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Prevalence and Risk Factors of Musculoskeletal Disorders of Motorcyclists

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Abstract

A cross-sectional study was conducted to explore the prevalence and risk factors of musculoskeletal disorders (MSDs) among non-occupational motorcyclists (NMCs) and occupational motorcyclists (OMCs). *Results*: By using self-administered questionnaires, information pertaining health history, work environment and demographic profiles were obtained from 884 respondents; NMCs (N=560) and OMCs (N=324) including mail deliveries (N=189), dispatch boy (N=53) and traffic enforcement officers (N=82). There was significant difference in mean body mass index (BMI), daily riding time, daily mileage, monthly riding time and posture score between the two groups with OMCs reported higher mean values. The most commonly affected body regions (>50%) among the motorcyclists for the past 7 days and 12 months prior to the study were lower back, neck, shoulder, upper back and hips/thighs/buttocks. Low back pain (LBP) was the most reported symptom with a 12-month prevalence whereby OMCs denoted a higher prevalence of 82.3% as compared with NMCs (62.8%). In addition to that, OMCs experienced higher frequencies and longer duration of LBP together with a higher percentage of absenteeism from work due to LBP. After adjusting for the effects of demographic characteristics and lifestyle factors, we found that riding time, posture score, smoking status and past accident were the major factors significantly associated with higher LBP prevalence in motorcyclists. *Conclusions:* A high prevalence of MSDs in motorcyclists was found particularly among OMCs. The prevalence of LBP among the motorcyclists in this study is comparable and for some cases, is higher to that of other studies carried out on drivers.

Keywords: Musculoskeletal disorders, Motorcyclists, Occupational, Low back pain, Questionnaire.

1. Introduction

Musculoskeletal disorders (MSDs) are a common health problem throughout the world, affecting not only industries but also the general population. Transportation sectors also face the same arising problem especially in the western countries where modes of transportation are diverse and convenient. For example, occupational drivers such as taxi drivers [1] and bus drivers [2] are groups of workers that have been reported widely as being at an increased risk of low back pain (LBP). This health problem was also prevalent among non-occupational (social, domestic and pleasure) car drivers even though their driving exposure was much lesser as compared to occupational drivers [3].

Nevertheless, little is known about the prevalence of MSDs among motorcyclists, mainly for those who utilize motorcycles as part of their daily transportation and for leisure activities. Even though past studies have been conducted to investigate the prevalence of MSDs among riders who used motorcycles as part of their job (occupational motorcyclists); for example motorcycle police officers [4, 5] and mail deliveries [6], a proper study investigating the health problems among non-occupational motorcyclists is still lacking.

Furthermore, motorcycle related issues have been a concern in road safety. Most of the studies on motorcycle problems were concentrated on the crash involving motorcycle rather than the motorcycle riding process itself. That is to be expected due to the severe nature of the crash and the number of fatalities involved. It is a fact that being involved in a motorcycle crash poses greater injuries as compared to motorcycle riding. However, the risk in developing MSDs by solely riding a motorcycle is still a concern and needs to be addressed. This is because the quality of life may be affected for those experiencing the symptoms of MSDs. It has been revealed that people who experience LBP were likely to be absent from work [7] and this has also affects the organization and society as a whole.

The purpose of this paper is to present the findings on the prevalence of MSDs among motorcyclists in Malaysia and its impact on proper work efficiency and long term health care. It is also a road safety concern as there may be cases where MSDs or discomfort experienced by the motorcyclists during riding might influence their postural behavior and concentration, thus endangering themselves and other road users. Hence, the need of this study is vital to better improve the health quality of a population as well as the safety of the motorcyclists.

2. Methods

The study was a cross-sectional survey carried out to investigate the prevalence of MSDs among motorcyclists. A questionnaire was modified and translated into Malay language from its original version [8] in order to suit Malaysian motorcyclists. The original questionnaire has been widely used in numerous studies [2, 9]. It was being used as a guideline to assess the association between MSDs and whole-body vibration (WBV) among occupational drivers. The questionnaire consists of three main sections; information about MSDs, work environment and demographic profiles.

Information about riding posture was added in the questionnaire and presented as posture score (PS). PS was computed from the total sum of the severity scores assigned to the postures (torso straight (2), torso bent (3), torso twisted (4) and torso bent and twisted simultaneously (5)) and frequencies of occurrence (never

(0), occasionally (1) and often (2)). For instance, PS was used to investigate the contribution of posture to LBP among city bus drivers [2].

The questionnaires were distributed at public venues (such as rest areas, shopping complexes, restaurants, etc) and at job-related places (such as post office, police station and offices). Klang Valley area was selected for the prevalence study by considering the fact that it is a highly populated area for motorcyclists. Based on recent statistics of newly registered vehicles, Selangor and Kuala Lumpur constitute at least 26% of total Malaysian motorcyclists in year 2007 [10]. Therefore it can be considered as having sufficient samples; at least for the prevalence study.

In this study, stratified sampling was used to obtain maximum information at minimal cost. Two groups; non-occupational and occupational motorcyclists were used to represent the majority of motorcyclists in Malaysia. All of the participants involved in the survey were employed workers who rode motorcycles as part of their transportation (non-occupational motorcyclists) and/or as part of their jobs (occupational motorcyclists). Only the data of the working participants who have worked at their current jobs for at least a year were analyzed. *Non-occupational motorcyclists (NMCs):* The study group consisted of 560 employed workers who rode motorcycles for the purposes of daily commuting and leisure activities. Their jobs could involve various working postures, for example office workers who spent much of their time sitting and walking. Some of the respondents may have had more than one working posture, but none of them rode motorcycles as part of their jobs.

Occupational motorcyclists (OMCs): The study group consisted of 189 mail deliveries, 53 dispatch boys and 82 traffics enforcement officers who rode motorcycles for most of their working hours.

The feasibility of the questionnaire was tested in a sample of motorcyclists before the survey began. In order to obtain accurate responses, the questions and selection of answers were explained thoroughly to avoid misleading interpretation of MSDs among the respondents. Trained research assistants were employed to conduct the survey. The average completion time for each questionnaire was between 10 and 30 minutes. A total of 884 copies of the study questionnaire were distributed and 705 copies that met the inclusion criterion were analyzed.

3. Analysis

Test of mean of independent population (NMCs vs. OMCs) was used to compare the two study groups in terms of age, BMI, daily and monthly riding hours, daily and monthly mileage, and posture score. Chi-square test was used to determine the associations between three factors; (1) frequency of LBP; (2) duration of LBP; and (3) time absent from work due to LBP, and the study groups. Univariate logistic regression analysis was conducted to determine the significance of individual predictors of LBP. Multiple logistic regression analysis was conducted to identify important factors linked to LBP by using backward elimination method. A p-value of <0.05 was considered to indicate statistical significance.

4. Results

4.1 Characteristics of study groups

A total of 606 respondents were male (87.6%) and 86 respondents (12.4%) were female. The female respondents comprised 30.4% of NMCs while there was none for OMCs. About 22.9% of the respondents were involved in any type of accident with road accidents being mostly reported. Current and ex-smokers comprised 3.6% and 48.3% respectively, while the remaining 48.1% were non-smokers. Current and ex-smokers comprised more than half (70%) of OMCs as compared to NMCs (39.9%). Table 1 summarizes the profile of respondents according to study groups in terms of sex, regular exercise, past accidents and smoking habits.

The overall subjects were aged between 17 and 60 years old with mean age 28.47 (7.31). The mean age difference between both study groups was not statistically significant (p=0.111, 95% -2.004, 0.206) which indicates that the two groups are identical in age. The Body Mass Index (BMI) of the overall respondents was ranged from 13 to 44 with a mean of 23 (3.934). Based on the international BMI classification, mean BMI of the study population is generally accepted as being in the 'Normal' category [11]. The difference of mean BMI between both study groups is statistically significant (p=0.008, 95% CI -1.424, -0.219). It can be concluded that mean BMI of OMCs was higher than NMCs (23.5 vs. 22.7).

Both groups also differed significantly in mean riding hours and distance travelled. For example, the mean daily riding hours for NMCs was 1.7 hours while for OMCs was higher (6 hours). The two measures (daily riding hours and mileage) were significantly correlated ($p < 0.01$), however the strength of the relationship was low (Pearson's r correlation coefficient = 0.304). This is due to the fact that motorcycles were driven at a range of different speeds. Table 2 summarizes the mean comparison of age, BMI, riding hours, distance travelled and posture score (PS) between non-occupational and occupational motorcyclists.

4.2 Musculoskeletal disorders

The results of the study, as illustrated in Fig. 1, demonstrated that the most commonly affected body regions among the NMCs for the past 12 months prior to the study were lower back (62.8%), followed by shoulders (52.6%), upper back (52.4%), neck (50.7%), hips/ thighs/ buttocks (47.5%), wrists/ arms (32.2%), ankles/ feet (28.0%) and elbows (19.4%).

Table 1: Profile of Respondents by Study Groups

Variable	**Non-occupational Motorcyclists**		**Occupational Motorcyclists**	
	N	**Percentage (%)**	**N**	**Percentage (%)**
Sex				
Male	336	79.6	270	100
Female	86	20.4		
Regular exercise				
No	171	40.6	93	33
Yes	250	59.4	189	67
Past accident				
No	342	81	198	71.2
Yes	80	19	90	28.8
Smoking Habits				
Never smoked	252	60.1	83	30
Formerly smoked	7	1.7	18	6.5
Currently smoke	160	38.2	176	63.5

Table 2: Mean Comparison between Non-Occupational and Occupational Motorcyclists

Variable	**Non-occupational Motorcyclists**		**Occupational Motorcyclists**		**p-value**
	N	**Mean (SD)**	**N**	**Mean (SD)**	
Age (years)	422	28.11 (7.357)	280	29.01 (7.220)	0.111
BMI (kg/m2)	420	22.71 (3.417)	266	23.53 (4.597)	0.008
Daily riding time (hr)	422	1.69 (1.1035)	283	5.99 (2.71)	<0.001
Monthly riding time (hr)	422	52.33 (39.41)	274	143.98 (128.25)	<0.001
Daily mileage (km)	422	51.7 (53.55)	280	66.73 (64.23)	0.001
Monthly mileage (km)	422	1421.9 (1501.9)	275	1508.35 (1863.18)	0.519
Posture score (PS)	378	10.47 (5.505)	260	13.54 (6.807)	<0.001

LBP was more prevalent among OMCs as compared to NMCs. This difference is statistically significant ($p<0.05$). As shown in Fig. 1 and Fig. 2, the prevalence of MSDs for the past 12 months was significantly higher for both OMCs and NMCs as compared to the 7-day prevalence. The lowest period of prevalence for both study groups was elbows (NMC=19.4%, OMC=27.7%).

4.3 Frequency and duration of LBP (12-month prevalence)

Questions on "How many episodes have you had?" and "How long does it last?" indicate the frequency and duration of LBP experienced by the respondents for the past 12 months. Respondents were asked to choose the number of episodes (ranged from 0 to >10) and the duration of LBP (ranged from never to always) in the questionnaire.

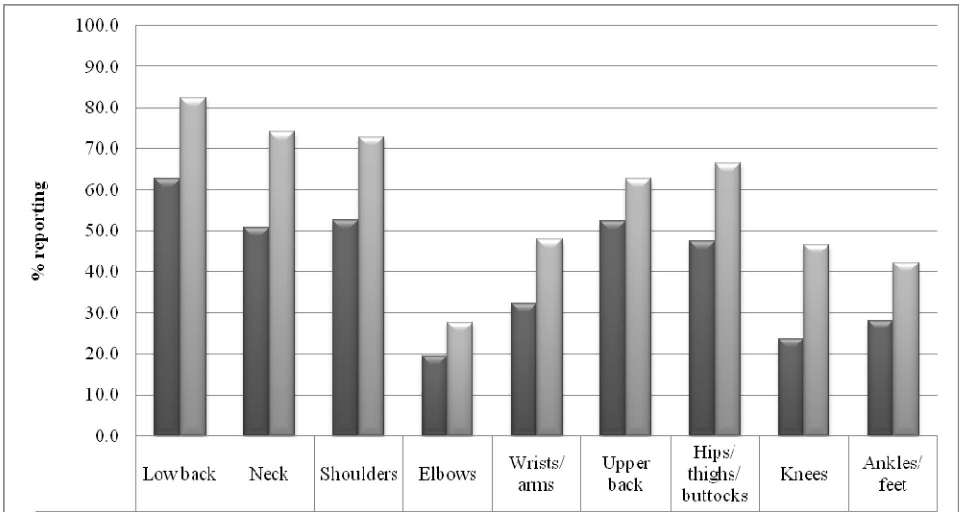
As shown in Table 3, 39% of OMCs experienced more than five times of LBP than NMCs for the past 12 months. Most of the respondents experienced LBP that lasted in hours. Besides that, OMCs also experienced a longer duration of LBP as compared to NMCs. For example, only 10% of NMCs who experienced LBP lasted more than 2 days as compared to 26% for OMCs. This shows that the severity of LBP for OMCs was higher than NMCs. Significant association was found between these two factors and the study groups ($p<0.001$).

4.4 Absence from work due to LBP (12-month prevalence)

Question on "How much time did you have to take off from work due to LBP?" was asked to cater information on the effects of LBP to work efficiency. As shown in Table 4, category on "Never" was the most frequently reported, followed by "1-4 weeks" category. OMCs reported a higher percentage of absenteeism than NMCs. Nevertheless, there was no significant association found between time absent from work and the study groups ($p=0.274$).

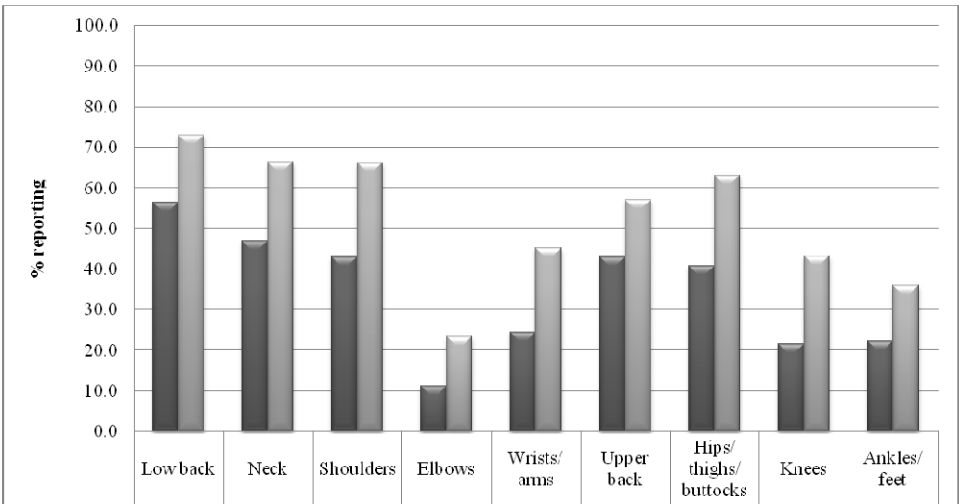
Table 3: Episodes and Duration of LBP (12-month prevalence)

Variable	Non-occupational Motorcyclists [N (%)]	Occupational Motorcyclists [N (%)]	p-value
Episodes of LBP			
1	92 (41.8)	34 (18)	< 0.001
2-5 times	71 (32.3)	80 (42.6)	
6-10 times	39 (17.7)	46 (24.5)	
> 10 times	18 (8.2)	28 (14.9)	
Duration of LBP			
Hours	161 (73.2)	76 (40.4)	<0.001
1-2 days	39 (17.7)	62 (33)	
3-6 days	8 (3.6)	10 (5.3)	
1-3 weeks	2 (0.9)	19 (10.1)	
1-3 months	3 (1.4)	6 (3.2)	
3-6 months	0 (0)	5 (2.7)	
Always	7 (3.2)	10 (5.3)	



	Low back	Neck	Shoulders	Elbows	Wrists/ arms	Upper back	Hips/ thighs/ buttocks	Knees	Ankles/ feet
NMC (%)	62.8	50.7	52.6	19.4	32.2	52.4	47.5	23.7	28.0
OMC (%)	82.3	74.2	72.8	27.7	48.0	62.6	66.4	46.5	42.2

Figure 1: Discomfort experienced by the motorcyclists at some time in the past 12 months according to study groups.



	Low back	Neck	Shoulders	Elbows	Wrists/ arms	Upper back	Hips/ thighs/ buttocks	Knees	Ankles/ feet
NMC (%)	56.4	47.0	43.1	11.1	24.4	43.1	40.8	21.6	22.3
OMC (%)	73.1	66.4	66.1	23.4	45.3	57.1	63.0	43.2	35.9

Figure 2: Discomfort experienced by the motorcyclists at some time in the past 7 days according to study groups.

Table 4: Time Absent from Work Due to LBP (12-month prevalence)

Time	Non-occupational Motorcyclists [N (%)]	Occupational Motorcyclists [N (%)]	p-value
Never	173 (78.6)	138 (75.8)	0.274
1-4 weeks	33 (15)	30 (16.5)	
1-3 months	9 (4.1)	11 (6)	
4-6 months	4 (1.8)	1 (0.6)	
> 6 months	1 (0.5)	2 (1.1)	

4.5 Risk factors associated with LBP

The univariate regression analysis was performed to determine the significance of individual predictors of LBP (Table 5). Multiple logistic regression analysis using backward elimination method was performed to indicate factors with the strongest influence on LBP among motorcyclists (Table 6).

The factors considered in the regression models were carefully chosen as to avoid multicolinearity, in which a strong correlation between two or more predictors can pose a problem to the validity of the final model. After adjusting for the effects of demographic characteristics and lifestyle factors, we found that daily riding hours, posture score (PS), smoking status and past accident were the major factors significantly associated with higher LBP prevalence in motorcyclists. The Hosmer-Lemeshow goodness of fit test (p=0.341) indicates that there is a good fit between the model and the data.

Table 5: Unadjusted univariate odd ratios with 95% confidence intervals (95% CI) for association of risk factors with LBP (12 months) among motorcyclists

Factor	Crude OR (95% CI)	p-value
Age	1.027 (1.003,1.052)	0.030*
BMI	1.018 (0.976,1.062)	0.406
Posture score (PS)	1.080 (1.046,1.114)	<0.001*
Daily riding hours	1.180 (1.102,1.264)	<0.001*
Daily mileage	1.004 (0.998,1.003)	0.704
Monthly riding hours	1.004 (1.001,1.006)	0.002*
Monthly mileage	1.000 (1.000,1.000)	0.598
Gender		
Female		
Male	3.090 (1.947,4.889)	<0.001*
Past accident		
No		
Yes	2.598 (1.646,4.102)	<0.001*
Regular exercise		
No		
Yes	1.132 (0.811, 1.579)	0.466
Smoking habits		
No		

Yes	2.297 (1.644, 3.209)	<0.001*
Study group		
Non-occupational Motorcyclists		
Occupational Motorcyclists	2.76(1.919, 3.972)	<0.001*

* $p < 0.05$

Table 6: Summarized Results of Multiple Logistic Regression Analysis

Factor	Adjusted OR (95% CI)	p-value
Posture score (PS)	1.064 (1.029, 1.100)	<0.001
Daily riding hours	1.110 (1.030, 1.196)	0.006
Past accident		
No		
Yes	1.951 (1.207, 3.153)	0.006
Smoking habits		
No		
Yes	1.765 (1.214, 2.565)	0.003

5. Discussion

The study demonstrated a high prevalence of LBP among motorcyclists as the highest complaint in comparison to other body regions. Since there is lack of studies on LBP among motorcyclists, these results may be compared to those of previous research that were associated with drivers. The prevalence of LBP among motorcyclists for both study groups was quite high when compare with other established studies on vehicle drivers [1, 2, 3, 4]. This may be due to the fact that motorcyclists require more cognitive and physical demands than drivers [12].

Furthermore, we found that the occurrence of MSDs was more prevalent in OMCs. The same trend could also be observed in a previous study on drivers [3] whereby, 55% of the respondents who drive cars as part of their jobs reported experiencing significantly higher low back trouble than social, domestic and pleasure car drivers (45%). In addition, it was reported that higher prevalence rates of LBP occur in occupational setting [13].

A high prevalence of shoulder pain could also be observed from the study. This can be compared with a previous study conducted on motorcycle police motorcyclists [4]. In that particular study, police motorcyclists reported prevalence rates of 13.4% and 45.4% for shoulder pain and shoulder stiffness respectively as compared to controls. However, in our study, the prevalence percentage of shoulder pain among the enforcement traffic officers was significantly higher (77.8%) than what was being reported in the abovementioned study.

The relatively high levels of MSDs among motorcyclists may be attributed to the fact that riding requires excessive use of body parts. When riding a motorcycle, consistent use of shoulder, neck, upper and lower back, and legs are important since all these body parts are needed to maintain stability while riding and it is also involved a lot of maneuvering. Besides that, prolonged sitting and fixed posture can lead to muscular fatigue [12]. This can also be associated with the discomfort experienced by motorcyclists.

In addition, exposure to vibration may add to the severity of the health problems experienced. Exposure to whole body vibration (WBV) has been proven to be of an important factor associated with MSDs, with the most frequently reported adverse effects being LBP [14]. The vibration is not initiated from the seat alone; instead it also comes from the handlebar. Vibration exposure from the handlebar could lead to symptoms in the finger and shoulder [15].

The occurrence of MSDs among motorcyclists has also led to work inefficiency in term of work absenteeism. Furthermore, it has been shown that LBP is one of the main reasons for workers to be absent from work in developing countries [7]. In our study, OMCs reported slightly higher percentage of medical absence due to LBP than NMCs. Nevertheless, it does not reflect in the number of days/weeks/months. On the other hand, as reported by [3], those who drove cars as part of their jobs had more days absent from work due to low back trouble than social, domestic and pleasure car drivers.

The association of potential risk factors with LBP was also examined in this cross sectional study. It was found that there was a significant association between daily riding hours and LBP. Although there is a lack of scientific evidences on the effects of riding hours to the occurrence of LBP for motorcycle riders, there exist some evidences that touch on this factor to car drivers. For instance, driving for more than 4 hours per day has been shown to cause low back trouble to car drivers [3].

In addition, there was a significant association between PS and LBP in the present study. Changes in posture have been shown to be an effect of discomfort [16]. It is probable that due to discomfort during riding, motorcyclists may tend to recover their comfort by sitting awkwardly or changing their riding postures. It may also be due to the inexistence of back rest on motorcycles.

6. Conclusion

In conclusion, there was a high prevalence of MSDs among motorcyclists in Malaysia. The prevalence of LBP among the motorcyclists in this study is comparable and for some cases, is higher to that of other studies carried out on drivers. Riding hours, posture score, smoking status and past accident were the major factors significantly associated with higher LBP prevalence in motorcyclists.

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