ORIGINAL ARTICLE

A SYSTEMATIC REVIEW ON IDENTIFYING ASSOCIATED FACTORS IN DECIDING WORK- RELATEDNESS OF CHRONIC BACK PAIN AMONG EMPLOYEES AT WORK

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ABSTRACT

Chronic low back pain is a common and preventable complain among workers. Large amount of financial and benefit cost has been spent by the developed countries to prevent, treat and rehabilitate a large number of workers that are exposed to hazards attributing to low back pain. Efforts on primary prevention of low back pain has been challenging due to difficulties in affirming work- relatedness of chronic back pain among workers. As such, efforts have to be focused on the existing literatures to propose acceptable variables to define work- relatedness specific to occupational low back pain. Evidences suggest twisting, frequent manual lifting of objects, duration of daily exposure, coping mechanism towards the pain, body mass index (BMI), smoking status and physical activity are associated with occupational back pain. However, further research efforts are needed to establish stronger evidence and improve the occupational safety and health of our workers that are exposed to all these hazards throughout the day on a daily basis.

KEYWORDS: *chronic back pain; work- relatedness; work; factors*

INTRODUCTION

Chronic back injuries related medical benefits and compensation ranged from absence from work to financial costs. Absences due to these spinal disorders have ranged from those more than 90 days (15% cases) to beyond 180 days (9%)[1]. In terms of costs, $ 477 million was paid out to employees with spinal disorders due to workplace in Quebec, Canada in 2002. Similar scenario could be found in the United States at an increasing rate from USD 509.3 million in 2006 to USD 516.5 million in 2007[2].

According to Shraim et al.[3], although two thirds of LBP cases return to work (RTW), increased length of disability (LOD) due to chronic low back pain (LBP) is linked to increased likelihood of permanent disability. In Malaysia, disabling back disorders (147 cases) were the second commonest occupational diseases that were reported and awarded compensation by the Social Security Organization (SOCSO) after noise induced hearing loss[4].

Similarly, such benefits and compensation could only be awarded when work- relatedness decision is well- established. Unfortunately, decisions became difficult when presentations of the back pain are inconsistent with investigative findings especially the Magnetic Resonance Imaging (MRI). Therefore, the concept of work- relatedness although significantly important, would remain an on- going debate in the scientific world. This is because definitions and factors in determining chronic back pain due to work have been conflicting thus far. In theory, back injuries were due to overexertion or lifting objects over a stipulated period depending on the dose- exposure and severity of the aggravating task at work. Therefore, systematic review on work- relatedness for clinicians while at the same time easily understood by the lay people would ease and promote effective risk communication that would prevent unnecessary misunderstandings.

Work- related decision has two main stakeholders in identifying the appropriate criteria or attribute among individuals with chronic back pain; the ergonomist versus the clinician approach. The exhaustive detail approach by ergonomists to objectively record and give values to all hazard and exposures variables that existed primary at the workplace may be relatively impractical for physicians/ clinicians to practice in a patient-doctor setting. All these attributes could be divided to ergonomic factors, factors related to work organization, psychosocial factors at work, individual characteristics and health behaviours[5]. Such approach would be to identify evidence-based variables from both disciplines that would aid other physicians and policy makers to make scientific- based decisions in terms of awarding benefits and compensations by defining work-

relatedness of each claimant on case per case basis.

As globally, the human population is gradually aging, chronic low back pain would be a very common problem[6] or complain. Therefore, the work- relatedness question would be pertinent in addressing benefits and compensation in the near future. A healthy back would have its physiological degenerative or aging process. At which group or a point in time in an individual, one would consider an backache due to workplace or due to aging degenerating process of a normal physiology of the human body. The challenge or gaps in the near future would be to identify symptoms, signs, or attributes that define work- relatedness. As such, workplace attributes includes, ergonomic and organizational or environmental factors.

There are worker factors such as smoking that may influence the onset of pain due to poor vascular conditions of the back. With this, one could categorize these factors into psychosocial, individual characteristics and health lifestyle of the worker or employee. Thus, this review would determine the association between work- related disabling back pain with relevant ergonomic-related factors, work organization factors, employee's psychosocial factors at work, employee's individual characteristics and health lifestyles from past literatures.

METHODS

For the purpose of this review, all observational studies related to chronic back pain at work were chosen. As such, numerous studies with various designs; cohort, case- control and cross- sectional studies were identified from various electronic databases including PubMED, Medline, Ovid Medline, EBSCOhost, SpringerLink, ScienceDirect, MD Consult, BMJ Journals, and Informa Healthcare. The target population of interest was working age population who are healthy without pre- existing chronic medical illness. The factors of interest were compared within similar study designs; 3 levels of literature comparison based on study designs and strength of evidence.

Presence or absence of factors related to chronic low back pain at work of interest was specifically identified, compared and summarized. The outcomes were defined as number of employees with work- related chronic back pain or employees who received absence from work benefits, compensation or sick listing certificates due to chronic back pain. Using PubMED as the main search engine, the following keywords were used: (factors *OR* attributes *OR* association *OR* connections *OR* agents) *AND* (chronic *OR* long onset *OR* long duration) *AND* (back *OR* low back *OR* spinal) *AND* (pain *OR* discomfort *OR* disorder *OR* disturbance *OR* uneasiness) *AND* (workers *OR* employees) *AND* (work *OR* occupation *OR* employment) *NOT* (rehabilitation *OR* return to work) *NOT* (imaging *OR* treatment *OR* drugs).

RESULT

Based on the search engine mentioned above, a total of 48 articles were identified. However, 28 literatures were available and in full English articles. Unfortunately, eleven articles had different objectives, assessment techniques and the outcomes that were pre- decided for our review. Finally, ten cohort studies, one case-control study and seven cross- sectional studies were involved in our review. The grading of the level of evidence was adapted from the Revman 5 and GradePro of the Cochrane Collaboration (Figure 1).

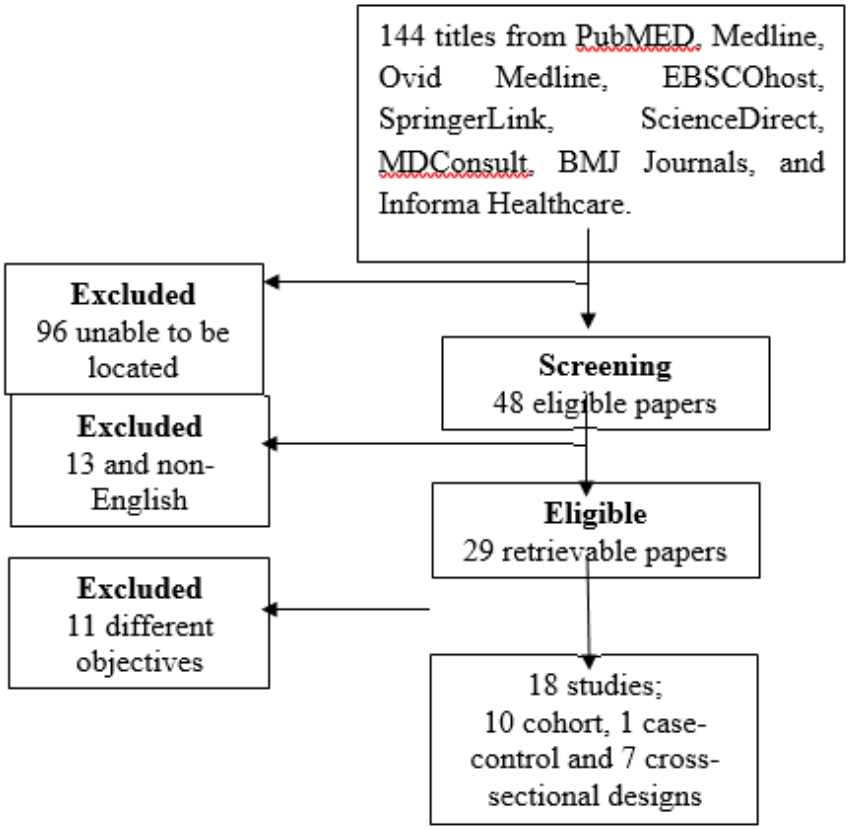

Figure 1: Summary of search strategy and exclusion process for work- related chronic back pain (PRISMA Flow Chart).

The 11 articles had been compared their strength of the studies based on the individuals study designs, etc. The systematic review table of risk comparisons that would produce the final adjusted risk is available in the Revman 5 software, especially Table 3. However, the analysis is limited due to the limited parameters studied in relation to work- relatedness as compared to the development of onset of back pain and disease development. Even among cohort studies (Figure 3), there were various studies that were subjected to various biases.

For the purpose of comparison of variables, the ten cohort studies were predominantly used in our review as summarized from Table 1 to Table 3. The case- control and cross- sectional studies would be greatly discussed in the discussion section in view that the level evidence are relatively lower and non- ideal to be compared with the cohort studies. Table 1 and Table 2 show the comparison among the cohort designs divided into factors at workplace with health characteristics and behaviours of employees with occupational back pain. At the workplace, the relationship between physical factors suggested such as manual handling of materials, twisting, duration of daily working exposure with occupational low back pain had been rather weak significance among the cohort studies.[7,8,9,10,11] However, Alexopoulus et al.[12], a cross- sectional study reported low- back pain that was not significantly associated with manual handling but was associated with strenuous back postures (OR= 1.85; 95 CI%: 1.02- 3.35). Spyropoulus et al.[13] reported lifetime prevalence low back pain among white collars were associated with sitting time $\geq$ 6 hours (OR= 1.59; 95 CI%: 1.06- 2.37) while factors related to body distance from computer screen (OR= 0.25; 95 CI%: 0.08- 0.79) seem to have a protective effect.

Table 1 Workplace factors associated with low back pain

First author, country, year (reference no.)	Sample size; participation rate at baseline, follow- up	Study participants	Associated factors at workplace	Relative Risk/ Prevalence ratio (95% Confidence Interval)	Definitions of LBP	Adjustments
Elders, Netherlands, 2004, (15)	288; 85% (1998), 62% (1999), 54% (2000), 43% (2001)	Prospective cohort study, scaffolding company, 12-monthly interval follow- up associating manual handling with low back pain. Respondents were those ≥ 35 years old.	High strenuous arm movements (general) **High manual handling of materials (recurrence)** **High job demand and low job control (recurrence)**	NS* **2.02 (1.12- 3.66)** **2.16 (1.12- 4.21)**	A person who experienced an episode of pain, stiffness, or discomfort of the lower back.	Multivariate analysis
Miranda, Finland, 2002 (8)	7000; 74% (1992), 61% (1993), 47% (1994), 43% (1995)	A prospective cohort study on musculoskeletal pain and potential risk factors among employees of a large forest industry. Baseline and recruitment was conducted in 1992 with annual follow- up from 1993 to 1995. The mean age of the respondents were approximately 45.3 ± 9.2 years old.	**Twisting movements of the trunk during a work day** Not at all or only little **Moderately** **Much** Working in kneeling or squatting position Not at all < ½ hour/ day ½- 1 hour/ day > 1 hour/ day	 1.00 **1.60 (1.10- 2.50)** **1.90 (1.10- 3.20)** 1.00 0.90 NS* 0.60 NS* 1.40 NS*	Modified version of Nordic Questionnaire with questions defining sciatic pain as low back pain radiating below the knee. Besides that the total number of days with pain within the 12 months was also documented. A manikin was used to denote the anatomic area.	Multivariate adjustments; sex, age, smoking, mental stress, walking, twisting movements of the trunk, working in kneeling or squatting position, working with a hand above shoulder level, jogging and job satisfaction.
Turner, United States, 2008 (11)	4354; 49.3% (July 2002- April 2004), 43.3% (12 months after claim submission)	The Washington Workers' Compensation Disability Risk Identification Study Cohort is a prospective - based study that identified risk factors for chronic musculoskeletal disorder disability. Recruitment was done from July 2002 to April 2004. Baseline was obtained from interviews, Department of Labour and Industries administrative	Heavy lifting (ref= not at all/ occasional) Frequent Constant **Job hectic (ref= disagree)** **Agree** **Strongly agree**	 0.84 NS* 1.20 NS* **1.84 (1.16- 2.91)** **2.16 (1.32- 3.54)**	Work disability was used as the outcome of the study. Instead of low back pain definition, disability was wage replacement compensation given until a worker returns to work or is judged to be medically stable and able to work.	Stepwise logistic regression and receiver operating curve (ROC).

	databases, and medical review. Respondents must have the primary outcome of wage replacement compensation for temporary total disability ('work disability') 12 months after claim submission.	**Job accommodation (ref= offered) Not offered**	**1.91 (1.31- 2.76)**	

NS Not significant association*
NS Not significant in both male and female stratification*

Table 2 Health characteristics and behaviours associated with low back pain at work

First author, country, year (reference no.)	Sample size; participation rate at baseline, follow- up	Study participants	Health characteristics and behaviours	Relative Risk/ Prevalence ratio (95% Confidence Interval)	Definitions of LBP	Adjustments
Elders, Netherlands, 2004, (15)	337; 85% (1998), 62% (1999), 54% (2000), 43% (2001)	Prospective cohort study, scaffolding company, 12- monthly interval follow- up associating manual handling with low back pain. Respondents were those ≥ 35 years old.	Age (yrs) Cumulative incidence < 35 35- 44 > 44 Cumulative recurrence < 35 35- 44 > 44	 1.00 2.22 NS* 0.68 NS* 1.00 1.00 NS* 1.50 NS*	A person who experienced an episode of pain, stiffness, or discomfort of the lower back.	Multivariate analysis
Miranda, Finland, 2002 (8)	7000; 74% (1992), 61% (1993), 47% (1994), 43% (1995)	A prospective cohort study on musculoskeletal pain and potential risk factors among employees of a large forest industry. Baseline and recruitment was	Gender Male Female **Age (years)** < 35 **35- 44** **45- 54**	 1.00 1.10 NS* 1.00 **2.10 (1.1- 4.1)** **2.00**	Modified version of Nordic Questionnaire with questions defining sciatic pain as low back pain radiating below the knee. Besides that the total number of days with pain within	Multivariate adjustments; sex, age, smoking, mental stress, walking, twisting movements of the trunk, working in kneeling or squatting position,

		conducted in 1992 with annual follow- up from 1993 to 1995. The mean age of the respondents were approximately 45.3 ± 9.2 years old.	≥ 55	**(1.0- 4.0)** **3.30 (1.4- 7.6)**	the 12 months was also documented. A manikin was used to denote the anatomic area.	working with a hand above shoulder level, jogging and job satisfaction.
Turner, United States, 2008 (11)	4354; 49.3% (July 2002- April 2004), 43.3% (12 months after claim submission)	The Washington Workers' Compensation Disability Risk Identification Study Cohort is a prospective -based study that identified risk factors for chronic musculoskeletal disorder disability. Recruitment was done from July 2002 to April 2004. Baseline was obtained from interviews, Department of Labour and Industries administrative databases, and medical review. Respondents must have the primary outcome of wage replacement compensation for temporary total disability ('work disability') 12 months after claim submission.	Age (years) (ref= 35-44) ≤ 24 25- 34 45- 54 ≥ 55 Gender (ref= females) Males Education (ref= high school) Less than high school Vocational or some college College Catastrophizing[a] [ref= 0- 1 (very low)] Low (< 2) Moderate (2- <3) **High (3- 4)** Recovery expectation [ref= 10 (very high)] High (7- 8) **Low (0- 6) or declined to answer**	 0.54 NS* 0.73 NS* 1.00 NS* 1.00 NS* 1.11 NS* 0.92 NS* 0.78 NS* 0.53 NS* 1.44 NS* 1.68 NS* **2.41 (1.37- 4.22)** 1.46 NS* **1.76 (1.20- 2.58)**	Work disability was used as the outcome of the study. Instead of low back pain definition, disability was wage replacement or compensation given until a worker returns to work or is judged to be medically stable and able to work.	Stepwise logistic regression and receiver operating curve (ROC).

Fear- avoidance[a] [ref= <3 (very low)]	
Low- moderate (3- <5)	1.60 NS*
High (5- <6)	**2.02 (1.11- 3.69)**
Very high (6)	**2.21 (1.17- 4.17)**
Mental health [ref= > 50 (above mean population)]	
41- 50	1.54 NS*
30- 40	**1.69 (1.05- 2.73)**
< 30	**2.21 (1.32- 3.71)**

NS Not significant association*
[a] Higher scores indicate worse psychological status
[b] Higher scores indicate better psychological status

Table 3: Quality of the evidence of factors attributing to chronic low back pain

Outcomes	No of Participants (studies)	Quality of the evidence (GRADE)
Abenhaim 1995 (Specific vs Non- specific Back Pain) Medical records and questionnaire Follow-up: 2 years	2500 (1 study)	⊕⊖⊖⊖ **very low**
Elder 2003 (Sickness Absence vs Healthy) Questionnaire adapted from Nordic and Karasek Model Follow-up: 3 years	337 (1 study)	⊕⊕⊖⊖ **low**
Elder 2004 (Low Back Pain vs Healthy) Questionnaire based from Karazek Model Follow-up: 3 years	288 (1 study)	⊕⊖⊖⊖ **very low**
Kaaria 2010 (Low Back Pain vs Healthy) Questionnaire and Survey Follow-up: 5-7 years	8960 (1 study)	⊕⊖⊖⊖ **very low**
Kopec 2004 (Back Pain vs Healthy) Questionnaire and Survey Follow-up: 5 years	7856 (1 study)	⊕⊖⊖⊖ **very low**
Latza 2002 (Low Back Pain vs Healthy) Questionnaire and Survey Follow-up: 5 years	571 (1 study)	⊕⊖⊖⊖ **very low**
Miranda 2002 (Severe Sciatic vs No Pain) Questionnaire adapted from Nordic Follow-up: 4 years	7000 (1 study)	⊕⊖⊖⊖ **very low**
Nahit 2003 (Low Back Pain vs Healthy) Questionnaire adapted from Karasek Model Follow-up: 2 years	1081 (1 study)	⊕⊖⊖⊖ **very low**
Stevenson 2000 (Low Back Pain vs Healthy) Questionnaire, Survey and Physical Examination Follow-up: 2 years	526 (1 study)	⊕⊖⊖⊖ **very low**
Turner 2008 (Wage Replacement vs None) Interview via telephone Follow-up: 3 years	4354 (1 study)	⊕⊖⊖⊖ **very low**

GRADE Working Group grades of evidence
***High quality**: Further research is very unlikely to change our confidence in the estimate of effect.*
***Moderate quality**: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.*
***Low quality**: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.*
***Very low quality**: We are very uncertain about the estimate.*

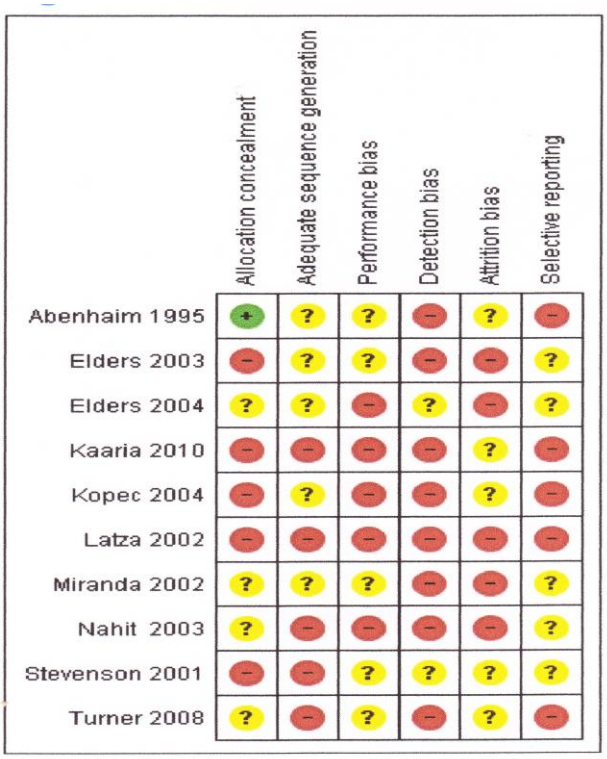

Figure 2: Biases identified among the cohort studies

Among the psychosocial factors at work, occupational job dissatisfaction, high job demands, hectic job, absence of job accommodation, psychological distress and monotonous work were noted to be rated to occupational low back pain.[8,11,14,15] Unfortunately, there were other cohort studies who reported the psychosocial factors to be not significant.[10,16] Among the cross sectional studies, only Spyropoulus et al.[13] reported psychosocial factors of repetitive work (OR= 0.67; 95 CI%: 0.47- 0.95) and anger at work (OR= 1.24; 95 CI%: 1.10- 1.41) to be statistically significant with chronic low back pain.

With regards to individual characteristics and health behaviours, age factor was inconsistently reported to be associated with occupational low back pain with significant reporting from relatively older Canada and Europe studies[8,17,18] but studies from the Netherlands and United States[11,15,19] reported non- significance. After adjusting for multiple confounding factors, Boshuizen et al.[20] reported consistent non- significant associated between age factors with chronic back pain among workers exposed to whole- body vibration from fork- lift trucks and freight- container trucks. The non- significance trend was also supported by a few cross- sectional studies.[12,13,21] Only Hurwitz & Morgenstern[22] (OR= 1.31, 95 CI%: 1.18- 1.45), Burton et al.[23] and Mustard et al.[24] (OR= 1.42, 95 CI%: 1.13- 1.79) showed weak association between occupational back pain with age.

Smoking factor had been consistently associated with occupational back pain.[8,16] Besides smoking, Kaaria et al.[16] also reported occupational back pain among female workers was related to their increased body mass index (BMI) and physical inactivity while these attributes were not significant among male workers. Among the cross-sectional studies, BMI was reported to have weak association (OR= 1.10, 95 CI %: 1.05- 1.16)[13] if not, no significant association[6] to occupational back pain. Mustard et al.[24] reported non- significance of physical activity with occupational back pain.

Among health behaviours of interest; mental stress, high levels of catastrophizing, low recovery expectation and very high fear avoidance behaviours were associated with occupational low back pain.[8, 11] However, the results of health behaviours among cross- sectional studies have been conflicting with Alexopoulos et al.[12] that reported strong association (OR= 4.33, 95 CI %: 2.31- 8.10) but Mustard et al.[24] reported non-significant associations.

DISCUSSIONS

Base on the systemic review conducted; twisting, frequent manual lifting of objects and duration of daily exposure were significant ergonomic- related factors among cohort and cross- sectional studies.[7,8,10,11,15] Although not commonly discussed on cohort studies, whole body vibration association with occupational back pain was reported by case-

control study of Boshuizen et al.[20] while awkward strenuous postures were reported by cross-sectional study Alexopoulus et al.[12]

High job demand, and work pace in the form of hectic job which is related organizational procedures and functions were reported by Miranda et al.,[8] Nahit et al.,[14] Elders & Burdorf,[15] and Turner et al.[11]. These studies also place importance of employees' satisfaction at work that was associated with occupational back pain. Lack of control at work was reported by Nahit et al.[14] and Kaaria et al.[16] not to be significant with occupational back pain and there were no cross-sectional studies that examine this attribute. However, the psychosocial factors (innate or related to organization) seem to be conflicting with other cohort studies reporting non-significance.[10,16] Social support including supervisory support was not found in the cohort studies and was not significant using multivariate analysis of Alexopoulus et al.[12]

Similar to psychological factors, evidence from within cohort,[8,11,15,17,18,19] case- control[20] and cross-sectional[12,13,22,23,24] studies have been conflicting in association between aging factors with occupational back pain. The conflicting findings could be explained hypothetically in the form of biological plausibility for two reasons. An increase prevalence of back pain with aging due to disc degenerative changes that starts as early as 30 years of age and confounded by the healthy worker effect especially the younger population. However, with the appropriate exposure at work and dose-response over time, occupational back pain would also occur among younger patients resulting in non- significance reporting from Turner et al.,[11] Elders & Burdorf,[15] Elders et al.,[19] Burton et al.,[23] and Mustard et al.[24]

Although not mentioning specifically as coping mechanism in managing occupational back pain, cohort studies had supported the association between occupational back pain with stress, high levels of catastrophizing, low recovery expectation and very high fear avoidance behaviours.[8,11] Besides that; BMI, smoking and physical inactivity had been reported to be associated with occupational back pain.[8,16] Gender characteristics and education level had been consistently found to be not significant with occupational back pain among most studies.[8,11,17,22] Unfortunately, there are some suggested attributes that were not mentioned in the articles included in this review. Attributes related to bending and physical object workload suggested in Hamberg- van Reenen et al.[25] were not identified or comparable in this systemic review. Social support among colleagues was noted related to secondary and tertiary prevention rather than predisposing the onset of chronic low back pain. Individual characteristics and health behaviours such as past injuries or illnesses, income and recreational exercise as suggested by some studies were also not compared.[5,26,27,28,29]

Most of the cohort studies involved a large number of participants and established a dose- response relationship to illustrate the occurrence of the occupational back pain. However, similar to most observational studies, there were limitations that were discussed over the years. Table 3 summarized the level of evidence and recommendations needed for future research related to occupational back pain. The average exposure time conducted among the selected studies was between three to five years. Efforts have been taken to minimize selection bias among the cohort studies. Like most studies, Abenhaim et al.[17] had taken measures to identify the targeted group of respondents to be included in the studies to reduce self- selection biases. Subject or case definitions at times would be complex and effective probability sampling was difficult aspect to perform and monitor especially when a large number of participants are being recruited. For example, Latza et al.[7] mentioned of a mixed sampling frame from routine health check- up of employer's liability insurance scheme and through advertisements. The final recruitment were five different types of construction workers that were recruited in which ranged from house painter, bricklayer, carpenter, concrete builders and unskilled workers which were not evenly distributed nor stratified. With such distribution, the exposure of the hazard related to the job task various among the subgroups and would reflect infirmities related to repetitive manual handling largely suffered among bricklayers instead of the overall construction workers.

Miranda et al.[8] had developed an appropriate protocol to identify and standardized the respondents of their study to be symptom- free of sciatica during the recruitment phase. The standardized Nordic Questionnaire was modified with clear case definition used over a period of 12 months from baseline assessment. Besides addressing recall bias or overestimation of past exposure to be declared at baseline, this approach increases differential misclassification bias. However, the methodology could be strengthened further with physical or investigative assessments documented by a third party such as done in Abenhaim et al.[17] instead of depending of self-reporting alone by the respondents. Non-differential misclassification of exposure to factors attributing to low back pain was common throughout most of the cohort studies as most of the respondents were unaware of the hazard at

work, chose to bear and work with the hazard or to leave the occupation when their back condition did not improve. This was a common reason most respondents did not continue most of their follow-up throughout the study periods.[8,15,19,30,31,32] With regards to results from Kopec & Sayre[10] and Nahit et al.[14], the results from these studies have to viewed with caution as the presence of misclassification of confounders which was the physical factors would have a significant distortion of interaction of the adjusted odd ratios and levels of significance reported. The objectives of these studies were to examine the interaction of psychosocial factors with the onset of low back pain while controlling the direct influence of physical factors such as manual handling which is hypothesized to have stronger strength of causality compared to the former.

The outcome of the studies of Miranda et al.[8] and Abenhaim et al.[17] were well- defined and comparable with their respective set objectives. Outcome bias in terms of un- comparability of the statistical analysis with other cohort studies occurred in Elders & Burdorf[15] and Elders et al.[19] and as a one- tail *P*- value was performed. Among the selected cohort studies, Stevenson et al.[18] had designed the most elaborate and extensive test battery and survey variables for their Low Back Pain (LBP) Outcome Survey from tested and reliable seven variable assessments such as electromyographic (EMG) signal to the Health, Lifestyle and Job Satisfaction (HLJS) Survey which minimized the occurrence of detection bias. These approaches used by Stevenson et al.[37] gave greater reliability and confidence to the outcomes reported as compared to those studies that relied on self- defined and self- reported questionnaires.[7,8,10,14,15,31] Attrition bias due to significant numbers of respondents being lost from follow- up over the years were noted in some of the cohort studies.[6,7,8,19] Kopec & Sayre,[10] Abenhaim et al.,[17] and Elders et al.[19] reported all the data misrepresentation or observational flaws in their studies. Selective reporting were generally low with most of decided objectives were reported and answered except of Turner et al.[11] that did not document clear and focused objectives in their article.

Next, it would be important to highlight about the other articles that were not included in this review. As mentioned earlier, only full articles in the English language available in our institution was collected. Of these, there were some articles that had un- comparable objectives,[9,31,32,33,39] study designs, methodology,[30,34,35,36,37,38] and population of interest.[19] Numerous papers had objectives that identified back pain at work due to the hazard that were studied (e.g. relationships between manual handling that was associated with back diseases during working period or environment). Unfortunately, there was a lack of research of proving a back pain complained by an employees to be directly associated to the task that there were doing at that point of time. Most complains were very retrospective and general complains documented in most studies. Besides that, other variables such as behavioural habits (e.g. smoking) and workers anthropometry were not documented or studies. As such detection bias and selective reporting was built innate into the methodology of these studies. It would be a great help of better cohort studies would be design for greater analysis of relative risk could be performed.

Emphasis was given more towards cohort studies in considering the importance of dose- response, strength of association, temporal sequence, plausibility of association and consistency when comparing the results of those studies for causality. Emphasis was also place on primary prevention of occupational back pain. Therefore, keywords related to secondary and tertiary prevention efforts such as hospitalization, imaging, rehabilitation and return to work were decided not to be included in this review.

CONCLUSIONS

Twisting, frequent manual lifting of objects and the duration of daily exposure are three associated factors that had consistent reporting with occupational back pain related to workplace. Other non- ergonomic related factors associated with occupational back pain were coping mechanism towards the pain, body mass index (BMI), smoking status and physical activity were associated with occupational back pain. Gender and education level were consistently not associated with low back pain. Other associated factors such as age were consistently conflicting among scientific evidence. However, the level of evidences thus far had been low and further research with improved methodology, statistical analysis with regards to the aging factor and assessment approach would add more knowledge to our scientific understanding of occupational low back pain. Research efforts in including associated factors related to bending, the quantitative physical object workload needed to develop back pain; past injuries or illnesses, income and recreational exercise should be increased to establish stronger evidence to improve the occupational safety and health of our workers that are exposed to all these hazards throughout the day on a daily basis. More research with stronger study designs are required in the search for strong criteria or associations to define work- relatedness of a back pain.

Acknowledgement

This work is supported by National University of Malaysia, Kuala Lumpur, Malaysia. Special appreciation is expressed to the Cochrane Collaboration and the relevant associated parties.

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