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The risk Factors for the Prevalence of Work-Related Musculoskeletal Disorders among Construction Workers: A Review

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Abstract

Construction trades are considered to be at high risk for work-related musculoskeletal disorders (WRMSDs) due to their nature. Previous reviews have addressed various risk factors for developing WRMSDs among construction workers. However, the results appear insufficient because proper evidence was not reported. Therefore, this current review aims to summarize the occurrence rates of WRMSDs and quantify the relationships between various risk factors and WRMSDs among construction workers. Literature searches were conducted through the following six electronic databases from 2000 to 2022: ScienceDirect, PubMed, Web of Science, Google Scholar, ResearchGate, and Medline. Selected articles were classified as having a strong, moderate, limited, and no effect, respectively, based on their association with WRMSDs. From the selected 66 articles, the highest occurrence rates of WRMSDs were found in construction workers (ranging from 33% to 89%). There were several significant risk factors for developing WRMSDs in construction workers, including age, working experiences, awkward working postures, vibration, repetitive body movement, manual material handling, biomechanical stress, and physical fatigue. However, most of the study was conducted through a cross-sectional survey to investigate the relationships between these risk factors and WRMSDs in construction workers. Experimental, longitudinal, and real-time task-based studies can be conducted to determine the insights on risk factors and WRMSDs among construction workers. This study may help improve awareness about risk factors for developing WRMSDs among construction workers.

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ıctors, Work-related musculoskeletal disorders, Prevalence, Construction workers

1 | Introduction

Work-related musculoskeletal disorders (WRMSDs) refer to injuries and pains affecting in the joints, tendons, muscles, ligaments, cartilage, and blood vessels [1],[2]. Due to their exposure to ergonomic risk factors, construction workers are at a high risk of developing WRMSDs. Globally, the incidence of WRMSDs among construction workers is significantly elevated [3]. For instance, the occurrences rates of WRMSDs among construction workers in various countries were as follows: Saudi Arabia (12-month prevalence)[4] at 48.5%, Taiwan (12-month prevalence)[5] at 68%, Malaysia (12-month prevalence)[6] at 67.7%, Hong Kong

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(3-month prevalence)[7] 41%, Pakistan (7-day prevalence)[8] 89%, and Nigeria (7-day prevalence)[9] at 87.3%. According to recent findings, approximately 77% of American construction workers reported at least one body part disorder the previous year [10].

In addition to causing physical discomfort, WRMSDs may lead to increased work absenteeism and financial burdens for construction workers [11]. Bhattacharya found that the US construction industry authorities spend over $400 million annually on workers' compensation [12]. It has been revealed that approximately 85% of sick leave cases in the Swedish construction industry are related to WRMSDs [13]. The rate of injuries due to WRMSDs among construction workers is the highest when compared to other sectors, at 45 per 10000 workers [14]. These statistics clearly demonstrate the association between WRMSDs and productivity in the construction industry.

According to the Occupational Safety and Health Administration (OSHA), several risk factors, including repetitive movement, vibrations, awkward working postures, excessive force, contact stress, air temperature, and manual material handling, can lead to the development of WRMSDs [14]. Due to the nature of their jobs, construction industry workers are frequently exposed to various physical stressors, which may raise the risk of WRMSDs development. Abnormal working postures among construction workers are also known contributors to WRMSDs development. Individual factors, such as age, working experiences, and job type, can also induce WRMSDs among construction workers [4],[15]. Researchers have revealed that the lower back, neck, and upper extremities are the most affected body parts [16], [17]. During overhead work, construction workers often experience shoulder and neck pain [18]. This discomfort is attributed to vibrations from machines and non-neutral body postures [18]. However, researchers have recommended various reliable risk assessment techniques to identify construction workers at risk of developing WRMSDs [19].

Using proper tools, equipment, and postures can help mitigate awkward working habits. To reduce the detrimental effects of job hazards on the development of WRMSDs in construction workers and minimize physical risk exposures associated with WRMSDs, both the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) have recommended general ergonomics regulations [20]. Authors have also recommended identifying potential risk factors for WRMSDs at the beginning stages [21]. However, different construction trades are associated with distinct types of risk factors, making it essential to identify the trades-specific risk factors to establish appropriate occupational strategies.

Despite recent literature comparing and summarizing prevalence estimates of WRMSDs and evidence for relationships between physical and psychological risk factors and WRMSDs in construction workers from various trades [22], it did not include a summary of the relationship between individual factors and other biomechanical factors and WRMSDs in construction workers. The current review study aims to review the prevalence rates of WRMSDs and determine the levels of effect concerning the associations between various individual, ergonomic, and other risk factors and WRMSDs among construction workers, with the aim of supporting the current occupational guidelines for workers in this industry.

2 | Methods

2.1 | Searching approach

In this study, the authors conducted searches and reviewed articles from six specific electronic databases: ScienceDirect, PubMed, Web of Science, Google Scholar, ResearchGate, and Medline. Peer-reviewed journals, conference proceedings, case studies, and review articles were searched from 2000 to 2022 using the primary keywords: risk factors, musculoskeletal disorders, and construction workers. The search spanned from November 2022 to May 2023. Each article's title and abstract were used to determine its inclusion in the current study, followed by a thorough reading of the selected manuscripts. There were no language restrictions during the initial search, and a database was formed using the retrieved articles.

2.2 | Study inclusion and exclusion criteria

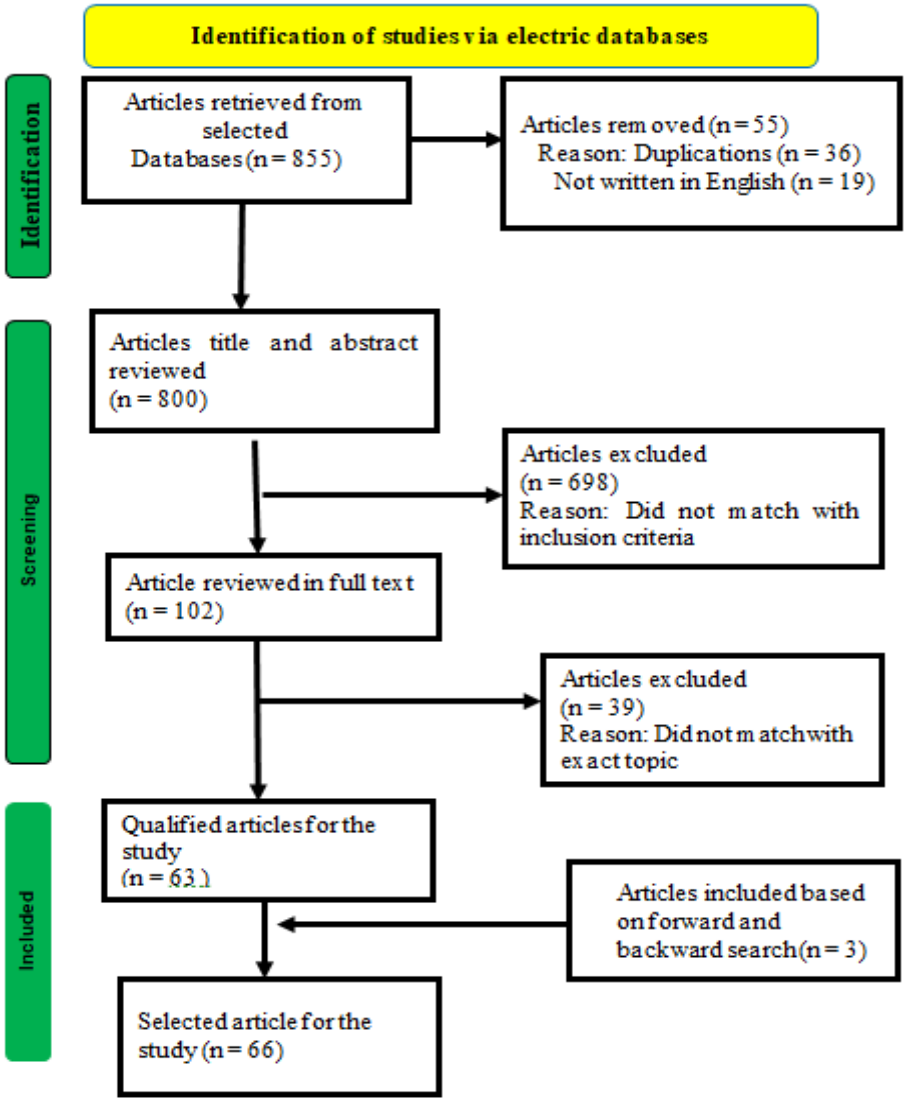

Fig. 1. The flow diagram of the review study

In this study, the following criteria were employed to determine which articles to include: (i) Duplication: A database was created to identify and remove duplicate articles; (ii) Published in English: Articles not written in English were excluded; (iii) Sample: Only article focusing on workers within the construction sector were considered; (iv) Types of article: Included cross-sectional studies, direct observational, experimental studies; (v) Risk factors: Selected papers were required to examine the associations between WRMSDs and various risk factors, including individual, ergonomic, psychosocial and others. Exclusion criteria comprised studies investigating risk factors for work-related musculoskeletal disorders (WRMSDs) in sectors other than construction, simulation models, and skeletal models.

Articles were classified based on the association between risk factors and WRMSDs. The classification of the selected articles was as follows: (i) Strong effect: Consistent findings in various studies with a high association with WRMSDs; (ii) Moderate effect: Consistent results in various studies with medium association with WRMSDs; (iii) Limited effect: Consistent description findings in various studies with a lower association with WRMSDs; and (iv) No effect: Consistent description findings in various studies with no relationship with WRMSDs. *Fig. 1* represents the flow diagram of the procedure followed for this review study. Two independent readers screened the selected articles based on the selection criteria to avoid bias.

3 | Results

3.1 | Prevalence of work-related musculoskeletal disorders (WRMSDs) among construction workers

The incidence of work-related musculoskeletal disorders (WRMSDs) occurrences among construction workers is increasing day by day all over the world. *Table 1* shows studies on the prevalence of work-related musculoskeletal disorders (WRMSDs) among construction workers in various countries. The selected studies were conducted in fourteen different countries or sites, including Pakistan, Nigeria, the USA, Trinidad, Hong Kong, Thailand, Malaysia, Saudi Arabia, Sri Lanka, Iran, Netherlands, Ghana, India, and Ethiopia. Among these studies, nine were cross-sectional surveys; three included surveys with additional features – one involving face-to-face interviews and medical examinations, and another combining a survey with observation. The participants' ages ranged from 16 years to 75 years.

Table 1. Prevalence of WRMSDs among construction workers

Study	Country	Method	Population	Mean / Range age (years)	Rate of WRMSDs (%)
Kashif et al.[8]	Pakistan	Cross-sectional Survey	666	34.49	89
Adedoyin et al.[9]	Nigeria	Cross-sectional Survey	118	18-35	87.3
Wang et al.[23]	USA	Cross-sectional Survey	10,000	>16	40
Shane Mungroo and Sang Choi[24]	Trinidad	Survey and Observational study	62	34	54
Wen Yi and Albert Chan[7]	Hong Kong	Face-to-face interview and Medical examination	942	45.1	41
Hanklang et al.[25]	Thailand	Cross-sectional Survey	272	48.2	57.7
Deros et al.[6]	Malaysia	Cross-sectional Survey	66	17-50	66.7
Ahmad Alghadir and Shahnawaz Anwer[4]	Saudi Arabia	Cross-sectional Survey	165	20-55	48.5
Reddy et al.[26]	India	Cross-sectional Survey	308	21-40	33.8
Fernando et al.,[27]	Sri Lanka	Cross-sectional Survey	192	18-75	82.5
Derakhshan Jazari[28]	Iran	self-reported survey	850	37.5	53.5
Boschman[29]	Netherlands	Baseline questionnaire survey	750	50	67
Mustaphanet al.[30]	Ghana	Questionnaire survey	215	18-36	56
Berhanu et al.[31]	Ethiopia	Cross-sectional Survey	566	25.78	39

Seven studies reported a 12-month prevalence of WRMSDs [4],[23],[25],[32]-[35], while three studies reported a 7-day prevalence of WRMSDs among construction workers [8],[9],[36].

3.2|Supporting studies about the association between individual risk factors and WRMSDs.

Table 2 represents the association between individual risk factors and WRMSDs in construction workers.

Table 2. The supporting studies for the association between individual risk factors and WRMSDs

Study	Risk Factors	Levels of findings of a specific risk factor
Derakhshan Jazari[28]	Gender	M
Ekpenyong and Inyang[35], Muhamed et al.[15]	Age	S
Ahmad Alghadir and Shahnawaz Anwer[4], Jaffar et al.[37]	Working experiences	S
Deros et al.[6]	Job types	M
Ekpenyong and Inyang [35], Egwuonwu et al.[32]	Body Mass Index (BMI)	M
Ahmad Alghadir and Shahnawaz Anwer [4]	Marital status	N
Kashif et al.[8]	Drug receiving habits	L

S = Strong effect, M = Moderate effect, L = Limited effect, N = No effect

Age and work experience exhibited a strong effect on WRMSDs in construction workers, whereas drug-receiving habits showed a limited effect. However, a moderate effect for WRMSDs was found for gender, job types, and BMI. Additionally, there was no significant effect for WRMSDs among construction workers for marital status.

3.3|Supporting studies about the association between ergonomics risk factors and WRMSDs

The current study is primarily intended to summarize the supporting evidence regarding the task-specific risk factors contributing to WRMSDs in construction workers. In general, various physical activities can differentially contribute to the risk of WRMSDs in various body regions. In this review, ergonomic risk factors can be categoriezed as follows: (i) awkward working postures, such as bending, twisting, reaching, pulling, lifting, or cramping positions; (ii) repetitive body movement; (iii) vibration created by machines; (iv) static loading (holding an object for long periods); (v) manual material

handling; and (vi) excessive workload (too much work to handle).

Table 3 shows the evidence for the association between ergonomic risk factors and WRMSDs in construction workers. Awkward working postures, repetitive body movement, machine vibration, and manual material handling (MMH) were all identified as ergonomic risk factors for WRMSDs in construction workers. However, there was moderate evidence for the associations between static loading and WRMSDs in construction workers.

Table 3. The supporting studies for the association between Ergonomics risk factors and WRMSDs

Study	Ergonomic risk factors	Levels of findings of a specific risk factor
Antwi-Afari et al. [38], Egwuonwu et al. [32], Hanklang et al. [25], Kaminskas et al. [39], Palikhe et al. [42]	Awkward working postures	S
Egwuonwu et al. [32], Palikhe et al. [40],Neeraja and Swarochish[41], Reddy [42], Subedi and Pradhananga [43]	Repetitive body movement	S
Wang et al. [23], Yildizeln et al. [44], Mustapha et al. [30], Lop et al. [45]	Vibration	S
Saha et al. [46] , Hanklang et al.[25], Abas et al.[47]	Static Loading	M
Boschman [29], Saudi et al. [48], Ekpenyong and Inyang [35]	Manual material handling (MMH)	S
Boschman [29], Neeraja, and Swarochish [41], Robroek et al. [49]	Excessive workload	M

S = Strong effect, M = Moderate effect, L = lower effect, N = No effect

3.4|Supporting studies about the association between other risk factors and WRMSDs.

Table 4 demonstrates strong evidence to support associations between other risk factors and WRMSDs in construction workers. On the other hand, there is moderate evidence indicating associationa between personal protective equipment (PPE) and physical stress with WRMSDs in construction workers. Moreover, there is limited evidence suggesting that mental stress and air temperature were associated with WRMSDs in construction workers.

Table 4: The supporting studies for the association between other risk factors and WRMSDs

Study	Risk Factors	Levels of findings of a specific risk factor
Antwi-Afari et al. [38], Patial et al. [50], Arias et al. [51], Umer et al. [52], Parida et al. [53], Parida and Ray [54], Palikhe et al. [40], Breloff et al. [55], Antwi-Afari et al. [16]	Biomechanical	S
Derakhshan Jazari [11], Yan [33], Wong et al. [56],	PPE	M
Ng and Chan [57], Frimpong [58]	Mental stress	L
Mustapha et al. [13], Yi and Chan [59],	Air temperature	L
Ekpenyong and Inyang [35], Egwuonwu et al. [39], Hanklang et al. [25],	Physical fatigue	S

S = Strong effect, M = Moderate effect, L = lower effect, N = No effect

4 | Discussion

Work-related musculoskeletal disorders (WRMSDs) in construction workers are a global concern. The prevalence rates of WRMSDs among construction workers in different countries range from 33% to 89%. The most common affected body parts were lower back pain (66%) followed by neck (44%), shoulders (43%), and knee (37%) among the construction workers [60],[61]. Additionally, the prevalence rates of wrist, hand, and lumber injuries were 21%, 22%, and 54%, respectively, among construction workers [61], [62]. This variation in prevalence can be attributed to the fact that the majority of the listed articles were cross-sectional survey, with only one article conducted a face-to-face interview and medical examination [7]. Future research is required to determine the prevalence of WRMSDs across various construction industries. Additionally, more study should be combined with objective and subjective evaluations that can distinguish the outcomes. These may include direct observation-based, video analyses, laboratory experimental, and real-time field assessment.

Researchers have revealed that individual factors play an important role in developing WRMSDs in construction workers [4]. Although working experiences and worker characteristics are strongly linked to WRMSDs in construction workers, the relationship between other individual factors and WRMSDs remains unclear.

However, this study identified the most common ergonomic risk factors in construction workers for WRMSDs, which differ from those reported in other industries. Working in an abnormal posture, performing overhead work, and engaging in prolonged repetitive body movements, for example, were

found to increase the risk of developing low back pain in construction workers in the current study. In contrast, previous reviews have highlighted that high workforce, bending, twisting, and working in hot environments contribute to the development of WRMSDs in the agriculture, forestry, and machine manufacturing industries [63].

The discrepancy suggests the existence of task-specific risk factors. Generally, in developing countries, it is common for one worker to perform multiple construction tasks. For example, findings from studies involving wall-plastering workers may not be applicable to brick-laying workers. Regretfully, many of these studies surveyed workers from various construction sectors, making it challenging to identify task-specific ergonomic risk factors for the development of WRMSDs. Therefore, future research should investigate task-oriented risk factors for WRMSDs to address this issue.

Despite previous research demonstrating causal relationships between some common ergonomic risk factors, such as machine vibration, awkward working postures, repetitive body movements, and WRMSDs among workers in various industries (e.g., firefighter, agriculture, petroleum, nursing, etc.) [64], [65]. Nevertheless, their reports were not generalized to construction workers. As a result, potential future field research should aim to establish causal relationships between different ergonomic risk factors and WRMSDs in a variety of construction worker tasks.

Other factors such as biomechanical, PPE, and physical work stress have been identified as risk factors for developing WRMSDs in construction workers. Previous literature reviews have found a link between high physical work stress and WRMSDs in workers in various industries, including construction [66]. According to Antwi-Afari et al., lifting weights and maintaining certain postures were significantly associated with an increased risk of WRMSDs in the lower extremities [16]. Similarly, there is a moderate evidence regarding the use of PPE and its association with WRMSDs in construction workers, but limited evidence for the relationships between mental stress, air temperature, and WRMSDs [56],[57],[59].

Unfortunately, some of the included studies reported some biomechanical risk factors (such as lifting, carrying, and MMH) for WRMSDs in construction workers based on the laboratory experiment and specific tasks. Future studies can be conducted based on real-time work and explore other biomechanical risk factors, such as twisting, bending, and different working postures, body angles, acceleration, and more.

5 | Limitations of the study

Despite employing a systematic approach, the current review study has certain limitations related to the articles included. Firstly, the selected articles were collected from six electronics databases, and it may be beneficial to consider additional databases. Secondly, most of the included studies were designed as cross-sectional surveys to find out the relationship between risk factors and WRMSDs in construction workers. While cross-sectional surveys are an effective method for studying WRMSDs, alternative research could also be explored. Thirdly, only English-written articles were selected, potentially overlooking relevant studies in other languages. Finally, the current review categorized the risk factors as individual, ergonomic, and other risk factors, but there is a needed for a more comprehensive identification and analysis of other potential risk factors.

Conclusion

The prevalence rates of WRMSDs among construction workers have been summarized in this review study. Evidence supporting the associations between significant risk variables and WRMSDs in construction workers is also addressed herein. The results of this study underscore that WRMSDs among construction workers constitute a global problem. Strong evidence indicates that various individual (e.g., age, working experience), ergonomic (e.g., awkward body postures, repetitive body movement, vibration, high workload), and other factors (e.g., biomechanical, PPE, mental stress) were related to the development of WRMSDs in construction workers. This study will increase the awareness of the various risk factors related to WRMSDs in construction workers. However, due to the cross-sectional nature of study, the exact associations between various risk factors and the occurrence rate of WRMSDs remain somewhat unclear. Therefore, conducting experimental and real-time-based studies is essential to establish the precise relationships between risk factors and WRMSDs in construction workers. Biomechanical simulation may also be helpful in exploring another risk factors (e.g., bending, twisting, angular velocity, acceleration, joint, and muscle force) related to WRMSDs.

Conflicts of Interest

No conflict of interest

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