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Risk factors analysis: Work-related musculoskeletal disorders among male traffic policemen using high-powered motorcycles

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ABSTRACT

Introduction: The occupational safety and health issues for police riders and other professional riders are often related to ergonomic hazards and risks. The purpose of this research was to identify the factors that contribute to the health effects in developing work-related musculoskeletal disorders (WMSDs) among male traffic policemen using high-powered motorcycles.

Materials and methods: A cross-sectional study was conducted using 137 police riders. A set of questionnaires including the Standardised Nordic Questionnaire (SNQ) and human vibration meter (Svantek 106) was used in this study.

Results: The prevalence of WMSDs was 67.9%. Multiple logistic regression analysis revealed that the duration of riding a motorcycle (OR = 0.175, 95% CI:0.052, 0.581), years of service (OR = 0.152, 95% CI: 0.040, 0.567), and hand-arm vibration, HAV (OR = 3.053, 95% CI: 1.126, 8.280) were significant risk factors for the prevalence of WMSDs.

Discussion: The majority of riders reported symptoms of WMSDs within the past 12 months. Riding duration, years of service, and hand-arm vibration (HAV) were found to be the most important risk factors for WMSDs in this rider group. The results highlight that in the context of ergonomic interaction, high-powered motorcycles and the police riders are not a good fit. Hence, further study is needed to improve the safety and health of the police riders.

1. Introduction

In recent years, the role of ergonomic factors in the workplace, in terms of the development of musculoskeletal disorders, has been a topic of interest and debate worldwide. Ergonomics is defined as adapting tasks, tools, equipment, and work stations to fit the workers to help reduce physical stress and eliminate any potentially serious and disabling work-related musculoskeletal disorders (WMSDs) among workers (McPhee, 2015). The long-term use of high-powered motorcycles renders the riders prone to develop WMSDs, such as low back pain, disc dislocation, and spine injury (Ramasamy et al., 2017). Stress and fatigue are known to be common contributing factors of two-wheeler accidents due to various reasons including work-related conditions (Kar et al., 2010). The epidemiological studies and literature review stated that two categories of risk factors can be considered in developing WMSDs – occupational and non-occupational (Nunes, 2009). The occupational factors include awkward posture, rank, years of service, and long riding duration (Karmegam et al., 2011; Lopez-Alonso et al., 2013; Rhee et al., 2013; Ghasemkhani and Mahmudi, 2008; Bovenzi et al., 2006). Meanwhile, non-occupational factors are race, marital status, educational level, age, body mass index, history of injury, and smoking (Weinstein et al., 2014; Amin et al., 2014; Ekpenyong and Inyang, 2014; Deborah et al., 2010; Viester et al., 2013).

Traffic police are one of the occupations that involves a motorcycle – approximately 50% of traffic police use a motorcycle as their main vehicle while on duty. These professional motorcycle riders ride for many hours while on duty with a mean of 5.64 h per day; during this time they are exposed to vibration that may become critical since overexposure may cause discomfort, stress, decrease their performance, and even pose health risks including WMSDs (Moreno et al., 2011). Mirbod et al. (1997) suggested that riders who ride a motorcycle for more than 5 h per day are subject to overexposure to WMSDs symptoms,

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which can start to develop within a few hours of riding a motorcycle (Mirbod et al., 1997). However, health problems, especially WMSDs among motorcycle riders, are often overlooked in research even though they involve a large number of users in Malaysia. Thus, it is crucial to investigate the prevalence of WMSDs and the factors that contribute to this problem since traffic police riders are prone to accidents and spinal injuries due to their physical work load and psychological job factors.

Therefore, this study is conducted among traffic police riders to determine the prevalence of WMSDs and the risk factors, such as vibration, duration of riding, and rank under a grant from the Malaysian Government and Universiti Putra Malaysia. The data are a part of a cross-sectional study that focuses on determining the prevalence of WMSDs and revealing the non-occupational and occupational risk factors.

2. Materials and methods

The one-hundred-and-thirty-seven out of one-hundred-and-forty respondents riding high-powered motorcycles (CBX 750 P21) who participated in this study were male and with an age range of 20–55 years old. All the traffic police riders had the same work tasks and used paved roads for riding motorcycles in an urban city area. This study was a cross-sectional study. The respondents were selected using simple random sampling based on the inclusive criteria and exclusive criteria listed below:

a) Male riders, because almost 98% of traffic police riders are male.
b) Aged 20 to 55-years-old, as this is the range of the working population and traffic police riders.
c) Respondents who have ridden a CBX 750 P21 Honda police motorcycle for the duration of one year or more, because developing WMSDs is influenced by time exposure.

The exclusive criterion is:

a) Present a history of musculoskeletal disease or injuries before qualifying as a traffic police rider. This criterion is selected to make sure the WMSDs reported in this study are not attributable to a previous job or different occupational sector.

Each respondent was required to answer a pre-survey questionnaire before they actively participate in this study to make sure they met all the criteria listed above. The sampling frame was taken from the name list of all employees working at the Kuala Lumpur Traffic Police Station. The name lists were obtained from the Human Resources Department. However, this study was only focus on traffic police from point duty department only to ensure the consistency of data which different department have different task or job, and duration of riding police's motorcycle. The responsibilities of point duty are control the traffic congestion in city centre and outskirt, escorting the VIP or any event and patrol the selected location and find any offense of road users.

2.1. Questionnaire

The questionnaire consists of three sections, namely, Parts A, B, and C. Part A includes socio-demographic information (9 items) such as age, race, marital status, educational level, and monthly income. Part B consists of occupational information (15 items) including previous job experience, riding experience as a traffic policeman rider, duration of hours per shift, and the duration of riding a motorcycle per day. Meanwhile for Part C, the standardised Nordic Musculoskeletal Questionnaire (NMQ) was used to indicate complaints from the respondents of WMSDs in any part of the body (9 parts of body). This questionnaire was distributed to the respondents during their break in a meeting room at the Traffic Police Station. The questionnaire was briefly explained to each of the respondents and written consent was obtained from the respondents to participate in this study. The questionnaire session lasted approximately 15 min. This participation was voluntary, and that participant may withdraw anytime without penalty or loss of benefit to which the participant was entitled.

2.2. Vibration measurement

The Svantek 106, which is a six-channel human vibration meter, was used to assess and measure the level of whole-body vibration (WBV) and hand-arm vibration (HAV) in this study. This equipment meets the requirements of ISO 2631-1,2,5, ISO 5349 and directive 2002/44/EC of the European Parliament. The instrument for WBV measurement included a SV 38V seat-accelerometer, which was placed directly on the seat cushion, and the instrument for HAV measurement included a SV 105A set with triaxial accelerometer that enables hand-arm vibration measurements. A frequency-weighted root-mean-square acceleration (RMS) for the three translational axes (X, Y, and Z axis), as described by ISO, was used. From each axis of vibration, a frequency-weighted RMS acceleration was measured. Meanwhile, the VDV was then calculated after the RMS calculation was done in the WBV calculation. All the results were compared with the EU Directive.

The human vibration meter was used to measure the level of vibration to which the riders were exposed. Each measurement was taken for an average duration of 30 min with an interval of 1 s for data logging. Each test was taken around 10:00 a.m. to 10:30 a.m., to ensure consistency of traffic conditions. The measurement was taken for 30 min because the average time taken by traffic police riders in riding a motorcycle was approximately 30 min per task.

2.3. Statistical analysis

All the data gathered from the questionnaires and measurements were analysed using IBM SPSS (Statistical Package for the Social Science) version 22.0. This study was conducted using 95% confident level, 80% of power and the results of $p \leq 0.05$ was considered significant. Since the data in this research were not normally distributed, the Mann-Whitney *U* test was used to compare the median of the vibration exposure level (WBV and HAV) between the traffic police riders with WMSDs and those without WMSDs. In addition, the chi-square test was used to test the association between the categorical independent variables with the presence of WMSDs. The significant data in the Mann-Whitney *U* test and chi-square test were further analysed using multiple logistic regression. Since the dependent variable had a dichotomous outcome (Present of work-related musculoskeletal diseases: Yes/No), binary logistic regression was used in this test.

2.4. Ethical issues

This study was submitted and approved by the Ethics Committee, Universiti Putra Malaysia (reference number: UPM/TNCPI/RMC/1.4.18.1 (JKEUPM)/F2). Permission was received to conduct research in two police stations. Permission from the respondents who were selected to participate in this study was also obtained through the written consent of the respondents before the study was conducted. The privacy of the information and confidentiality of the respondents were protected.

3. Results

The socio-demographic information of the subjects is shown in Table 1. By dividing the past 12 months of WMSDs according to body part – neck, shoulder, upper back, elbow, hand/wrist, lower back, waist/thigh, knee, and leg/ankle – the highest prevalence was found to be the neck and shoulder (35.8%). This was followed by the lower back and waist/thigh (34.3%). The results are shown in Tables 2 and 3.

The chi-square test was done to determine whether the non-occupational (socio-demographic and lifestyle) and occupational

Table 1
Socio-demographic profile, lifestyle and occupational background of the traffic police riders (N = 137).

Variables	Total (N = 137)		
	n	(%)	Mean ± SD
Age (Years)			34.45 ± 9.89
≤30	68	49.6	
31-38	29	21.2	
39-46	11	8.0	
≥47	29	21.2	
Ethnicity			
Malay	105	76.6	
Indian	2	1.5	
Other	30	21.9	
Marital Status			
Single	29	21.2	
Married	108	78.8	
Body Mass Index (BMI)			25.45 + 4.59
Underweight (<18.5)	5	3.6	
Normal (18.5–24.9)	60	43.8	
Overweight (25–29.9)	53	38.7	
Obese (>30)	19	13.9	
Educational level			
Primary school	1	0.7	
Secondary school	119	86.9	
Higher education	17	12.4	
Smoking			
Yes	86	62.8	
No	51	37.2	
Physical Activity			
Yes	112	81.8	
No	25	18.2	
Rank			
Constable	40	29.2	
Lance Corporal	25	18.2	
Corporal	61	44.5	
Sergeant	11	8.0	
Duration of daily riding traffic motorcycle (hours)			5.64 ± 1.56
Less than 4 h	62	45.3	
4 h and above	75	54.7	
Year of services as traffic police riders			5.51 ± 4.43
Less than 5 years	96	70.1	
5 years and above	41	29.9	
Riding posture			
Ideal	38	27.7	
Non-ideal	99	72.3	
History of Body Injury			
Yes	57	41.6	
No	80	58.4	

profile are significantly associated with the WMSDs symptoms reported by the traffic police riders for the past 12 months. The risk factors involved included age, ethnicity, marital status, BMI, educational level, smoking, history of injury, and physical activity (Table 4). The risk factors originating from the occupation itself were also tested, including rank, daily duration of riding a traffic motorcycle (hours), years of service as a traffic police rider, and riding posture. The chi-square test results revealed that only marital status ($\chi^2 = 4.406$, $p = 0.036$), rank ($\chi^2 = 12.074$, $p = 0.007$), and daily duration of riding a traffic motorcycle ($\chi^2 = 8.839$, $p < 0.01$) were significantly associated with the WMSDs symptoms reported.

Table 5 shows that there was a significant difference between the

Table 2
Prevalence of WMSDs among the traffic policemen riders studied (N = 137).

Variables	Frequency (n)	%
WMSDs at Any Body Parts (Lifetime Prevalence)		
Yes	121	88.3
No	16	11.7
WMSDs at Any Body Parts (One-Year Prevalence)		
Yes	93	67.9
No	44	32.1

Table 3
Twelve Months prevalence of WMSDs among the respondents, divided by body part.

Body part	Prevalence (%)
Neck	35.8
Shoulder	35.8
Upper back	22.6
Elbow	7.3
Hand/wrist	19.7
Lower back	34.3
Waist/thigh	34.3
Knee	28.5
Leg/ankle	22.6

median of WBV A(8) for respondents who complained of WMSDs during the past 12 months and the respondents who did not complain of WMSDs during the past 12 months ($p < 0.01$, Z-value = −3.437). Besides that, there was also a significant difference in the median HAV A(8) ($p < 0.01$) between the respondents who complained of WMSDs and those who did not complain of WMSDs.

Table 6 shows the results for the binary logistic regression. The WMSDs were used as the dependent variable and riding posture, marital status, age, BMI, smoking, physical activity, history of body injury, WBV in A(8), HAV in A(8), riding duration, rank, and years of service as traffic police riders were used as the independent variables in this test after the assumptions were met. After these twelve predictor variables were considered together, they significantly predicted whether WMSDs were present among the riders, $\chi = 68.306$, df = 14, N = 137, $p < 0.01$. The logistic regression shows that the odds for reporting WMSDs among riders increases 3.053 for every 1 m-per-second-squared (m/s^2) increase in HAV A(8). It was also found that WMSDs were strongly associated with other factors – riding traffic police motorcycle for more than 4 h and five years of service as a traffic police rider – that increased the level of risk of getting WMSDs by 1.75 and 1.88, respectively.

The prediction model of WMSDs among traffic police riders is:

Logit (P) = In [P/1-P] = 0.782 - [1.745*duration of riding] – [1.887*years of service] + [1.116*HAV in A(8)]

4. Discussion

4.1. Prevalence of WMSDs

The present study found that the one-year prevalence of WMSDs among traffic police riders was more than half of the population, which was 67.9%. This is aligned with many other studies conducted among police officers that also reported that the prevalence of WMSDs was more than 50% of the population studied. Nazmul (2013) found that 80% of the respondents suffered WMSDs among traffic police officers in Bangladesh (Nazmul, 2013). The study by Cho et al. (2014), which was conducted among Korean police officers, reported a prevalence of 76.8% (Cho et al., 2014). Another study, which was done by Ana et al. (2015) among police officers in Brazil, reported the prevalence of MSDs as 75.0% (Ana et al., 2015).

According to body parts, the highest prevalence of WMSDs was found in the neck and shoulder (35.8%). This finding was parallel with several studies where the neck and shoulder was the most common body area of WMSDs among police officers (Mirbod et al., 1997; Cho et al., 2014). In this present study, this trend may be caused by the body posture while riding the motorcycle. Since the CBX 750 applies a standard posture while riding the motorcycle, the awkward posture, such as prolonged over-reached posture can lead to shoulder injuries, shoulder pain, and thoracic outlet syndrome, which can cause fatigue issues for the muscles in the neck and shoulder (Andrew, 2010). In addition, Weng (2001) suggested that wearing a helmet while riding a motorcycle

Table 4
Association between non-occupational and occupational profile with WMSDs among traffic police riders (N = 137).

Variables	WMSDs Reporting (one-year prevalence)			X^2	p-value
	Yes	No	Total		
	n(%)	n(%)	n(%)		
Age (Years)					
≤ 30	43 (46.2)	25 (56.8)	68(49.6)	3.840	0.279
31-38	18(19.4)	11 (25.0)	29(21.2)		
39-46	9(9.7)	2(4.5)	11(8.0)		
≥47	23(24.7)	6(13.6)	29(21.2)		
Ethnicity					
Malay	74(79.6)	31 (70.5)	105 (76.6)	4.836	0.089
Indian	0(0.0)	2(4.5)	2(1.5)		
Other	19(20.4)	11 (25.0)	30(21.9)		
Marital Status					
Single	15(16.1)	14 (31.8)	29(21.2)	4.406	0.036*
Married	78(83.9)	30 (68.2)	108 (78.8)		
Body Mass Index (BMI)					
Underweight (<18.5)	4(4.3)	1(2.3)	5(3.6)	0.859	0.835
Normal (18.5–24.9)	39(41.9)	21 (47.7)	60(43.8)		
Overweight (25.0–29.9)	36(38.7)	17 (38.6)	53(38.7)		
Obese (≥30.0)	14(15.1)	5(11.4)	19(13.9)		
Educational level					
Primary school	1 (1.1)	0(0.0)	1(0.7)	2.404	0.301
Secondary school	83(89.2)	36 (81.8)	119 (86.9)		
Higher education	9(9.7)	8(18.2)	17(12.4)		
Smoking					
Yes	55(59.1)	31 (70.5)	86(62.8)	1.636	0.257
No	38(40.9)	13 (29.5)	51(37.2)		
Physical Activity					
Yes	75(80.6)	37 (84.1)	112 (81.8)	0.238	0.626
No	18(19.4)	7(15.9)	25(18.2)		
History of body injury					
Yes	37(39.8)	20 (45.5)	57(41.6)	0.395	0.530
No	56(60.2)	24 (54.5)	80(58.4)		
Year of services as traffic police riders					
Less than 5 years	62(66.7)	34 (77.3)	96(70.1)	1.602	0.206
5 years and above	31(33.3)	10 (22.7)	41(29.9)		
Riding posture					
Ideal	27 (29.03)	11 (25.0)	38 (27.74)	0.242	0.686
Non-ideal	66 (70.97)	33 (75.0)	99 (72.27)		
Rank					
Constable	19(20.4)	21 (47.7)	40 (29.2)	12.074	0.007*
Lance Corporal	17(18.3)	8(18.2)	25 (18.2)		
Corporal	49(52.7)	12 (27.3)	61 (44.5)		
Sergeant	8(8.6)	3(6.8)	11 (8.0)		
Duration of daily riding traffic motorcycle (hours)					
Less than 4 h	34 (36.6)	28 (63.6)	62(45.3)	8.839	<0.01**

*p-value is significant at $p < 0.05$.
**p-value is significant at $p < 0.01$.

Table 5
Comparison of median WBV and HAV exposure between WMSDs and no WMSDs among traffic police riders (N = 137).

Variable	Median (IQR)		Mann-Whitney Test (Z value)	p-value
	WMSDs reporting	No WMSDs reporting		
WBV A(8) (m/s^2)	0.46(0.16)	0.42(0.16)	−3.437	<0.01**
HAV A(8) (m/s^2)	2.14(0.80)	1.55(0.59)	−4.864	<0.01**

***p-value is significant at $p < 0.01$.

Table 6
Factors associated with WMSDs among traffic police riders from logistic regression analyses (N = 137).

Variables	Coefficient (B)	Adjusted OR (95% CI)	Wald Statistics	p-value
Marital status				
Single	−0.536	0.585(0.150, 2.279)	0.597	0.440
Married		1.00		
Age	−0.020	0.980 (0.890,1.078)	0.172	0.678
Body Mass Index (BMI)	−0.024	0.976 (0.867,1.100)	0.154	0.694
Smoking				
Yes	0.544	1.723 (0.579,5.129)	0.956	0.328
No		1.00		
Physical activity				
Yes	−0.156	0.856 (0.193,3.791)	0.042	0.838
No		1.00		
History of body injury				
Yes	0.464	1.590 (0.531,4.765)	0.687	0.407
No		1.00		
Riding posture				
Ideal	−0.292	0.747 (0.230,2.425)	0.236	0.627
Non-ideal		1.00		
Rank				
Constable	−1.319	0.267 (0.012,6.011)	0.690	0.720
Lance Corporal	−0.701	0.496 (0.024,10.308)	0.205	
Corporal	−0.245	0.781 (0.074,8.200)	0.042	
Sergeant		1.00		
HAV in A(8)	1.116	3.053 (1.126,8.280)	4.808	0.028*
WBV in A(8)	2.906	18.277 (0.277,599.168)	1.995	0.158
Riding duration (hours)				
Less than 4 h	−1.745	0.175 (0.052,0.581)	8.084	0.004**
4 h and above		1.00		
Year of services as traffic police riders				
Less than 5 years	−1.887	0.152 (0.040,0.567)	7.846	0.005**
5 years and above		1.00		

*p-value is significant at $p \leq 0.05$.
**p-value is significant at $p < 0.01$.

requires considerable support from the rider's neck, since the head is a very heavy part of the body (Weng, 2001). This can lead to muscle problems in the neck area, and, as this area is connected to the spinal cord, it indirectly affects the muscular trapezius (shoulder region). Furthermore, based on the observations and interviews with the respondents, the present study found that neck-shoulder pain was likely caused by repeatedly lifting the large size CBX 750 Honda on and off the motorcycle stand for parking during the duration of work as it is a heavy motorcycle. This is supported by Gyi and Porter (1998) who also found that traffic police motorcyclists had higher reported severity of shoulder pain than the traffic car drivers (Gyi and Porter, 1998). AstrÖm et al. (2006) suggested that respondents who were exposed to the HAV tend to increase their grip force, which can lead to an increase in the static muscle activity in the arm, neck, and shoulder area (AstrÖm et al., 2006).

In the present study, the second highest prevalence of WMSDs was the lower back and waist/thigh (34.3%). Many studies have agreed that the lower back was one of the disorders suffered by police officers (Nazmul, 2013; Jennifer, 2006; Anderson et al., 2011; Shea and Poliquin, 2011). Brown (1998) found that a quarter of the respondents reported that their WMSDs caused them to take sick leave of up to five days (Brown, 1998). The majority of the policemen did not experience low back pain before being recruited into the force, which proves that some factors of policing caused the WMSDs among policemen (Anderson et al., 2011). Gyi and Porter (1998) concluded that traffic policemen have a high prevalence of low back pain since they have high exposure to driving, which requires them to spend their shift in the same car all day (Gyi and Porter, 1998). They agreed that traffic policemen experienced WMSDs for longer periods of time within the past year compared to other general duty policemen. Since the major working posture for traffic police is sitting (riding motorcycle) and standing (to control the road congestion), the centre of gravity for their body usually focuses on the hip and waist area, especially during standing. This means that the hip and waist area of the body carries most of the body weight, which may cause fatigue and strain of the muscles around that area during most of their work activities. As a result, the waist/hip and lower back show the second highest prevalence of WMSDs after the shoulder and neck. However, the different study subjects or work tasks among policemen seem to cause pain in different parts of the body, which could be due to the different body muscles used, the level of severity of the body muscles used, and the working conditions.

4.2. Vibration

This study found that the A(8) value of WBV ($0.43 \pm 0.14\,m/s^2$) did not exceed either the EAV or ELV. However, thirty-eight (27.7%) out of one-hundred-thirty-seven respondents were exposed to more than EAV ($0.5\,m/s^2$), and the Z-axis ($0.53 \pm 0.16\,m/s^2$) had the highest magnitude compared to the other axes. This finding was supported by previous research in which the Z-axis magnitude (vertical direction) was the dominant direction of WBV among commercial motorcycle riders (Ndimila et al., 2013). The value of WBV exposed by the traffic police riders in this study ranged from 0.13 to $0.85\,m/s^2$. Chen et al. (2009) also found that motorcycle exposure of WBV was greater than that for 4-wheel vehicles since the WBV exposure among motorcycle riders was up to $1.11\,m/s^2$ whereas for taxi drivers it was only up to $0.55\,m/s^2$, and for highway transport track drivers it was up to $0.56\,m/s^2$ (Lin et al., 2012; Chen et al., 2003, 2009; Cann et al., 2004). This happens because motorcycle riders sit on a flat seat without back support, which absorbs energy, and the vertical vibrations become greater; thus, meaning that motorcycle riders are more prone to WMSDs compared to car drivers. Therefore, action should be taken by management to reduce the level of vibration to which the riders are exposed.

In this present study, the A(8) value of HAV ($2.25 \pm 1.21\,m/s^2$) did not exceed either the EAV or the ELV. This outcome was similar to the previous findings in Japan where the HAV value did not exceed the limit of EAV ($2.0 \pm 0.1\,m/s^2$) among traffic police riders (Mirbod et al., 1997). However, the A(8) value of HAV was up to $8.36\,m/s^2$ among respondents, which is considered very high exposure to vibration. Hewitt (2010) mentioned that the measurements of vibration were different from one another because they were not only influenced by the intensity of vibration, but also the hand-arm posture, the physical characteristics of the operator, and the grip and feed forces applied (Hewitt, 2010).

4.3. Risk factors

The multivariate binary logistic regression analysis showed that the riding duration in hours, years of service as a traffic police rider, and HAV in A(8) had a significant association with WMSDs, but that no non-occupational factors showed a significant association with WMSDs in the present study after the adjustment was done.

Riders who were riding more than 4 h per day had 1.75 times greater odds of WMSDs compared to those who were riding less than 4 h per day. The possible explanation could be that when the length of riding hours per day exceeds 4 h, the riders experience prolonged exposure to a static posture without lumbar support. This result is also supported by previous studies that found that the rate of muscle discomfort level increased over time among riders because of the absence of lumbar support when riding a motorcycle (Karmegam et al., 2012; Daraiseh et al., 2010; Joubert and London, 2007). The duration of work posture had a strong relationship with self-reported WMSDs based on Ariëns et al. (2010) who found that workers who were working 4 h or more per day had 1.4 times greater odds of reporting WMSDs compared to those working 2 h per day due to the static work posture and limited time for rest breaks (Ariëns et al., 2010). Adopting the same position during riding a motorcycle with limited movement for a prolonged period in one day can lead to muscle stiffness and reduced blood flow, which results in fatigue and discomfort among riders (Alias et al., 2016). In addition, the prolonged over-reached posture during riding can lead to the high prevalence of developing WMSDs among riders.

In the present study, it was also found that WMSDs were strongly associated with other factors, including years of service as a traffic police rider, in that less than five years reduced the level of risk of getting WMSDs by 0.152. Similar findings have been published in previous research that found that the years of service had a significant association with WMSDs (Aghilinejad et al., 2012; Borle et al., 2012; Irurhe et al., 2013; Mirmohammadi, 2012; Karwan et al., 2015). This might be because traffic police riders with only a few years of service did not have enough exposure and time for WMSDs to develop and act as a risk factors compared to those with a longer period of service. This finding was supported by Bedru (2016) who found that workers who had worked more than six years were 2.5 times more likely to get WMSDs compared to workers who had fewer years of service (Bedru, 2016). In addition, riders who spent lots of time riding a motorcycle had a higher tendency to develop WMSDs compared to people using other modes of transportation, especially among riders in the occupational sector.

The logistic regression also showed that the odds of reporting WMSDs among riders increased 3.053 for every 1 m-per-second-squared (m/s^2) increase in HAV A(8). This finding was aligned with a previous study that found that the HAV exposure A(8) was significantly associated with WMSDs with an odds ratio of 7.75 (Nasaruddin et al., 2014). The WMSDs among workers became worse, especially in the upper parts of the body in the presence of HAV (Bernard, 1997). Bhattacharya and McGlothlin (2012) stated that the presence of vibration on a handle may encourage the users to tighten their grip more than usual, which may lead to an increase in the transmission of vibration to the hand-arm, which can cause WMSDs in long term-exposure (Bhattacharya and McGlothlin, 2012).

4.4. Study limitation

Since this study is a cross-sectional study, it is almost impossible to fully account the risk factors and assessment of WMSDs in this study due to the budget and time constraints. The results were also limited to male riders only.

5. Conclusion

The present study showed that the duration of riding, and years of service as a traffic police rider were the most important risk factors for

WMSDs among traffic police riders. Hand-arm vibration exposure is also a contributing factor for increasing the risk of WMSDs. This study demonstrated that the risk factors of developing WMSDs do not rely on one factor alone. Besides, since this study showed the high prevalence in neck, shoulder and low back area, it is suggested to improve and analyse the design of helmet or provide lumbar support that suit and ergonomic for the riders. Hence, further study is needed to improve the safety and health of the police riders. It is also recommended for the employer of the traffic police riders to do further investigation based on the fact that the majority of the workers studied reported WMSDs symptoms in the past 12 months. This is because WMSDs are irreversible and there is no cure for this disease; hence, only a proactive approach is effective for tackling the problem of WMSDs among them.

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