JOURNAL OF CLINICAL AND HEALTH SCIENCES

REVIEW

Prevalence of Occupational Diseases among Small and Medium Industry Workers in Malaysia: A Systematic Review

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Received
11th May 2019
Received in revised form
20th August 2019
Accepted
17th September 2019

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ABSTRACT

Occupational diseases are one of the major health problems related to workplace hazards. However, the epidemiological data for this problem is scarce especially among Small and Medium Industry (SMI) workers. These workers are vulnerable to occupational health problem due to lack of knowledge and implementation of health and safety in the workplace. In Malaysia, most of the SMI workers have limited coverage for basic occupational health services which may worsen their health. Thus, this article aims to provide a review on the burden of occupational health problems among them. The electronic and library searches were used to extract the information from both published and unpublished articles that were not limited to any year of publication until 2017. One hundred and ninety-six published articles and 198 unpublished articles were retrieved from the database. Only 19 published articles and 25 unpublished articles met the eligibility criteria. Prevalence data of occupational diseases/poisoning, including overall and body specific (musculoskeletal disorders) was extracted in raw data from the eligible studies. Prevalent statistics on occupational musculoskeletal diseases (1.3% - 97.6%), noise-induced hearing loss (29.4% - 73.3%), occupational skin diseases (10.5% - 84.3%), respiratory (1.9% - 92.2%) and occupational poisoning (14.9% - 17.7%) among the working population is different within published papers compared to unpublished ones. In Malaysia, there are no specific statistic that give a true picture of the burden of occupational diseases in the SMI. However, this review concludes that musculoskeletal diseases are significant occupational problems among SMI workers.

KEYWORDS: Prevalence, Occupational diseases, Health and safety, Small and medium industry, Review

INTRODUCTION

The definition of Small and Medium Industry (SMI) is different between countries depending on a few factors such as the output value, location, number of workers, fixed asset size and ownership through technology and innovation (1). Malaysia uses the definition based on the number of total workers and output value which is similar to developed countries like the USA, the United Kingdom, Japan, China and Korea (2). In Malaysia, industries with less than 200 employees and sales turnover of less than Malaysian Ringgit (MYR) 50 million is identified as an SMI (3). More than 65% of the total working population is from the SMI sector that includes manufacturing, construction, mining and quarrying and agricultural and services (4). The SMIs play a vital role in economic growth of the local population as well as increasing the industrial activities in Malaysia. However, the implementation of occupational health and safety (OHS) within the SMIs has not always been part of their agenda due to lack of knowledge and awareness (5). This industry is largely exposed to potential occupational hazards where occupational diseases and injuries has been known to cause serious problems among workers in this sector.

From the 69,823 diagnostic codes in the International Classification of Disease version 10 (ICD-10), only 106 diseases are recognized as occupational diseases or poisoning by the International Labour Organization (ILO) (6). From the 106 diseases listed in the ILO List of Occupational Diseases R194, 27 diseases are listed in the Third Schedule of the Factories and Machineries Act 1967 (Act 139) whereas 28 diseases are listed in the Third Schedule of the Occupational Safety and Heatlth (OSH) Act 1994 (Act 514). Previous studies commonly reported on increasing number of occupational diseases but the reported cases in the SMIs remain a critical issue (7). Perhaps, much of the lesson learnt for occupational disease come from the research studies conducted in large industry but not from SMI (8,9). It is almost taken for granted that the SMI workers may also pose a higher risk for developing occupational diseases. Evidence shows that 81% of Iranian worker in small-scale weaving industry suffered back pain due to awkward posture. Poor working condition and lack of awareness on the health and safety in the workplace may contribute to the higher prevalence of back pain in the country (10). It is common in the SMI that the workers have lack of knowledge regarding safety and health in the workplace. Whereas, workers exposed to flour dust in small-scale bakeries, Iraq reported higher prevalence of respiratory problems compared to the non-exposed workers. The prevalence increased as the worker exposed for longer duration (11).

SMI workers are exposed to potential health risk in the workplace. It is even worse as nowadays, many SMI are attempting to gain more profit by increasing the production with lower cost without considering the welfare of the workers. It was reported that more than half of the countries in the world do not provide official statistics on occupational diseases especially in SMI. Statistics of occupational diseases are often under-reported even in countries that already have established reporting practices.

Many developing countries still do not have a social security system and, if present, the system does not reach the SMI sector. Reports and records of OSH in SMIs are often unsatisfactory. Thus, the official figures are often lower than the actual situation (12). This situation is also happened in Malaysia whereby the statistic of occupational disease among SMI workers are still lacking and under-reported. The similar problems of under-reporting is commonly reported in other countries (13,14).

This might be due to lack of work-related skills in identifying occupational diseases. Some of the medical personnel have limited knowledge identifying the relationship between workplace exposure and occupational health problems which can lead to the misinterpretation of the diagnosis (15). For example, asthma has no pathological or clinical differences between work-related or non-work-related cases. It is crucial for the medical personnel to critically diagnose the patients by looking into their occupational history to see the onset of the disease. Due to this, poor participation of medical personnel in notifying the occupational disease is a problem of poor report on occupational disease even though the notification system is already established (14). In addition, the large-scale industries are more prone to subcontract the riskier tasks to the SMI with high time pressure and constraints. This circumstance may increase the incidence of occupational diseases in the SMI. It will be worsened if the SMI have lack of occupational health and safety resources and can lead to the difficulty to conduct medical surveillance and identify the occupational diseases. It is very important to focus on these SMI workers because they do not have in-house medical staff with limited access to occupational health services compared to the large-scale industries. Although workers' compensation and notification system data are common sources of data used to measure the incidence of occupational diseases, it may underestimate the prevalence of occupational disorders (16,17). Thus, this paper aims to review the evidence available to date about the prevalence of occupational diseases among SMI workers in Malaysia using both published and unpublished studies.

METHODOLOGY

Search Strategy

Published studies

An extensive review of published papers was carried out using search engines such as PUBMED, MEDLINE, PROQUEST, Science Direct, Web of Science and Google Scholar. The scientific literature search was conducted using keywords (including synonyms and plural forms) and combinations of key words, including "occupation" OR "workplace" AND; "occupational diseases" OR "occupational poisoning" AND; "small and medium enterprises" OR "small and medium industries" OR "SME" OR "SMI". Searching strategy also included cross-referencing of research and review papers.

Unpublished studies

To review the unpublished studies, an application letter was sent to the selected university libraries in Malaysia to explore their theses and proceedings. The thesis was chosen based on departments offering related occupational safety and health courses. The same keywords as mentioned in the literature review were used for the database that had been recorded in the form of soft copies and online. For the library with no databases storage, the thesis title and abstract were examined one-by-one using the similar keywords. The following institutions and their departments were selected for unpublished studies:

i. Hamdan Tahir Library, Universiti Sains Malaysia, Kelantan.

ii. T. J Danaraj Medical Library, Faculty of Medical, Universiti Malaya, Kuala Lumpur.

iii. Engineering Library, Faculty of Engineering, Universiti Malaya, Kuala Lumpur.

iv. Medical Centre Library, Universiti Kebangsaan Malaysia, Kuala Lumpur

v. Dr. Abdul Latiff Library, Universiti Kebangsaan Malaysia, Kuala Lumpur

vi. Medical and Health Sciences Library, Universiti Putra Malaysia, Serdang, Selangor

Inclusion criteria

- The entire time scale of publication for both published and unpublished studies in Malaysia were used up to 2017.
- We included only articles published in English and Bahasa Malaysia.
- Type of study: All observational studies
- Type of population: Working age population 18 years and above
- Exposure to any occupational hazards.
- Outcome: Any occupational diseases.

Exclusion criteria

The exclusion criteria were non-SMI such as Multinational companies, Government sector; or those companies/industries that have more than 200 workers for manufacturing industries; and with more than 75 workers for services and other industries. These exclusion criteria did not take into account the industries' sales turnover, as the researchers do not usually report this information in their studies. These exclusion criteria aim to narrow the scope of this review.

Data collection and analysis

At least two authors in this study, comprising of experts in public health and/or occupational health and safety, carried out data extraction from the reviewed articles. We used the definition of occupational disease/poisoning based on the ILO List of Occupational Diseases that was published in 2010 (6). Prioritization of the occupational diseases were based on the number of studies reported in the review. Any disparities were discussed and consensus was achieved by mutual agreement. Selection of the studies were done based on the screening of title and abstract for further analysis and summarization. Both published and unpublished were critically appraised using STROBE statement. Prevalence was extracted from the studies included in the review. Descriptive comparison such as

type of workers, exposure/risk and assessment were qualitatively synthesized. Meta-analysis was not done due the difficulty to extract the estimates which were not reported in the study.

RESULTS

The PRISMA flow chart (Figure 1) depicts the number of published articles and theses screened at each stage for inclusion and exclusion into the review (18). Table 1 shows a summary of studies in relation to occupational health problems in the SMI workplace in Malaysia. The table provides details about type of occupational exposure, target population and sample size. Whereas, the exposure and outcome assessment as well as the main findings are summarized in Table 2.

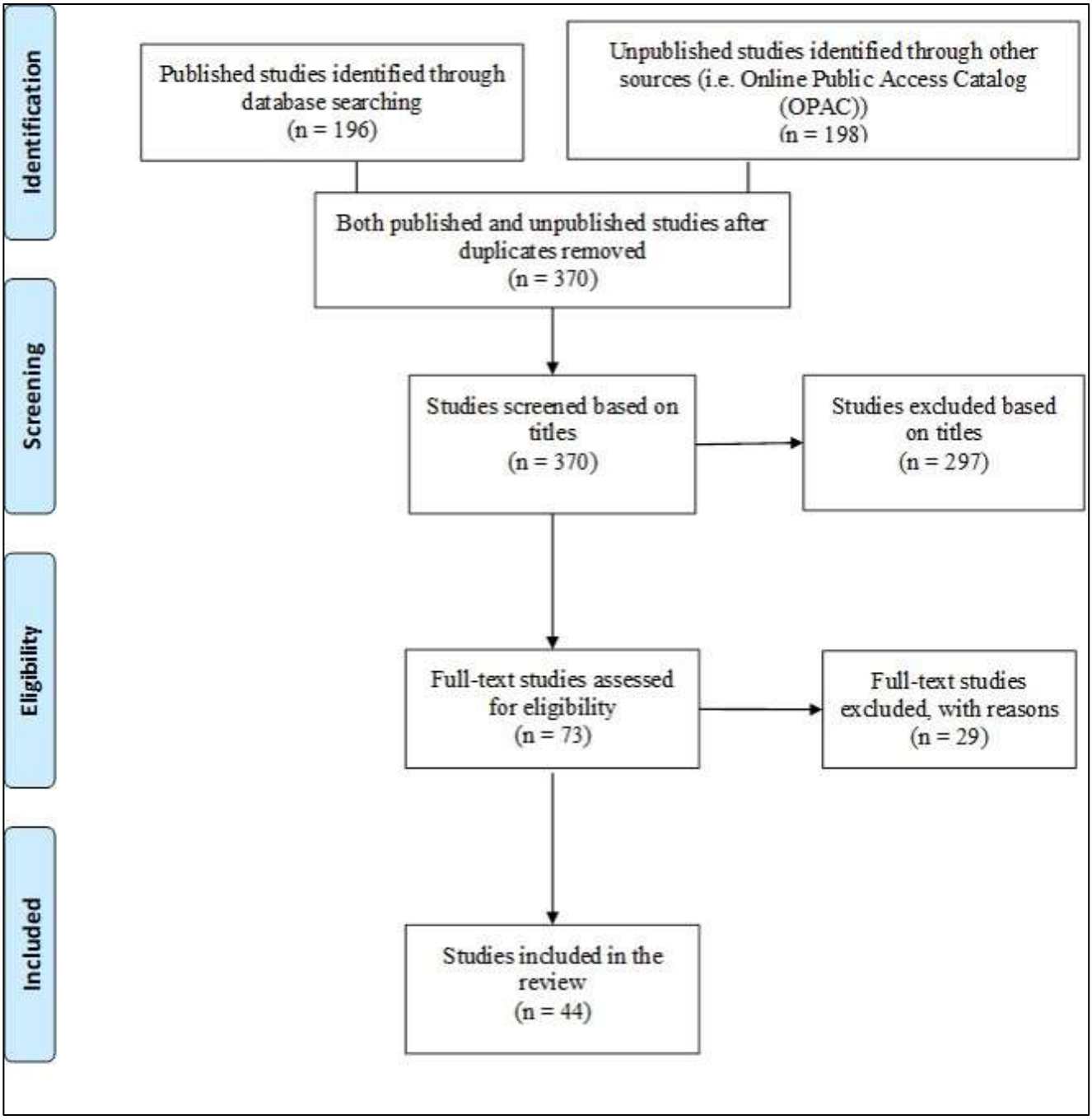

Figure 1 PRISMA flow chart of search results at each stage of screening showing inclusions and exclusions (18)

Table 1 Summary of epidemiology study on occupational disease in SMI, Malaysia

Author (s)	Type of workers	Exposure/risk	Sample size
Published studies			
Work-related musculoskeletal disorder (WMSD)			
Abd et al (21)	Car tyre service centre workers	Ergonomic	Test subjects: 12
Aziz et al (27)	Electronics assembly plant workers	Working posture	Test subjects: 11
Deros et al (19)	Manufacturing workers	Manual handling	Test subjects: 36
Deros et al (23)	Construction workers	Heavy lifting and repetitive task	Test subjects: 60 (male workers)
Loo & Yeow (26)	Brazing operators	Workplace condition and posture	Test subjects: 8
Musa, Kyi, & Rampal (20)	Batik factory workers	Ergonomic	Test subjects: 202
Nur et al (24)	Automotive manufacturing workers	Repetitive task	Test subjects: 152
Rahman et al (21)	Construction workers	Ergonomic	Test subjects: 43
Saw Bin et al (26)	Semiconductor factory workers	Repetitive task and body posture	Test subjects: 40
Noise induced hearing loss (NIHL)			
Hanidza et al (29)	Grass cutting workers	Noise	Test subjects: 18
Ismail et al (30)	Quarry workers	Noise	Test subjects: 97
Sam et al (31)	Manufacturing workers	Noise	Test subjects: 146
Occupational skin disease			
Wooi et al (32)	Paddy farmers	*Cercariae*	Test subjects: 359
Yap (33)	Patients attended skin clinic	Allergens	Patients: 11, 401
Occupational respiratory problems			
Amaran et al (34)	Street hawkers	$PM_{2.5}$ and CO	Street hawkers: 60 Comparative group: 60
Musa, Naing et al (25)	Rice millers	Rice husk dust	Test subjects: 69 (male: 63; female: 6 excluded from analysis due to small number)

Occupational mental health problems			
Jalil et al (37)	Office workers	Individual characteristics	Test subjects: 111
Janipha et al (36)	Designers	Work stressors	Test subjects: 159
Salleh et al (35)	Furniture factory workers	Job characteristics and organizational working environment	Test subjects: 190
Unpublished studies			
Work-related musculoskeletal disorder (WMSD)			
Awang Lukman (41)	Commercial vehicle drivers	Vibration	Test subjects: 118
Bakri (43)	Semiconductor factory workers	Ergonomic	Test subjects: 350
Chi (44)	Printing shop workers	Ergonomic	Test subjects: 250
Embong (46)	Batik industry workers	Ergonomic	Test subjects: 120
Ezani (40)	Palm plantation workers	Ergonomic	Test subjects: 84
Selvaraj (45)	Poultry workers	Ergonomic	Test subjects: 150
Sabanayagam (38)	Transportation and services workers	Ergonomic	Test subjects: 91
Yew (39)	Taxi drivers	Ergonomic	Test subjects: 104
Zuli (42)	Semiconductor factory workers	Ergonomic	Test subjects: 295
Occupational neurotoxicity			
Abd Rahman (52)	Tobacco-growing farmers	Organophosphate	Exposed group: 45 Non-exposed group:45
Ayub (53)	Battery plant workers	Lead	Test subjects: 105
Chew (47)	Mechanics	Toluene	Exposed group: 51 Non-exposed group:20
Hod (51)	Rice farmers	Chlorpyrifos	Test subjects: 100
Kabolani (54)	Welders	Isocyanate	Test subjects: 104
Mohamed Razi (50)	Coatings industry workers	Organic solvents	Exposed group: 121 Non-exposed group:127
Yaakob (49)	Chemical plant workers	Volatile organic compounds (VOCs)	Exposed group: 40 Non-exposed group:40
Yong (48)	Glass manufacturing workers	Toluene	Exposed group: 51 Non-exposed group:20

Occupational respiratory problems			
Bahruddin (55)	Photocopy shop female worker	$PM_{2.5}$ and UFP	Exposed group: 30 Non-exposed group: 30
Kabolani (54)	Welders	Isocyanate	Test subjects: 104
Mahmood (57)	Sawmill workers	Wood dust	Exposed group: 83 Non-exposed group: 50
Saupin (56)	Flour based factory worker	Flour dust	Test subjects: 216 (recruited from 5 factories)
Sidek (58)	Furniture factory worker	Wood dust	Exposed group: 97 Non-exposed group: 97
Noise induced hearing loss (NIHL)			
Mohamed Noorzeli (59)	Manufacturing workers	Noise	Test subjects: 60
Occupational Skin Diseases			
Chokeli (60)	Rice farmers	Herbicides	Exposed group: 75 Non-exposed group: 30
Mat Bah (61)	Printing industry workers	Chemicals	Test subjects: 218

Table 2 Description of exposure and outcome assessments; and main finding(s)

Author(s)	Assessment		Main finding(s)
	Exposure/risk	Outcome	
Published studies			
Work-related musculoskeletal disorder (WMSD)			
Abd et al (21)	Questionnaire	Questionnaire	• Heavy lifting was the main source of injury (83.3%) • Prevalence based on body parts: – Hand/wrist (91.7%) – Shoulder (83.3%) – Elbow (75%) – Lower leg (75%) – Neck (66.7%) – Knee (58.3%) – Ankle/feet (33.3%) – Lower back (30%) – Thigh/hip (16.7%)

Aziz et al (27)	Classify workers into standing and sitting	Surface electromyography	• Prolonged sitting caused higher muscular activity at the upper back of the workers	• High muscular activity at the lower back was observed among prolonged standing workers.
Deros et al (19)	Rapid Upper Limb Assessment (RULA)	Questionnaire	• Prevalence of discomfort (very uncomfortable): – Arm (15.6%) – Wrist (12.5%) – Upper back (12.5%) – Lower back (9.4%)	• Current manual material handling used should be changed to reduce the prevalence of body discomfort
Deros et al (23)	Questionnaire	Standardized Nordic Musculoskeletal Questionnaire	• Prevalence based on body parts: – Lower back (45%) – Shoulder (28.3%) – Neck (16.7%) – Wrist/hand (15%) – Upper back (13.3%)	– Knee (13.3%) – Elbow (10%) – Hip/thigh (8.3%) – Ankle/feet (5%)
Loo & Yeow (27)	Rapid Upper Limb Assessment (RULA) Workplace design and posture intervention	Questionnaire	• Complaints on neck, shoulders, upper arms, wrist and lower back were reduced with improved working conditions and postures.	
Musa, Kyi, & Rampal (20)	-	Standardized Nordic Musculoskeletal Questionnaire	• Prevalence of MSD (60.2%) • Prevalence based on body parts: – Shoulder (41%) – Lower back (34.4%) – Ankle (34.4%)	• Factors associated with MSD – Duration of employment (< 5 years) – Age (<35 years old) – Prolonged standing (≥ 4 hours)

Nur et al (24)	-	Standardized Nordic Musculoskeletal Questionnaire	• Prevalence of MSD (76.7%) • Prevalence based on body parts: – Neck (49.7%) – Hand/wrist (48%) – Shoulder (46.7%) – Upper back (33.6%) – Lower back (21.7%) – Knee (15.8%) – Thigh/hip (14.5%) – Elbow (6.6%) – Ankle (1.3%)	
Rahman et al (21)	Workplace Ergonomic Risk Assessment (WERA)	Self-report charts (Body Discomfort Chart)	• Prevalence based on body parts: – Back (97.6%) – Shoulder (90.7%) – Wrist/hand (86%) – Elbow (81.4%) – Leg (70%) – Neck (70%)	• Poor posture and repetition were significantly associated with pain in shoulder, wrist and back.
Saw Bin et al (26)	Direct observation	Questionnaire	• Poor working condition significantly increased the risk of danger (r = -0.369), body stress (r = -0.369), job dissatisfaction (r = - 0.398).	• Workers complained on neck and back pains through subjective assessment. • Factors related to neck and back pains: – Repetitive work – Bad posture
Noise induced hearing loss (NIHL)				
Hanidza et al (29)	Personal noise dosimeter	Audiometric test	• Mean noise exposure level: 88 db(A) • Prevalence of NIHL (29.4%)	
Ismail et al (30)	Sound level meter	Questionnaire Audiometric test	• Mean noise exposure level: 98 db(A) • Prevalence of NIHL (57%)	• Age and practice scores were significantly associated with NIHL
Sam et al (31)	Exposure data record	Questionnaire Audiometric test	• Prevalence of NIHL (73.3%) • Prevalence of hearing impairment (23.3%)	• Working duration (more than 10 years) was associated with NIHL

Occupational skin disease

Wooi et al (32)	Snail and water sample	Questionnaire	• Prevalence of dermatitis: – Infected more than two time (84.3%) – Infected at least four times (30.4%)	• Factors associated with dermatitis: – Older age (≥70 years old) – Female – Working during preparation of fields & transplanting stages – Water sources from river and irrigation canal – Rearing of duck and cow
Yap (33)	Health record	Health record	• Prevalence of allergic contact dermatitis among indigenous people working in agricultural sectors (10.8%).	

Occupational respiratory problems

Amaran et al (34)	Personal air monitoring	IUATLD Bronchial Symptoms Questionnaire 1984 Lung function test	• Prevalence: – Wheezing (68.3%) – Chest tightness (66.7%) – Cough (63.3%) – Phlegm (50%) • Mean personal exposure: – $PM_{2.5}$: Street hawkers =31.05 µg/m^3, Comparison group=19.41 µg/m^3 – CO: Street hawkers=2.42 ppm, Comparison group=1.51 ppm	• $PM_{2.5}$ contributed significantly to all respiratory symptoms: – Wheeze (Odds Ratio, OR=10.39, 95% CI=2.67-40.41) – Chest tightness (OR=3.02, 95%CI=2.30-13.10) – Coughing (OR=2.78, 95%CI=1.88-8.77) – Phlegm (OR=7.5, 95%CI=6.97-17.78) • Only FEV_1 (litres) was significantly lower among the exposed than the comparative group (Z=-1.96, p=0.04)

Musa, Naing et al (25)	Medical and work history questionnaire	BMRC questionnaire (1966) Lung function test	• Prevalence: – Chest tightness (34.9%) – Morning phlegm (31.7%) – Shortness of breath (31.7%) – Morning cough (19.0%) • Factors related to shortness of breath: – Age – Duration of employment • Factor related to morning phlegm and morning cough: – Smoking	• Mean value for FEV was low (2.56 L) compared to predicted value of healthy Malaysian population (2.69 L). – The difference was not significant (p = 0.07) • There was a significant difference of the FVC mean value between the exposed group (2.76 L) with healthy Malaysian population (3.47 L) (p < 0.00l) • No significant relationship was found after adjusting age and employment duration
Occupational mental health problems				
Jalil et al (37)	Questionnaire	Questionnaire	• Factors associated with low job performance due to work stress: - Smoking - Drinking habit - Working overtime	
Janipha et al (36)	Questionnaire	Questionnaire	• Factors related to work stress: - Poor planning - High job demand	- Poor working condition - Poor relationship with co-workers
Salleh et al (35)	Questionnaire	Questionnaire	• Prevalence of work stress (35.8%) • Factors significantly associated with work stress: - Integrity - Conflict - Job security - Adaptability - Support	

Unpublished studies

Work-related musculoskeletal disorder (WMSD)

Awang Lukman (41)	Human vibration monitor VINET (vibration injury network) questionnaire	Standardized Nordic Musculoskeletal Questionnaire	• Prevalence based on body parts: – Lower back (66.4%) – Shoulder (50.9%) – Upper back (49.1%) – Neck (48.2%) – Forearm/hand (25.5%) – Knee (25.5%)	• Factors significantly associated with low back pain: – Heavy lifting – Daily vibration exposure – Awkward posture
Bakri (43)	Questionnaire	Questionnaire	• Main ergonomic risk factor: repetitive motion • Prevalence based on body parts: - Shoulder (68.3%) - Upper and lower back (62.6%) - Neck (61.7%)	- Wrist/hand (52%) - Thigh and knee (48.9%)
Chi (44)	Rapid Upper Limb Assessment (RULA)	Standardized Nordic Musculoskeletal Questionnaire	• Overall prevalence of musculoskeletal symptoms: 79.6% • Prevalence based on body parts: - Lower back (48%) - Shoulder (44.4%) - Knee (32.8%) - Neck (29.6%) - Upper back (28.8%) - Wrist/hand (20.8%) - Ankle/feet (19.6%) - Hip/thigh (10.4%) - Elbow (9.6%)	• Factors significantly associated with symptoms: - Gender - Job duration - Awkward posture
Embong (46)	Questionnaire	Questionnaire	• Prevalence based on body parts: - Back (62.5%) - Wrist (47.5%) - Neck (25.8%) - Knee (18.3%)	• Factors associated with back pain: - Prolong standing - Leaning forward

Ezani (40)	Quick Exposure Check	Standardized Nordic Musculoskeletal Questionnaire	• High ergonomic risk exposure was observed for back body part • Prevalence based on body parts: - Lower back (39.1%) - Shoulder (18.4%) - Neck (12.6%)	• Longer working hours was significantly associated with high ergonomic exposure for lower back, shoulder and neck
Selvaraj (45)	Questionnaire	Questionnaire	• Prevalence based on body parts: - Wrist (72%) - Shoulder (66%) - Neck (48.7%)	• Factors significantly associated with symptoms: - Awkward posture
Sabanayagam (38)	-	Questionnaire	• Prevalence of low back pain: 39.6%	
Yew (39)		Orebro Musculoskeletal Pain Questionnaire	• Prevalence of musculoskeletal disorders: 59.6%	• Factors associated with musculoskeletal disorders: - Habit of sleeping in car seat - Frequency of handling baggage
Zuli (42)	Questionnaire	Standardized Nordic Musculoskeletal Questionnaire	• Prevalence based on body parts: - Shoulder (60%) - Upper back (57.3%) - Neck (56.6%) - Lower back (40%) - Wrist/hand (39.7%)	• Factors significantly associated with lower back pain: - Non-neutral position - High psychological job demand
Occupational neurotoxicity				
Abd Rahman (52)	Blood test	Questionnaire Neuro Core Battery test (NCBT)	• Mean serum cholinesterase activity was lowered in exposed group compare to non-exposed group.	• Exposed group scored lower in NCBT compared to non-exposed group

Ayub (53)	Blood test Airborne monitoring data record	Questionnaire	• Blood lead level increases 0.22 ug / dl for every increase of 1 ug / dl lead in the air • Not wearing glove was associated with increase blood lead level	• High exposure groups tend to show forgetful symptoms
Chew (47)	Urine test	Neuro Core Battery test (NCBT)	• Hippuric acid in urine: - Exposed group: 2.7 x 10-4 (4.0 x 10-4) g / g creatinine - Unexposed group: 3.0 x 10-5 (5.0 x 10-5) g / g creatinine	• Exposed group showed significant scored significantly lower for all NCTB results compared to unexposed groups
Hod (51)	Blood test	Questionnaire	• Mean (SD) chlorpyrifos levels: 7.29 (5.84) ng / ml	• Poor knowledge and practice of handling pesticide were associated with high chlorpyrifos exposure
Kabolani (54)	Urine test	Questionnaire	• Highest level of isocyanide in the urine was observed among the welders.	• No significant differences for isocyanide levels in urine among respondents who have any symptoms with those who do not have symptoms.
Mohamed Razi (50)	-	Q16 questionnaires	• Prevalence of abnormal Q16 score: 14.9%	• Workers exposed to organic solvent were at higher risk to have chronic neurotoxicity symptoms
Yaakob (49)	VOC sampling	Neuro Core Battery test (NCBT)	• Higher VOC was found in processing area • Prevalence of fatigue: 17.7%	• Poor neurobehavioral performances were observed among exposed workers
Yong (48)	Urine test	Neuro Core Battery test (NCBT)	• Hippuric acid in urine: - Exposed group: 2.2 x 10-4 (1.1 x 10-3) g / g creatinine - Unexposed group: 0.25 x 10-4 (2.1 x 10-5) g creatinine	• Exposed group showed significant scored significantly lower for all NCTB results compared to unexposed groups

Occupational respiratory problems

Bahruddin (55)	Personal air monitoring	ATS questionnaire Lung function test	• Prevalence: - Cough (26.7%) - Phlegm (16.7%) - Chest tightness (3.3%) - Wheezing (6.7%) • There was a significant association between $PM_{2.5}$ with FVC% predicted (r=-0.404, *p*=0.027); UFP with FEV_1% predicted (r=0.377, *p*=0.04)	• Mean personal exposure: - $PM_{2.5}$: Exposed=62.3 µg/m³, Non-exposed=13.1 µg/m³ - UFP: Exposed=14567.1 pt/cc, Non-exposed=3662.6 pt/cc
Kabolani (54)	Medical and work history questionnaire	Questionnaire	• Prevalence: – Wheezing (34.6%) – Shortness of breath (30.8%) – Chest tightness (17.3%) – Cough (17.3%)	
Mahmood (57)	Personal air monitoring	Modified respiratory questionnaire Lung function test	• Prevalence: – Nose irritation (92.2%) – Cough (88.1%) – Wheezing (85.7%) • Mean personal exposure (inhalable wood dust): – Exposed workers=18.84 ±27.99 mg/m³ – Non-exposed workers=0.48 ±0.21 mg/ m³.	• There was negative correlation between the wood dust exposure with %FEV1 (*p*=0.001, r= -0.670) and %FVC (*p*=0.001, r= -0.820). – Increased of exposure to inhalable wood dust cause reduction of %FVC and %FEV1. – However, it is not significant after regression analysis.
Saupin (56)	Chemical Health Risk Assessment	ATS questionnaire Lung function test	• Prevalence: – Frequent sputum (8.8%), – Frequent cough (7.9%) – Wheezing (4.4%), – Shortness of breath on the first day of work (3.7%) or the day -day after (1.9%)	• Prevalence of FEV_1 less than 80% (16.2%) • Abnormal FEV_1 is higher among worker who: – aged over 40 years old – worked in blending section

			– Symptoms of asthma or chronic obstructive airway disease (4.6%)	– were not trained to properly wear a face mask – think that health education is not important
Sidek (58)	Medical and work history questionnaire Lung function test	BMRC questionnaire	• Prevalence: – Chest tightness (39.2%) – Morning cough (35.1%) – Morning phlegm (35.1%) • 71% of exposed group had abnormal pulmonary function. – Mild restriction (30.9%) – Moderate restriction (24.7%) – Severe restriction (15.5%)	• Factors associated with FEV_1 & FVC: (multiple linear regression) - Duration of smoking - Height - Duration of work - Number of cigarette smoke per day • Factor associated with FEV_1/FVC: (multiple linear regression) - Age
Noise induced hearing loss (NIHL)				
Mohamed Noorzeli (59)	-	Questionnaire	• Reported symptoms: – ear pain (21.7%) – ear discharge (5.0%) – ringing in the ears (15.0%).	• Young age was a risk factor of NIHL among workers exposed to noise more than 85db(A)
Occupational Skin Diseases				
Chokeli (60)	Fluorescent tracer Exposure evaluation matrix (EEM) Dermal exposure ranking method (DERM)	Questionnaire	• Body part exposed to pesticides: – Finger – Back of thorax • Highest prevalence of skin symptom: – Itchiness (20%) – Rashes (10.5%)	• Factors associated with skin symptom: – Poor hygiene practices – Smoking
Mat Bah (61)	-	Skin patch Questionnaire	• Prevalence: – Skin diseases on hand (34.9%) – Eczema on hand/wrist/forearm (29.8%) – Contact dermatitis (19.7%)	• Risk factor for skin diseases: – Printing activity

Published Studies

Of the 196 papers that reported occupational diseases in Malaysia, only 19 papers were conducted in the SMI sector. From these 19 publications, nine were about work-related musculoskeletal disorders (WMSD), followed with three occupational mental health problems, three for occupational noise-induced hearing loss (NIHL), two each for occupational skin problems and occupational respiratory problems.

WMSD

The prevalence of WMSD among SMI workers were varied. Deros, Daruis & Basir (19) reported that 21.9% of steel factory workers who did repeated manual motion had lower back pain and other musculoskeletal diseases. High prevalence of WMSD were also reported among construction workers (66.7%), batik printing workers (60.2%), commercial vehicle drivers (66.4%), automotive manufacturing workers (76.9%), and vehicular tire service workers (91.7%) (20–24). Most of these workers experienced pain in their necks and shoulders (22,24,25), wrists, arms and lower legs (19,22-24), elbows (23), and lower backs (25).

Ergonomic risk factor is one of the major contributors for musculoskeletal problems. Most of these workers were exposed to ergonomic risk factors for more than four hours without adequate rest (25,26). For example, repetitive motion activities such as lifting heavy objects, standing and squatting in long periods, awkward posture positions, high pressure on hands, and prolonged bending of the body were observed among vehicular tire service workers (22). Similar findings were also observed among workers in electronics, garments, fabrications, and automotive industries (24,25,27). Other ergonomic risk factors include prolonged sitting and standing (28), static posture and use of excessive force (24,26).

NIHL

A study by Hadniza *et al* (29) showed that five of the eighteen grass cutting workers (29.4%) were found to have NIHL. Whereas a total of 57% of quarry workers in northern Malaysia suffered from NIHL and experienced tinnitus (30). Higher prevalence of NIHL (73.3%) were also reported among manufacturing workers in Selangor and 23% of them suffered hearing impairment (31). Workers with NIHL problems were exposed to excessive noise exceeding the permissible exposure limit of 90 dBA. Other factors such as old age, extended duration of employment and poor preventive measures contributed to occupational NIHL problems among these workers (29–31).

Occupational Skin Problems

One of the review articles reported on dermatitis caused by infection with *cercariae* (cercarial dermatitis) which was caused by a parasite known as *Schistosome cercariae* among farmers in Kelantan (32). These farmers complained of severe itching of lesions on their hands and feet after working in the rice fields. The incidence of dermatitis among these farmers are between 47.9% and 96.6%, and showed a significant association between the type of work and the prevalence of dermatitis ($p = 0.001$). The study also found that 57.7% of cases were among elderly workers aged 70 and above and the percentage among women were a little higher (49.0%) compared to men (47.1%).

Another study by Yap (33) showed that about 10.8% of patients who attended the Skin Clinic at Sarawak General Hospital between 2000 and 2008 reportedly suffered contact dermatitis especially among indigenous workers in the agricultural industry. This finding was associated with the exposure to allergens such as paraben mixture, followed by potassium dichromate and 5-chloro-2-methyl-3-isothiazolin-4-one. However, incomplete data on the type of occupation in the patient's health records made it difficult to give concrete evidence on the relationship between exposure at work and the occurrence of contact dermatitis.

Occupational Respiratory Problems

Musa et al. (25) reported that the most frequent symptoms experienced by workers exposed to rice husk dust were chest tightness (34.9%), phlegm in the morning (31.7%), shortness of breath (31.7%) and cough in the morning (19.0%). The study also showed that those workers aged 41 years and above who worked

for more than 10 years in the factory were at risk of suffering shortness of breath. Forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) among the exposed workers were lower when compared with the expected value. However, the difference was significant only in FVC.

Amaran et al. (34) reported that the mean particulate matter 2.5 ($PM_{2.5}$) levels were found to be higher in the hawker street areas than in the restaurants (respectively 31.05 (1.62) µg / m^3 and 19:41 (1:51) µg / m^3). The mean carbon monoxide (CO) level was also slightly higher (2.42 ppm) than in the restaurant (1.51 ppm). Exposure to $PM_{2.5}$ was associated with symptoms of respiratory sounds, chest tightness, cough and phlegm among street hawkers compared to workers in restaurants. FEV_1 was also significantly lower among street hawkers compared to workers in restaurants ($z = -1963$, $p = 0.04$). The study concluded that respiratory symptoms and decreased lung function were more common in street hawkers compared to workers in restaurants.

Occupational Mental Health Problems

Research among workers in the furniture industry found that about 36% of them experienced stress at work (35). The cause of stress is very diverse which includes working under the supervision of a head that does not have the proper qualifications, unreasonable objectives and deadlines for submission of assignments. This study found that the level of authority at work and the job is inversely proportional to pressure and have a high correlation between the two. This will affect the quality of work and economic benefits if it is continued.

A study among a group of designers showed that job stress was related to the demands of work, work planning, work environment and the relationship between colleagues. They perceived that job dissatisfaction (53%) and work challenge (23%) as the job stressors. This in turn affects their work performance and leads to poor quality design (36). Work pressure, occupational depression and occupational anxiety are also found to occur among office workers. Smoking and habit of drinking were found to affects the job performance due to their excuses to relief the urgent pressures at work stress. In addition, working overtime was also related to the job pressure at work (37).

Unpublished Studies

A total of 198 unpublished theses were assessed from the six main universities offering the OSH programs. Online Public Access Catalog (OPAC) of the universities' libraries or lists prepared by the librarians was used to screen for the relevant thesis, unlimited to any years of its publication. Twenty-five theses were conducted among SMI workers. A total of nine studies were related on WMSD, eight were related to occupational neurotoxicity, one for NIHL, five were on occupational respiratory problems and, two were on skin problems.

WMSD

Sabanayagam (38) reported that transportation and storing services workers suffered low back pain (39.6%) and might be due to lack of awareness on ergonomic issue. In addition, sleeping at the driver's seat and frequent handling of baggage were associated with higher prevalence of musculoskeletal problems (60%) among taxi drivers (39). High prevalence of musculoskeletal problems was also reported among workers in palm oil estates with the most affected body part is joints at the neck area (56%), followed by back (53.6%), shoulder joint (45.2%), also hand and wrist (44%) (40). Other study also reported that vibration was a factor associated with the musculoskeletal problems (41).

Workers in semiconductor and printing industries were also complained on musculoskeletal problems. The common body parts affected were shoulder (60%), followed by upper back (57.3%), neck (56.6%), lower back (40%) and hand and wrist (39.7%) (41–43). Those workers who had awkward posture (OR=2.4, 95% CI 1.1-4.4) and experienced high psychological job demand (OR=2.1, 95% CI 1.2-3.8) were at higher risk to suffer low back pain (42). Other risk factors include older age, being a male, long working duration and awkward posture while carrying and pushing weight in printing shop (44). Workers from

various industries were also reported to have musculoskeletal problems such as tailors (52%), meat-processing workers (92%), and batik industries workers (62.5%). Awkward postures and prolong standings were the common ergonomic risk factors identified among these workers (45,46).

Occupational Neurotoxicity

The reviewed studies showed that those workers exposed to toluene had higher urinary hippuric acid concentration levels compared to their counterparts. They also scored lower in Neuro Core Battery test (NCBT) which might indicate their neurobehavior impairment (47,48). Poor neurobehavioral performance was also reported among workers exposed to volatile organic compounds (49). In addition, a group of workers exposed to organic solvent complained of chronic neurotoxicity symptoms, fatigue, chest pressure, excessive sweating without cause and pain at least once a week (50).

About 7% of rice farmers in Sabak Bernam were found to contain chlorpyrifos in their blood. Poor knowledge and practice to control pesticides were the significant factors toward the elevation of chlorpyrifos levels in their blood (51). Long term exposure of organophosphates among farmers in a tobacco plantation were also observed to have poor neurobehavioral performance. They also experienced excessive sweating, weakness in the arms, numbness in the hands and face, as well as changes in facial musculature (52).

Ayub (53) reported that battery plant workers exposed to airborne lead and did not wear gloves showed higher blood lead concentration levels. They also suffered with forgetful symptoms as noted by their family members, excessive tiredness and headache. Kabolani (54) reported that the highest level of isocyanide in the urine was observed among the welders. However, there were no significant difference of isocyanide levels in urine among respondents who were having symptoms compared to those without symptoms.

Occupational Respiratory Problems

Bahruddin (55) reported that the copy shop workers often experienced sputum (16.7%), wheezing (6.7%) and chest tightness (3.3%) when exposed to $PM_{2.5}$ and ultrafine particles (UFP). There was a significant correlation between FVC and FEV_1 with $PM_{2.5}$ and UFP. Percent of those with FVC, FEV_1 and FEV_1/FVC abnormalities were higher among copy shop workers compared to the comparison group. High exposure to flour dust were also reported among bread making factory workers. They experienced cough (7.9%), frequent sputum (8.8%), asthma-like breathing (wheezing) (4.4%), and shortness of breath on the first day of work (3.7%) or the day after (1.9%). The prevalence of FEV_1 less than 80% was 16.2% and employees with symptoms of asthma or chronic obstructive airway disease was 4.6% (56).

A study conducted by Mahmood (57) involved employees in sawmills showed the highest levels of inhalable wood dust (46.83 mg/m³), which far exceeded the Permissible Exposure Limit (PEL) of 1 mg/m³. The analysis also showed a significant correlation between the levels of inhalable wood dust with FVC and FEV_1, where FEV_1 decreased with increasing inhalable wood dust. Similar findings were also reported among furniture factory workers. High prevalence of respiratory symptoms such as cough (35.1%), phlegm in the morning (35.1%), chest tightness (39.2%), shortness of breath (29.9%), irritation of the skin (47.4%) and eyes (31.9%), sneezing (29.9%) and colds (11.3%) were reported. Impaired lung function were also observed among them (58). Other study by Kabolani (54) found that most of the welders exposed to isocyanates experienced wheezing symptoms (34.6%) followed by shortness of breath (30.8%), chest tightness (17.3%) and cough (17.3%). However, there were no significant association between isocyanate exposure duration and respiratory symptoms (p=0.296).

NIHL

Mohamed Noorzeli (59) also conducted a study on 60 employees of a manufacturing plant in Shah Alam who were exposed to noise above 85 dB (A) for the identification of risk factors for NIHL. Among the

reported symptoms were ear pain (21.7%), ear discharge (5.0%) and ringing in the ears (15.0%).

Occupational Skin Diseases

Fingers (36.6%) and thoracic back (35.2%) were the body parts most contaminated with pesticides among paddy farmers. Whereas the most frequent symptoms were itchiness (20%) and rashes (10.5%). Poor hygiene practice and smoking were the risk factors for the occurrence of itchiness and rashes among them (60). In addition, workers in the printing industry suffered skin diseases in the hand (34.9%), eczema on the hand, wrist and forearm (29.8%), and contact dermatitis (19.7%) (61).

DISCUSSION

Prevalence of WMSD (1.3% - 97.6%), occupational neurotoxicity (14.9% - 17.7%), occupational respiratory diseases (1.9% - 92.2%), NIHL (29.4% - 73.3%), occupational skin diseases (10.5% - 84.3%) and occupational mental health problems in the working population is different in the published and unpublished papers. Both publish and unpublished review showed that the focus is more on musculoskeletal problems among SMI workers in Malaysia from various industries such as steel mills and fabrication, electronics and semiconductor manufacturing. Other occupational health problems include contact dermatitis, occupational respiratory diseases, occupational neurotoxicity and occupational mental health problems.

The comparison shows the prevalence of occupational diseases reported in the reviewed studies among the population of workers in various industries are higher than the statistical prevalence of occupational diseases and poisoning for workers in Malaysia based on data from the Department of Occupational Safety and Health (DOSH), Malaysia and workers' compensation insurance from Social Security Organization (SOCSO). The latest data from DOSH shows an increase in notification for NIHL (3,377 cases), followed by WMSD (91 cases), occupational diseases caused by biological agents (52 cases), occupational respiratory diseases and occupational skin diseases (27 cases each), and psychological and occupational cancer (one case each) (62). The reported data by Ministry of Health (MOH), Malaysia from 1997 to 1998 showed that the most common occupational diseases were contact dermatitis, chemical and pesticide poisoning cases, and occupational respiratory diseases. However, the report concluded that many occupational diseases and poisoning were under-reported (63).

A review data from SOCSO from year 2002 to 2006, reported that the overall incidence level for occupational diseases was 2.8 per 100,000 workers. There was an increased trend in the total and level of occupational diseases every year. The most frequently reported diseases were NIHL (32%) and WMSD (28%) (64). The latest SOCSO report showed the highest claim were due to WMSD (675 cases), followed by NIHL (358 cases), occupational skin disease (288 cases), diseases caused by vibration (156 cases), occupational respiratory diseases (106 cases) and chemical poisoning (104 cases) while 515 cases that could not be clearly classified were categorized under other diseases (65).

Summarization of the review results on occupational diseases and poisoning, either from MOH and DOSH was inappropriate to be interpolated to occupational diseases and poisoning trends in SMI sector because many were un-reported. However, it at least provides the impression that occupational poisoning illnesses, occupational skin diseases and occupational respiratory diseases are among the important occupational diseases in Malaysia. The least notified occupational disease was WMSD. It was least reported because ergonomic assessment to identify the occupational musculoskeletal disease is only carried out at workplaces involving high job intensity (66).

Statistics from SOCSO was significantly better at reflecting the trend of occupational diseases in Malaysia and can be interpolated into scenarios in SMIs. This is due to the fact that employees in government services were not included in the statistics. The occupational diseases trend from the latest results of SOCSO statistical claims are almost similar to the trend from screening results done in SMIs by DOSH. The review concluded that the most frequent occupational diseases in Malaysia is WMSD, followed by NIHL, occupational skin diseases and occupational

respiratory diseases. This is a better trend to be interpolated into SMIs in Malaysia.

For comparison, in Finland, NIHL is the highest occupational disease reported in 2013. This was followed by other occupational diseases such as skin diseases, allergies and respiratory disease from asbestos exposure, and repetitive strain injury (67). Whereas in Taiwan, WMSD was the most notified case, followed by NIHL, occupational respiratory diseases, skin diseases, and others (68). In Australia, six categories of occupational diseases had been identified as national priorities for the first five years based on a report issued from the Occupational Health and Safety (OHS) Strategy 2002 - 2012. Among them were musculoskeletal diseases, mental illness, cancer (excluding skin cancer), asthma, contact dermatitis and noise-induced hearing loss (69). In addition, the musculoskeletal disease reported as the highest incidence in the US, followed by other diseases such as skin disease, hearing impairment, respiratory problems and carpal tunnel syndrome (70).

Therefore, Finland has a high incidence of occupational diseases, when compared to Malaysia, Taiwan, Australia and the US. This may be due to a better reporting system and good accessibility to OSH programs by workers in Finland (71). Trends in occupational diseases also differ from country to country. It shows that the WMSD is the highest occupational disease in Malaysia, Taiwan and the US, but NIHL is highest in Finland and Australia, mental problems. Such differences may be due to under-reporting even in countries that already have established practices. Many developing countries still do not have a social security system and, if present, the system does not reach the SMI sector. Reports and records of OSH in SMIs are often unsatisfactory. Thus, the official figures are often lower than actual (12).

Under-reporting is the main issue on the differences between the reviews results and data from Malaysia notification and compensation systems. The Factory and Machineries Act 1967 was implemented in Malaysia to enforce all occupational diseases and poisoning to be notified, so DOSH may investigate the incident. However, the implementation of basic occupational health services within the SMI sector is seen to be less effective as the number of occupational diseases and poisoning is under-reported (72).

Reason for underreporting include a worker might conceal an illness due to fear of job loss especially those workers who have illegal immigration status and who are afraid to be deported. Some of these workers are also unaware that they might suffer the occupational illness and do not have the desire to report it to their employer (73). In addition, the failure of healthcare provider to diagnose the occupational disease might be the reason of under-reporting. For example, the long latency period of occupational disease might be revealed only after the workers left the job (17). Economic factors may also play a role in under-reporting. For example, some employers might conceal the data because high number of reported occupational disease can lead to further workplace inspection by the regulatory agency and can increase the workers' compensation premium (74).

Another reason is the non-compliance of the Malaysia law under Occupational Safety Act 139 and Factories and Machineries Act 514. It showed that more than 90% of the SMIs in the small sector do not comply with the law. Only 3.1% of the personnel can be assumed to have the knowledge and expertise in occupational safety. The main reason is the lack of human resource and knowledge of the law; laws that have been provisioned were difficult to comply and costly to implement, and they assume that their work environment is not of high risk (23).

Findings from our reviewed studies had identified the association between occupational hazards and health problems. Despite this, most of these significant findings were not adjusted for potential confounders such as duration of smoking, duration of employment and the use of personal protective equipment. Controlling the confounders is crucial to avoid bias in estimating the exposure effect (75). It is also unclear whether the different degree of exposure might give harmful effects. Thus, it is important to identify a strategy to obtain accurate information on level of exposure.

Majority of the reviewed studies on occupational health problems in SMI, Malaysia used the cross sectional study design, except two studies that used intervention (27) and case report (33). The studies are limited by small sample sizes that may give a weaker link between occupational exposure and health problems. The need to include many SMIs in future studies is crucial in order to have a sufficient sample size and increasing the possible heterogeneity among industries in term of work process and workers (76).

Questionnaires have been used widely in assessing the occupational health problems among SMI workers in Malaysia. The workers provided their general information, working history, medical history and questions related to occupational health problems based on self-reported data, which may lead to information bias. However, the use of a standardized and validated screening tool such as the Nordic musculoskeletal questionnaire (24) and American Thoracic Society (ATS) respiratory symptoms questionnaire (55) appear to be the established tool to evaluate the health problems among workers. In addition, the studies were also complimented by the use of objective tools such as spirometry to measure the lung function (34), audiometric tests for hearing impairment (29) and NCBT for neurobehavioral performance (29). However, the use of different tools for outcome measures in these studies made it difficult to integrate the findings.

Much of the epidemiology studies in this review have suffered from inadequate exposure assessment. The exposure assessment aspect either qualitative or quantitative measurements were different across studies. All studies collected the exposure assessment based on work history and duration of exposure even though majority of them based their primary analysis on a comparison between exposed and unexposed group. However, it may lead to misclassification bias, which may limit the evidence on the link between occupational exposure and health problems. The selection of reference group is also very crucial because if they have been selected from similar community, they may nevertheless not be truly unexposed which again loses the power to detect detrimental effects (77).

The strength of this review is in the inclusion of both the peer-reviewed studies and the grey literature that have not been published in peer-reviewed journals. The literature search for this review includes both documents in English and Bahasa Malaysia. However, this review is limited to the studies within the database utilized. There may be some oversights related to the database selected. Nevertheless, we conducted an extensive manual searching especially on unpublished studies through consultation with the librarian and we are certain that all the studies that met our inclusion criteria have been considered in this review.

CONCLUSION

In conclusion, the most frequent occupational disease among SMI workers in Malaysia is WMSD. Other important diseases include NIHL, occupational skin and respiratory diseases, occupational poisoning and mental health problems. Even though the findings from this review were inconsistent, the occupational health problems showed some evidences among SMI workers in Malaysia despite the fact that it has been limited by methodological differences and weaknesses. In light of these challenges, the health risk is still a crucial issue in SMIs due to their limited resources and support. The lack of data and under-reporting information about the occupational diseases among SMI workers in Malaysia is troubling. More information is needed to tackle the occupational health issue in SMIs. Thus, there is an immediate need to look upon these issues comprehensively.

Conflict of Interest

Authors declare none.

Acknowledgements

The authors would like to acknowledge the funding support of this work by Department of Occupational Safety and Health Malaysia under the Research Development Project of 11th Malaysian Plan and IIUM Entrepreneurship and Consultancies Sdn. Bhd (Company No.: 563743-P) as the consultant firm

awarded by DOSH to manage this project (Contract No.: DOSH/05/2016/OHSIKS in addition to IIUM internal grant (RIGS16-116-0280). They also express thanks to the research assistants and everyone who contributed in the study.

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