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Risk Factors Associated with Musculoskeletal Disorders Among Professional Drivers in Asian Countries: A Systematic Review

(Faktor Risiko Yang Berkaitan Dengan Gangguan Muskuloskeletal dalam Kalangan Profesional Pemandu di Negara Asia: Tinjauan Sistematik)

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ABSTRACT

Musculoskeletal disorders (MSDs) are injuries in the musculoskeletal system caused by sustained or sudden exposure to repetitive motion, vibration, force, and awkward positions. Professional drivers are one of the working populations with a high risk of developing MSDs. Several studies had examined the prevalence and risk factors (RFs) for MSDs among professional drivers. Thus, this systematic review aims to analyze the literature and report the risk factors associated with MSDs among professional drivers in Asian countries. Published literature was systematically searched through EBSCOhost, Web of Science, and OVID. Studies which met the inclusion criteria were methodologically appraised using the Appraisal Tool for Cross-Sectional Studies (AXIS). Based on the studies included, the RFs reported to be significantly associated with MSDs among professional drivers included physical RFs, individual RFs, and psychosocial RFs. There were some RFs that did not fall into the three categories. The most frequently and comprehensively investigated RFs were the physical RFs. In conclusion, there were various RFs associated with MSDs among professional drivers in Asian countries. Further studies should be conducted to understand MSDs among professional drivers in different contexts and circumstances. A holistic and multidisciplinary approach should be used to develop effective management and preventive techniques to address this common occupational problem affecting a large proportion of the working population.

Keywords: Musculoskeletal disorders; risk factors; professional drivers; occupational health; Asian countries

ABSTRAK

Gangguan muskuloskeletal ialah kecederaan dalam sistem muskuloskeletal yang disebabkan oleh pendedahan secara tiba-tiba atau berterusan kepada pergerakan berulang, daya, getaran, dan kedudukan yang janggal. Pemandu profesional adalah salah satu populasi yang mempunyai risiko tinggi untuk mengalami gangguan muskuloskeletal. Terdapat beberapa kajian yang mengkaji kelaziman dan faktor risiko gangguan muskuloskeletal dalam kalangan pemandu profesional. Justeru, kajian sistematik ini bertujuan untuk menganalisis kajian dan melaporkan faktor risiko yang berkaitan dengan gangguan muskuloskeletal dalam kalangan pemandu profesional di negara-negara Asia. Pencarian secara sistematik telah di tiga pangkalan data, iaitu EBSCOhost, Web of Science, dan OVID. Kajian yang memenuhi kriteria kemasukan telah dinilai dengan menggunakan Appraisal Tool for Cross-Sectional Studies (AXIS). Berdasarkan kajian yang dirangkumi dalam kajian ini, faktor risiko yang mempunyai kaitan yang signifikan dengan gangguan muskuloskeletal dalam kalangan pemandu profesional termasuk faktor risiko fizikal, faktor risiko individu dan faktor risiko psikososial. Terdapat beberapa faktor risiko yang tidak termasuk dalam ketiga-tiga kategori. Faktor risiko yang paling kerap disiasat dan dikaji secara komprehensif ialah faktor risiko fizikal. Konklusinya, terdapat pelbagai faktor risiko yang berkaitan dengan gangguan muskuloskeletal dalam kalangan pemandu profesional di negara-negara Asia. Penyelidikan yang lebih lanjut perlu dijalankan untuk memahami gangguan muskuloskeletal dalam kalangan pemandu profesional dalam konteks dan keadaan yang berbeza. Pendekatan holistik yang melibatkan pelbagai disiplin harus digunakan untuk membangunkan strategi pengurusan dan pencegahan yang berkesan untuk menangani isu pekerjaan ini.

Kata Kunci: Gangguan muskuloskeletal; faktor risiko; pemandu profesional; kesihatan pekerjaan; negara-negara Asia

INTRODUCTION

Musculoskeletal disorders (MSDs) are injuries in the musculoskeletal system caused by sudden or sustained exposure to repetitive motion, vibration, force, and awkward body position. MSDs in different body parts are linked with numerous job tasks and can be worsened by work activities (Nazerian et al. 2020; Zulkarnain et al. 2021). In 2017, MSDs were Malaysia's first occupational disease ranking, making up 61.6% of the total disease (Abdullah & Dawal 2020; Socso 2018). Professional drivers drive a vehicle for work purposes (Joseph et al. 2020; Tamrin et al. 2014), which means that they are required to sit in their vehicle for a long period daily, as driving from one place to another is their source of income. The high prevalence of MSDs was significantly linked to work-related factors (Wang et al. 2017). According to Pickard et al. (2022), occupational driving is commonly associated with a high frequency of low back pain (LBP). However, the neck (Takasaki et al. 2014), shoulder (Sekkay et al. 2018), knee (Araújo et al. 2018), and foot (Ahire & Shukla 2021) were the other common regions with high prevalence as well. Severe MSDs can provoke disability, causing decreased work capability and lost income (Abledu et al. 2014).

Previous studies have reported a high prevalence of MSDs among professional drivers, such as taxi drivers, commercial vehicle drivers, and truck drivers (Awang Lukman et al. 2019; Mozafari et al. 2014). Professional drivers frequently meet severe adverse conditions while working, including excessive physical demands, traffic congestion, and continuous time pressure, which could impact their health (Joseph et al. 2021). According to Zulkarnain et al. (2021), MSDs can be manifested at any age and factor. The longer drivers work, the longer they have to sit in the vehicle and move to access vehicle accessories; therefore, increasing the chances of getting MSDs regardless of age (Estember & Huang 2019; Laal et al. 2018; Pradeepkumar et al. 2020). According to Estember and Huang (2019), an oral interview was conducted with bus drivers; they stated that the common causes of discomfort are muscle spasms in the neck and shoulders and incorrect upper and lower body posture. Frequent movements using the arms and wrists to operate the steering wheel, e-brake and clutch handle, as well as frequent movements of stepping on the pedals and bending the knees, can cause discomfort. Long periods of sitting are a common factor for bus drivers to experience pain in the hips, knees, and lower legs.

Epidemiological evidence proposes that MSDs are caused by three risk factors (RFs): physical, individual, and psychosocial (Joseph et al. 2021). The most frequently recognized physical RFs are an ergonomic mismatch, whole-body vibration, and the physical environment (Yasobant et al. 2015). A poorly ergonomically designed vehicle seat, with uncomfortable back support and an incorrect steering wheel position, may cause or contribute to awkward body postures. Moreover, drivers may sit in awkward postures to avoid discomfort caused by poor ergonomic seats for extended periods during their work. These postures include bending and twisting, leaning on one side, slumped sitting, and excessive reaching. Combined with an uncomfortable chair, these postures can place mechanical stress on the spine and surrounding soft structures and ultimately cause MSDs (Yasobant et al. 2015). Furthermore, irregularities on the road surface, or speed bumps, and the oscillation of the seat whilst the car accelerates are also considered to contribute to MSDs (Araújo et al. 2018).

Besides, certain individual RFs such as age, gender, general health status, body mass index (BMI), and previous symptoms are associated with MSDs in professional drivers (Yasobant et al. 2015). According to Laal et al. (2018), there was a positive relationship between ageing, shoulder sitting height, elbow sitting height, and the severity of discomfort in the upper back. Moreover, drivers with high BMI levels mainly experienced severe discomfort in their shoulders, arms, elbows, and hips (Laal et al. 2018). Bovenzi (2010) found occupational drivers are at high risk of developing LBP due to long-term driving and exposure to whole-body vibrations. Further supporting this association between increased driving time and injury risk are findings that older occupational drivers (65 years) have a greater risk of MSDs disorders when compared to younger drivers (25 years) due to more extended periods of whole-body vibrations (Ayari et al. 2011; Pickard et al. 2022).

Psychosocial stressors are all phenomena in the work environment that can damage a worker's physical and mental health (Zulkarnain et al. 2021). The psychosocial RFs associated with MSDs included dissatisfaction with work, stress, and job demand (Joseph et al. 2021; Kresal et al. 2017). A study in Ghana stated that most bus drivers feel stressed, and almost half of the respondents feel dissatisfied with their work. It was found that the perception of work stress and the perception of job dissatisfaction have a significant association with MSDs complaints among bus drivers (Abledu et al. 2014). Regarding Tamrin et al. (2014), most participants with MSDs complained that they felt emotionally exhausted while working, and many bus drivers felt stressed and worried. Furthermore, it highlighted that stress perception, anxiety perception, fatigue perception, and the perception of confusion were risk factors for MSDs complaints. Previous studies hypothesized that psychosocial stressors interact through

neurogenic and neuroendocrine complexes. It affects muscle tension, spinal cord tension, and fatigue, causing drivers to experience traumatic injuries (Hartvigsen et al. 2018). To lessen the incidence of MSDs associated with professional drivers, we must improve our understanding of the RFs that contribute to the development of MSDs.

Several studies have examined the prevalence and RFs of MSDs among professional drivers in recent years. However, existing literature has not given sufficient attention to the RFs that lead to the development of MSDs. Therefore, it is essential to review the published literature to identify the RFs contributing to the development of MSDs to reduce the incidence of MSDs among professional drivers. This systematic review aims to analyze the literature and report on the RFs associated with MSDs among professional drivers in Asian countries.

METHODS

LITERATURE SEARCH AND RESEARCH QUESTION

A systematic search was carried out for a-month long across the electronic databases, EBSCOhost, Web of Science, and OVID. Potential studies were identified using the key terms: ("musculoskeletal disorder" OR "musculoskeletal pain" OR "musculoskeletal injury" OR "low back pain" OR "back pain" OR "lumbar pain") AND ("driver" OR "drivers" OR "driving" OR "drive") OR ("car" OR "cars" OR "vehicle"). Following the data search, results were imported into Endnote X9, and duplicates were removed. The remaining studies were screened by title and abstract for relevance, and any studies not of relevance to this review were excluded. The patient, intervention, comparison, outcome (PICO) strategy was used to develop the research question: What Are the Risk Factors Associated with Musculoskeletal Disorders Among Professional Drivers in Asian Countries?

ELIGIBILITY CRITERIA

This systematic review consists of quantitative primary research studies investigating the RFs associated with MSDs among professional drivers in Asian countries. Studies were included according to the following criteria: (1) cross-sectional studies conducted in Asian countries; (2) subjects should be professional drivers >18 years old; (3) studies published in peer-reviewed academic journals; and (4) studies in English language. The papers published from January 2011 to December 2021 were accepted to ensure that the retrieved studies were contemporary.

To ensure that the risk factors were investigated in a relatively similar context, studies focusing on the MSDs among professional drivers who drove three-wheeled vehicles and heavy-duty vehicles were excluded. Besides, the studies were excluded if they (1) were non-scientific studies or literature reviews; (2) focused on subjects in which driving was not the primary job task; and (3) were related only to intervention.

QUALITY ASSESSMENT

Studies forming this review were then critically appraised using the Appraisal Tool for Cross-Sectional Studies (AXIS) (Downes et al. 2016). The AXIS tool is a critical appraisal tool that addresses study design and reporting quality and the risk of bias in a cross-sectional study, which was developed in 2016 and contained 20 items.

DATA EXTRACTION

The study characteristics extracted from the reviewed studies included information on the authors, year of publication, country of study, number of participants, type of vehicle, outcome measure used, and the key findings from each study. Risk factors were extracted, where possible, as well as musculoskeletal disorder data. Once data were extracted and tabulated, naturally emerging themes were used to synthesize the data.

RESULTS

STUDY SELECTION

The PRISMA guidelines have adhered to this systematic review's search, screening, and reporting (Knobloch et al. 2011). The initial search from the three electronic databases identified 278 studies. A total of 119 duplicates were removed before reviewing the studies. Then, the articles were filtered through title and abstract screening. Among the articles reviewed, the full texts of 26 studies were retrieved for further examination. Each study was independently reviewed to determine the degree to which they met the inclusion criteria. There were 16 studies excluded due to several reasons: longitudinal or prospective cohort studies, focused on professional drivers who drove three-wheeled vehicles and heavy-duty vehicles, focused on subjects in which driving was not the primary job task, and was related only to intervention. After deliberate examination, ten studies were finalized and selected to be critically appraised using the AXIS (Downes et al. 2016). The PRISMA four-phase flow chart is shown in Figure 1.

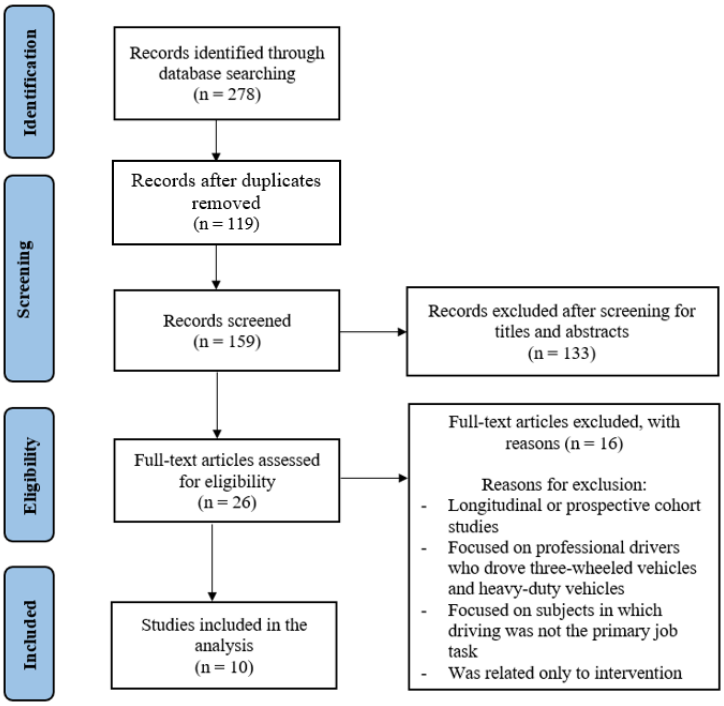

FIGURE 1. PRISMA four-phase flow chart

CRITICAL APPRAISAL OF THE STUDIES

As shown in Table 1, all ten studies had an introduction, establishing each study's context by discussing relevant literature. The authors had clearly stated their objectives in their respective studies. In this systematic review, all studies used a quantitative cross-sectional design appropriate for the stated aims. As for methodology, although the target population, sampling frame, and selection process were clearly defined, only three studies justified the sample size used (Awang Lukman et al. 2019; Jadhav 2016; Pradeepkumar et al. 2020). Pradeepkumar et al. (2020) applied the Yamane formula in calculating sample size, while Awang Lukman et al. (2019) and Jadhav (2016) calculated the sample size based on previous similar studies. Next, non-responders are categorized as non-relevant in this review as none of the studies used the non-responder population. The risk factors and outcome variables measured were appropriate to the stated aims. For study measures, Pradeepkumar et al. (2020) conducted a pilot survey and modified the questionnaire based on the feedback before conducting the study. Tamrin et al. (2014) carried out independent research to determine the reliability of the questionnaire study variables, while Awang Lukman et al. (2019), Bulduk et al. (2014), and Laal et al. (2018) applied measurements and instruments that were either globally accepted standards or had been published previously.

All the studies clearly stated software packages and the statistical significance level used. Among the studies, the study conducted by Jadhav (2016) did not provide a sufficient description of the statistical methods used to allow replication. Except for the study conducted by Jadhav (2016), all other studies included a basic descriptive analysis to summarize the data, gave comprehensive information about the sample used and measurements taken, and presented the results for all the analyses described. The numbers in the results, texts, figures, and tables were consistent. The authors' discussion and conclusions were justified by the results obtained. However, limitations were not discussed in the studies conducted by Sadeghi et al. (2012), Jadhav (2016), and Pradeepkumar et al. (2020). All the studies did not face any conflicts of interest or funding sources that may influence the interpretation of results. Regarding ethical approval and participant consent, all studies addressed and reported on these two aspects except the study conducted by Sadeghi et al. (2012).

SUMMARY OF THE STUDY DETAILS

An overview of the findings from all the studies included is presented in Table 2, with a summary of (a) study design, (b) participant/population, (c) sample size, (d) outcome measure, and (e) key findings. This review categorized the RFs before further discussion. Three categories of RFs

TABLE 1. Study Appraisal using the Appraisal tool for Cross-Sectional Studies (AXIS)

	Sadeghi et al. (2012)	Mozafari et al. (2014)	Bulduk et al. (2014)	Tamrin et al. (2014)	Jadhav (2016)	Wang et al. (2017)	Laal et al. (2018)	Arslan et al. (2019)	Awang Lukman et al. (2019)	Pradeepkumar et al. (2020)
Introduction										
1. Were the aims/objectives of the study clear	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Methods										
2. Was the study design appropriate for the stated aim(s)?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3. Was sample size justified?	×	×	×	×	✓	×	×	×	✓	✓
4. Was the target/reference population clearly defined?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6. Was the selection process likely to select subjects/ participants that were representative of the target/ reference population under investigation?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7. Were measures undertaken to address and categorize non-responders?	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
8. Were the risk factor and outcome variables measured appropriate to the aims of the study?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9. Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?	×	×	✓	✓	×	×	✓	×	✓	✓
10. Is it clear what was used to determined statistical significance and/or precision estimates? (e.g. p-values, confidence intervals)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	✓	✓	✓	✓	×	✓	✓	✓	✓	✓
Results										
12. Were the basic data adequately described?	✓	✓	✓	✓	×	✓	✓	✓	✓	✓
13. Does the response rate raise concerns about non-response bias?	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
14. If appropriate, was information about non-responders described?	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

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15. Were the results internally consistent?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16. Were the results presented for all the analyses described in the methods?	✓	✓	✓	✓	×	✓	✓	✓	✓	✓
Discussion										
17. Were the authors' discussions and conclusions justified by the results?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
18. Were the limitations of the study discussed?	×	✓	✓	✓	×	✓	✓	✓	✓	×
Other										
19. Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	×	×	×	×	×	×	×	×	×	×
20. Was ethical approval or consent of participants attained?	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes: ✓ refers to 'yes'; × refers to 'no'; NR refers to 'not relevant'; NA refers to 'not addressed'.

were recognized among the ten included articles: physical, individual, and psychosocial. The RFs that did not belong to these three classifications were separately categorized as "other RFs". In the studies, the different types of vehicles reported included bus (five studies), taxi (three studies), lorry (one study), and commercial vehicles (one study).

PHYSICAL RISK FACTORS

Seven of the ten studies reviewed reported physical RFs associated with MSDs among professional drivers in Asian countries (Arslan et al. 2019; Awang Lukman et al. 2019; Bulduk et al. 2014; Laal et al. 2018; Pradeepkumar et al. 2020; Tamrin et al. 2014). The various physical RFs reported included hardness of the seat's material, contour, design, lifting, eye sitting height, sitting height, and repetitive tasks. According to Laal et al. (2018), sitting height and eye sitting height had a significant and inverse relationship with the severity of discomfort in the driver's elbow and ankle ($p<0.05$).

Among the seven studies, lack of seat adjustability, uncomfortable seats, awkward working positions, heavy loads, and body bending were the physical RFs associated significantly with MSDs among professional drivers reported twice in different studies. A significantly higher frequency of LBP was found among commercial vehicle drivers who often handled heavy loads manually and those who adopted awkward body postures during manual muscle handling (Awang Lukman et al. 2019).

In addition, it was noticed that prolonged sitting and whole-body vibration (WBV) exposure had been reported as physical RFs that were significantly associated with MSDs among the population in three different studies, respectively. The study conducted by Tamrin et al. (2014) among bus drivers in Peninsular Malaysia suggested that the total vibration value of eight hours frequency-weighted root-mean-square (r.m.s.) acceleration ran over the action value of EU Directive 2002/44/EC (average = 0.54 ± 0.073 m/s^2). In this condition, 69.3% of the bus drivers complained of having MSDs, as the daily vibration exposure was more than the daily exposure action value set by the Directive (0.5 m/s^2). Awang Lukman et al. (2019) found a significant association between LBP and daily vibration exposure in their study involving commercial vehicle drivers in Sabah. There was a higher prevalence of LBP among the drivers (77.6%) who were exposed to $A_z(8)$ at the mean value and above, in comparison with the reference group (53.8%) [POR = 2.97, 95% CI [1.30, 6.76]].

INDIVIDUAL RISK FACTORS

All ten studies reported on individual RFs significantly associated with professional drivers in this review. The individual RFs reported included age, exercise status, history of previous MSDs, driving accident history, body mass index (BMI), smoking habits, drinking, lack of awareness regarding ergonomics, working part-time, and ethnic group. Among the RFs, age and BMI were the most frequently reported individual RFs.

Four studies reported that MSDs were significantly associated with drivers' age (Bulduk et al. 2014; Mozafari et al. 2014; Pradeepkumar et al. 2020; Sadeghi et al. 2012), while Wang et al. (2017) found that LBP was not significantly associated with age. In this review, only one study found no significant association between smoking and LBP (Wang et al. 2017). According to Awang Lukman et al. (2019), the prevalence of LBP was the highest among the participants from three ethnic groups, which were Kadazan, Dusun, and Murut, compared to Malay and other ethnic groups (POR=3.92, 95% C.I [1.48, 10.40]). Only one study reported a significant association between a lack of ergonomic awareness and LBP (Arslan et al. 2019).

PSYCHOSOCIAL RISK FACTORS

Six studies in this review reported psychosocial RFs were associated with MSDs among professional drivers (Arslan et al. 2019; Awang Lukman et al. 2019; Bulduk et al. 2014; Jadhav 2016; Pradeepkumar et al. 2020; Tamrin et al. 2014). According to Tamrin et al. (2014), psychological factors, which included feeling stressed, worried, exhausted, and confused, were significant RFs of MSDs among Malaysian bus drivers. Two studies reported stress and job dissatisfaction as the psychosocial RFs associated with MSDs among professional drivers. The others psychosocial RFs reported were high job demand, low job support, and low job control. In a comparative study involving public bus transport drivers and non-drivers (Jadhav 2016), the percentage of drivers (28.7%) who were dissatisfied with their job was significantly higher than non-drivers (7.6%).

OTHER RISK FACTORS

RFs that did not belong to the three classifications were separately categorized in this review. Other RFs associated with MSDs among professional drivers which were related to working conditions included working duration, years of

TABLE 2. Key metrics and findings for included studies

Author	Design	Participant/Population	Sample Size	Outcome Measure	Key Findings
Sadeghi et al. (2012)	Quantitative cross-sectional design	Bus drivers in Iran	n=95	- Anthropometric Measurement - Self-administered questionnaire which contained Body Discomfort Chart (BDC)	• $p<0.05$ - The relationship between the variables of age and neck pain is straight. - Bus drivers who worked more than half of day had disorders in their hands, wrists, and forearm. - Bus drivers who did not exercise routinely had more disorders in their hands, fingers, knees, legs, and wrists. - Bus drivers who had chronic back pain felt discomforts in the neck, low back, knees, and ankles. - Bus drivers who had vertebral disc surgery had discomforts in the pelvis. - Bus drivers who had at least one accident in their driving history had discomforts in their thighs.
Mozafari et al. (2014)	Quantitative cross-sectional design	Lorry drivers with at least five years working experience, above 20 years old, without a history of rheumatologic diseases and previous non-work-related MSDs	n=173	- Self-developed questionnaire to collect demographic data - Iranian version of standardized Nordic Questionnaire (SNQ)	• MSD was significantly associated with the drivers' age ($p<0.001$). • MSD had a significant association with BMI ($p=0.039$) in the past year. • Prevalence of musculoskeletal disorders within last week in drivers with 15 years of working experience and above were significantly higher, • $z$compared to those with <10 and 10-15 years of working experience ($p=0.007$). • Lumbar region ($p=0.008$) and wrist ($p<0.001$) had a significant relationship with work duration.
Bulduk et al. (2014)	Quantitative cross-sectional design	Turkish taxi drivers from Ankara, Turkey who were male, 18 years old or above and joined The Public Vehicle Owners and Drivers' Union	n=382	Quick Exposure Check (QEC)	• Drivers' score of risk exposure was high for back (static) (32.1 ± 4.4) and moderate for back (moving) (19.3 ± 4.7). • The score of risk exposure was very high for shoulder/arm, wrist/hand, and neck. • 52.10% and 23.80% of taxi drivers had very high and high stress scores. • Prevalence rate of musculoskeletal problems had a significant association with drivers' ages ($p < 0.05$) and years of working as a driver ($p < 0.05$). • The most common factors were handling heavy loads, awkward working positions, variable working hours and lack of rest.

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Tamrin et al. (2014)	Quantitative cross-sectional design	Male commercial bus drivers in Peninsular Malaysia	n=1181 From the total respondents, - respondents that were randomly selected for measurement of WBV (n=193) - respondents selected for postural observation (n=223)	- Self-developed and piloted questionnaire with adaptations from English Nordic Questionnaire, - Malay Language version of the Profile of Mood States - Human Vibration Meter by 01dB-Metravib with a triaxial accelerometer (0.4–1000 Hz) and ISO 2631-1 standard - Adapted Ovako Working Posture Analysis System	• Using a 95% Confidence Interval - Risk factors that were associated significantly with MSDs included smoking, working conditions, feeling stressed, worried, fatigued, and confused. - Seat characteristics, including lack of seat adjustability, uncomfortable seats, hardness of the seat's material, the seat's contour, seat's design, and magnitude of WBV exposure of greater than 0.5 m/s^2 r.m.s. were associated with MSDs.
Jadhav (2016)	Quantitative comparative cross-sectional design	Public bus transport drivers with minimum two years working experience, and no LBP when joining the department, Non-drivers working at the same depot	Public bus transport drivers (n=178), Non-drivers (n=184)	Self-administered questionnaire which was translated into the Marathi language	• Frequency of working night shifts were much higher among drivers (66.8%), compared to non-drivers (17.4%). At the start of work, the comfort levels of drivers and non-drivers were significantly different ($p<0.001$). • Percentage of drivers (28.7%) who were dissatisfied with their job was significantly higher than non-drivers (7.6%). • Risk factors such as prolonged sitting in one posture, night shifts, lack of exercise, and smoking were significantly higher among drivers.
Wang et al. (2017)	Quantitative cross-sectional design	Taxi drivers in Jinan, China who worked for at least 40 hours weekly during the recent four weeks, had no less than one year of working experience and were permanently employed	n=719	Self-developed questionnaire which included a modified Delphi questionnaire and a Nordic Musculoskeletal Questionnaire	• Using a 95% Confidence Interval, results of both univariate and multivariate logistic regression analysis revealed that - risk of reporting LBP increased with higher BMI, longer daily driving duration, more work years, and night shifts - risk of reporting LBP decreased with longer sleeping durations, more physical activities, and more rest days. • There was no significant association between age, smoking, drinking and LBP.

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Laal et al. (2018)	Quantitative cross-sectional design	Bus drivers in Zahedan City who had at least one-year job experience, without a history of spinal surgery, and non-job-related MSDs	n=60	- Anthropometric measurement - Body Discomfort Chart (BDC)	Drivers had either severe or very severe discomfort in the lower back (33.30%), upper back (18.30%), and knee (15.00%). There was a direct and significant relationship between BMI and discomfort in the arm, elbow, shoulder, and hip (p<0.05). Sitting height and eye sitting height had a significant and inverse relationship with the severity of discomfort in the ankle and elbow (p<0.05).
Arslan et al. (2019)	Quantitative cross-sectional design	Taxi drivers who were male, between 20-60 years old with more than one-year working experience from Iran and Pakistan	Iranian (n=600), Pakistanis (n=600)	- Self-administered questionnaires in Persian and Urdu languages - Roland Morris Disability Questionnaire	Pain intensity between drivers from both countries was not significantly different (p=0.123). Lack of exercise, career duration as a driver, driving within city, daily driving hours, lifting, forward bending, uncomfortable seat, lack of ergonomics awareness, and job dissatisfaction were the main reasons for LBP.
Awang Lukman et al. (2019)	Quantitative cross-sectional design	Qualified commercial vehicles drivers with one-year working experience and above who were hired by two companies in Kota Kinabalu, Sabah	n=110	- Modified Malay language version of VINET - Calibrated VI-400Pro Human Vibration Monitor with a triaxial accelerometer.	The daily vibration exposure $A_z(8)$ and $A_v(8)$ had significant association with LBP. Drivers who often handled heavy loads manually had a significantly higher prevalence of LBP than those who did not (POR=3.99, 95% C.I [1.65, 9.63]). Drivers who had awkward postures during MMH had a significantly higher prevalence of LBP than those who did not (POR=3.99, 95% C.I [1.65, 9.63]). LBP was significantly associated with Ethnic groups. 60.9% of participants experienced high job demand. 7.3% and 6.4% of participants had low job support and low job control.
Pradeepkumar et al. (2020)	Quantitative cross-sectional design	Full-time bus drivers in Karnataka, South India who aged between 24-55 years	n=301	Self-developed and piloted questionnaire which was formed based on Modified Nordic Musculoskeletal Questionnaire	WMSDs were found predominantly in the age group of 30-40 years. The highest occurrence of MSDs was reported in drivers who had 11-15 years of working experience. BMI, current health status, seat adaptability, prolonged sitting, body bending, number of breaks, shift timings, exercise status, doing repetitive task, outside food dependency, exposure to vibration, work stress, drinking water and restrooms accessibility showed significant association with WMSD in bus drivers.

working as a professional driver, frequency of trip daily, resting time, night shifts, sleeping duration, and driving within a city (Arslan et al. 2019; Bulduk et al. 2014; Jadhav 2016; Mozafari et al. 2014; Pradeepkumar et al. 2020; Sadeghi et al. 2012; Tamrin et al. 2014; Wang et al. 2017). In addition, Pradeepkumar et al. (2020) stated that outside food dependency, drinking water, and restroom accessibility were also RFs that showed significant association with WMSDs among bus drivers.

DISCUSSION

This systematic review aimed to identify and report the RFs associated with MSDs among professional drivers in Asian countries. All the studies included were cross-sectional studies; thus, no conclusion about causality could be drawn. Current information would indicate possible relationships (Baadjou et al. 2016). This review also determined some frequently reported RFs for MSDs among professional drivers.

Based on this review, the RFs identified included physical RFs, individual RFs, psychosocial RFs, and other RFs. Physical RFs consist of work environment factors and physical demands. The work environment factors significantly associated with MSDs included seat characteristics, seat adjustability, eye sitting height, and sitting height. The findings were similar to the study by Raffler et al. (2016), which concluded that work environments were the most significant contributor to creating various musculoskeletal pain. All studies obtained consistent results. Physical demands such as lifting, doing repetitive tasks, awkward working positions, handling heavy loads, prolonged sitting, and WBV exposure were reported to be significantly associated with MSDs among professional drivers. The findings were in agreement with the review by Joseph et al. (2021), in which the authors suggested that physical RFs displayed strong evidence of a relationship with work-related musculoskeletal disorders (WRMSDs).

In terms of individual RFs, the RFs reported included age, exercise status, history of previous MSDs, driving accident history, BMI, smoking habits, drinking, lack of awareness regarding ergonomics, working part-time, and ethnic group. It was noticed that some studies considered the history of previous MSDs as one of the RFs to be investigated. In contrast, some studies excluded participants with a history of MSDs. A history of MSDs was previously found to be a significant RFs for developing MSDs (Zack et al. 2018). This might be why some studies excluded participants with a history of MSDs. In this review, age and smoking were the individual RFs that displayed inconsistent results as Wang et al. (2017) indicated that there was no clear association between age, smoking and LBP, while other studies suggested that age and smoking habit were significantly associated with MSDs among professional drivers (Arslan et al. 2019; Bulduk et al. 2014; Jadhav 2016; Mozafari et al. 2014; Pradeepkumar et al. 2020; Sadeghi et al. 2012; Tamrin et al. 2014). The results were contrary to those obtained by Joseph et al. (2021). The review found inconclusive evidence of a relationship between most of the individual RFs with WRMSDs.

In this review, the psychosocial RFs reported to be significantly associated with MSDs among professional drivers in Asian countries were stress, fatigue, confusion, job dissatisfaction, high job demand, low job support, and low job control. There was no contradictory result obtained for the psychosocial RFs reported. Osipow job stress questionnaire is one of the validated questionnaires that can be used to investigate psychosocial RFs among professional drivers (Hajiamini et al. 2011; Rahimpour et al. 2020). However, as two studies applied self-developed questionnaires to collect data; if a validated and reliable instrument was used, more accurate and valid results could be obtained. For other risk factors, various RFs related to working conditions were reported to be significantly associated with MSDs among professional drivers. Apostolopoulos et al. (2013) supported the findings, who stated that workplace organization presented serious challenges for professional drivers.

LIMITATIONS, STRENGTHS, AND IMPLICATIONS

This review was distinct from earlier studies as it investigated the RFs associated with MSDs among professional drivers in Asian countries. However, there were some limitations in this review. Firstly, a wide heterogeneity of parameters in the included studies could influence the translation of review findings into practice. Some studies involved a relatively small sample size, so that specific exposure might vary. Besides, different studies used phrases to report RFs, such as “body bending” and “forward bending”, without clearly defining the activities. The interpretation and classification of RFs might not be accurate. However, this review was conducted following the good standards of practice suggested by PRISMA guidelines (Knobloch et al. 2011). In addition, the studies selected were critically appraised using the AXIS (Downes et al. 2016).

CONCLUSION

The findings showed various RFs associated with MSDs among professional drivers in Asian countries. Based on this review, the most frequently and comprehensively investigated RFs were the physical RFs, such as awkward postures and WBV. However, individual, psychosocial, and other RFs associated with MSDs among this population should not be neglected. Working conditions significantly associated with MSDs should also be given proper attention. In conclusion, further studies should be conducted to understand MSDs among professional drivers in different contexts and circumstances. A holistic and multidisciplinary approach should be used to develop effective management and preventive tactics to address this common occupational problem affecting a large proportion of the working population.

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