

Correlations between Physical Activity, Work Duration, and Stress on the Risk of Musculoskeletal Disorders in Online Motorcycle Drivers in Surakarta

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ABSTRACT

Background: Motorcycle taxi drivers drive motorcycles with a static posture and there are significant deviations in angles of certain body joints that trigger susceptibility to movement system injuries, namely musculoskeletal disorders (MSDs). The study aimed to analyze the correlation between the determinants of MSDs, namely physical activity, work duration, and stress on the risk of MSDs incidents in online motorcycle taxi drivers in Surakarta.

Subjects and Method: This observational analytical study with a cross-sectional study approach. A sample of 250 online motorcycle taxi drivers in Surakarta was selected using a cluster random sampling technique. The dependent variable of the study was MSDs. The independent variables of the study were physical activity, duration of work, and stress. The data collection technique was conducted through interviews by using questionnaire sheets with instruments i.e. International Physical Activity Questionnaire (IPAQ), Work Stress Scale (WSS), and Nordic Body Map (NBP). Data analysis was carried out using a multivariate STATA application with multiple binary logistic regression.

Results: The risk of MSDs in online motorcycle taxi drivers in Surakarta increased with the age of older than or equal to 34 years (OR= 2.66; CI 95%= 1.54 to 4.59; p= <0.001), BMI of more than 25 (OR= 1.33; CI 95%= 0.77 to 2.27; p= 0.303), work duration of more than 4 hours per day (OR= 2.43; CI 95%= 1.24 to 4.78; p= 0.010), high stress level (OR= 1.58; CI 95%= 0.89 to 2.83; p = 0.126), and status as an active smoker (OR= 1.27; CI 95%= 0.74 to 2.19; p= 0.378). The risk of MSDs in online motorcycle taxi drivers in Surakarta decreased with active physical activity (OR= 0.36; CI 95%= 0.15 to 0.86; p = 0.021). Age, BMI, physical activity, work duration, stress, and smoking status influenced the risk of MSDs by 8.2%, and the rest were influenced by other determinants.

Conclusion: There is a statistically significant correlation between age, physical activity, and duration of work on the risk of MSDs, however, there was no significant correlation between BMI, stress, and smoking status on the risk of MSDs.

Keywords: Physical activity, stress, musculoskeletal disorders, motorcycle taxi drivers

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BACKGROUND

Musculoskeletal disorders (MSDs) or musculoskeletal disorders are disorders that refer to the locomotor system, including those occurring in muscles, tendons, cartilage, and/or joints. MSDs are most commonly characterized by pain or tenderness and mobility limitations that occur over a short to long period, and are relevant from childhood to old age (Tami et al., 2021). According to WHO, the condition of MSDs leads to limited personal ability to participate socially, reduced levels of well-being, decreased ability and work capacity or even results in early retirement (WHO, 2022).

Data from the Global Burden of Disease (GBD) in 2019, there are around 1.71 billion people in the world living with musculoskeletal problems, with varied prevalence based on age and diagnosis. High-income countries are revealed to be the most affected with 441 million people, followed by countries in the Western Pacific Region with 427 million people, and the Southeast Asia Region with 369 million people. According to WHO, MSDs are cited as the largest contributor to years lived with disability (YLDs) worldwide with about 149 million cases (17%) of the total cases (WHO, 2022).

According to the Centers for Diseases Control and Prevention (CDC), work environment and job performance can trigger MSDs, called work-related musculoskeletal disorder (WMSDs) (CDC, 2020). The National Institute for Occupational Safety and Health (NIOSH), mentions that workplace conditions that contribute to MSDs are physical and psychological stress. Physical stress consists of strength or load factors, repetition, and work postures and work tools. Psychosocial stress consists of work organization factors, factors outside the workplace, and workers' factors (Roquelaure, 2018).

Vehicle drivers are one of the jobs at risk of experiencing MSDs. Motorcycle taxi drivers who work by riding motorcycles carrying passengers who are exposed to static posture for a long period with significant deviations in angles of certain body joints will become susceptible to MSDs. The factors triggering the occurrence of musculoskeletal disorders in motorcycle drivers are classified according to non-occupational factors and occupational factors. The non-occupational factors consist of age, gender, body mass index, marital status, status, education level, and smoking. Occupational factors include working period, duration of work, and working posture. Vibration is also a trigger factor for MSDs in motorcycle drivers, although transmitted vibrations are still within the limits recommended by the Occupational Safety and Health Administration (OSHA) (Diyana et al., 2019).

Berrones-Sanz (2017) study the health condition of motorcycle taxi drivers in Mexico, it was found that the majority of MSDs occur in the neck, shoulders, lower back, and elbow areas. Muscle fatigue can be triggered by heavy traffic conditions, bumpy roads, forward-leaning and perpendicular posture. Other findings state that riding comfort will decrease if the riding duration is above 10 minutes and will become saturated after 30 minutes (Arunachalam et al., 2021). In addition, the impact on health of motorcycle drivers is also associated with stress (Anoop dan Binoosh, 2019).

Motorcycle taxi drivers who work with a static sitting body position or do not move much can be at risk of MSDs, if physical activity is insufficient and occurs prolonged, Physical activity as one of the steps of prevention both primary and secondary against non-communicable diseases has been studied previously (Petermann-Rocha et al., 2019; Andriani and Sudaryanto, 2022). Physical activity carried out regularly

and measurably is stated to help increase work productivity and quality of human life regardless of certain age groups (Grabara et al., 2018). In addition, physical activity has also been proven to suppress and prevent the incidence of MSDs in all age groups (Nawrocka et al., 2019).

An observation made by Rashid et al. (2021), through an indoor motorcycle riding simulation that was recorded and visually monitored, it was discovered that riders were likely to conduct some body stretching movements after 1 hour and 30 minutes of riding. After the simulation session, some respondents who worked as motorcycle taxi drivers complained of discomfort in the neck, shoulders, wrists, and/or back (Rashid et al., 2021). In other words, motorcycle taxi drivers are close to the risk of MSDs.

Online motorcycle taxi driver is an informal job with an uncertain amount of income that will lead to stress. Stress can trigger the release of epinephrine and norepinephrine, which results in changes in epinephrine and abnormal heart rate, as well as affecting muscle performance (Li et al., 2021). Continuous psychological stress and burden have been scientifically proven to have a direct impact on the occurrence of MSDs and also decreased work performance (Fortes et al., 2020).

The number of motorcycle taxi drivers in Indonesia has increased in recent years. This is triggered by the improvement of information technology that presents application-based motorcycle taxi services through platforms that can be accessed in the network commonly called online motorcycle taxis. This new transportation service provides mobility options that are considered quite important for people living in developing countries (Nguyen-Phuoc et al., 2020). Motorcycle riders have a high risk of MSDs, where the occurrence of MSDs can affect work productivity and service quality

(Berrones-Sanz, 2017). In that sense, researchers intend to survey to determine the prevalence of MSDs complaints in online motorcycle taxi drivers based on body regions and analyze how the correlation between physical activity, work duration, and stress toward the incidences. In general, the study aims to analyze the correlation between the determinants of MSDs to the incidence of MSDs in online motorcycle taxi drivers.

SUBJECTS AND METHOD

1. Study Design

This study observed the effects of exposure toward the results through observational analytical study with a cross sectional study approach. The study was conducted in Surakarta City which consisted of five sub-districts, namely Pasar Kliwon, Jebres, Banjarsari, Laweyan and Serengan. Data collection was conducted from October to November 2023.

2. Population and Sample

The generalization of area to be studied, referred to as the population, namely online motorcycle taxi drivers in Surakarta with a total of 3,500 people. According to the rule of thumb the number of samples is 5 to 10 times the number of items. The sample in this study was determined using the cluster random sampling technique. The sample of this study consisted of 250 respondents.

The inclusion criteria that the subject should meet to become a sample, namely the main job was only as an online motorcycle taxi driver, with 1 year of working period at the minimum, resided and operated in Surakarta, male, and willing to contribute to the implementation of the study by agreeing to informed consent.

Exclusion criteria that make subjects unable to contribute as samples, namely online motorcycle taxi drivers who only provided food or goods delivery services and

with a history of comorbidities, such as hypertension, and congenital physical disabilities or due to injury.

3. Study Variables

The independent variables of this study consisted of physical activity, work duration, and stress. The dependent variable of this study was musculoskeletal disorders.

4. Conceptual Definition

Physical activity: active body movements with a specific purpose in a certain frequency and duration which are performed daily.

Work duration: the amount of time need by a person to complete his job duties each day.

Stress: the emotional mental or psychological state that a person feels in dealing with pressure in the work environment.

Musculoskeletal disorders: a condition of a collection of complaints in the form of pain, weakness, and/or stiffness in muscle organs and surrounding connective tissue in certain body regions that occur as a result of activities during work.

5. Study Instruments

The International Physical Activity Questionnaire (IPAQ) is a measure of physical activity levels in adult individuals. The results of validity tests that have been conducted by previous researchers stated that IPAQ is better for measuring physical activity levels ($r= 0.56$; $p= 0.010$) (Meh et al., 2021).

The duration of work in this study was measured using questionnaires and categorized according to theoretical studies and related research. The classification is less than or equal to 4 hours per day and more than 4 hours per day. Work Stress Scale (WSS), is an instrument developed by the researchers themselves to measure stress levels in app-based workers who directly interact with consumers. WSS was applied with an interview method consisting of 7 items of questions about the feelings and

thoughts of the sample during the past week. Each question is scored on a Linkert scale, with point 0 for "no" answers, point 1 for "occasionally" answers, and point 2 for "yes" answers. This instrument has been tested statistically and declared valid with the calculated r value greater than the r table value for a sample number of 30 people, which was 0.36. In addition, this instrument has also been declared reliable with an alpha Cronbach value of 0.89.

Nordic Body Map (NBM), a questionnaire developed by Kuorinka et al., in 1987 with funding from the Nordic Council Ministers to measure musculoskeletal disorders. This ergonomics checklist questionnaire is applied to identify complaints of discomfort in the muscles of workers (Agustin et al., 2021). This instrument was applied through interviews. The validity test result of the Indonesian version of the NBM instrument was declared valid and reliable with an alpha Cronbach of 0.92 (Dewi et al., 2023).

6. Data Analysis

The data in this study were processed by analysis consisting of univariate analysis, bivariate analysis with chi square test, and multivariate analysis with multiple binary logistic regression.

7. Research Ethics

The study has obtained ethical clearance from the Health Research Ethics Committee of Dr. Moewardi Surakarta Hospital number 1.793/X/HREC/2023.

RESULTS

Data in this study were collected through interview method using questionnaires. The respondents of this study were 250 online motorcycle taxi drivers in Surakarta City.

1. Identify the Prevalence of MSDs

The prevalence of MSDs according to body regions based on the number of cases from the highest, namely 69 cases in the lower

back (25.7%), 34 cases in the neck (12.6%), 27 cases in the buttocks (10.0%), 25 cases in the right hand (9.3%), 24 cases in the shoulder (8.9%), 19 cases in the right wrist (7.0%), 16 cases in the left wrist (5.9%), 14

cases in the left hand (5.2%), 12 cases in the right shoulder (4.4%), 10 cases in the left shoulder (3.7%), 8 cases in the groin (2.9%), 7 cases in the upper back (2.6%), and 3 cases in the right elbow (1.1%).

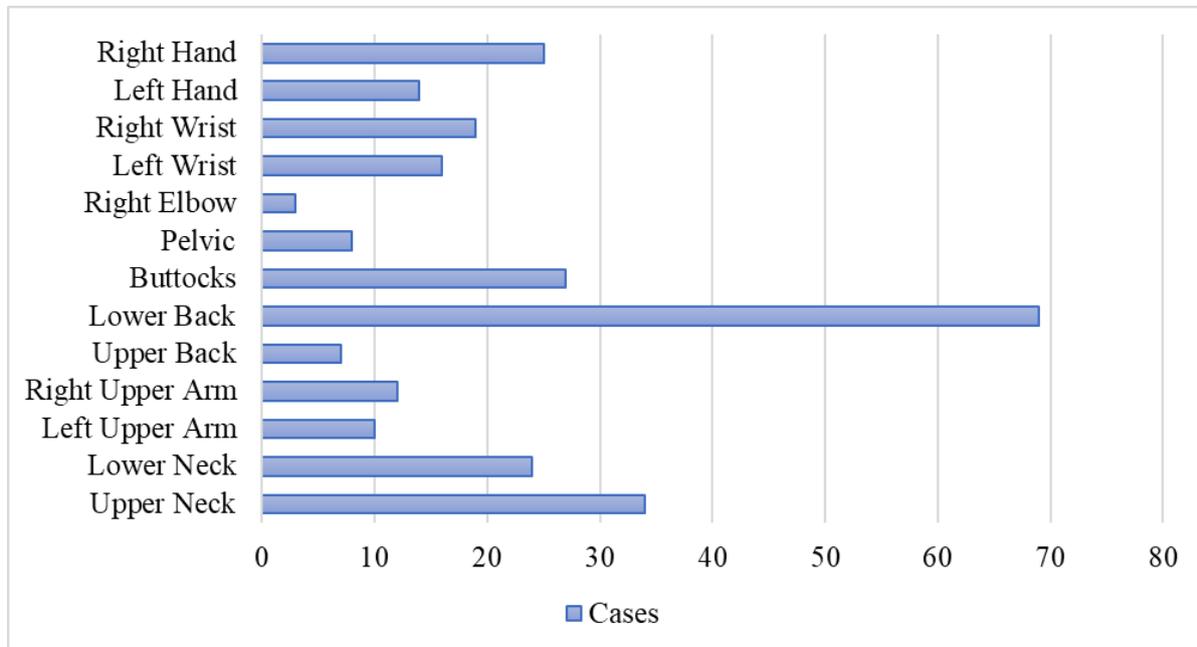


Figure 1. Prevalence of MSDs based on body region

2. Univariate Analysis

The categorical data show the characteristics of this study data listed in Table 1 for dichotomous data and Table 2 for continuous data. Based on Table 1 and Table 2 the majority of subjects had high school education of 80.8% with an average age of 35.82 years, an average BMI of 24.73, and 70.4% of

active smoker subjects. According to their work, the majority work through the GOJEK platform at 55.2%, with an average working period of 3.92 years, an average work duration of 5.93 hours per day, 70.4% of subjects accompanied by work-related stress, and 48.80% of subjects with complaints of MSDs.

Table 1. Characteristics of the study subject with continuous data

Item	Mean	SD	Min	Max
Age	35.82	9.65	21	60
Body Mass Index	24.73	5.29	13	38
Working Period	3.92	1.69	1	10
Work Duration	5.92	1.73	3	10
Stress	3.22	2.94	0	11
MSDs	29.77	2.71	28	40

Table 2. Characteristics of study subjects with dichotomous data

Characteristic	Category	Frequency (n)	Percentage (%)	Mean	SD
Age	<34	122	48.8	0.51	0.50
	≥34	128	51.2		

Characteristic	Category	Frequency (n)	Percentage (%)	Mean	SD
Body Mass Index	<25	130	52.0	0.48	0.50
	≥25	120	48.0		
Level of Education	Primary School	2	0.8	2.08	0.46
	Secondary School	10	4.0		
	High School	202	80.8		
	Higher Education	36	14.4		
Work Platform	GOJEK	138	55.2	0.56	0.69
	GRAB	83	33.2		
	MAXIM	29	11.6		
Working Period	<4 years	97	38.8	0.61	0.49
	≥4 years	153	61.2		
Physical Activity	Less Active	220	88.0	0.12	0.33
	Active	30	12.0		
Work Duration	≤4 hours/day	52	20.8	0.79	0.40
	>4 hours/day	198	79.2		
Stress	No	74	29.6	0.70	0.46
	Yes	176	70.4		
Smoking Status	No	99	39.6	0.60	0.49
	Yes	151	60.4		
MSDs	No	128	51.2	0.49	0.50
	Yes	122	48.8		

3. Bivariate Analysis

Bivariate analysis used to examine the effect between each independent variable on the dependent variable was performed with a statistical chi-square test. Table 3 presents the results of the chi-square test analysis of factors related to the risk of MSDs in online motorcycle taxi drivers in Surakarta. The results of the hypothesis test in Table 3

showed that there was a statistically significant correlation between age (OR= 11.74; $p= 0.001$), physical activity (OR= 4.82; $p= 0.028$), and duration of work (OR= 5.29; $p= 0.021$) to the risk of MSDs, however for BMI correlation it was statistically insignificant (OR= 1.89; $p= 0.168$), stress (OR= 2.01; $p= 0.157$), and smoking (OR= 0.36; $p= 0.550$).

Table 3. Results of the bivariate chi-square test of correlation between factors associated with the risk of MSDs.

Independent Variables	Risk of MSDs				OR	p
	No MSDs		MSDs			
	N	%	N	%		
Age						
<34	76	30.40	52	20.80	11.74	0.001
≥34	46	18.40	76	30.40		
BMI						
<25	72	28.80	56	22.40	1.89	0.168
≥25	58	23.20	64	25.60		
Physical Activity						
Less Active	107	42.80	113	45.20	4.82	0.028
Active	21	8.40	9	3.60		
Work Duration						
≤4 hours/day	34	13.60	18	7.20	5.29	0.021

Independent Variables	Risk of MSDs				OR	p
	No MSDs		MSDs			
	N	%	N	%		
>4 hours/day	94	37.60	104	41.60		
Stress						
No	43	17.20	31	12.40	2.01	0.157
Yes	85	34.00	91	36.40		
Smoking						
No	43	17.20	31	12.40	0.36	0.550
Yes	85	34.00	91	36.40		

4. Multivariate Analysis

Multivariate analysis was used to examine the effect of independent variables on the dependent variable simultaneously which in this study was carried out with multiple binary logistic regression statistics. Table 4 presents the results of multiple logistic regression analyses of factors associated with the risk of MSDs. The results show that there was a correlation between age and the risk of MSDs and the correlation was statistically significant. Online motorcycle taxi drivers older than 34 years had a 2.66 times risk of MSDs compared to those younger than 34 years (aOR= 2.66; CI 95%= 1.54 to 4.59; $p < 0.001$).

The results showed that there was a correlation between BMI and the risk of MSDs, however, the correlation was statistically insignificant. Online motorcycle taxi drivers with a BMI of more than 25 had a 1.33 times risk of MSDs compared to those with less than 25 (aOR= 1.33; CI 95%= 0.77 to 2.27; $p = 0.303$). The results showed that there was a correlation between physical activity and the risk of MSDs and the correlation was statistically significant. Online motorcycle taxi drivers with active physical activity were able to reduce the risk of MSDs 0.36 times compared to those with less active physical activity (aOR= 0.36; CI 95%= 0.15 to 0.86; $p = 0.021$).

The results of the hypothesis test show that there was a correlation between work duration, and the risk of MSDs, and the correlation was statistically significant. Online motorcycle taxi drivers with a work duration of more than 4 hours per day had 2.43 times the risk of MSDs compared to those with a work duration of less than 4 hours per day (aOR= 2.43; CI 95%= 1.24 to 4.78; $p = 0.010$). Table 4, showed that there was a correlation between stress and the risk of MSDs, however, the correlation was statistically insignificant. Online motorcycle taxi drivers with high stress levels had a 1.58 times risk of MSDs compared to those with low stress levels (aOR= 1.58; CI 95%= 0.89 to 2.83; $p = 0.126$).

The results test showed that there was a correlation between smoking status and the risk of MSDs, however, the correlation was statistically insignificant. The online motorcycle taxi drivers who smoked had 1.27 times the risk of MSDs compared to nonsmokers (aOR= 1.27; CI 95%= 0.74 to 2.19; $p = 0.378$). The results of the coefficient of determination test obtained a Nagelkerke R^2 value of 0.082, meaning that age, BMI, physical activity, work duration, stress, and smoking status affected the risk of MSDs by 8.2%, and the rest were affected by other determinants

Table 4. Results of multivariate multiple binary logistic regression test of correlation between factors associated with risk of MSDs.

MSDs	aOR	Standard Error	CI 95%		p
			Lower limit	Upper limit	
Age	2.66	0.74	1.54	4.58	<0.001
BMI	1.33	0.34	0.77	2.23	0.303
Physical Activity	0.36	0.16	0.15	0.86	0.021
Durasi Kerja	2.43	0.83	1.23	4.78	0.010
Stres	1.58	0.47	0.88	2.82	0.126
Status Merokok	1.28	0.35	0.74	2.19	0.378
Constant	0.17	0.08	0.07	0.45	<0.001
Nagelkerke R ² = 8.2%					
Log likelihood= -159.02					

DISCUSSION

1. MSDs Prevalence

The overall prevalence of MSDs from a total of 250 motorcycle taxi drivers was 48.8% of them had complaints of MSDs and the remaining 51.2% did not have complaints of MSDs. According to the regional classification of the body, there were 268 cases of MSDs with the highest order of cases, namely 25.7% cases in the lower back, 12.6% cases in the neck, and 10.0% cases in the buttocks.

This study is in line with a previous study conducted by Tchounga et al. (2022), which concludes that the overall prevalence of MSDs in taxi drivers is 86.8%. The most commonly affected body region is the lower back with 72.8% of cases, followed by the neck with 42.4% of cases, and the knee with 29.1% (Tchounga et al., 2022). In a study conducted by Joseph et al. (2020), in a meta-analysis review reporting the prevalence of MSDs in professional drivers, it discovered that the neck area ranks second after the lower back with 42.4% cases

In professional drivers, the back region will be the main part affected as a result of vehicle vibration risk factors. In addition, it can also be caused by other risk factors in the form of a sedentary lifestyle. WMSDs complaints arise as a result of the accumulation of chronic exposure that occurs from year to year in the work environment

(Tchounga et al., 2022). There is a correlation between injury risk factors and a high-risk work environment with head-forward posture (Romadhoni et al., 2021).

Berrones-Sanz (2017) study the health of motorcycle taxi drivers and stated that muscle fatigue occurs as a result of body posture while driving, heavy traffic conditions, and bumpy roads. This condition indicates a clinical need to investigate the biomechanics and motor control mechanisms of the body among professional drivers. Currently, there is no empirical evidence on the pathogenesis of musculoskeletal problems among professional drivers (Joseph et al., 2020).

2. Correlation of Age with Risk of MSDs

The results of this study showed that the risk of MSDs in online motorcycle taxi drivers in Surakarta increased with age greater than or equal to 34 years (aOR= 2.66; CI 95%= 1.54 to 4.59; p= <0.001). This finding is similar to the results of a study conducted by Li et al. (2021), that age is associated with the risk of WMSDs, and statistically, the correlation is significant ($\chi^2= 96.46$; p<0.001). Workers under the age of 30 are more at risk of developing MSDs than those over the age of 30 years (Li et al., 2021). Other studies by Araújo et al. (2021), stated that there is a correlation between age and the risk of

WMSDs, but statistically stated not significant (OR= 1.03; CI 95%= 0.63 to 1.70; p= 0.820). Motorcycle drivers over the age of 35 are more at risk of developing MSDs (Araújo et al., 2021).

The prevalence of MSDs increases with age. In general, at a young age, a person's physical condition is in good shape for the possibility of fighting diseases and the ability to speed up the healing process. On the other hand, with age there is an increase in the intensity of the workload that accumulates gradually over time will result in MSDs (Li et al., 2021). Age-related degenerative processes are considered to be a factor that also contributes to the incidence of MSDs. This condition occurs because in the elderly, physiologically there will be a decrease in functional capacity (AlOmar, 2021).

3. Correlation of BMI with Risk of MSDs

The results of this study showed that the risk of MSDs in online motorcycle taxi drivers in Surakarta increased with a BMI of more than 25 (aOR= 1.33; CI 95%= 0.77 to 2.27; p= 0.303). This study is in line with a study conducted by Al-Omar (2021), stating that BMI in the underweight category (aOR= 0.97; CI 95%= 0.69 to 1.37; p= 0.880), overweight (aOR= 1.06; CI 95%= 0.90 to 1.25; p= 0.430), and obese (aOR= 1.12; CI 95%= 0.91 to 1.38; p= 0.270) increase the risk of MSDs compared to normal weight, however the correlation is statistically insignificant. The risk of MSDs directly increases with a BMI of ≥ 25 (Romadhoni et al., 2018).

Being overweight can trigger biomechanical stress on the body's movement system, especially joints, and also affect gait and posture (AlOmar, 2021). Scientific evidence explains that excess weight can increase the risk of back pain. This occurs due to the increased physical load on the articular discs and musculoskeletal system in the spine (Diyana et al., 2019).

4. Correlation of Physical Activity with Risk of MSDs

The risk of MSDs in online motorcycle taxi drivers in Surakarta decreased with active physical activity (aOR= 0.36; CI 95%= 0.15 to 0.86; p= 0.021). The findings of this study are similar to a previous study conducted by Algarni et al. (2020), that physical activity has a positive and significant correlation with the incidence of MSDs due to work ($\chi^2= 2.00$; p= 0.160). Other findings from a study by Tami et al. (2021), stated that there was no significant correlation between physical activity and MSDs (aOR= 0.51; CI95%= 0.20 to 1.27; p<0.050). However, the results of observations indicate the prevalence of MSDs is higher in respondents with inactive categories of physical activity compared to active ones (Tami et al., 2021).

Individuals who are physically active are proven to be able to reduce the risk of MSDs. Workers with increased physical capacity will cause a relative decrease in workload. Physical activity is able to increase the oxygenation of body tissues through increased blood flow in muscles affected by the endothelium (Ezzatvar et al., 2019). Another mechanism, namely physical activity can increase the strength, flexibility, and pain threshold of muscles and ligaments to be stronger so that they can function optimally and prevent the risk of injury (Ojukwu et al., 2021).

Physical activity is one of the measures that can be applied to prevent susceptibility from non-communicable diseases, including proven to be able to suppress and prevent the incidence of MSDs (Nawrocka et al., 2019; Petermann-Rocha et al., 2019; Andriani, 2022). If physical activity is carried out measurably and regularly, it will help improve the quality of life and work productivity in all age groups (Grabara et al., 2018). WHO recommends adults to do 75 minutes of high-intensity physical activity

per week or 150 minutes of moderate-intensity physical activity per week (Bontrup et al., 2019; Ghasemi and Asiyeh Pirzadeh, 2019).

5. Correlation of Work Duration with Risk of MSDs

The results of this study showed that the risk of MSDs in online motorcycle taxi drivers in Surakarta increased with a work duration of more than 4 hours per day (aOR= 2.43; CI 95%= 1.24 to 4.78; p= 0.010). The results of this study are in line with a study conducted by Yan et al. (2017), that increased duration of work is associated with an increased prevalence of WMSDs. Individuals with a working duration of 41 to 50 hours per week ($\chi^2= 40.18$; p<0.010) and with a duration of work greater than or equal to 51 hours per week ($\chi^2= 17.13$; p<0.010) endure increased prevalence of WMSDs compared to individuals with a duration of work of 40 hours per week and the correlation is statistically significant (Yan et al., 2017). While the study conducted by Luan et al. (2018) states that there is a statistically significant correlation between work duration and WMSDs (aOR= 1.70; CI 95%= 0.50 to 6.50; p= 0.417).

Increased work duration is stated as a significant risk factor for MSDs. Rashid et al. (2021), made visual observations through driving simulations in a room. The results of this study discovered that after 1 hour and 30 minutes of driving, the drivers perform body stretching movements (Rashid et al., 2021). The results of another study discover a decrease in driving comfort starting after 30 minutes (Arunachalam et al., 2021). While driving, the body tends to be in a static sitting position, and sustained sub-maximal contractions occur that provoke increased discomfort and neuromuscular fatigue. Muscle endurance will decrease after 3 hours of driving duty (Lecocq et al., 2020).

6. Correlation of Work Duration with Risks of MSDs

The results of this study showed that the risk of MSDs in online motorcycle taxi drivers in Surakarta increased with high-stress levels (aOR= 1.58; CI 95%= 0.89 to 2.83; p= 0.126). This finding corresponds with a study conducted by Li et al. (2021), that work stress (OR= 1.32; CI 95%= 1.05 to 1.67; p<0.010) and mental disorder (OR= 2.94; CI 95%= 2.25 to 3.84; p<0.010) increase the risk of MSDs. Another study by Hämmig (2020) concluded mild category work stress (aOR= 2.61; CI 95%= 1.12 to 6.06; p<0.050), medium (aOR= 5.20; CI 95%= 2.36 to 11.45; p<0.050), and severe category work stress (aOR= 13.03; CI 95%= 5.64 to 30.08; p<0.050) can increase MSDs, compared to the absence of work stress. Medical workers with high levels of work stress and often lifting heavy weights are at risk for back pain (Mubarok et al., 2022).

The health conditions in motorcycle drivers can be affected by stress (Anoop and Binoosh, 2019). Stress is proven to affect the release of epinephrine and norepinephrine which affect muscle performance (Li et al., 2021). Stress will trigger a physiological reaction in the form of a biochemical stress response. This condition results in decreased blood supply to the extremities, increased muscle tension, and activation of the musculoskeletal system load, leaving muscle fibers vulnerable to injury (Ng, Voo and Maakip, 2019; Hämmig, 2020)

7. Correlation of Smoking Status with Risk of MSDs

The results of this study showed that the risk of MSDs in online motorcycle taxi drivers in Surakarta increased with the status of active smokers (aOR= 1.27; CI 95%= 0.74 to 2.19; p= 0.378). This study is in line with a study conducted by Diyana et al. (2019), that smoking status correlates with the risk of WMSDs, however, the correlation is not

statistically significant. Motorcycle drivers who were active smokers had a 1.72 times risk of MSDs compared to nonsmokers (aOR= 1.72; CI 95%= 0.58 to 5.13; p= 0.328). Smoking status is a non-occupational factor that triggers WMSDs (Diyana et al., 2019).

This study concludes that the risk of MSDs in online motorcycle taxi drivers in Surakarta increases with age greater than or equal to 34 years, BMI greater than 25, work duration more than 4 hours per day, high stress levels, and status as active smokers. The risk of MSDs in online motorcycle taxi drivers in Surakarta decreases with active physical activity.

Based on the results of this study, it is necessary to make behavioral changes to prevent and suppress the incidence of MSDs, especially in motorcycle taxi drivers so that they can increase work performance and productivity. The efforts that can be made are slowing down the degenerative process due to age, maintaining BMI in the normal category, doing physical activity actively, limiting the duration of motorcycle riding to a maximum of 4 hours per day, doing stress management due to work, and quitting smoking. This study has limitations, that researchers only examine complaints of MSDs in general based on body regions, without further examination to determine the type of pain.

AUTHOR CONTRIBUTION

Isna Andriani was the researcher who selected topics, collected research data and analyzed data. Sumardiyono and Bhisma Murti reviewed the study documents.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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