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REVIEW ARTICLE

Pattern, risks, and outcomes of orthopedic injuries among construction workers: a systematic review

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ABSTRACT

Background: Construction is among the most debilitating and hazardous industries globally. The construction industry accounts for the greatest incidence of injuries and deaths. Occupational accidents pose significant health risks and result in considerable social and economic consequences. Orthopedic injuries are common and may arise from occupational activities and accidents. They possess potential effects on persons' lives. Identifying the patterns, risks, and consequences of orthopedic injuries among construction workers (CWs) is essential for developing effective preventative strategies.

Objective: To evaluate the patterns, risks, and consequences of orthopedic injuries among CWs by a review of existing studies on this topic.

Methods: Electronic databases were searched to identify pertinent papers associated with the present issue utilizing relevant terminology. The search was limited to publications from 2016 to the present. The qualifying papers were original works produced in English that documented orthopedic injuries in studies addressing occupational injuries among CWs.

Results: Nine studies met the specified criteria, encompassing a total of 2918 CWs. The results were classified into injury prevalence, patterns, afflicted regions, causes, risk factors, and outcomes.

Conclusion: Orthopedic injuries are the predominant category of occupational injuries among CWs. Fractures and dislocations of the upper and lower limbs are the most prevalent injuries. The risk factors and consequences of injuries were inadequately and inaccurately documented.

Keywords: Orthopedic injuries, outcomes, construction workers, patterns, risk factors.

Introduction

The construction industry is among the most hazardous and debilitating sectors globally. Employment in the construction sector is predominantly transient, and upon project completion, workers are compelled to seek alternative employment opportunities. The majority of construction industry workers were semi-skilled or unskilled, possessing little education, lacking training, and unfamiliar with the risks and instruments pertinent to the construction sector, hence increasing the risk of work-related accidents [1,2]. The construction industry accounts for the greatest incidence of injuries and deaths [3]. In the United States, the injury rate stands at 29%, above the average of other industries [3].

Industrial injury denotes any human disease, injury, or fatality arising from an industrial mishap that signifies a possible worldwide burden [4,5]. Occupational injuries account for 30% of medically treated injuries among persons aged 18-64 years [6]. Moreover, these incidents result in around 2.78 million fatalities and 374 million injuries.

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Occupational accidents pose significant health risks and result in considerable social and economic consequences. Research has established that contingent workers are at an elevated risk of occupational injuries and deaths relative to their counterparts in other industries [7,8]. Negative health consequences from industrial injuries have been shown to last long after the commencement of the damage [9]. Significant injuries, including possible work absences or lasting disabilities, are prevalent in the construction industry [1]. The burden of long-term job incapacity has considerable economic ramifications, representing a substantial share of workers' lost output and compensation expenses [10].

Orthopedic injuries are common and can significantly affect people's lives [11]. They are significant reasons for referrals to healthcare institutions; such injuries may arise from different sources, including spontaneous injuries, vehicular accidents, or occupational hazards [12]. Orthopedic injuries encompass fractures, dislocations, sprains, and strains, affecting the lower and upper limbs, pelvis, and spine [13]. Identifying injuries in the construction business is essential for developing preventative methods, particularly for orthopedic injuries, as research lacks emphasis on such injuries among construction workers (CWs) [14]. This systematic review aimed to uncover the patterns, risks, causes, and consequences of orthopedic injuries among CWs by thoroughly examining publications that describe occupational injuries in this population, due to a scarcity of research specifically addressing orthopedic injuries among CWs.

Method and Search Strategy

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist [15]. The electronic databases, including PubMed, Google Scholar, Scopus, and Science Direct, were examined to acquire pertinent papers concerning the current subject. The search technique used relevant phrases such as "construction workers, orthopedic injuries, occupational injuries, fractures, patterns, causes, risks, and outcomes." The search was limited to publications from 2016 to the present. All acquired publications were meticulously reviewed to ensure no noteworthy studies were overlooked.

Eligibility criteria

The findings were checked to preclude duplicate articles and those conducted on other populations and were not conducted on CWs. Articles focused on CWs but did not report occupational and/or orthopedic injuries were also excluded. Furthermore, the articles that reported occupational injuries among CWs and did not involve orthopedic injuries were precluded. Articles were considered for eligibility if they reported the pattern and/or cause and/or risk factors and/or outcomes of orthopedic injuries. Also, the eligible articles were the original ones written in the English language and were available for full-text. The illustration of the eligibility is displayed in Figure 1.

Data review and analysis

The first step was reviewing the abstracts of each article to determine the data of interest for extraction. A deep review was performed for the full-text to extract the data of interest, including those related to orthopedic injuries. Extraction of the data was done using a specially designed Excel sheet; the data were then revised and transferred to a pre-designed table to summarize the data under major titles.

Results

There were nine studies [16-24] that were eligible and enrolled in this review (**Table 1**). The studies were published in the period from 2017 to 2025. Seven studies were cross-sectional [2,4-16,25,21-23], and one of them was descriptive cross-sectional [21], whereas one of the remaining two studies was case-control [24], and the last study was conducted based on data collected from the database of workers' compensation service [20].

Also, seven studies were conducted on 2,918 CWs with dominance of male workers compared to female ones [16-19,21-23], and one of them was conducted on male workers only [16]. The study that retrieved data on injuries reported the inclusion of 158,947 injuries, also with a dominance of male injuries [20]. The last study compared between 100 cases with injuries with 90 controls without injuries, but with no mention of the gender of the workers [24].

The findings can be categorized into six major categories as follows:

The prevalence of occupational injuries was reported in seven studies [16-19,21-24] with a range of 25.9% [16] to 87.5% [21], whereas one study reported the prevalence of fetal (2%) and non-fetal (98%) injuries [20].

Orthopedic injuries were the major reported injuries and included various injuries with various rates between the different enrolled studies; fractures and dislocations prevalence was reported as following: fracture/dislocation (8.6%) [16], (7.8%) [19], (70%) [24], bone fracture (10.9%) [17], dislocation (8.33%) [18], (9%) [22], (7.7%) [24], fracture (2.7%) [21], (5.9%) [22], (18.6%) [24], fractures (57.9%) with the major fracture occurs in hand and finger (7.5%) and rib fracture as the second common injury (7.2%) [20].

Other orthopedic injuries, included muscle/ligament strain (14.7%) [16], strain (6.4%) [17], strain (7.58%), sprain (24.24%) [18], sprain/back pain (23.8%) [19], sprain (4.8%), amputation (2.9%) [20], lower/upper back musculoskeletal strain (40.6%), repetitive strain injury (21.1%) [21], and amputation (0.5%) [22], (3%) [24].

The injured parts displayed great heterogeneity between the included studies as some studies combined the rates of some parts together; therefore,

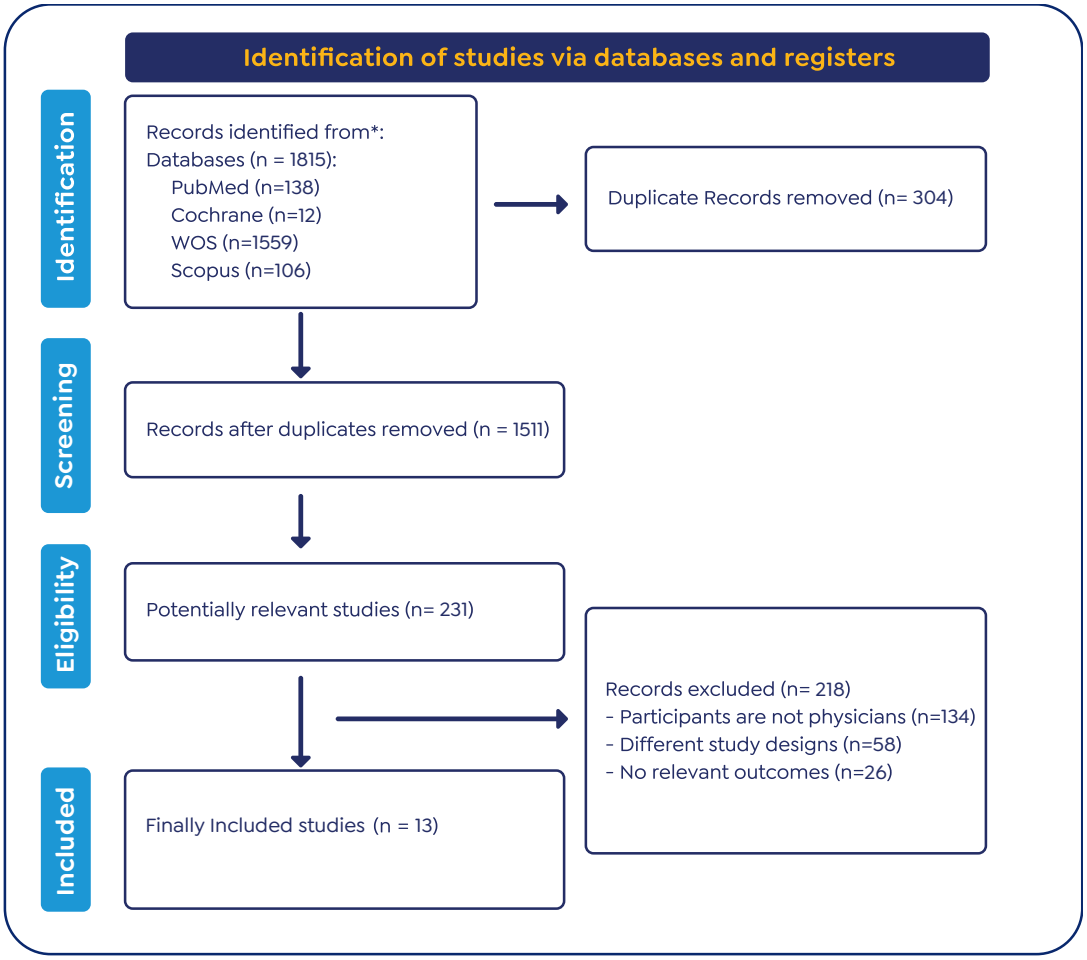

Figure 1. Eligibility of the studies.

the affected parts included lower limb/foot (43.1%), upper limb/hand (37.9%), head, neck/back/shoulder (19%) [16], hand (23.94%), head (22.53%), leg (24.9%), axial (23%) [17], upper limb (47.7%), lower limb (61.9%), head and neck (12.1%), chest and abdomen (21.2%) [19], leg (17.5%), waist/lower back (29.9%), forearm/palm/finger (18.9%), chest (8.9%) [21], included hand (39.8%), toes (20.4%), leg figures (5.8%), head (4%), upper leg (2.7%) lower leg (2.7%), upper arm (1.8%), lower arm (0.5%), chest (1.8%), knee (1.3%) [22], finger (23.1%), head (15.4%), toe (12.2%), hand (26.9%), and leg (17.9%) [23], extremity (55.1%), chest (3.06%), head and neck (4.08%) [24].

Similarly the causes of injuries revealed great heterogeneity between the studies and they included fall from height (26.7%), struck by object (47.4%), strain from lifting or bending (25.9%) [16], object fall (40.91%), stepping, striking, struck (38.64%), fall of person (9.09%) [18], hit by a fallen object (20.4%) [19], (7.6%) [22], (18%) [24], (23.1%) [23], fell from height (17.3%) [19], (1%) [21], (19.5%) [22], (13.4%) [23], overexertion during lifting (15.9%) [20], (10.2%) [21], (8.1%) [22], slips (18.5%) [21], slipping falls (62%) [24], fall from ground level (2.3%) [21], (23.5%) [22], (38.5%) [23], and lifting heavy objects (9.6%) [23].

The risk factors of injuries were reported in only four studies [16,19,22,24]; injuries were lined with workers from small construction (OR = 2.01), working more than 8 hours (OR = 2.3) [16], male gender Adjusted Odds Ratio (aOR = 3.06), working less than 8 hours (aOR = 3.46), smoking tobacco (aOR = 1.97) [19], longer service year (aOR = 2.79), poor attention to work (aOR = 2.65), working with vibrating hand tools (aOR = 3.23), no aware about occupational hazards (aOR = 4.66), alcohol consumption (aOR = 3.16) [22], not using protective equipment (aOR = 3.6), no receive of health and safety training (aOR = 5.07), no workplace supervision (aOR = 2.07), job dissatisfaction (aOR = 1.9) [23], rural residence (aOR = 3.01), job category of being a carpenter (aOR = 5.4) or painter (aOR = 6.1) and having no history of injuries (aOR = 6.6) [24].

The outcomes of the injuries were barely reported and only four studies reported the outcomes of injuries with regard to the ability to work [16,19,23,24]; one study revealed that 25.9% were able to continue with all work duties, 71.5% temporarily were unable to do work, whereas 2.6% were permanently unable to do some work duties, but the time point at which the ability of

Table 1. Summary of the extracted data.

Author and publication year	Study design	Population characteristics	Results and main findings
Allana et al. [16]	Cross-sectional survey	*N* = 448 male CWs	• Occupational injury prevalence was 25.9%. • Injured parts included lower limb/foot (43.1%), upper limb/hand (37.9%), hand and neck/back/shoulder (19%). • Injury causes included fall from height (26.7%), struck by object (47.4%), and strain from lifting or bending (25.9%). • Injury patterns included muscle or ligament strain (14.7%), fractures/dislocations (8.6%). • Workers from small construction were more likely to report injuries, with an OR of 2.01, and working more than 8 hours daily had greater odds of injury, with an OR of 2.30. • Outcomes of injury included being able to continue with all work duties (25.9%), temporarily unable to do work (71.5%), and permanently unable to do some work duties (2.6%).
Aliyi et al. [17]	Cross-sectional	*N* = 393 CWs • Males = 302 (76.8%) • Females = 91 (23.2%)	• Occupational injury prevalence was 54.2%. • Injured parts included hand (23.94%), head (22.53%), leg (24.9%), and axial (23%). • Injury patterns included bone fracture (10.9%), strain (6.4%), and permanent disability (0.3%).
Mohanty et al. [18]	Cross-sectional	*N* = 260 CWs • Males = 221 (85%) • Females = 39 (15%)	• Occupational injury prevalence was 50.77%. • Injury patterns included sprain (24.24%), strain (7.58%), and dislocation (8.33%). • Injury causes included object fall (40.91%), stepping, striking, and being struck (38.64%), and fall of a person (9.09%).
Kinteh and **Bass [19]**	Cross-sectional	*N* = 500 CWs • Males = 466 (93.2%) • Females = 34 (6.8%)	• Occupational injury prevalence was 56.4%. • Injury parts, including upper limbs (47.7%), lower limbs (61.9%), head and neck (12.1%), and chest and abdomen (21.2%). • Injury patterns included dislocation/fracture (7.8%), sprain/back pain (23.8%), and puncture (22.8%). • Injury causes included being hit by a fallen object (20.4%), falling from a height (17.3%), and overexertion during lifting (15.9%). • The multivariate analysis revealed that being a male worker (aOR = 3.06), had <8 hours of work daily (aOR = 3.46), smoking tobacco (aOR = 1.97), and consuming alcohol (aOR = 0.27) were significantly associated with injuries from building construction work. • TTRW was <1 day (13.1%), 2-3 days among (9.1%), 4-5 days among (10.5%), and more than 5 days among (22.6%).
Jung et al. [20]	Data collected from workers' compensation and welfare service	*N* = 158,947 accepted claims of occupational injuries in CWs • *Males' injuries = 155,308 (97.7%) • emales' injuries = 3,639 (2.3%)	• Non-fetal injuries prevalence was 98% and fetal claims were 2%. • Injuries included fractures (57.9%), sprains (4.8%), and amputations (2.9%). • Fractures of the hand and finger represented 7.5%, rib fracture was 7.2%.

Author and publication year	Study design	Population characteristics	Results and main findings
Yankson et al. [22]	Descriptive cross-sectional	*N* = 353 CWs • Males = 342 (96.9%) • Females = 11 (3.1%)	• Occupational injury prevalence was 87.5%. • Injured parts included the waist/lower back (29.9%), the forearm/palm/finger (18.9%), the leg (17.5%), and the chest (8.9%). • Injury patterns included lower/upper back musculoskeletal strains (40.6%), repetitive strain injury (21.1%), and fracture (2.7%). • Injury causes included slips (18.5%), overexertion during lifting (10.2%), falls from ground level (2.3%), falls from height (1%), and others (42.2%).
Berhanu et al. [22]	Cross-sectional	*N* = 566 CWs • Males = 295 (52.1%) • Females = 271 (47.9%)	• Occupational injury prevalence was 39%. • Injured parts, included hand (39.8%), toes (20.4%), leg figures (5.8%), head (4%), upper leg (2.7%) lower leg (2.7%), upper arm (1.8%), lower arm (0.5%), chest (1.8%), knee (1.3%) • Injury patterns included dislocation (9%), fracture (5.9%), and amputation (0.5%). • Injury causes included falls from ground level (23.5%), falls from height (19.5%), being hit by a falling object (7.6%), and overexertion during lifting (8.1%). • Occupational injury occurrence was associated with single workers (aOR = 0.50), longer service year (aOR = 2.79), poor attention to work (aOR = 2.65), working with vibrating hand tools (aOR = 3.23), no aware of occupational hazards (aOR = 4.66), and alcohol consumption (aOR = 3.16).
Lette et al. [23]	Cross-sectional	*N* = 398 CWs • Males = 306 (76.9%) • Females = 32 (23.1%)	• Occupational injuries prevalence was 39.2%. • Injured parts included finger (23.1%), head (15.4%), toe (12.2%), hand (26.9%), and leg (17.9%). • Injury patterns included fracture (18.6%) and dislocation (7.7%). • Injury causes included falling from the same level (38.5%), being hurt by a movable or falling object (23.1%), falling from height (13.4%), and lifting heavy objects (9.6%). • Not using protective equipment (aOR = 3.6), not receiving health and safety training (aOR = 5.07), not having workplace supervision (aOR = 2.07), and job dissatisfaction (aOR = 1.9) were linked with injury, whereas female gender was a protective factor (aOR = 0.3). • Days of absence from work were more than 3 days among 36.5% and ≤3 days among 63.5%.
Khashaba et al. [24]	Case-control	*N* = 190 CWs • Cases with injuries = 100 • Controls with no injuries = 90 • Gender	• Injury causes included slipping falls (62%) and object falls (18%). • Injured parts included extremity (55.1%), chest (3.06%), and head and neck (4.08%). • Injury patterns included fracture/dislocation (70%) and amputation (3%). • Logistic analysis revealed that the predictors of occupational injuries were rural residence (aOR = 3.01), job category of being a carpenter (aOR = 5.4) or painter (aOR = 6.1), and having no history of injuries (aOR = 6.6). • Days away from work ranged between 3 and 216 days.

working was assessed was not reported [16]. Time to return work (TTRW) was <1 day among 13.1%, 2-3 days among 9.1%, 4-5 days among 10.5%, whereas 22.6% required more than 5 days to return to work (RTW) [19]. Another study reported the absence days from work, and they were more than three days among 36.5% of subjects, and they were 3 days or fewer among 63.5% [23]. The last study reported the range of days being off work, and they were 3-216 days [24].

Discussion

Employment in the construction sector has an elevated risk of injury, making it one of the most perilous sectors globally [26]. Community workers, particularly in developing nations, are more susceptible to safety and health risks [27]. Orthopedic injuries are a major reason for referrals to healthcare facilities and may arise from occupational activities [12]. Nonetheless, there has been no prior investigation documenting orthopedic injuries among CWs. Moreover, no prior research has concentrated on this topic, and the existing literature exclusively addresses occupational injuries among CWs. Consequently, we performed this study to ascertain orthopedic injuries among CWs by examining studies that documented occupational injuries within this demographic, specifically focusing on orthopedic injuries as a category of reported occupational injuries.

A prior meta-analysis indicated that construction-related accidents constituted 57% of occupational injuries in Africa, ranking second behind manufacturing [25]. The data indicates that the prevalence of occupational injuries among CWs varied from 25.9% to 87.5%, demonstrating a significant frequency with a broad range. An earlier investigation examined work-related injuries among CWs in Ethiopia, including eleven publications, and determined that the aggregated prevalence of these injuries was 46.78%. Occupational injury risk variables were male workers (OR = 2.44), insufficient safety training (OR = 2.43), and non-utilization of protective equipment (OR = 2.32). Nevertheless, the investigation did not address orthopedic injuries [28].

The total prevalence of orthopedic injuries among CWs was not provided, as the research included focused on various types of orthopedic injuries. Orthopedic injuries encompass fractures, dislocations, sprains, strains, ligament injuries, and knee injuries [13]. The prevalence of fracture/dislocation was notably high, ranging from 7.8% to 70%, followed by fracture alone, which varied between 2.7% and 57.9%, and dislocation alone, with a range of 7.7% to 9%.

Consequently, we might infer that fractures and dislocations were the most common orthopedic injuries. Additional orthopedic injuries were documented, but at reduced frequencies, including sprains. The studies showed significant variability in the reporting of orthopedic injuries, attributable to the aggregation of certain ailments into a single category, while others were delineated in separate investigations. Significant variances were identified about the affected regions; still, we could infer that injuries were more prevalent in the upper and lower extremities and their constituents.

The majority of occupational injuries and disorders identified in CWs are complex in character [26]. The etiology of orthopedic injuries is diverse, encompassing falls from heights, ground-level falls, occupational injuries, sports-related injuries, and road traffic accidents [13]. Falls from elevation and falls from ground level were the most often reported and predominant causes of injury. Nevertheless, the same reasons were described for occupational injuries in general, without special reference to orthopedic injuries. Fall-related injuries are the primary cause of death and illness among workers in the USA, with CWs bearing an unequal burden [29].

The risk variables for injuries have received diminished attention in the literature and exhibit significant variation between research. Additionally, a dispute concerning the risk associated with the number of working hours was noted; one research indicated that working over 8 hours significantly elevated the likelihood of injuries by more than twofold (OR = 2.3) [16]. Conversely, another study indicated that working fewer than 8 hours significantly heightened the chance of injuries by almost three times. Consequently, more focus and examination of the risk variables are essential to formulate preventative methods.

Significant injuries resulting in possible work absences or lasting disabilities are prevalent in the construction sector [3]. The consequences of injuries received diminished attention in the literature, which mostly concentrated on the capacity and RTW. One study documented the rates of workers who could RTW [16], while another reported the rates of workers returning based on the time required to do so [19]. The third study presented the proportions of workers returning to work after a specified duration, and finally, the last study detailed the range of days absent from work [24]. Such investigations demonstrated discrepancies in the reporting of RTW as outcomes of injuries. This variety indicated that the consequences of injuries reflected in RTW are affected by several factors; however, the studies did not examine these aspects. However, we may propose that the severity and location of the injury may be a decisive determinant for RTW. Prior research indicated that, among 223 participants, the return-to-work rate was 78% after extremity/spine injuries and 73% after head traumas [30]. Research at an orthopedic facility in Hong Kong found that 80% of 323 patients with job-related injuries successfully returned to work, with a mean recovery period of 10.6 months. The failure to RTW was significantly associated with many circumstances, including a delay of over 5 months for physiotherapy, mental evaluation, and legal conflicts

[31]. A prior review indicated that the RTW was affected by age, self-efficacy, and educational attainment. This review did not concentrate on CWs [32].

A separate review examined two studies involving young individuals with occupational injuries to the lower limb or lower back, revealing difficulties in generalizing the findings to the targeted age group due to a lack of studies specifically addressing this demographic and the absence of results categorized by age [33]. Likewise, we could ascertain the instances, patterns, hazards, and consequences of occupational injuries among CWs, and we could extract data pertinent to orthopedic injuries. Moreover, orthopedic injuries were the predominant category of occupational injuries. Nonetheless, we cannot extrapolate the risks, causes, and consequences of occupational injuries to those specifically related to orthopedics.

Conclusion

Orthopedic injuries are the predominant category of occupational injuries among CWs, particularly fractures and dislocations affecting the upper and lower extremities. Falls constituted the primary source of occupational injuries, and literature indicated that they were also the predominant risk factor for orthopedic injuries. The risk variables associated with occupational injuries and their consequences were typically recorded inadequately and with imprecision. Nonetheless, we may conclude that RTW is the primary outcome that should be assessed for orthopedic injuries.

Limitations, strengths, and recommendations

This review had significant limitations, including the lack of research reporting orthopedic injuries among CWs; nonetheless, we were able to obtain data on orthopedic injuries from studies addressing occupational injuries. This was undertaken due to a deficiency in the literature on this issue, necessitating the identification of this gap. Furthermore, there was a lack of sufficient and accurate data about risk factors and return to work, which warrants the initiation of additional research examining these two aspects related to occupational and orthopedic injuries among CWs. The third restriction was the variation identified in the reporting of injury components, causes, and return-to-work outcomes. This study possesses notable strengths, including being the inaugural examination of the current topic and identifying gaps in the literature concerning many aspects and inquiries. Consequently, more research is strongly advised.

List of Abbreviations:

CWs	construction workers
OR	Odds Ratio
RTW	return to work
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this article.

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Author contribution

Nasser Sulaiman Alqadhib: Conceptualization of the study, study design, data interpretation, and critical revision of the manuscript. Osman Hashim Mohamed: Literature review, drafting of the introduction and discussion sections, and coordination of study logistics. Fayo Haji: Manuscript drafting, referencing, formatting, and final proofreading before submission. All authors read and approved the final version of the manuscript.

Consent for publication

NA.

Consent to participate

NA.

Ethical approval

NA.

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