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ORIGINAL ARTICLE

MUSCULOSKELETAL DISCOMFORT AND ITS ASSOCIATED RISK FACTORS AMONG TRAIN DRIVERS

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ABSTRACT

This study was conducted to determine the prevalence and associated risk factors of musculoskeletal disorders among train drivers in Kuala Lumpur. In this cross-sectional study, 44 train drivers were interviewed using a self-administered questionnaire consists of socio-demographic information and occupational exposure; and a modified Nordic Standardised Questionnaire for questions related to musculoskeletal discomfort symptoms. Results showed that lower back (18.6%) are the most reported discomfort among train drivers, followed by neck (16.7%), knee (13.7%), and upper back (13.7%). Statistical analysis using Chi-square showed there is a significant association between discomfort in the neck with age ($p<0.05$), length of service ($p<0.05$), and the perception of driver's seat comfort and suitability ($P<0.001$). Previous working experience, driving duration, and shift work were associated with shoulder, wrist and thigh discomfort. This study suggested that further investigation and early control measure need to be done to prevent the risk of the musculoskeletal problem among train drivers.

***Key words**: musculoskeletal disorders, occupational hazards, ergonomics, freight, cargo, locomotive, prevalence.*

INTRODUCTION

Musculoskeletal disorders (MSDs) cover a wide range of conditions that cause inflammation and degeneration of the musculoskeletal system such as carpal tunnel syndrome, osteoarthritis, and low back pain. In Malaysia, there is increasing numbers of reports and claims from musculoskeletal disorders caused by work activities[1]. Numerous studies have proven that driving is associated with MSDs among bus drivers[2,3,4,5,6], truck drivers[7,8], taxi drivers[9], lorry drivers[10] and forklift drivers[11]. Train drivers also are one of the work population that is at high risk of developing musculoskeletal disorders due to the nature of driving task and design of the cabin. Previous studies have identified prolonged sitting, vehicle vibration[12], working posture, duration of working hour[13], psychosocial job factors and physical workload[14] are associated with MSDs among drivers.

While there are studies conducted among train drivers for mental workload[15] and symptomatic knee osteoarthritis of railways worker[16], however, there are very few studies have been done to explore the ergonomics aspect of the train drivers in Malaysia despite the occupational hazards exposed to them every day at work. Therefore, this study was conducted to determine the prevalence of musculoskeletal discomfort among train drivers in Kuala Lumpur and its associated risk factors. Results obtained from this study may be useful in establishing control measure to prevent musculoskeletal problems as well as to improve safety and health aspects among train drivers.

METHODOLOGY

Study Design and Sampling

A cross-sectional study was conducted among train drivers to determine the prevalence and its associated risk factors. A stratified random sampling of train drivers at a railway company in Kuala Lumpur was chosen based on the type of train they drive. Short distance and long distance cargo train drivers were selected for this study because they were exposed to long driving duration, shift work, and poor workspace in the train's cabin.

This study was conducted using a self-administered questionnaire consists of three parts. The first part consists of socio-demographic information such as gender, age, race, height, weight, health status, smoking, and drinking habit. The second part is focusing on gathering information related to occupational exposure which then were classified

into employment history, work background, and workplace condition and work practice. Employment history includes information on the length of service, previous working experience, and part-time job. While, work background gathered information on working days per week, driving duration per day, driving duration per trip, total trip per day, hours of rest before the next trip and shift work. For workplace condition and work practice include questions on exercise before work, seat adjustability, driver's perception of seat comfort and suitability, vibration exposure and Personal Protective Equipment (PPE) usage. The third part is to obtained information related to musculoskeletal discomfort using a modified version of validated Standardised Nordic Questionnaire (SNQ)[17] and Extended Nordic Questionnaire (NMQ-E)[18].

The questionnaire was then tested in the pilot study for its consistency and reliability. A pilot study was done to a population with almost similar to the study population work background. The questionnaire was distributed to 25 bus drivers at Pekeliling Bus Station, Kuala Lumpur. Results of the pilot study showed a good reliability with Cronbach alpha value of 0.821.

Respondent work as a train driver, age at least 18 years old, and have worked at least one year at the current workplace are eligible to participate in this study. While respondents with musculoskeletal disorders history due to accident or other diseases condition will automatically exclude from this study. As the respondents were from different background and educational level, the face-to-face interview was conducted to obtained accurate information from the respondents and to ensure all questions are answered. Due to the train schedule, worker's work schedule and researcher's schedule and availability to access the workplace, the survey was conducted via convenient sampling. Five interview sessions have been allocated in a specific time and day at the train driver's office. For each session, around seven to ten drivers were interviewed making a total of 50 respondents interviewed. However, six of the respondents were excluded from the study because they did not meet the inclusion criteria of the study population making only 44 valid questionnaires were obtained.

Ethical Approval

Prior to participating in this study, respondents were brief on the purpose of the study conducted. Respondents are informed that participation in this study is based on voluntary basis and consent form must be signed prior to the interview session. All information obtained during the interview will not be disclosed and will only be used for study purpose only. This study was approved by the Universiti Kebangsaan Malaysia Research Ethics Committee (Approval No.: UKM 1.5.3.5/244/NN-006-2015).

Statistical Analysis

Data were analysed using IBM SPSS Statistics software version 20. Descriptive analyses were used to summarise the socio-demographic information, and occupational exposure. Chi-square analysis were performed to determine the association between socio-demographic, employment history, work background, and workplace condition and work practice risk factors for musculoskeletal discomfort. Prior to Chi-square analyses all of the continuous and nominal independent variables were classified into two categories. If any cases where Chi-square test assumption were violated, the Fischer exact test were performed.

RESULTS

Socio-demographic Information

A total of 44 respondents were interviewed during this study. All of the respondents were male, Malaysian, and aged between 22 to 57 years old with the mean age of 33 years old. Respondents were 88.6% are Malay and only 11.4% are Indian. Majority of the respondents are married (59.1%), smoking (56.8%), did not drink alcohol (95.5%), and graduated from secondary high school (56.1%). The mean BMI for the respondents are 25.6 with more than half of the respondents (56.8%) have BMI within the normal range, 27.3% are overweight and 15.9% are obese. Most of the respondents (84.1%) claimed that they are healthy and did not have any health problem.

Occupational Exposure

Employment History

The respondent's length of service varies from 2 years to 39 years, with the mean of 10.7 years. More than half (65.9%) of the respondents work less than 10 years and 34.1% has been working for more than 11 years. Ninety percent of the respondents did not have any previous working experience involving driving vehicle. Majority of the respondents also claimed that they did not do any part time job other than being a train driver (93.2%) and did not work in shift (77.3%).

Work Background

On average, respondents work for 5 days per week with 43.2% and 56.8% work up to 6 days per week. For the driving duration per day, respondents stated an average of 8 hours per day with most of the respondents (72.7%) drive at least 8 hours per day and only 27.3% drive more than 8 hours per day. Respondents also stated that the driving duration

per trip can be as short as 2 hours and up to 11 hours per trip with an average of 7 hours per trip. Mostly, respondents can only manage to drive one trip per day, and up to only two trips per day based on planned work schedule without any delayed or unexpected event. Respondents also mentioned that they were given at least nine to twelve hours of rest before begin driving for the next trip.

Workplace Condition and Work Practice

Respondents were asked about the suitability, comfort, and adjustability of the seat in the driver's cabin. Most of the respondents (70.5%) mentioned that the seat in the driver's cabin cannot be adjusted, while 29.5% said otherwise. Majority of the respondents (86.4%) also stated that the driver's seat is not comfortable and not suitable for the driving task. For the perception of vibration exposure during driving, almost all (97.7%) of the respondents interviewed claimed that they are exposed to vibration during driving. Respondents also were asked on healthy work practice, most of the respondents did not exercise before going to work (70.5%), and did not wear personal protective equipment (PPE) provided (61.4%) even though earplug was provided by the employer.

Musculoskeletal Discomfort

Respondents need to report on any discomfort or pain they had experienced for the past 12 months. Result shows that lower back is the most reported discomfort and pain among respondents with 18.6%, followed by neck (16.7%), knee and upper back with both 13.7%. Pain and discomfort reported on the thigh, shoulder, and leg were 11.3%, 9.8%, and 9.3% respectively. The least reported pain and discomfort are at the wrist and elbow with 3.4% both.

Risk Factors Associated with Musculoskeletal Discomfort

Result from Table 1 shows that age and marital status is the only socio-demographic factors that were significantly associated with neck pain. Other socio-demographic factors such as race, BMI, education status and smoking status are not significantly associated with musculoskeletal discomfort.

Table 1*: Association between socio-demographic risk factor and musculoskeletal discomfort among train drivers*

Risk factors	Musculoskeletal Discomfort/Pain								
	Low back	Neck	Knee	Upper back	Thigh	Shoulder	Leg	Wrist	Elbow
	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)
Age (year)	0.666[a]	0.031*	0.820	0.098	0.989	0.741	0.967	0.693	0.232[a]
<30	19(50)	21(61.8)	15((53.6)	12(42.9)	12(52.2)	11(55)	10(52.6)	3(42.9)	2(28.6)
≥30	19(50)	13(38.2)	13(46.4)	16(57.1)	11(47.8)	9(45)	9(47.4)	4(57.1)	5(71.4)
Race	0.130[a]	0.069[a]	0.999[a]	0.999[a]	0.176[a]	0.999[a]	0.370[a]	0.574[a]	0.574[a]
Malay	35(92.1)	32(94.1)	25(89.3)	25(89.3)	22(95.7)	18(90)	18(94.7)	7(100)	7(100)
Indian	3(7.9)	2(5.9)	3(10.7)	3(10.7%)	1(4.3)	2(10)	1(5.3)	0(0)	0(0)
BMI	0.999[a]	0.074	0.954	0.186	0.074	0.824	0.086	0.680[a]	0.680[a]
Normal (≤24.9)	22(57.9)	22(64.7)	16(57.1)	18(64.3)	16(69.6)	11(55)	8(42.1)	5(71.4)	5(71.4)
Over-weight (≥25.0)	16(42.1)	12(35.3)	12(42.9)	10(35.7)	7(30.4)	9(45)	11(57.9)	2(28.6)	2(28.6)
Marital status	0.208[a]	0.031*	0.325	0.354	0.329	0.911	0.632	0.682[a]	0.682[a]
Single	14(36.8)	17(50)	13(46.4)	10(35.7)	11(47.8)	8(40)	7(36.8)	2(28.6)	2(28.6)
Married	24(63.2)	17(50)	15(53.6)	18(64.3)	12(52.2)	12(60)	12(63.2)	5(71.4)	5(71.4)
Education	0.999[a]	0.701[a]	0.159	0.159	0.659	0.278	0.202	0.184[a]	0.662[a]
Secondary School	12(31.6)	10(29.4)	11(39.3)	11(39.3)	8(34.8)	8(40)	8(42.1)	4(57.1)	3(42.9)
High School	26(68.4)	24(70.6)	17(60.7)	17(60.7)	15(65.2)	12(60)	11(57.9)	3(42.9)	4(57.1)
Smoking status	0.684[a]	0.999[a]	0.954	0.227	0.515	0.405	0.459	0.443[a]	0.210[a]
Yes	21(55.3)	19(55.9)	16(57.1)	14(50)	12(52.2)	10(50)	12(63.2)	3(42.9)	2(28.6)
No	17(44.7)	15(44.1)	12(42.9)	14(50)	11(47.8)	10(50)	7(36.8)	4(57.1)	5(71.4)

*significant at p<0.05

a Fischer Exact Test

For the employment history (Table 2), length of service showed an association with neck pain and discomfort with the prevalence were higher among respondents working 10 years and below. Previous working experience involving driving vehicles shows a significant association with pain and discomfort at the shoulder. Part-time job shows no association with any of the musculoskeletal discomfort.

Table 2: ***Association between employment history and musculoskeletal discomfort among train drivers***

Risk factors	Musculoskeletal Discomfort/Pain								
	Low back	Neck	Knee	Upper back	Thigh	Shoulder	Leg	Wrist	Elbow
	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)
Length of services (years)	0.999[a]	0.019*	0.336	0.105	0.999[a]	0.450	0.737	0.675[a]	0.207[a]
≤10 years	25(65.8)	26(76.5)	17(60.7)	16(57.1)	15(65.2)	12(60)	12(63.2)	4(57.1)	3(42.9)
≥11 years	13(34.2)	8(23.5)	11(39.3)	12(42.9)	8(34.8)	8(40)	7(36.8)	3(42.9)	4(57.1)
Previous working experience involving driving vehicle	0.999[a]	0.559[a]	0.999[a]	0.999[a]	0.609[a]	0.036*	0.300[a]	0.513[a]	0.513[a]
Yes	4(10.5)	4(11.8)	3(10.7)	3(10.7)	3(13)	4(20)	3(15.8)	1(14.3)	1(14.3)
No	34(89.5)	30(88.2)	25(89.3)	25(89.3)	20(87)	16(80)	16(84.2)	6(85.7)	6(85.7)
Part-time job	0.999[a]	0.548[a]	0.999[a]	0.543	0.100[a]	0.239[a]	0.999[a]	0.999[a]	0.999[a]
Yes	3(7.9)	2(5.9)	2(7.1)	1(3.6)	0(0)	0(0)	1(5.3)	0(0)	0(0)
No	35(92.1)	32(94.1)	26(92.9)	27(96.4)	23(100)	20(100)	18(94.7)	7(100)	7(100)

*significant at p<0.05

a Fischer Exact Test

Driving duration of more than 9 hours per day is significantly associated with pain and discomfort at the wrist. Shift work also were found to be associated with thigh pain and discomfort. However, working days per week and driving duration per trip were not associated with musculoskeletal discomfort (Table 3). Table 4 showed the result of workplace condition and work practice with musculoskeletal discomfort. Of all the variables examined, only seat comfort and suitability showed a significant association with neck pain and discomfort.

Table 3: ***Association between work background and musculoskeletal discomfort among train drivers***

Risk factors	Musculoskeletal Discomfort/Pain								
	Low back	Neck	Knee	Upper back	Thigh	Shoulder	Leg	Wrist	Elbow
	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)
Working days per week (days)	0.999[a]	0.287[a]	0.490	0.490	0.570	0.317	0.459	0.119[a]	0.680[a]
≤ 5	16(42.1)	13(38.2)	11(39.3)	11(39.3)	9(39.1)	7(35)	7(36.8)	1(14.3)	2(28.6)
≥ 6	22(57.9)	21(61.8)	17(60.7)	17(60.7)	14(60.9)	13(65)	12(63.2)	6(85.7)	5(71.4)
Driving duration per day (hours)	0.586[a]	0.659[a]	0.450[a]	0.450[a]	0.462[a]	0.710[a]	0.467[a]	0.024*	0.138[a]
≤ 8	31(81.6)	26(76.5)	21(75)	21(75)	17(73.9)	15(75)	14(73.7)	3(42.9)	4(57.1)
≥ 9	7(18.4)	8(23.5)	7(25)	7(25)	6(26.1)	5(25)	5(26.3)	4(57.1)	3(42.9)
Driving duration per trip (hours)	0.375[a]	0.716[a]	0.354	0.325	0.139	0.083	0.168	0.103[a]	0.103[a]
≤ 7	21(55.3)	21(61.8)	18(64.3)	15(53.6)	16(69.6)	9(45)	9(47.4)	2(28.6)	2(28.6)
≥ 8	17(44.7)	13(38.2)	10(35.7)	13(46.4)	7(30.4)	11(55)	10(52.6)	5(71.4)	5(71.4)
Shift work	0.999[a]	0.999[a]	0.999[a]	0.133[a]	0.031*	0.999[a]	0.723[a]	0.999[a]	0.999[a]
Yes	9(23.7)	8(23.5)	6(21.4)	4(14.3)	2(8.7)	5(25)	5(26.3)	1(14.3)	1(14.3)
No	29(76.3)	26(76.5)	22(78.6)	24(85.7)	21(91.3)	15(75)	14(73.7)	6(85.7)	6(85.7)

*significant at p<0.05

a Fischer Exact Test

Table 4: ***Association between workplace condition and work practise with musculoskeletal discomfort among train drivers***

Risk factors	Musculoskeletal Discomfort/Pain								
	Low back	Neck	Knee	Upper back	Thigh	Shoulder	Leg	Wrist	Elbow
	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)	p value n(%)
Seat adjustability	0.999[a]	0.449[a]	0.999[a]	0.999[a]	0.064	0.546	0.682	0.654[a]	0.654[a]
Yes	11(28.9)	9(26.5)	8(28.6)	8(28.6)	4(17.4)	5(25)	5(26.3)	1(14.3)	1(14.3)
No	27(71.1)	25(73.5)	20(71.4)	20(71.4)	19(82.6)	15*75)	14(73.7)	6(85.7)	6(85.7)
Seat comfort and suitability	0.182[a]	0.001**	0.169[a]	0.999[a]	0.088[a]	0.198[a]	0.213[a]	0.568[a]	0.568[a]
Yes	4(10.5)	1(16.7)	2(7.1)	4(14.3)	1(4.3)	1(5)	1(5.3)	0(0)	0(0)
No	34(89.5)	33(97.1)	26(92.9)	24(85.7)	22(95.7)	19(95)	18(94.7)	7(100)	7(100)
Vibration exposure during driving	0.999[a]	0.999[a]	0.364[a]	0.364[a]	0.999[a]	0.999[a]	0.999[a]	0.999[a]	0.999[a]
Yes	37(97.4)	33(97.1)	28(100)	28(100)	22(95.7)	20(100)	19(100)	7(100)	7(100)
No	1(2.6)	1(2.9)	0(0)	0(0)	1(4.3)	0(0)	0(0)	0(0)	0(0)
Exercise before work	0.339[a]	0.697[a]	0.999[a]	0.999[a]	0.599	0.546	0.355	0.654[a]	0.654[a]
Yes	10(26.3)	11(32.4)	8(28.6)	8(28.6)	6(26.1)	5(25)	7(36.8)	1(14.3)	1(14.3)
No	28(73.7)	23(67.6)	20(71.4)	20(71.4)	17(73.9)	15(75)	12(63.2)	6(85.7)	6(85.7)
Wearing personal protection equipment (PPE)	0.662[a]	0.999[a]	0.598	0.242	0.944	0.999[a]	0.680	0.999[a]	0.689[a]
Yes	14(36.8)	13(38.2)	10(35.7)	9*32.1)	9(39.1)	8(40)	8(42.1)	3(42.9)	2(28.6)
No	24(63.2)	21(61.8)	18(64.3)	19(67.9)	14(60.9)	12(60)	11(57.9)	4(57.1)	5(71.4)

** significant at p<0.001

a Fischer Exact Test

DISCUSSION

This study found that lower back pain is the most reported musculoskeletal symptom among train drivers. Study finding is similar to a study among commercial bus drivers[3], university bus drivers[2,5], minibus drivers[4] and truck drivers[7] where these studies found that lower back is the most reported pain by drivers. Similar trends of reported musculoskeletal disorders were also found in another study among drivers where neck is the second highest reported musculoskeletal discomfort[3,4,5]. The higher prevalence of discomfort at the lower back and neck among train drivers might be due to poor design of the driver's seat[3,5] and the cabin design which lead to awkward driving posture. Although some of the train's seat can be adjusted, some of the train's cabins observed have limited seat adjustment leading to an uncomfortable working posture. The poor placement between driver's seat and the control panel including the gear making the driver to adopt flexed and adducted arm, and sometimes extended reach of the arm when handling the train. Some of the train side rear view mirror is not sufficient for the driver to observe the railway track in reverse direction making them to adopt awkward posture by bending and rotating their body over the window to observe the track. The high prevalence of musculoskeletal discomfort also contributes by the driving task itself which is monotonous and static. Train drivers are required to stay alert and focus on the journey to observed any obstacles or unexpected event on the railway track. Prolonged sitting during driving may lead to tension and stiffness in the neck and lumbar region and cause discomfort and pain in the region [4,10,19]. Train drivers also may occasionally apply excessive grip on steering and control panel inside the cabin while driving the train. However, train drivers adopt less repetitive movement of the hand compared to other vehicles drivers such as bus, truck, and taxi during driving. This explains why the wrist and elbow show

less discomfort compared to other body part among train drivers.

A study among taxi drivers in Ankara[19] and truck drivers in Iran[7] showed that increasing age and years of driving are related to musculoskeletal problem. Another study at a railway company showed that neck complains occur more often among workers within 46 – 55 years old[20]. Surprisingly, this study showed opposite findings with neck pain were associated with younger workers age below 30. The opposite findings might be contributed by the excessive use of technology gadget such as smartphone among teenagers and young adult as supported by a study conducted by the British Chiropractic Association[21].

Even though some studies have not found the association between marital status and the occurrence of low back pain[3,22]. This study found that marital status is significantly associated with neck discomfort and pain among train drivers. The findings are similar to the findings among male kitchen workers in India[23], military service workers in USA[24] and in the National Health Survey among Iranian population[25]. Married women have increased risk of developing musculoskeletal disorders due to households work at home. However, it is still unclear on the effect of marital status on the occurrence of low back pain taking into consideration of better economic and psychosocial support among married individuals[24].

Increasing length of service is associated with the occurrence of neck discomfort and pain among train drivers. Static posture during driving may contribute to the stiffness at the neck when drivers have to stay alert and focus during driving. Increasing risk of developing musculoskeletal disorders with increasing length of service also were found in a study among taxi drivers[19], lorry drivers[10], manual handling workers[26], and male kitchen worker[23]. Musculoskeletal disorders tend to occur among workers working more than 5 years due to cumulative exposure to the workload, health status, and aging process[26,23]. However, this study showed that respondents work less than 10 years, and also respondents without working experience involving driving vehicles are prone to shoulder pain and discomfort compared to respondents with previous working experience. Respondents with previous working experience with driving vehicles may have the advantage of optimising their driving skills, knowledge, and technique making them less prone to musculoskeletal discomfort. Besides that, workers with less driving experience usually are younger than experienced workers. As mentioned earlier, the attachment to technology gadget and modern lifestyle among young workers may contribute to the high occurrence of musculoskeletal discomfort among workers working less than 10 years.

Driving duration were found to be associated with pain and discomfort at the wrist similar to the findings among lorry drivers[10] and bus drivers[3]. The discomfort at the wrist may be due to the excessive grip on steering or excessive force on the wrist when handling the control panel inside the train cabin. However, this study findings were contradicting with other study for working days per week and driving duration per trip. This may be due to different working days duration and driving trip duration among workers with some of the respondents has shorter working days and shorter driving trip.

Shift work is associated with thigh discomfort and pain. There is still uncertainty on the effect mechanism of shift work on the occurrence of musculoskeletal disorders[27]. However, a study among nurses to determine the effect of shift work can be concluded that the occurrence of low back pain increased due to stress on shift work itself and also working on weekend[27].

Findings from a study conducted among commercial drivers in Malaysia showed that seat characteristics contribute to the occurrence of musculoskeletal disorders among drivers[3]. In this study, seat adjustability was not associated with any musculoskeletal discomfort. However, seat comfort and suitability were found to be associated with neck discomfort and pain among respondents who claimed that the seat is not comfortable and not suitable for driving. The design of the driver's seat in some of the train which do not have head support may contribute to this finding. Another study also found that poorly designed of driver's seat and working area contribute to the occurrence of musculoskeletal disorders among drivers[3,5,28].

Numerous studies[3,12] have found the significant association between driving, whole body vibration and musculoskeletal disorders. Even though majority of the respondents claimed that they are exposed to vibration, there is no significant association between perception of vibration exposure and musculoskeletal discomfort. Perception of vibration in this study cannot be used as a determinant in making conclusion on exposure and effect of vibration due to the non-existence of proper and validated assessment and measurement on vibration exposure among train drivers.

CONCLUSION

The higher prevalence of musculoskeletal discomfort at the lower back, neck, knee and upper back showed that train drivers are exposed to ergonomics risk factors due to work exposure. The length of service, driving duration, shift work and the perception of seat comfort and suitability showed significant association with musculoskeletal discomfort. The result of this study highlighted the need for preventive and control measure to prevent the risk of developing musculoskeletal disorders among train drivers. This study emphasizes on the occurrence of musculoskeletal disorders among train based on the observational study. A more comprehensive study using a different study design to determine the cause and effect of the risk factors among train drivers need to be conducted including study on posture and the effect of vibration on musculoskeletal disorders. Other occupational factors such as environmental and psychosocial factors also can be included to better understand the interaction of driving condition of train drivers and the occurrence of musculoskeletal disorders among train drivers.

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