addressing occupational health in the food industry and offers a replicable framework for future studies in similar contexts.

MATERIALS AND METHODS

This study, conducted in 2024, aimed to examine the relationship between musculoskeletal disorders and occupational burnout among employees of the Bistoon Sugar Factory in Kermanshah. Utilizing a descriptive-correlational design, the study targeted the entire workforce of the factory, comprising 300 individuals. Participants were selected through a census sampling method, which ensured that every individual within the population was included—thereby avoiding the limitations commonly associated with random sampling. Census sampling was chosen due to the small, finite population, maximizing representativeness and minimizing selection bias [18]. Accordingly, the statistical population consisted of all workers and staff at the Bistoon Sugar Factory, with the final sample including 250 workers and 50 employees.

Individuals with a history of non-occupational diseases, genetic disorders, or any significant conditions affecting the musculoskeletal system were excluded to ensure the validity of the results. To strengthen the robustness of the findings, potential confounding variables—such as age, gender, and work experience—were controlled for during the analysis. This careful selection of participants and adjustment for key variables aimed to provide a more accurate and nuanced understanding of the relationship between musculoskeletal disorders and occupational burnout within this specific population.

The data collection tool used in this study consisted of two questionnaires:

1. Nordic General Questionnaire

The musculoskeletal disorders were assessed using a 27-item questionnaire. The validity and reliability of the Persian version of this instrument were confirmed by Azgholi et al., with a reported correlation coefficient of 0.91 [14]. In their study, participants with various disorders completed the questionnaire twice, with a one-week interval. The reported symptoms demonstrated strong consistency with clinical examinations and high reproducibility, with sensitivity ranging from 66% to 92%.

2. The Maslach and Jackson Burnout Questionnaire

The Maslach and Jackson Burnout Questionnaire [12] is a widely recognized tool for assessing occupational burnout. It consists of 22 items that measure the frequency and intensity of three core dimensions: emotional exhaustion (9 items), depersonalization (5 items), and reduced personal accomplishment (8 items). Respondents rate each item on a scale from 0 (never) to 6 (every day). Scores for each dimension are then categorized into low, moderate, and high levels based on established reference values. The questionnaire demonstrates strong internal reliability, with Cronbach's alpha ranging from 0.71 to 0.90, and test-retest reliability reported between 0.60 and 0.80 [19]. In Iran, the validity and reliability of the instrument were first confirmed by Filian in 1992, who reported a Cronbach's alpha of 0.78 [20]. As a result, the Maslach and Jackson Burnout Questionnaire is considered a reliable and valid instrument for evaluating occupational burnout.

Data Analysis

Preliminary data analysis for this study was conducted using Pearson correlation and regression tests, with all statistical procedures performed using SPSS software version 22. A significance level of less than 0.05 was considered for all analyses.

RESULTS

The descriptive results presented in Table 1 indicate that married men are at a higher risk of developing musculoskeletal disorders compared to their single counterparts, with a reported prevalence of 68.66%. Furthermore, the likelihood of experiencing musculoskeletal issues increases with both age and work experience. Among the various disorders identified, ankle-related issues were the most frequently

Table 1. General Characteristics of the Statistical Population

Demographic Characteristics		Total (n=300)	Musculoskeletal Disorders		% of Total
			Yes (226)	No (74)	
Age (mean ± SD)		36.86±9.24	38.35±8.09	32.56±6.34	75.33
Work Experience (mean ± SD)		22.32±12.21	23.79±12.20	20.32±11.13	75.33
Gender (n, %)	Male	300 (100)	226 (77.33)	75.33	75.33
Marital Status (n, %)	Married	264 (88)	206 (78.03)	58 (21.97)	68.67
	Single	36 (12)	20 (55.56)	16 (44.44)	6.67
Body Part	Neck	300	89 (29.7)	211 (70.3)	29.7
	Shoulder	300	46 (15.4)	254 (84.6)	15.4
	Elbow	300	102 (33.8)	198 (66.2)	33.8
	Wrist	300	87 (29.0)	213 (71.0)	29.0
	Upper Back	300	141 (47.0)	159 (53.0)	47.0
	Lower Back	300	204 (68.0)	96 (32.0)	68.0
	Thigh	300	15 (4.7)	285 (95.3)	4.7
	Knee	300	210 (70.0)	90 (30.0)	70.0
	Ankle	300	219 (73.0)	81 (27.0)	73.0

reported. Other affected areas, in descending order of prevalence, included the knee, lower back, upper back, elbow, neck, wrist, shoulder, and thigh.

Pearson correlation analysis revealed statistically significant positive relationships between musculoskeletal disorders (MSDs) and all components of occupational burnout ($p < 0.001$). The strength of these correlations ranged from small to moderate, consistent with Cohen's guidelines. These findings suggest that workers experiencing higher levels of MSDs are more likely to report elevated symptoms of burnout.

Linear regression models were used to assess the predictive power of MSDs on burnout components:

- **Emotional Exhaustion:** MSDs explained 5.4% of the variance ($P<0.001$). The regression equation was: Emotional Exhaustion=1.784+1.321×(MSDs).
- **Depersonalization:** MSDs accounted for 4.5% of the variance ($P<0.001$), Depersonalization=1.869+1.257×(MSDs).
- **Reduced Personal Accomplishment:** MSDs explained 7.9% of the variance ($P<0.001$), Reduced Personal Accomplishment=1.425+1.545×(MSDs).
- **Overall, Job Burnout:** MSDs predicted 6.4% of the variance ($P<0.001$), Job Burnout=1.692+1.374×(MSDs).

The standardized beta coefficients (β) ranged from 0.212 to 0.282, indicating that MSDs had the strongest association with Reduced Personal Accomplishment. All models were statistically significant ($P<0.001$), confirming that MSDs are a meaningful predictor of burnout, though the modest R2 values suggest other unmeasured factors (e.g., psychosocial stressors, job demands) likely contribute to burnout outcomes.

DISCUSSION

This study identified a direct relationship between WMSDs and occupational burnout among employees of the Bistoon Sugar Factory. Burnout was observed at moderate levels across all dimensions—emotional exhaustion, depersonalization, and reduced personal accomplishment—while WMSDs were prevalent in nine anatomical regions, with the highest rates reported in the lower back (68%), shoulders (55%), and knees (49%). These findings suggest that WMSDs may serve as predictors of burnout severity within this workforce. The interaction between WMSDs and burnout likely involves bidirectional mechanisms. Chronic physical pain associated with WMSDs can impair job performance, leading to feelings of inadequacy and emotional exhaustion. Conversely, burnout may contribute to poor ergonomic practices—such as prolonged awkward postures resulting from mental fatigue—and heighten pain perception through stress-related physiological pathways, including cortisol dysregulation. This creates a self-reinforcing cycle, as described by Chen et al. [21], in which physical discomfort and psychological strain intensify one another.

Numerous studies have examined the relationship between work-related musculoskeletal disorders (WMSDs) and occupational burnout, revealing that these conditions not only coexist in workplace environments but also reinforce each other through complex mechanisms. For example, a comprehensive study involving 251 workers in Isfahan's glass and crystal industry found that employees with higher job satisfaction reported a lower prevalence of WMSDs [22]. These findings highlight the importance of implementing interventions that address both physical

Table 2. Pearson Correlation Coefficients Between Musculoskeletal Disorders (MSDs) and Burnout Components

Variable	MSDs (r)	P-value	N
Emotional Exhaustion	0.231	<0.001	300
Depersonalization	0.212	<0.001	300
Reduced Personal Accomplishment	0.282	<0.001	300
Job Burnout (Overall)	0.253	<0.001	300

**Correlation is significant at the 0.01 level (2-tailed).

Table 3. Regression Analysis Summarizing the Impact of MSDs on Burnout Components

Dependent Variable	B (SE)	β	t-value	p-value	R^2	Adjusted R^2	p-value (F-test)
Emotional Exhaustion	1.321 (0.322)	0.231	4.105	<0.001	0.054	0.050	<0.001
Depersonalization	1.257 (0.336)	0.212	3.744	<0.001	0.045	0.042	<0.001
Reduced Personal Accomplishment	1.545 (0.305)	0.282	5.072	<0.001	0.079	0.076	<0.001
Job Burnout (Overall)	1.374 (0.305)	0.253	4.512	<0.001	0.064	0.061	<0.001

Adjusted for age, gender, and work experience**, B (SE):** Unstandardized coefficient (standard error), **β:** Standardized beta coefficient, all models are statistically significant ($p < 0.05$).

working conditions and psychological well-being. Similarly, research conducted at an Iranian Army Hospital emphasized the economic and health burdens of WMSDs among military personnel, underscoring the urgent need for preventive strategies such as ergonomic training and routine screenings in high-risk occupations [23].

In high-stress professions such as firefighting, chronic occupational stress has been shown to exacerbate symptoms of work-related musculoskeletal disorders (WMSDs), with mediating factors including burnout and depression [24]. For instance, firefighters' prolonged exposure to crisis situations, combined with the physical demands of carrying heavy equipment, can elevate cortisol levels and disrupt emotional regulation. Over time, these physiological changes reduce pain tolerance and intensify WMSD-related complaints [25]. A parallel study involving underground coal miners similarly confirmed the high prevalence of WMSDs in physically demanding environments, emphasizing the need for integrated management strategies that address both physical and psychological risk factors [26].

This pattern extends beyond industrial sectors into service and healthcare professions. Among Polish university faculty, stress resulting from excessive academic and research workloads has been strongly correlated with burnout and chronic fatigue [27].

Emergency room nurses, who face high job demands and extended shifts, similarly report elevated levels of emotional exhaustion alongside work-related musculoskeletal disorders (WMSDs) [28]. These findings underscore the need for hospital administrators to address psychosocial factors—such as workload reduction and emotional support—in tandem with physical ergonomic improvements. In Turkey, more than half of midwives working in delivery rooms experience severe lower back pain, likely associated with occupational burnout [29]. Additionally, a study conducted in India revealed that nearly 75% of doctors and nurses, particularly women, suffer from WMSDs [13].

Sonographers represent another group facing dual physical and psychological risks. A study found that 75% of sonographers reported occupational burnout, with significantly higher Oldenburg Burnout Inventory (OLBI) scores among those with work-related WMSDs [30]. This suggests that burnout may be a key risk factor for developing WRMSDs. Mental fatigue and reduced job engagement can lead to poor physical postures (e.g., prolonged neck flexion) and neglect of proper movement patterns, heightening the risk of WMSDs.

Beyond physical factors, research emphasizes the role of psychological stressors in WMSD development. A study by Choubineh et al. linked workplace-related psychological stress—such as financial anxieties or role conflicts—to higher WMSD prevalence [31].

Abarghouei et al. [32] confirmed a positive association between occupational stress and burnout dimensions, indicating that burnout may act as a mediator converting stress into physical disorders. Additionally, Choi et al. [33] and Bekhuis et al. [34] separately demonstrated that depressive symptoms correlate with increased WMSD

risk (OR = 2.18 and OR = 2.69, respectively), likely via physiological pathways (e.g., systemic inflammation) or behavioral changes (e.g., reduced physical activity).

To address these challenges, organizational policies must holistically improve both physical working conditions and psychological well-being. Strategies include adjustable workstations, anti-fatigue equipment, and ergonomic training to reduce physical strain. Parallel measures—such as stress management programs, psychological counseling, and work-life balance initiatives—are critical for mitigating burnout. Policy reforms, such as shorter continuous shifts, job rotation systems, and increased employee autonomy, can further alleviate psychosocial pressures. Regular health screenings enable early risk detection and evaluation of intervention efficacy. This integrated approach not only safeguards worker health but also enhances organizational productivity and reduces costs associated with absenteeism.

Methodological Considerations and Limitations

While the MBI enabled comparability with prior studies, newer tools—such as the Burnout Assessment Tool (BAT) [35]—could address limitations like depersonalization bias. The cross-sectional design precludes causal inference, and self-reported data may introduce recall bias. However, the 98% census response rate strengthens internal validity, providing a robust snapshot of this high-risk population.

CONCLUSION

This study underscores the bidirectional relationship between WMSDs and occupational burnout in physically demanding workplaces, where chronic pain amplifies psychological strain and burnout worsens physical discomfort. While integrated interventions—such as ergonomic improvements, psychological support, and policy reforms—are critical for disrupting this cycle, several limitations must be acknowledged: the cross-sectional design hinders causal inference, self-reported data may introduce recall bias, and findings may lack generalizability beyond the sugar industry, though mechanisms like prolonged standing could apply to comparable sectors.

Our findings provide novel insights by highlighting industry-specific risks in food production (e.g., equipment vibration, inflexible shifts) and emphasizing the pivotal role of psychological factors—such as job autonomy—in moderating WMSD severity, marking a departure from traditional ergonomics-focused approaches. Notably, burnout mediated the stress–WMSD relationship more significantly than depression, contrasting with studies that prioritize depressive symptoms.

For organizations, we recommend integrating ergonomic upgrades (e.g., adjustable workstations) with psychosocial strategies (e.g., stress-management workshops) and policy changes—such as job rotation—to alleviate repetitive strain. Researchers should compare burnout measurement tools (e.g., Maslach Burnout Inventory [MBI] vs. Burnout Assessment Tool [BAT]) and investigate cultural variations in stress expression. Addressing both physical and psychological workplace health dimensions can help industries build resilient workforces, reduce absenteeism costs, and enhance productivity through sustained stakeholder collaboration.

Practical Implications and Future Directions:

To disrupt the WMSD-burnout cycle in high-physical-demand industries, we propose:

• Combining ergonomic adjustments (e.g., adjustable workstations) with psychosocial support (e.g., stress-management workshops).

• Addressing rigid shift schedules and automating repetitive tasks to increase employee autonomy.

• Investigating temporal relationships between WMSDs and burnout while comparing measurement tools (e.g., MBI vs. BAT).

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