Risk factors of work-related musculoskeletal disorders among airport baggage handlers: A Systematic Review

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Abstract

Work-related musculoskeletal disorders (WMSDs) are a significant health problem among airport baggage handlers. A systematic review of the prevalence and risk factors of WMSDs among airport baggage handlers is lacking. This study aimed to systematically review the existing literature that presents estimates for WMSD prevalence and risk factors among airport baggage handlers. **Methods:** The systematic review was carried out on PubMed, EMBASE, CHINAIL, Scopus, Google Scholar, Thai Journal Online, and ThaiLIS. The search will include journal articles written in English and Thai from the above-specified databases from 2012 to the present. Studies were included if they met the inclusion criteria which investigated the prevalence and risk factors associated with WMSDs. The studies were qualitatively assessed using the JBI quality appraisal tool. **Results:** The literature search yielded 45 records through electronic databases and additional records identified through other sources 23 records, although only 7 English studies passed the inclusion criteria. Four of the studies were cohort studies, and three were cross-sectional. The lower back was the most frequently reported specific injured body part, with an estimated WMSD prevalence range between 32.6-70%. The risk factors can be classified into four groups. The individual factors include smoking, seniority, and age. The biomechanical factors, such as awkward working postures, heavy lifting, and turning around frequently. The psychosocial factors include interpersonal relations and negative opinions of the work. Organization factors include time pressure and work task duration. **Conclusions:** To prevent WMSDs among airport baggage handlers, the risk factors of individual, biomechanical, psychosocial, and organization should be understood.

Keywords : airport baggage handlers, risk factor, systematic review, work-related musculoskeletal disorders

Background

Work-related musculoskeletal disorders (WMSDs) are a significant health problem throughout the world both within developed and developing countries and a major problem in various sectors.[1,2] The World Health Organization (WHO) reported that musculoskeletal conditions are the most common causes of disability and limitations related to daily living and gainful employment.[3] WMSDs constitute a major occupational health hazard among workers and still increasing.[4,5,6,7]

The impact of WMSDs on working life is due to costs for sick leave and health care and reduced health-related quality of life.[8] Besides sickness absence and chronic occupational disability, WMSDs cloud also leads to reduced work effectiveness.[9] In addition, WMSDs significantly limit mobility and dexterity, leading to early retirement from work, lower levels of well-being, and reduced ability to participate in society.[10] The Health, Safety & Environment (UK) reports that an estimated 28.4 million working days were lost due to WMSDs on average, each person suffering from these disorders took an estimated 23 days off work per year, with an estimated cost to the economy of £5.7 billion.[2] A study by Chen et al[8] found that, in this

cross-sectional study of 192 countries and territories, 7.3 lived with disability and $180.7 billion in total costs associated with WMSDs.

Factors potentially contributing to the development of WMSDs from the literature review can be classified into five groups. Firstly, individual factors: Individual factors such as, such as demographic-gender, age, height and weight, personality, lifestyle, co-morbidity, history of MSDs, and social–marital status, economic, and race. Secondly, organization and social factors such as pace of work, repetitive work, time patterns, and payment systems. Thirdly, psychosocial factors: The mechanism of psychological factors to WMSDs is when job stress affects the human body which undergoes psychological, physiological, and behavioral, there are changes in body chemistry that may increase the risk of WMSDs.[11] Fourthly, Biomechanical factors: Three major factors, awkward body positions, forceful exertions, and repetition.[12,13,14,15] Finally, other factors such as social factors, work procedure, and equipment. These factors are the causes of WMSDs among airport baggage handlers.

Airport baggage handlers, work in the baggage handling area of the airport and are an important part of airport operations. They are also a group with WMSDs. Previous systematic reviews about prevalence and risk factors related to WMSDs found studies in various occupations. For instance, the prevalence and risk factors of WMSDs in the catering industry, musicians, nurses, and operating room personnel.[16,17,18,19] There is no recent systematic review of prevalence and risk factors studies of WMSDs in airport baggage handlers. Knowing the evidence-based prevalence and risk factors that lead to WMSDs has significant implications for airport baggage handlers. This study aimed to systematically review the existing literature that presents estimates for musculoskeletal prevalence and risk factors among airport baggage handlers globally. The specifics of a systematic review of this study were 1) to determine the pooled estimated prevalence and risk factors of WMSDs among airport baggage handlers, and 2) to describe the general prevalence and risk factor characteristics of WMSDs among airport baggage handlers.

Methods

This review followed guidance published by the Centre for Reviews and Dissemination, the Cochrane Collaboration, and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [20] (Fig. 1).

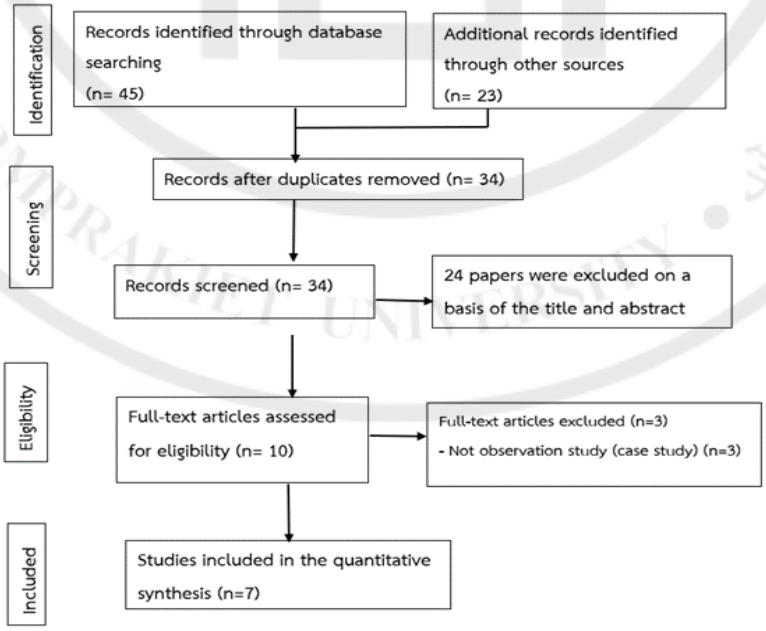

Fig 1 Study selection flow diagram following the PRISMA guidelines

Searching strategy

An electronic literature search was conducted in PubMed, EMBASE, CHINAIL, Scopus, Google Scholar, Thai Journal Online (ThaiJo), and ThaiLIS to identify relevant published articles. The last search date was 23 April 2023. Studies were limited to peer-reviewed, written in English or Thai, and published from 2012 to 2023. The terms related to Musculoskeletal disorder, prevalence, and risk factor (epidemiology, cohort study, cohort analysis, cross-sectional study, cross-sectional analysis, and observational analysis. The search string will be built as follows: ("luggage handler*") OR ("porter*") OR ("baggage handler*") AND ("work-related musculoskeletal diseases" OR "musculoskeletal-disease*" OR "musculoskeletal" OR "musculoskeletal pain" "Musculoskeletal-injury*" OR "musculoskeletal-abnormality*" OR "back pain*" OR "shoulder pain*" OR "neck pain*" OR "wrist pain*" OR " elbow pain*" OR "hand pain*" OR "arm pain") AND ("prevalence*" OR "occurrence*" OR "frequency*" OR "epidemiology" OR "risk factor*" OR "predictor*" OR "influencing factor*" OR "influence factor*" OR "related factor*".

Eligibility criteria

Types of study included cross-sectional studies, prospective cohorts, and case-control studies that reported and determined the prevalence or risk factors for WMSDs among airport baggage handlers. The letters, editorials, conference proceedings, policy statements, and textbooks were excluded. Studies meeting the inclusion criteria were eligible for review. Full texts had to be published and available in English or Thai language.

Inclusion criteria were set following PEO domains. Studies meeting all the following criteria were included in this review:

1. Participants: Participants of the studies were airport baggage handlers

2. Exposure: Exposure to the studies was risk factors detailed as follows.

2. 1 Individual factors: such as demographic-gender, age, height and weight, personality, lifestyle, co-morbidity, history of MSDs, and social–marital status, economic, and race.

2.2 Organization factors: such as working under time pressure, the pace of work, lack of time to recover, inflexibility of procedures and checks

2.3 Psychosocial factors: such as job strain, social support at work, and job dissatisfaction

2.4 Biomechanical factors: such as awkward posture, forceful exertion, and repetition

2.5 Other factors: such as social factors, work procedure, equipment, and environment.

3. Outcomes: The outcome of the studies were work-related musculoskeletal disorders

Exclusion criteria

Studies without available full-text articles were excluded.

Data extraction

Data extraction was completed by two reviewers (one reviewer extracted data from the included studies and another reviewer cross-checked the extracted data). The main categories of data were extracted: characteristics of the samples, methodological characteristics of each study, prevalence and location of the body, and risk factors. Where the same dataset was reported in more than one article, the dataset was considered a duplicate, thus only one article was included in the systematic review. If one study reports prevalence, incidence, or risk factors data collected in different countries or in different time episodes, we also extract the data.

Quality assessment of included studies

Based on the Joanna Briggs Institute (JBI) quality appraisal tool, all 7 articles fulfilled we predetermined requirement for a score. The result shows that 3 studies got a full score of 9 (42.86%), and 4 articles scored 8 (57.14 %) (Table 1).

Results

Search results

The literature search yielded 45 records through electronic databases and additional records identified through other sources 23 records. After excluding 34 duplicates, we screened the titles and abstracts of the remaining 34 records for screened. Of the remaining 34 articles, 24 were eliminated in the second round for papers that were excluded on the basis of the title and abstract. Full-text articles were assessed for eligibility 10, and 3 full-text articles were excluded because of not match the study design. In the end, 7 articles were included from English medical databases. A flow diagram is presented in Fig 1.

Included studies characteristics

Among the seven studies, four were conducted at Copenhagen Airport [21,22,23,24], one was conducted at the Swedish Airport [25], one was conducted at the Chinese Airport [26], and one was conducted at the Mehrabad International Airport. [27] The prevalence and location of body parts of WMSD are reported in four studies (57.14 %). [23,25,26,27] The risk factors are explored in 7 studies (100%). The detailed characteristics and extracted data of the included studies for the prevalence and risk factors are summarized in Table 2.

Prevalence and locations of WMSD among airport baggage handlers

The publications were published from 2012 to 2023 (Table 2). Among them, four were conducted at Copenhagen airport, Denmark (57 %), one was conducted at the Swedish airport, Sweden (14.28 %), one was conducted at the Chinese airport, China (14.28 %), and one was conducted at the Mehrabad International airport, Iran (14.28 %). The studies were mainly cohort studies (57.14 %, n = 4), and there were three cross-sectional studies (42.86%). The results show that the locations of the body where WMSD occurred were the lower back, upper back, neck, shoulder, elbows, wrists, hips, knees, ankles, and heels region. The lower back region was the most frequently reported specific injured body part for airport baggage handlers, the results show an estimated WMSD prevalence range between 32.6 - 70 %. Followed by the shoulder, neck, wrists, and knee region among these workers, the result shows an estimated WMSD prevalence range were 7.18 - 60 %, 14.40 - 38.1 %, and 9.57 - 35.20 %, respectively. However, two citations reported that the hips region found the lowest prevalence of WMSD between the range 7.60 - 7.66%.

Risk factors

According to the findings from these seven articles, they are from four countries including Denmark, Sweden, China, and Iran. The risk factors can be classified into four groups (Table 2). **Individual factors** including three risk factors were smoking behavior (OR=1.699), baggage handler seniority, and age of the worker. **Biomechanical factors** including nine risk factors were awkward working postures, heavy lifting, turning around frequently (OR=1.716), turning and blending at the same time frequently (OR=8.267), exercise after work (OR =3.645), labor intensity (OR =2.508), long-term lifting in awkward working positions, long-term heavy lifting in kneeling, and long-term heavy lifting in a squatting position. **Psychosocial factors** including two risk factors were workers being dissatisfied with interpersonal relations, and workers with a more negative opinion of the

work. **Organization factors** including two risk factors were time pressure and work task duration

Discussion

Prevalence and locations of WMSD

The survey found a wide range of WMSD prevalence among airport baggage handlers across different body parts. It is known that different research tools can lead to different conclusions about the locations of WMSD. The study of Tafazzol et al[27] applies the use of the Nordic Musculoskeletal Questionnaire (NMQ).[28] This questionnaire quantifies musculoskeletal pain and activity prevention in whole body regions including wrists, forearms, elbows, shoulders, neck, trunk, back, legs, and knees. Therefore, this study reports prevalence on the whole body. In the study by Bern et al[23] was collected using a self-administered questionnaire. The study by Wang et al[26] was designed by a research group in accordance with NMQ. The study by Bergsten et al[25] was collected using a questionnaire addressing MSDs (Standardized Nordic Questionnaire) and psychosocial factors (Copenhagen Psychosocial Questionnaire, COPSOQ). As mentioned, the research tools could be the cause of this difference in conclusions about the locations of WMSD. This systematic review of four studies shows the same result that the lower back region was the most frequently reported specific injured body part, the results show an estimated WMSD prevalence range between 32.6 - 70 %. [23,25,26,27] Followed by the shoulder, neck, wrists, and knees. However, the hips region was found the lowest prevalence of WMSD. [23,27]

Risk factors

Due to the cross-sectional study and cohort, the likely risk factors among airport baggage handlers can be classified into individual factors, psychosocial factors, organization factors, and biomechanical factors. Individual factors include three risk factors smoking behavior, baggage handler seniority, and age of the worker. The age association was stronger among baggage handlers (IRR = 1.40; 95 % CI), baggage handlers had increased incidence at younger ages than the reference population at Copenhagen airport. [21] While baggage handler seniority was significantly, and positively associated with WMSDs at Copenhagen Airport.[23] Psychosocial factors include workers being dissatisfied with interpersonal relations being more likely to show both pains interfering with work and intense pain, and workers with a more negative opinion of the work at the Swedish airport.[25] Organization factors include time pressure and work task duration at Copenhagen Airport. [21,22] The results also reported that biomechanical factors include awkward working postures, heavy lifting, turning around frequently, turning and blending at the same time frequently, exercise after work, labor intensity, long-term lifting in awkward working positions, long-term heavy lifting in kneeling, and long-term heavy lifting in a squatting position. [21,22,23,24,26,27]

This systematic review shows that biomechanical factors are the main risk factors contributing to WMSDs among airport baggage handlers. The most common biochemical factors contributing to WMSDs were heavy lifting and awkward working posture.[21,22,23,24,27] In the performance of the airport baggage handlers, the average weight of passenger baggage is 15 kg/ piece. However, many airlines allow baggage weights up to 32 kg/ piece (Qatar Airlines, American Airlines, British Airways, etc.). This violates the conservative limit of the National Institute for Occupational Safety and Health loads of 25 kg/ piece.[27] The average baggage handler lifts about 4-5 tonnes per day, and some days up to 10 tonnes.[29] In addition, the space is limited and the ceiling in the baggage compartment height is only about 1 meter above the floor in a Boeing 737-800 which is the most widely used commercial airplane worldwide. This requires the baggage handlers to perform lifting in awkward positions which are the most common are kneeling, stooped, and sitting positions. [29,30,31] From the situation,

airport baggage handlers do heavy physical work, heavy lifting, and working in awkward postures, which are potential work-related risk factors for WMSDs. [14,32,33,34,35]

Biomechanical factors can be found in six studies and often work in combination with other factors to affect and bring to WMSDs among airport baggage handlers.[21, 22, 23, 24, 26, 27] The factors that can combine with biochemical factors are individual factors and organization factors. In terms of individual factors including smoking behavior (OR=1.699) [26], baggage handler seniority, and the age association among baggage handlers was a stronger incidence rate ratio.[21] While organization factors include time pressure [21] and work task duration. [23]

Conclusion

Airport baggage handlers frequently suffer work-related musculoskeletal disorders. The most common region of the body in which these injuries occur is the lower back, followed by the shoulders and neck. Numerous risk factors were found to be predisposing to work-related musculoskeletal disorders including individual factors, psychosocial factors, organization factors, and biomechanical factors. The most biochemical factors contributing to WMSDs were heavy lifting and awkward working posture.

Limitation

The lack of epidemiological information about WMSDs among airport baggage handlers is apparent. Further studies are needed to investigate the relationship between prevalence, risk factors, and forms of WMSDs among airport baggage handlers.

Recommendations

This systematic review addressed the prevalence and risk factors of WMSDs among airport baggage handlers. To understand the prevalence and risk factors of WMSDs among airport baggage handlers. The prevalence of WMSDs was very high, and risk factors associated with WMSDs among airport baggage handlers were identified, as a result, an interventional study should be conducted to prevent WMSDs in this unique industry.

Table 1 Methodological quality assessment of included studies using the Joanna Briggs Institute (JBI) quality appraisal tool (ReportingPrevalence data)

No	Author/ Publication Year	Criteria									
		Appropriate sample frame	**Study participant recruitment in an appropriate**	**Sample size adequate**	**The study subject and setting are described in detail**	**Data analysis conducted with sufficient coverage**	**Valid Method**	**Assessment of the outcome**	**Statistic analysis**	**Response rate**	**JBI (score) 9**
1	Tafazzol et al. (2016).	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
2	Wang et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
3	Bergsten et al. (2015).	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
4	Thygesen et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
5	Møller et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
6	Bern et al.(2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
7	Mikkelsen et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8

Table 2 Characteristics of 7 studies included in the systematic reviews

No.	Author/ Publication Year	Location	Study design	Sample characteristics	Prevalence and locations of the body	Risk factors
1	Tafazzol et al. (2016).	Mehrabad International airport	Cross-sectional	-255 baggage handlers. - Mean lifting frequency of 5.67±2.44 lifts per minute. - The loads measured for these observations had a mean of 15.35±5.09 kg.	Low back = 34.93%, Neck = 14.3% Shoulder = 7.18%, Upper back= 15.31 %, Wrists = 9.57 %, Elbow= 8.70%, Hip = 7.66 %, Knees (also thigh) = 20.1 %, Heel = 12.4 %, Ankle = 12.44%	**Biomechanical factors** 1. Awkward working postures 2. Handle overweight baggage (Heavy lifting)
2	Wang et al. (2018)	Chinese airport	-Cross-sectional	-550 flight baggage porters -**Mean age** = 34.5 years (SD. = 6.5) -A length of employment for less than 3 years = 64 % **- General Health:** Good health 41 % (n =176), Felt fine 48.3% (n= 207), Bad 10.8% (n= 46)	Lower back = 62.7%, Neck pain =38.1%, Hand/wrist = 35.2 %, Shoulder pain = 32.4%	**Individual factors:** Smoking behavior (OR=1.699) **Biomechanical factors:** Turn around frequently (OR=1.716), Turn and blend at the same time frequently (OR=8.267), Exercise after work (OR =3.645), Labor intensity (OR =2.508)
3	Bergsten et al. (2015).	Swedish airport	Cross-sectional	-525 baggage handlers from six Swedish airport **-Male:** n = 515 (98%), **Female**: n =10 (2%) **- Age** <34 = 48.76%, 35–49 =33.71%, >50 = 13.52% **- General Health:** Excellent/very good 50%, Good 36%, Somewhat bad 13%, Health rating missing 1%	The one-year prevalence of pain in the lower back and shoulders were 70% and 60%, respectively	**Psychosocial factors** 1. Workers being dissatisfied with interpersonal relations are more likely to show both pains interfering with work and intense pain 2. Workers with a more negative opinion of the work
4	Thygesen et al. (2016)	Copenhagen airport	Cohort	-3,396 baggage handlers and 63,909 workers in the reference group - **Mean age:** 29 years **- Body mass index:** <18.5= 0.1%, 18.5–24.9, 34.1%, 25. 0–29.9, 48.4% , ≥30.0, 16.2 %, Missing, 1.2%	This study did not show the prevalence	**Biomechanical factors:** Long-term lifting in awkward working positions **Organization factors:** Time pressure influences the risk of subacromial shoulder disorder **Individual factor:** The age association among baggage handlers. was a stronger incidence rate ratio (IRR) = 1.40; 95 % CI)
5	Møller et al. (2018)	Copenhagen airport	Cohort	-1,688 baggage handlers and 1,973 workers in the reference group - **Mean age** 31 year **- Body mass index:** 18.5-24.9= 36%, 25.0-29.9= 48%, ≥30.0= 15%	This study did not show the prevalence	**Organization factors** - Work task duration **Biomechanical factors** - Heavy lifting (Shoulder load intensity)
6	Bern et al. (2013)	Copenhagen airport	Cohort	-3029 baggage handlers and a reference group of men in other unskilled occupations with less heavy work (n=2478). **- Seniority** (years): >0–3= 28.1%, 4–8= 22.7% , 9–16= 24.9%, 17–25= 15.0% , ≥ 26, 9.4% **-Mean height** = 181.2 cm., **Mean BW** = 87.4 kg.	Low back = 32.6 %, Neck/ upper back= 21.8%, Shoulder = 25.4 %, Elbows= 11.2 %, Wrists = 11.8%, Hips = 7.6%, Knees= 24.3%, Ankles = 8.1 %	**Individual factor** - Baggage handler seniority was significantly, positively associated with MSDs **Biomechanical factors** 1. Heavy lifting 2. Awkward working posture
7	Mikkelsen et al. (2016)	Copenhagen airport	Cohort	- 3,307 baggage handlers (63,934 referents) **-Age (year)** <30= 62%, 30–44 = 35 %, 45–59 = 3 % **- Body mass index:** 18.5–24.9= 34%, 25–29.9= 49%, 30.0+ = 17%	This study did not show the prevalence	**Biomechanical factors** - Long-term heavy lifting in a kneeling - Long-term heavy lifting in a squatting position

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