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Occupational Exposure and Risk Factors for Musculoskeletal Symptoms Among Workers: A Literature Review

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Abstract

Early musculoskeletal (MSK) symptoms across occupations often present as strain or fatigue, which may progress into long-term disorders and contribute to global burden disease. This reviewed literature examined occupational exposures and their association with musculoskeletal (MSK) symptoms related to work using MeSH term and Emtree in structuring a framework of population, context, and concept. The population (P) included workers, the concept (C) focused on prevalence and exposure, and the context (C) addressed musculoskeletal pain, discomfort, or symptoms. Eligible studies reporting self-reported prevalence or occupational risk factors were systematically extracted and summarized. Findings among 9 articles indicated majority prevalence of MSK symptoms higher than 60% measured mostly by Nordic Musculoskeletal Questionnaire (NMQ). The highest body part major in low back and upper limbs including wrists for pink-collar, while in blue-collar workers fairly distributed in upper and lower limbs. The physical exposure mainly due to injury body weight, meanwhile psychosocial occupational exposures such as mental stress, job tenure contribute significantly to musculoskeletal symptoms ($p < 0.001$) rather than physical exposure, with prevalence and distribution varying across body regions and occupational groups. These results emphasize the need for baseline data to guide future research based on job demands and inform targeted preventive strategies and workplace interventions.

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1. INTRODUCTION

Musculoskeletal disorders related to work represent a significant contributor to global burden disease, affecting productivity and functional capacity (Cieza et al., 2020). The prevalence rate of MSK conditions among workers consider to be substantial ranging from 61.5% (Gikaro et al., 2025) to greater as 94% in certain occupational groups of surgeons (Villareal et al, 2024). The significant impact could be seen in the worker's functional capacity, health quality of life, or disability (Alabdali et al., 2024; Cieza et al., 2020). Prior to progression into a medically diagnosed disorders, the condition associated with occupational activities including job demands, prolonged or static postures, the conditions commonly appears as musculoskeletal symptoms (Gikaro et al., 2025). These symptoms manifest as pain, functional limitation, or any discomforts such as stiffness located in various body part (Deng et al., 2021).

Occupational exposure across occupations varies substantially and associated with distinct MSK patterns. An evidence through a systematic review (Jacquier-Bret & Gorce, 2023) investigates that even within the same broad occupational category, healthcare workers, the distribution and prevalence of MSK symptoms differ according to particular professional roles. For instance, dentist, physiotherapist, or nurses share unlike symptom profiles, the prevalence occurs depend to their clinical tasks and workload intensity (Jacquier-Bret & Gorce, 2023; Sun et al., 2021). Similarly, a study demonstrated professionals who engaged in desk-based activities as educators reported higher prevalence in shoulder symptoms (Tesfaye et al., 2022). Ultimately, these findings reflect considerable variability across occupation and their work environments to MSK symptoms. However, the relative contribution of occupational exposure through their job tasks to these differences remains insufficient identified.

While most interventions have been conducted to mitigate MSK (Albanesi et al., 2022), early identifications of occupational exposure related to MSK are not always comprehensively investigated, whereas a thorough understanding of occupation-specific exposures is essential for identifying relevant risk factors and selecting appropriate preventive strategies. The existing evidence identified physical and psychological to MSK symptoms (Deng et al., 2021). Job dissatisfaction is indicated to be one of potential risk factors (Tesfaye et al., 2022), while duration and working experience associate with MSK prevalence (Kabore & Schepens, 2023), still, the range and relative contribution occupation specific risk factors remain insufficiently explored. Without evidence-based research addressed, persistent exposure to occupational risk factors might exacerbate severity of symptoms moreover increase the likelihood of long-term disability. Hence, the current study aimed to conduct a literature review that analyzing and synthesizing existing literatures to explore occupational exposure and risk factors associated with musculoskeletal symptoms related to work.

2. METHOD

The current literature review was conducted with particular search strategy, eligibility criteria, and data selection including extraction ((Indrayani et al., 2024). The search strategy was developed based on the clarity of defined study aim then structured using PCC framework from scientific databases included OvidMedline (PubMed) and Embase from 2019-2025. The participants (P) were defined as workers, the context (C) as musculoskeletal pain or discomforts or symptoms, and the concept (C) as prevalence or exposure. The keywords for this review were identified using Medical Subject Headings (MeSH) from PubMed and Emtree terms from Embase. Eligible criteria were selected in accordance to PCC, the population was restricted to workers; meanwhile the context

included musculoskeletal pain, discomforts, symptoms, or any complaint; the concept remaining the self-reported prevalence rate or ratio or exposure work related to musculoskeletal discomforts (Table 1).

Table 1. Search term and strategy to database searching.

Search strategy	Search term (MeSH and Emtree)	Searching syntax (Vocabulary and synonyms)
P	Workers	work* OR employ* OR personnel OR occupation OR "blue collar workers" OR "white collar workers"
C	Musculoskeletal pain, discomforts, symptoms	"Musculoskeletal pain" OR "Musculoskeletal discomforts" OR "Musculoskeletal symptoms"
C	Prevalence exposure	"Prevalence exposure" OR "Risk factors" OR "Determinant factors"
Embase	((work* OR employ* OR personnel:ti,ab,kw,de OR "blue collar workers" OR "white collar workers"/exp)) AND ("Musculoskeletal pain" OR "Musculoskeletal discomforts" OR "Musculoskeletal symptoms":ti,ab,kw,de OR "musculoskeletal disorder*/exp)) AND ("Prevalence exposure" OR "Risk factors" OR "Determinant factors":ti,ab,kw,de OR risk/exp))	
OvidMedline (PubMed)	((work* OR employ* OR personnel.mp OR "blue collar workers" OR "white collar workers")) AND ("Musculoskeletal pain" OR "Musculoskeletal discomforts" OR "Musculoskeletal symptoms".mp OR "musculoskeletal disorder*")) AND ("Prevalence exposure" OR "Risk factors" OR "Determinant factors".mp OR prevalence/exp))	

Regarding eligibility criteria, articles that adequately addressed the PCC framework and answered the research questions were included in the review. The majority articles excluded due to unavailability presenting musculoskeletal prevalence rate by body part. The current structured approach ensured the search process was aligned to study objective to identify existing relevant literatures. In the meantime, the data extraction was involved to manage all retrieved study in one table improving the readability and clarity of each reviewed literatures. Two reviewers were included to extract the items comprised of authors, years, and country; study participants; method; risk factors; and result including prevalence of MSK and each body part (Table 2).

3. RESULTS AND DISCUSSION

Nine studies with a total of 17,167 participants from two databases were included in the current review. Among nine, four articles are from PubMed (Alelyani et al., 2023; Gikaro et al., 2025; Kabore & Schepens, 2023; Mai & Kim, 2022; Villarreal et al., 2024). The reviewed studies were geographically diverse, representing populations from Sri Lanka, China, Germany, Taiwan, Vietnam, South Africa, Saudi Arabia, USA, and Tanzania. Majority study used cross-sectional analytic study with the Nordic Musculoskeletal Questionnaire (NMQ) are most commonly utilized instrument to assess pain or symptoms (Table 1), frequently supplemented by rating scale, where 0 to 10 indicate from no pain to worst possible pain or discomforts (Alelyani et al., 2023; Chandrasekara et al., 2020; Chen et al., 2022; Dong et al., 2019; Gikaro et al., 2025; Kabore & Schepens, 2023; Mai & Kim, 2022; Rickert et al., 2021; Villarreal et al., 2024). On the other hand, the current study shared different instrument used in a cross sectional

study of (Sahu et al., 2023) where Questionnaire on Scale of Symptoms Severity (SSS) indicate little symptoms to severe, No (1-3) and Yes (4-5); and direct observation technique in handicraft industrial workers (n = 33) (Table 2).

Table 2. The main included study characteristics.

Author, year, country	Study participants	Method	Risk factors to MSK	Prevalence of Any MSK (95%CI)	Prevalence of MSK symptoms by body region
(Chandrasekara et al., 2020), Sri Lanka	Factory workers (tea pluckers) (n=378)	Cross sectional study, Instrument used: Interviewer administered questionnaire (IAD),	Stress experienced (OR=1.974, 95% CI: 1.149-3.393)* Duration of work > 20-year (OR= 2.225, 95% CI 1.42-3.48)* Age > 50-year-old (OR 1.767, 95% CI 1.138-2.745)	(n=259) 68.5% (63.6-73.2)	Neck (22.5%) Shoulder (25.7%) Hand/arm (23.3%) Upper back (29.9%) Low back (43.4%) Knee (41.8%) Ankle (8.7%)
(Dong et al., 2019), China	Healthcare professional workers (n=14,720)	Cross sectional study, instrument used: Nordic Musculoskeletal Questionnaire (NMQ) and Dutch Musculoskeletal Questionnaire (DMQ)	Mental stress (2.35 95% CI 1.31-4.24)*** Psychological fatigue (OR 2.61 95% CI 1.45 – 4.65)*** Breaktime during works (OR 0.46 95% CI 0.32 – 0.68)*** Prolong standing (OR 2.51 95% CI 1.2 – 5.2)*** Age (OR 2.05 95% CI 1.01-4.18)* Obese (OR 2.5 95% CI 1.19–5.24)***	(n=13,421) 91.2%	Neck (47.6%) Shoulder (52.1%) Hand/arm (23.3%) Upper back (18.7%) Elbows (8.7%) Wrists/ hands (31.1%) Hips/thighs (12.1%) Low back (72.8%) Knee (65.7%) Ankle (23.6%)

			Work hours/ week (OR 2.35 95% CI 1.31– 4.24)***		
(Rickert et al., 2021), Germany	Professional dentists (n = 229)	Cross sectional, Instrument used: NMQ and Disability of the Arm, Shoulder, and Hand (DASH)	Female Age 25-30 (p = 0.016)* and Age 36-50 (p = 0.003)** Treatment > 8 hour/day p<0.001 Stress level moderate (p=0.042)*	92.6%	Neck (65.1%) Shoulder (58.1%) Hand/ wrists (5.8%) Elbow (17.0%) Upper back (49.3%) Low back (59.8%)
(Chen et al., 2022), Taiwan	Bus drivers (n = 152)	Cross sectional, Instrument used: NMQ and in-field observation	Tobacco smoking assoc. with neck (OR 1.98 95% Ci 1.02-3.84)* Stretching between trips assoc. with neck (OR 0.09 95% CI 0.04-0.20)*** Neck and shoulders injured assoc. with neck (OR 3.69 95%CI 1.81-7.51)*** Mental stress when driving assoc. with neck (OR 14.8 95%CI 4.90-44.67)*** Seat uncomfortable (OR 3.71 95%CI 1.66-8.30)** Job tenure >3 years (OR 3.87 95%CI 1.22-12.31)	78.3%	Neck (46.9%) Shoulder (40%) Hand/wrists (14.5%) Upper back (20.7%) Elbows (10.3%) Low back (37.2%) Buttocks (22.1%) Knee (22.1%) Ankle (9.7%)

(Mai & Kim, 2022), Vietnam	Nurses (Hospital nurses) (n = 225)	Cross sectional, Instrument used: Standardized Nordic Questionnaire (SNQ) 0-10 (no pain to severe pain); Physical Workload index questionnaire (PSQ) with Likert scale from never to very often (0-4)	Physical workload (PW) (r=0.20)** Psychological demands (PDs) (r=0.32)**	87.6%	Neck (61.8%) Shoulder (61.8%) Hand/wrists (34.2%) Upper back (35.1%) Elbows (24%) Low back (65.3%) Hip/pelvic (29.3%) Knee (42.2%) Ankle (16.4%)
(Kabore & Schepens, 2023), South Africa	Factory workers (Weavers) (n = 225)	Cross sectional, Instrument used: Nordic Questionnaire, Key Indicator Method (KIM) to measure the physical indicator method	Duration of work > 10-year assoc. with upper back (OR= 2.22, 95% CI 1.24-3.99)* Age > 40-year-old assoc. with knee (OR 1.89, 95% CI 1.32–2.87) Hours of work/day > 8 hr assoc. with upper back (OR= 2.00, 95% CI 1.11-3.61)*	85.4%	Neck (23.5%) Shoulder (40.5%) Hand/wrists (21.1%) Upper back (25.1%) Elbows (10.1%) Low back (70.9%) Hip/thighs (27.1%) Knee (36.8%) Ankle (25.5%)
(Alelyani et al., 2023), Saudi Arabia	Radiologist (n = 814)	Cross sectional, Instrument used: NMQ	Male radiologists (OR 2.12 95% CI 1.32-3.37)** Age 30-39 (OR 0.219 95% CI 0.05 – 0.83)* Years of experience 1-5 years (OR 4.37	87.7%	Neck (59%) Shoulder (48%) Hand/wrists (50.05%) Upper back (55%) Elbows (32%) Low back (57%)

			95% CI 1.94 – 9.82)*** Part-time employment status (OR 2.67 95%CI 1.43-4.98)**		Hip/thighs (40%) Knee (36%) Ankle (32%) Eye (54%)
(Villarreal et al., 2024), USA	Veterinary surgeon (n = 219)	Cross sectional, Outcome instrument used for pain scale of 0 = no pain to 10 = worst possible pain	Number of years performing surgery ($X^2 = 8.99$)* Age ($X^2 = 8.31$)* Weight assoc. with ankle feet ($X^2 = 11.46$)*	94%	Neck (74.4%) Shoulder (28.6%) Hand/wrists (51.8%) Upper back (53.3%) Low back (75.4%) Hip/thighs (16.6%) Knee (37.2%) Ankle (37.2%)
(Gikaro et al., 2025), Tanzania	Teachers (n = 205)	Cross sectional, outcome measure used Standardized NMQ	BMI (OR 1.14 95%CI 1.05–1.24)** Age (OR 1.08 95%CI 1.02–1.14)** Number of working hours (OR 0.75 95%CI 1.16–2.65)** Female (OR 2.87 95%CI 1.31–6.30)** Number of students in class (OR 95%CI 1.01 95%CI 1.00–1.01)	61.5%	Neck (74.4%) Shoulder (28.6%) Hand/wrists (51.8%) Upper back (53.3%) Low back (75.4%) Hip/thighs (16.6%) Knee (37.2%) Ankle (37.2%)

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Prevalence rate of MSK and body parts

The current literature was retrieved and extracted 12 months MSK experience, All study identified prevalence rate is more than 60% (Alelyani et al., 2023; Chandrasekara et al., 2020; Chen et al., 2022; Dong et al., 2019; Gikaro et al., 2025; Kabore & Schepens, 2023; Mai & Kim, 2022; Rickert et al., 2021; Villarreal et al., 2024). Meanwhile, only the study in China (Dong et al., 2019), Germany (Rickert et al., 2021), Vietnam (Mai & Kim,

2022), South Africa (Kabore & Schepens, 2023), Saudi Arabia (Alelyani et al., 2023), and the highest prevalence was assessed in USA (94%) (Villarreal et al., 2024). These findings demonstrate a consistent high prevalence of MSK symptoms related to work with all included articles reporting rate exceeding 60%. The highest occupational health burden may demonstrate in USA due to certain worker populations or awareness in self-reporting occupational health symptoms. The consistent elevated prevalence across countries presents a widespread global issue rather than a specific content phenomenon.

The highest prevalence rate among all body part is in low back (Chandrasekara et al., 2020; Dong et al., 2019; Rickert et al., 2021; Mai & Kim., 2022; Kabore & Schepens, 2023; Villarreal et al., 2024; Gikaro et al., 2025); followed by neck (Rickert et al., 2021; Gikaro et al., 2025; Villarreal et al., 2024; Alelyani et al., 2023; Mai & Kim, 2022; Chen et al., 2022;); and shoulder (Dong et al., 2019; Kabore & Schepens, 2023; Mai & Kim, 2022; Dong et al., 2019). Lower extremities symptoms were less frequently reported except study of Chandrasekara et al (2020); Dong et al. (2019); Mai & Kim (2022). Variations of prevalence rate underscore a reflection of difference in occupational tasks, environmental condition, including ergonomic and report practices. Predominance of low back, shoulder, and neck symptoms may attribute to prolonged and static sitting across occupations. The upper limbs symptoms reflect sustained static posture for upper limb overuse (Deng et al., 2021). Connected to the present review of lower limb involvement (Chandrasekara et al., 2020; Dong et al., 2019) was primarily observed in the knee region, indicating that the finding warrants further discussion in relation to specific occupational exposures and associated risk factors

Occupational exposure and risk factors

The current literature review was revealed three occupations including blue and pink collar workers. Three blue collar workers were identified including tea pluckers, bus driver, and weavers factory workers (Chandrasekara et al., 2020; Chen et al., 2021; Kabore & Schepens, 2023) and six pink collar workers mainly the occupations are service or care-based professions such as healthcare professionals and educators (Dong et al., 2019; Rickert et al., 2021; Mai & Kim, 2022; Alelyani et al., 2023; Villarreal et al., 2024; Gikaro et al., 2025). The result showed that study more likely focused on healthcare professionals (Indrayani et al., 2024). Blue-collar workers tend to report MSK symptoms more evenly across their body compared to pink-collar workers. The likelihood of phenomenon due to physical demanding involved both upper and lower limbs effort. In contrast, surgeon and radiologists, healthcare professions, primarily develop symptoms in upper limbs including neck, shoulder, low back, wrists due to prolonged static posture, repetitive or static hand movements which demanding a sustained visual focus, while the lower extremities have been supported (Jacquier-Bret & Gorce, 2023)

Majority occupational exposure of risk factors to MSK were categorized in physical and psychological. Stress experienced was significantly impact to MSK symptoms that was found in blue and pink-collar workers (Chandrasekara et al., 2020; Dong et al., 2019; Rickert et al., 2021; Chen et al., 2022; Mai & Kim, 2022). Longer duration of work more than 5 year is significantly impact to MSK symptoms (Chandrasekara et al., 2020; Chen et al., 2022; Kabore & Schepens, 2023; Alelyani et al., 2023). Older age was also count to impact MSK symptoms (Chandrasekara et al., 2020; Kabore & Schepens, 2023; Alelyani et al., 2023; Villarreal et al., 2024; Gikaro et al., 2025). The weight or BMI influence MSK symptoms (Alelyani et al., 2023; Dong et al., 2019; Villarreal et al., 2024; Gikaro et al., 2025). Work hours per week including number of performing surgery (Kabore & Schepens, 2023; Dong et al., 2019; Villarreal et al., 2024; Gikaro et al., 2025). Gender

was counted to contribute MSK symptoms (Rickert et al., 2021; Alelyani et al., 2023; Gikaro et al., 2025).

Three studies found mental stress in healthcare professions statistically significant to MSK symptoms OR 2.35 95% CI 1.31-4.24, $p < 0.001$ (Rickert et al., 2021; Dong et al., 2019; Mai & Kim, 2022), while the factory workers more in longer duration of work, older age, physical injured, tobacco smoking (Chen et al., 2022; Chandrasekara et al., 2020; Kabore & Schepens, 2023). This finding is consistent with the result showed that industrial workers shared the likelihood of MSK symptoms related to their experience and tasks (Dianat et al., 2020). The environment conditions also play significant role as the predictor to MSK symptoms particularly the factory workers exposed to outdoor settings (Chandrasekara et al., 2020) or those who prolonged static seated postures where seat support influence symptoms like in bus driver (Chen et al., 2022).

4. CONCLUSION

In conclusion, this literature review synthesized evidence from the included studies on occupational exposures and their association with musculoskeletal symptoms related to work. The findings indicate that physical together with psychosocial risk factors are consistently associated with occurrence of MSK symptoms, however, symptoms differ across body regions and occupational groups, reflecting variations in working activities and work environments. These results underscore the basic data to support the need to improve standardized MSK report outcome from occupational exposure perspectives, strengthen baseline surveillance of body part in different occupations, inform the risk factors in high exposure work environments.

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