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Original Article

The Prevalence of Musculoskeletal Disorder and the Association with Risk Factors among Auto Repair Mechanics in Klang Valley, Malaysia

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Abstract

Background: The primary objective of this study was to determine the association between risk factors and the prevalence of musculoskeletal disorder (MSD) among auto repair mechanics in Klang Valley, Malaysia.

Methods: Overall, 191 mechanics from eight auto repair centers in Klang Valley, Malaysia were stratified sampling as participants of this study. A modified version of the general Standardized Nordic Questionnaire was used for analyses of perceived MSD in nine different parts of the body. Rapid Upper Limb Assessment (RULA), vibration measurement on hand power tool, questionnaire on job content, force exertion was used in this study. Direct logistic regression was performed to assess the impact of risk factors on the MSD prevalence. The probability limits for evaluating statistical significance was $P < 0.05$.

Results: 87.4% of auto repair mechanics suffered from MSD. Logistic regression analysis revealed that factors were associated with symptoms on MSD: RULA (7.933, 95% CI 4.637-13.573) and orceful exertion (3.173, 95% CI 1.194 – 8.432). The magnitude of vibration of power tool exceeds action level 2.5m/s2 with (Mean=3.99+S.E. 0.071) and showed significant association with MSD in this study ($P<0.05$).

Conclusion: Auto repair mechanics at auto repair centers in Klang Valley are likely to be exposed to a variety of ergonomic hazards and risk factors. Therefore, ergonomics awareness between employer and employee with training and information sharing shall be increase to reduce the prevalence of MSDs.

Keywords: Musculoskeletal disorder (MSD), Auto repair mechanics, Hand arm vibration

Introduction

In Malaysia (2007), 2,700 people had been surveyed on musculoskeletal pain using the Community Oriented Program for the Control of Rheumatic Diseases (COPCORD) protocol initiated by International League against Rheumatism (ILAR) and WHO (1). Total of 2594 (96%) people that were interviewed suffer from musculoskeletal pain at spinal region. Based on the study, 14.4% complained of having pain at joints and/or musculoskeletal pain. Meanwhile, 11.6% had low back pain and 64.8% of them complained having pain pertaining to joints at knee area. Consequently, a partial of those examined with knee pain had clinical evidence of osteoarthritis. Based on the statistics provided from the Social Security Organization (SOCSO), employees who suffered from a common work-related disorder: musculo-skeletal disorders; had increased since 2006. In 2006, 14 people reported such cases and the numbers jumped to 238 in 2010. While in 2011, 268 people recorded of such disorder (2).

Automotive industry makes 3% (321,121) out of the total employment in Malaysia (3). Malaysian Road Transport Department reported that there are approximately 21 million vehicles in Malaysia in the year 2011 (4). This shows that there is a significant demand for both automotive service and maintenance. Currently, there are approximately 18, 000 outlets for auto repair in Malaysia with 209,835 employees (3).

Previous study in a car service center in Malaysia reported 91.7% of work-related MSD prevalence cases (5). It is equivalent to 192,417 from 209,835 (3), employees that are working in auto repair are affected with WMSD. The statistics highlights that the highest numbers of workers in car service center are in Klang Valley.

However, there is no studies have been done on this particularly largest portion of car service workers Therefore the aim of this study is to determine the prevalence of WMSD among auto repair mechanics in Klang Valley and its association with risk factors.

Materials and Methods

Study background and design

This cross-sectional study was conducted incorporating 191 auto repair mechanics from April 2012 to November 2013 from eight outlet centers in Klang Valley, Malaysia. These respective selected outlets were managed by the same company. It is located at various areas in Klang Valley which are; a) Selayang b) Segambut, c) Section 19, Petaling Jaya, d) Jalan 217, Petaling Jaya, e) Subang Jaya, f) Cheras, g) Puchong and h) Sungai Rasah.

This study emphasizes on maintenance service that can be defined as the preventive measures that involve operations such as maintaining engine oil, gear oil, wheel services, air-conditioner services etc. The types of vehicle that are being serviced are cars, vans, multi-purpose vehicles (MPVs), sport-utility vehicles (SUVs) and compact pickup trucks.

Questionnaires on the prevalence of MSD and the associated risk factors/Demography

Questionnaires were distributed to random mechanics in their respective outlets based on the exclusion criteria, which are male, no history of musculoskeletal injury and over 3 months working at the respective outlets. Each of the mechanics was briefed regarding with how to respond to the questionnaire. Prior to answering the questionnaire, the mechanics were asked to fill in a consent form to show that they willingly participate in the study. A research assistant observed and guided them throughout the session. Next, the questionnaires were checked by the research assistant to ensure that all part had been answered. Each session was conducted in approximately 30 minutes. The questionnaire included questions regarding with socio-demographic and background, working, outside activity and medical history information.

Prevalence of MSD

In order to obtain information on the musculoskeletal disorders (MSD), the standardized Nordic questionnaire (SNQ) was translated into Bahasa Malaysia and the translated version was used in the study. The questions were formed in simple structures like "Do you experience any pain, aching or discomfort within the past 7 days at shoulder?

Job content questionnaire (Karasek)

A self-administered questionnaire with instruments designed to measure social and psychological characteristics of jobs (Job Content Questionnaire, Karasek) (JCQ) was used to determine on how work environment will affects the risk factor of among the mechanics. Recommended format of Karasek JCQ (49 questions) is based on five scales 1) latitude, 2) psychological demands, 3) social support, 4) physical demands and 5) job insecurity. The questions were formed like "My job requires that I learn new things?: 1) strongly disagree 2) disagree 3) agree and 4) strongly agree." The score was measured by using the scale formulas as per JCQ user's guide. (7).

Psychological questionnaire (General Health Questionnaire 12 (GHQ-12)

GHQ-12 was also used to determine the mechanics' recent mental health (8). It is to assess the severity of psychological complications in the past

few weeks. The GHQ scoring method (0-0-1-1) was chosen over the simple Likert scale of 0-1-2-3, as this particular method is believed to help eliminate any biases that might result from the respondents who tend to choose responses 1 and 4 or 2 and 3, respectively. Adding all the items on the scale ranging from 0 to 12 summed up the scores. Due to the various thresholds of the GHQ-12, the mean GHQ score for a population of respondents was suggested as a rough indicator for the best cut-off point (9). Some examples of the questions in the GHQ-12 are: *1) Been able to concentrate on whatever you are doing.*

Force exertion (BORG CR-10)

For the analysis of perceived physical exertion while performing vehicle maintenance operation, Borg CR-10 Scale was used for the assessment (10). Example of the questions asked is: How would you rate the physical exertion of lifting up/down tire? The answer of physical exertion is rated on a scale from 0 (none at all) to 10 (extremely strong).

Posture Analysis

Posture analysis was conducted using Rapid Upper Limb Assessment RULA developed by Lynn McAtamney and E Nigel Corlett (11). This assessment is to analyze the exposure of individual workers to risk factors associated with posture inefficiency that probably lead upper limb disorders. There are approximately 191 mechanics were observed for WMSD. Three tasks of service process were assessed since it is the most common task among the mechanics. These included 1) working under vehicles for engine oil changing process 2) loosing/tightening tire nuts using impact wrench and 3) lifting up/down tires. For efficient observation, a video camera was used to capture the motion of the technician for the whole process. The video was then analyzed to assess the mechanics' postures in the three processes involved. A score is calculated for the posture of each body part. The combined individual scores for shoulder, elbow and wrist gave score A and those for neck, trunk and legs gave score B. Muscle use and force exerted in each task were attributed a score of 1 and 0, respectively, because they are static postures without loading; these scores were added to scores A and B to obtain scores C and D, respectively (11). Based on the design of the RULA method, each combination of scores C and D (a number of 1–7), called grand score, and reflects the musculoskeletal loading associated with the worker's posture.

Vibration measurement

HAV was measured on 191 mechanics in Klang Valley to measure the vibration magnitude of power tool that been exerted throughout the auto repair operation. The measurement was monitored using Larson Davis human Vibration Meter (HMV100). Its features three accelerometer input channels, a vector sum data channel, and a variety of weighting and band limiting filters as per regarded with Hand-Arm Vibration (HAV) analysis per ISO 5349 and EU directive 2002/44/EC (12). AV measurement was conducted in a total duration of one minute since the process of using impact wrench for loosening/tightening up nuts of tire does not exceed one minute. The daily vibration exposure, $A(8)$, for a worker carrying out one process or operating one tool can be calculated from a magnitude and exposure time, using the equation (1):

$$A(8) = a_{hv}\sqrt{\frac{T}{T_0}} \qquad (1)$$

Where a_{hv} is the vibration magnitude (m/s^2), T is the daily duration of exposure to the vibration magnitude a_{hv} in this study is 1 minute and T_0 is the reference duration of eight hours. The daily vibration exposure has units of metres per second squared (m/s^2), The quality control of each measurement are maintained by standard operating procedure and calibration of Larson Davis human vibration meter (HMV100).

Statistical analysis

Test - retest reliability test was done among 20 mechanics from auto repair outlet in Sg. Rasah, Klang. Questionnaire session was done twice with an interval of one week respectively. The Satisfaction with Life Scale has good internal consistency,

with a Cronbach alpha coefficient reported of 0.89. Statistical Package for Social Science (SPSS®) version 17 was used in data analysis. The probability limits for evaluating statistical significance was $P < 0.05$.

Results

Demographic information of respondents

The study showed that 51.8% are single, 46.6% had monthly income between US $ 500 to US $ 833, 61.8% are between 18 to 30 years old and 37.2% are overweight. There were significant association between MSD and the risk factors ($P<0.05$), which are ethnic group ($X^2=12.495$, $P=0.006$), marital status ($X^2=5.940$, $P=0.051$), monthly income ($X^2=11.570$, $P=0.003$), Body Mass Index ($X^2=7.259$, $P=0.007$), age ($X^2=6.145$, $P=0.046$) and smoking ($X^2=0.545$, $P=0.460$)

Working information of respondents

The majority of the respondent's takes overtime for and received incentives were 87.4% and 93.2% respectively. There was no significant association of MSD and the risk factors which were overtime takes by respondents and receiving incentives observed ($X^2=1.708$, $P=0.191$) and ($X^2=0.302$, $P=0.583$). Most of the respondents received OT allowance per month between US $ 667 to US $ 1,333 (49.2%) and incentives between 5-12 per year (68.6%.) There was significant association of MSD and amount of OT allowance ($X^2=6.565$, $P=0.038$). Low percentage for those who do part time as mechanics 7.3% and no significant association ($X^2=0.404$, $P=0.525$).

Other activities outside work

Most other activities outside work were performed 1-2 per year, which are painting (47.1%) and travel (52.9%). Sports was performed 1-2 per week (36.1%) and activities that performed everyday was housekeeping (43.5%). There were significant association of MSD and risk factors travel ($X^2=17.353$, $P=0.002$) and housekeeping ($X^2=14.203$, $P=0.007$).

Work related MSD risk factor

Physical factors

Rapid Upper Limb Assessment showed Task 1 and 2 with score that required further investigation (61.3%). There were significant association between MSD and Task 1 and 2 posture RULA score ($X^2=6.186$, $P=0.045$). While for Task 3 score, highly percentage required further investigation and change soon (70.2%). However, there was no significant association of MSD and posture risk factor ($X^2=4.761$, $P=0.092$). Hand arm vibration was measured and showed highly percentage of magnitude vibration above action level ($2.5m/s^2$), which was 87.4%. However, there was no significant association of MSD and hand arm vibration ($X^2=0.447$, $P=0.504$). Force exertion was observed, Task 1 with most of the force was weak with 71.1%, and forces were high for Task 2 and 3 76.3% and 83.7% respectively. There were significant association of MSD and forces exertion for Task 2 and 3 ($X^2=7.456$, $P=0.006$) and ($X^2=5.826$, $P=0.016$) respectively.

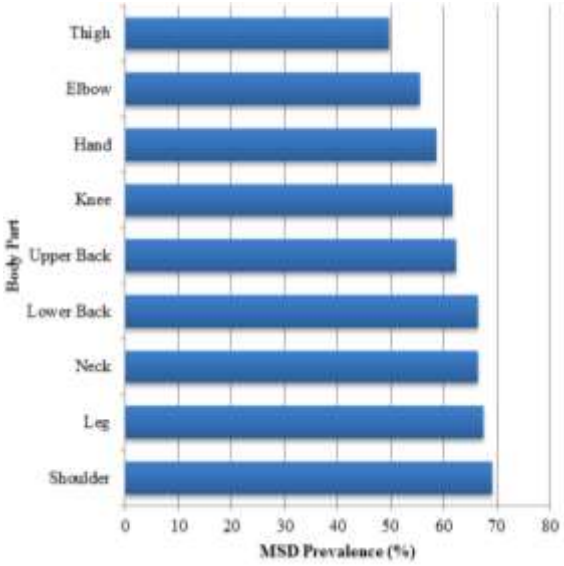

Fig. 1: Prevalence of pain and discomforts in different body parts

Psychological and job content factors

Psychological survey by GHQ12 was observed that 88.2% psychological healthy. There was no significant association between MSD and risk fac-

tor (X^2=2.472, *P*=0.116). While for job content questionnaire by Karasek, job demand showed high job demand with 52.7 % and significant association with MSD and risk factor (X^2=7.450, *P*=0.006). Low job strain ration with 63.5%, low co-worker support with 61.3%, high supervisor support with 62.3% and high job security 52.9%. These risk factors showed no significant association between MSD; Job strain ratio (X^2=0.000, *P*=0.992), co-worker support, (X^2=0.018, *P*=0.894), supervisor support (X^2=1.884, *P*=0.170) and job security (X^2=1.385, *P*=0.239).

Based on the standard Nordic questionnaire on body part pain, the highest complaint of MSD is at shoulder region (69.1%), followed by leg (67.5%), neck and lower back (66.5%) respectively (Fig. 1). Table 1 shows association between risk factors of MSD with results of logistic regression analysis. The Odds ratio increased with factors such as monthly income, BMI, posture (RULA), forceful exertion, hand arm vibration, psychological distress and high job demand. Detailed result is shown in Table 1.

Table 1: MSD and risk factors among auto repair mechanics in Klang Valley

Risk Variables		**Odds Ratio**	**95%C.I.**
BMI	Normal	0	
	Overweight	22.667*	7.132-72.037
Smoking	No	0	
	Yes	8.444*	4.232-16.851
Overtime	No	0	
	Yes	7.789*	4.831-12.559
Incentives	No	0	
	Yes	6.739*	4.349-10.443
Part time as a technician	No	0	
	Yes	13.000*	1.701-99.375
Rapid Upper Limb Assessment			
Task 1 & Task 2	Acceptable	0	
	Investigate further	3.600*	1.899-6.828
	Investigate further and change soon	5.103	0.915-28.458
	Investigate and change immediately		
Task 3	Acceptable	0	
	Investigate further	0	
	Investigate further and change soon	7.933*	4.637-13.573
	Investigate and change immediately	7.167*	3.050-16.837
Hand arm vibration	Below action level		
	Above action level	7.750*	3.711-16.184
Forceful exertion Borg			
Task 3	Weak		
	Strong	3.173*	1.194-8.432
Psychological condition - GHQ 12	Psychological healthy		
	Psychological distress	3.400*	1.254-9.216
Job insecurity	Low		
	High	2.867*	1.297-6.334

*$P<0.05$

Discussion

Prevalence of MSD

The study shows high prevalence of MSD among auto repair mechanics in Klang Valley with the highest complaint among 5 body parts. This finding is almost similar with previous research which reported of (5) who reported that the highest prevalence of MSD in auto repair industry is among Malaysian mechanics. However, compared to this current results, there prevalence was much lower (4.1%) compared to the finding of present study. In India, it is reported that 85% of auto repair mechanics of having high prevalence rate of MSD (13). Meanwhile, in comparison with developed countries such as Norway, the prevalence of MSD rate is 76% (14). In contrast with Malaysia, this study shows that MSD prevalence among Malaysian auto repair mechanics is higher than prevalence in developed country. Lack of occupational health awareness on ergonomics knowledge is said to be the contribution of this matter (based on personal communication with auto repair management).

Rapid Upper Limb Assessment

Based on the finding of this study, it is assessed that all task 1, 2 and 3 were significant associated with MSD (P=0.00). Recording odds ratio of 3.60 (RULA score 3-4) and 5.10 (RULA score 5-6) for task 1 and 2. While for task 3, odds ratio of 7.933 (RULA score 5-6) and 7.167 (RULA score 7). This indicated that respondents who had working in posture in RULA score 5-6 (Investigate further and change soon) were over 5 times more likely to report MSD than those who score 1(Acceptable) in RULA for task 1 and 2. While for task 3, respondents who had working in posture in RULA score 5-6 (Investigate further and change soon) and RULA score 7 (Investigate and change immediately) were over 7 times more likely to report MSD than those who score 1(Acceptable). The present study observed that auto repair technician work under vehicles for an average of less than 30 minutes per vehicle. Then, they took approximately 5 minutes to rest before continuing their work with other services. In a way, this has reduced the consequence of prolonged standing posture. This is similar to the previous study, which reported that awkward postures increase the risk of MSDs (15).

Forceful exertion

The study shows forceful exertion for task 3 was significant associated with MSD (P= 0.021) with odds ratio 3.173. This show that respondents who had reported strong force exertion use in task 3 were over 3 times more likely to report MSD than those who reported weak force exertion used. Lifting up/down tires that weigh 10kg or more per tire may affect the pain experienced by the mechanics at body part such as neck, back, shoulder, elbows, wrists, lower legs and knees (5). Higher levels of force resulted in higher discomfort (16). However, previous study focused mainly on force and not in combination with other MSD risk factors, such as posture. Since the mechanics are rewarded with incentives for each auto repair they perform, they tend to work at fast pace. For greater acceleration production at the beginning, greater demand for muscle response is required to initiate movement and stabilize proximal joints (17)

Hand arm vibration

It is found that the daily exposure A(8) value (Mean=3.99$\pm$S.E. 0.071) exceed both action level (2.5m/s$^{2)}$ and exposure limit value (5.0m/s^2) of EU directive 2002/44/EC. The present study also reported that the daily exposure A (8) hand arm vibration level is almost the same with the reports by (18) among car mechanics in Sweden (3.5m/s^2). In this study, there was significant association with risk factors (P<0.05) and odds ratio of 7.75. This was supported by earlier study results; hand arm vibration syndrome is common among Swedish car mechanics, in spite of short daily exposure to vibrations through vibratory tools (18).

Job content factors

The study shows most of the job content questionnaire by Karasek elements had no significant association except for job insecurity (P=0.009). This study reported the odds ratio 2.867. This in-

dicated that respondents who had high job insecurity were over 3 times more likely to report MSD than those who had low job insecurity. This was support by a study (19), job insecurity increased the risk of MSD significantly.

Other factors

Based on psychological health using General Health Questionnaire (GHQ 12) in this study, there was significant association between MSD (P=0.016). This is similar to study (20), where there is significant association between psychological and MSD (P>0.001). In this study BMI also show significant association (P<0.05) with recording odds ratio OR=22.667, 95% CI 7.132-72.037. Similar to finding by (21), overweight worker (n=111) reported odd ratio 1.38 to normal weight worker.

Study limitation

The main limitation of the present study was that it was of cross sectional design and not all risk factors assumed as being important were predictive. The results were also limited due to mechanics were not working on the same type of vehicle and process every day. Assumed that health indicators such as neck, shoulder and back MSDs were less likely to involve misclassification or recall bias because the case definition for a MSD was surveyed by 'relevant symptoms with duration of at least 1 in a life time, past 12 months, past a week and due of work.

Conclusions

Work related factors such as posture, force exertion and vibration were contributing factors in increasing the risk of MSD for auto repair mechanics, compared to other physical risk factors. As for other work-related factor such as BMI also contribute in the increasing risk of MSD. Therefore, the risk factors of MSD among auto repair mechanics are not necessarily attributed by merely one factor. Recommendation can be given by increase the ergonomics awareness between employer and employee with training and information sharing.

Ethical considerations

The study had been approved by The Ethic Committee of the Faculty of Medicine and Health Sciences, Putra University of Malaysia (UPM/TNCPI/RMC/IACUC/1.4.18.1/F1).

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