PREVALENCE OF MUSCULOSKELETAL DISORDER (MSD) SYMPTOMS AND THEIR ASSOCIATED RISK FACTORS AMONG E-HAILING DRIVERS IN SELANGOR: A CROSS-SECTIONAL STUDY

JOYCE YAP CHUN CHEE

A project report submitted in partial fulfilment of the requirements for the award of Bachelor of Science (Honours) Environmental, Occupational Safety and Health

Faculty of Engineering and Green Technology
Universiti Tunku Abdul Rahman

May 2025

DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

Signature :

Name : Joyce Yap Chun Chee

ID No. : 2101693

Date : 13-05-2025

APPROVAL FOR SUBMISSION

I certify that this project report entitled **"PREVALENCE OF MUSCULOSKELETAL DISORDER (MSD) SYMPTOMS AND THEIR ASSOCIATED RISK FACTORS AMONG E-HAILING DRIVERS IN SELANGOR: A CROSS-SECTIONAL STUDY"** was prepared by **JOYCE YAP CHUN CHEE** has met the required standard for submission in partial fulfilment of the requirements for the award of Bachelor of Science (Honours) Environmental, Occupational Safety and Health at Universiti Tunku Abdul Rahman.

Approved by,

Signature : ______________________

Supervisor : Dr. Lim Fang Lee

Date : 14.05.2025

Specially dedicated to

my beloved father, mother, sister, brother and aunt

ACKNOWLEDGEMENTS

This thesis would not have come to fruition without everyone's help in many ways. First and foremost, I would like to express my sincere gratitude to my research supervisor, Dr. Lim Fang Lee, for her invaluable patience, guidance, advice and constant support throughout the entire final year project research process.

My heartful thankfulness goes towards my family, specifically my father and aunt, for their help in obtaining responses from other e-hailing drivers during the data collection process at the e-hailing waiting area in Kuala Lumpur International Airport. Lastly, a token of appreciation is also forwarded to my sister, who has always been incredibly helpful and kind in assisting me throughout the whole journey of my research.

Lastly, I would like to thank my family again for their love, unwavering physical and mental support in supporting me to complete the final year project research. This endeavour would not have been possible without their belief in me.

PREVALENCE OF MUSCULOSKELETAL DISORDER (MSD) SYMPTOMS AND THEIR ASSOCIATED RISK FACTORS AMONG E-HAILING DRIVERS IN SELANGOR: A CROSS-SECTIONAL STUDY

ABSTRACT

As e-hailing drivers are frequently exposed to prolonged working hours, repetitive tasks, and poor ergonomics, the risk of developing MSDs is heightened. However, the prevalence and contributing factors of these symptoms remain understudied within Malaysia's e-hailing industry. This study aimed to identify the prevalence of MSD symptoms and assess the individual, occupational, physical and psychosocial factors contributing to their occurrence. A cross-sectional study design was employed, using homogeneous purposive sampling to recruit e-hailing drivers who met all inclusion criteria. This non-probabilistic method enabled the deliberate selection of participants relevant to the study objectives. A total of 188 completed survey questionnaires were collected from drivers at various waiting areas near Kuala Lumpur International Airport. After excluding 11 invalid responses, 177 valid responses were analysed. Data collected included socio-demographic background, work characteristics, psychosocial factors and self-reported MSD symptoms via Nordic Musculoskeletal Questionnaires. Descriptive statistics, Chi-square tests, binary logistic regression, multiple logistic, and linear regression analysis were conducted to assess associations between risk factors and MSD symptoms. The study found that 82.5 % of respondents experienced MSD symptoms, most commonly in the neck (62.7 %), shoulders (54.2 %) and lower back (54.2 %). Chi-square test results revealed that muscle pain before joining the e-hailing industry (OR = 4.196, 95 % CI = 1.868 – 9.423, $p < 0.001$), traumatic work or road accident history (OR = 3.838, 95 % CI = 1.395 – 10.557, $p = 0.006$), assisting with lifting luggage (OR = 15.536, 95 % CI = 1.559 – 154.809, $p = 0.017$) and job dissatisfaction (OR = 3.846, 95 % CI = 1.277 – 11.628, $p = 0.011$) were significantly associated with the prevalence of MSD symptoms. Subsequently, binary logistic regression was performed for each significant variable, adjusting for age and BMI to control for confounding. The same four variables remained significant. A multiple logistic regression model showed that muscle pain before joining e-hailing industry (OR = 5.488, 95 % CI = 1.994 – 15.108, $p < 0.001$), traumatic work or road accident history (OR = 4.48, 95 % CI = 1.277 – 15.750, $p = 0.019$), job dissatisfaction (OR = 4.913, 95 % CI = 1.356 – 17.794, $p = 0.015$) and lack of stretching/ massages during breaks (OR = 3.011, 95 % CI = 1.032 – 8.787, $p = 0.044$) were all significantly associated with MSD prevalence. Multiple linear regression revealed that mental stress from the job (B = 2.077, $\beta = 0.383$, 95 % CI = 1.306 – 2.848, $p < 0.001$), muscle pain before joining the e-hailing industry (B = 1.713, $\beta = 0.298$, 95 % CI = 0.970 – 2.457, $p < 0.001$), napping during breaks (B = 0.987, $\beta = 0.167$, 95 % CI = 0.250 – 1.724, $p = 0.009$), and being a non-smoker (B = 0.860, $\beta = 0.131$, 95 % CI = 0.025 – 1.695, $p = 0.044$) were significantly associated with higher MSD scores. Early identification and management of MSD symptoms are vital to prevent chronic health problems. Future longitudinal studies are recommended to explore additional risk factors like whole-body vibration and vehicle ergonomics.

Keywords: musculoskeletal disorders (MSDs), e-hailing drivers, occupational health, ergonomics, Nordic Musculoskeletal Questionnaire (NMQ)

Subject area: RC925-935 Diseases of the musculoskeletal system

TABLE OF CONTENTS

DECLARATION				**ii**
APPROVAL FOR SUBMISSION				**iii**
ACKNOWLEDGEMENTS				**vi**
ABSTRACT				**vii**
TABLE OF CONTENTS				**ix**
LIST OF TABLES				**xiii**
LIST OF FIGURES				**xv**
LIST OF SYMBOLS / ABBREVIATIONS				**xvi**
LIST OF APPENDICES				**xix**
CHAPTER				
1	**INTRODUCTION**			**1**
	1.1	Background		1
	1.2	Problem Statements		3
	1.3	Significance of the Study		7
	1.4	Objectives of the Study		9
		1.4.1	Research Aim	9
		1.4.2	Research Objectives	9
		1.4.3	Alternative Hypothesis	9
	1.5	Conceptual Framework		10
2	**LITERATURE REVIEW**			**12**
	2.1	Chapter Overview		12
	2.2	E-hailing Drivers		12

		2.2.1 Historical Development and Evolution of E-Hailing Services Globally and in Malaysia	12
	2.3	Musculoskeletal Disorders (MSDs)	17
		2.3.1 Occupational Musculoskeletal Disorders	18
	2.4	Risk Factors of Musculoskeletal Disorders (MSDs)	19
		2.4.1 Occupational Risk Factors	19
		2.4.2 Physical Risk Factors	22
		2.4.3 Individual Risk Factors	23
		2.4.4 Psychosocial Factors	29
	2.5	Previous Studies on Musculoskeletal Disorders Among Occupational Land Vehicle Drivers	30
3	**METHODOLOGY**		**50**
	3.1	Chapter Overview	50
	3.2	Study Design	50
	3.3	Study Location	51
	3.4	Study Population	53
	3.5	Sampling Method	53
	3.6	Sample Size	53
	3.7	Instrumentation	54
	3.8	Data Collection	56
	3.9	Data Analysis	58
		3.9.1 Data Cleansing and Preparation	58
		3.9.2 Statistical Analysis	58
	3.10	Ethical Considerations	61
4	**RESULTS AND DISCUSSION**		**62**
	4.1	Summary of Data Collection	62
	4.2	Individual Risk Factors	63
	4.3	Occupational Risk Factors	68
	4.4	Physical Risk Factors	71
	4.5	Psychosocial Factors	73

4.6 Prevalence of Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers 75
4.7 Associations of Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers 79
4.7.1 Associations of Individual Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers 79
4.7.2 Associations of Occupational Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers 86
4.7.3 Associations of Physical Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers 88
4.7.4 Associations of Psychosocial Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers 92
4.7.5 Adjusted Associations Between Individual, Occupational, Physical and Psychosocial Risk Factors and the Prevalence of MSD Symptoms Among E-hailing Drivers 94
4.8 Associations Between Individual, Occupational, Physical and Psychosocial Risk Factors and the MSD score 99
4.9 Summary of Factors Significantly Associated with MSDs 104

5 CONCLUSION 107
5.1 Research Conclusion 107
5.2 Strengths and Limitations of the Study 109
5.2.1 Strength of the Study 109
5.2.2 Limitations of the Study 110
5.3 Recommendations 111
5.3.1 Recommendations for Future Studies 111
5.3.2 Recommendations for Stakeholders 112

REFERENCES 113

APPENDICES **133**

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1:	Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers	32
Table 3.1:	Data Analysis Methods and Tests Respective to Each Study Objective	60
Table 4.1:	Socio-Demographic of Respondents (n=177)	64
Table 4.2:	Medical History and Current Condition (n = 177)	67
Table 4.3:	Working Characteristics of Respondents (n=177)	70
Table 4.4:	Physical Workload and Ergonomic Support Among E-hailing Drivers (n=177)	73
Table 4.5:	Psychosocial Conditions of E-hailing Drivers	74
Table 4.6:	Results of Nordic Musculoskeletal Questionnaire (n = 177)	77
Table 4.7:	Associations Between Individual Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)	83
Table 4.8:	Independent t-test for Individual Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)	85
Table 4.9:	Associations Between Occupational Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)	86
Table 4.10:	Independent t-test for Occupational Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)	87

Table 4.11: Associations Between Physical Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177) 89

Table 4.12: Associations Between Body Support with Prevalence of MSD Symptoms in Each Body Region Among E-Hailing Drivers (n = 177) 90

Table 4.13: Associations Between Psychosocial Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177) 93

Table 4.14: Binary Logistic Regression Analysis of Factors Associated with Prevalence of MSD Symptoms Adjusted for Age and BMI 95

Table 4.15: Multiple Logistic Regression Analysis of Factors Associated with Prevalence of MSD Symptoms 98

Table 4.16: Multiple Linear Regression Analysis of Factors Associated with MSD Score 102

Table 4.17: P-Values of Factors Significantly Associated with MSD Symptoms 105

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1.1:	Number of Occupational Disease Cases According to Agent Causes from 2018 to 2022	4
Figure 1.2:	The Trend of Reported Musculoskeletal Disorders in Comparison to Other Occupational Disease Cases and Compensation Claims for Permanent Disability from 2009 to 2014	5
Figure 1.3:	A Conceptual Framework of The Relationship Between Musculoskeletal Disorder (MSD) Symptoms Among E-hailing Drivers and The Associated Risk Factors	11
Figure 2.1:	Historical Development and Evolution of E-hailing Services Globally and in Malaysia	16
Figure 3.1:	E-hailing Waiting Area at KLIA Landside Operations	51
Figure 3.2:	E-Hailing Waiting Area at Charter Field Town	52
Figure 3.3:	Distribution of Public Transport in Selangor	52
Figure 3.4:	Research Procedure Flowchart	57
Figure 4.1:	Presence of MSD symptoms on Each Body Region and Overall Prevalence During the Past 12 Months (n = 177)	78
Figure 4.2:	Odds Ratios of Factors Significantly Associated with MSD Symptoms	106

LIST OF SYMBOLS / ABBREVIATIONS

AOR	Adjusted Odds Ratio
β	Standardised Regression Coefficient
CI	Confidence Interval
χ^2	Chi-square
d	Margin of Error
F	F-statistic
n	Sample Size
n (%)	Frequency (Percentage)
p	Prevalence
p	p-value
R^2	Coefficient of Determination
SD	Standard Deviation
z	Z-score for 95 % Confidence Limit
Cd	Cadmium
ANOVA	Analysis of Variance
APAD	Land Public Transport Agency
BMI	Body Mass Index
CLBP	Chronic Low Back Pain
COPD	Chronic Obstructive Pulmonary Disease
COVID-19	Coronavirus Disease 2019
DALY	Disability-Adjusted-Life Years
DOSH	Department of Occupational Safety and Health
DV	Dependent Variable
DWSA	Driving Work Station Assessment

GBD	Global Burden of Disease
GIS	Geographic Information System
GPS	Global Positioning System
GRTW	Gradual Return-to-Work
IV	Independent Variable
JKKP	Jabatan Keselamatan dan Kesihatan Pekerjaan
KLIA	Kuala Lumpur International Airport
LBP	Lower Back Pain
LPRE	Lumbar Repositioning Error
MET	Metabolic Equivalent of Task
MoT	Ministry of Transport
MSD	Musculoskeletal Disorder
nAChR	Nicotinic Acetylcholine Receptor
NDI	Neck Disability Index
NMQ	Nordic Musculoskeletal Questionnaire
ODI	Oswestry Disability Index
OR	Odds Ratio
OSH	Occupational Safety and Health
PSV	Public Service Vehicle
PTSS	Post-traumatic Stress Symptoms
PUSPAKOM	Computerised Vehicle Inspection Centre
RMDQ	Roland-Morris Disability Questionnaire
RTC	Road Traffic Crashes
RULA	Rapid Upper Limb Assessment
SKM	Cooperative Commission of Malaysia
SOCSO	Social Security Organisation
SPAD	Land Public Transport Commission
SPADI	Shoulder Pain and Disability Index
SPSS	Statistical Package for the Social Sciences
SSM	Companies Commission of Malaysia
TNC	Transportation Network Company
U.S.	United States
UTAR	Universiti Tunku Abdul Rahman

VAS	Visual Analogue Scale
VIF	Variance Inflation Factor
WRRS	Work-Related Road Safety

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Survey Questionnaire	133
B	Ethical Approval Letter	149

CHAPTER 1

INTRODUCTION

1.1 Background

Owing to rapid industrialisation and the escalating migration rate into metropolitan areas, the demand for an enhanced and mature public transportation system has surged (Al-Shakhrit, Masri and Othman, 2021). E-hailing was then introduced as a promising and viable extension to complement the existing public transportation in Malaysia, which primarily comprises bus, rail, and taxi (Shazwan Daud et al., 2023). Among these options, the e-hailing service distinguishes itself by virtue of its convenience, flexibility, cost-effectiveness, and, most importantly, affordability (Jais and Marzuki, 2020; Al-Shakhrit et al., 2021; Jamaluddin et al., 2021; Shazwan Daud et al., 2023). With the significant rise in e-hailing passengers, the e-hailing drivers' population has also experienced a massive expansion. Currently, Grab, the dominant company in the e-hailing sector in Malaysia, has more than 300 000 registered drivers, let alone a combined total of 32 authorised e-hailing firms (Grab Authorised Alpha Driver, 2024; Land Public Transport Agency (APAD), 2024). Apart from the strong market for e-hailing services, this occupation provides extensive flexibility in work arrangements, meaning that anyone, whether employed or not, can venture into this industry as a means of primary income or as a part-time job to alleviate their economic burdens (Salim et al., 2020; Al-Shakhrit, Masri and Othman, 2021).

As the e-hailing industry continues to flourish, it brings to light important considerations regarding the health and safety of the drivers. One pivotal concern is the prevalence of musculoskeletal disorders (MSDs), which refer to a broad spectrum of conditions that affect the human musculoskeletal system, such as muscles, ligaments, tendons, nerves, spinal discs, and bursa sacs (Department of Occupational Safety and Health (DOSH), 2017; Tang, 2022). Individuals who have musculoskeletal disorders experience either mild, temporary pain stemming from regular strains and sprains or severe chronic pain, which may result in a reduction or total loss of capacity to perform work (Ngatcha Tchounga et al., 2022; Tang, 2022). What aggravates MSDs is that they are not single-part targeted diseases, as they can affect multiple parts of the body simultaneously, contributing to various combinations of body pain and resulting in widespread discomfort (Tang, 2022). On the other hand, work-related MSDs or occupational MSDs are defined as injuries in the musculoskeletal system attributed to the working environment or the nature of the work itself. Several work-related risk factors include awkward posture, forceful and sustained exertions, repetitive motion, static and sustained posture, and vibration (Department of Occupational Safety and Health (DOSH), 2017). As reported by the Social Security Organisation (SOCSO) (2023), occupational MSDs were Malaysia's second-ranked occupational disease in 2022, accounting for 27.7 % of all reported work-related diseases.

Despite the fact that driving itself does not necessitate a high degree of physical workload, the drivers, especially full-time drivers, need to remain in a sustained posture for prolonged periods while reaching and conveying the passengers (Pickard et al., 2022). Driving in a stable posture involves sustaining various body parts, such as the neck, shoulder, arm muscles, and back, in consistent muscle contraction conditions, which may lead to muscle strain and pain (Maduagwu et al., 2022). Besides, prolonged sitting may expose the drivers to improper postures, which can also be impacted by other factors such as poor seat design. These ergonomic mismatches put the spine under excessive stress, engendering seating discomfort and increasing the risk of lower back pain (Pickard et al., 2022). The other commonly identified physical risk factors encompass extended exposure to whole-body vibration, which could largely depend on roadway conditions such as the presence of speed bumps and uneven road surfaces, repetitive motion while steering and forceful exertions during manual handling of luggage (Szűcs et al., 2020; Maduagwu et al., 2022; Ngatcha Tchounga et al., 2022; Pickard et al., 2022; Choy et al., 2023; Joseph et al., 2023). Aside from the physical risk factors, individual and psychosocial factors are associated with occupational MSDs in e-hailing drivers. Among all these risk factors, gender, age, medical history, health status, and lifestyle are classified under individual risk factors, whereas psychosocial factors include stress, job dissatisfaction, inconsistent job demands, time pressure, and risk for passenger abuse (Szűcs et al., 2020; Pickard et al., 2022; Choy et al., 2023; Joseph et al., 2023). In brief, the e-hailing industry involves prolonged sedentary working conditions that demand a high level of attention. Hence, it is unsurprising that the drivers are much more susceptible to musculoskeletal disorders due to multiple MSD risk factors exposure.

1.2 Problem Statements

Musculoskeletal disorders (MSDs) have been one of the significant health issues emerging in occupational settings, especially in low- and middle-income countries. According to the recent five-year statistics data provided by the Social Security Organisation (SOCSO) Malaysia, work-related MSDs have always been among the top three of the eight occupational disease agent causes, as shown in Figure 1.1 (Social Security Organisation (SOCSO), 2019; 2020; 2021; 2022; 2023).

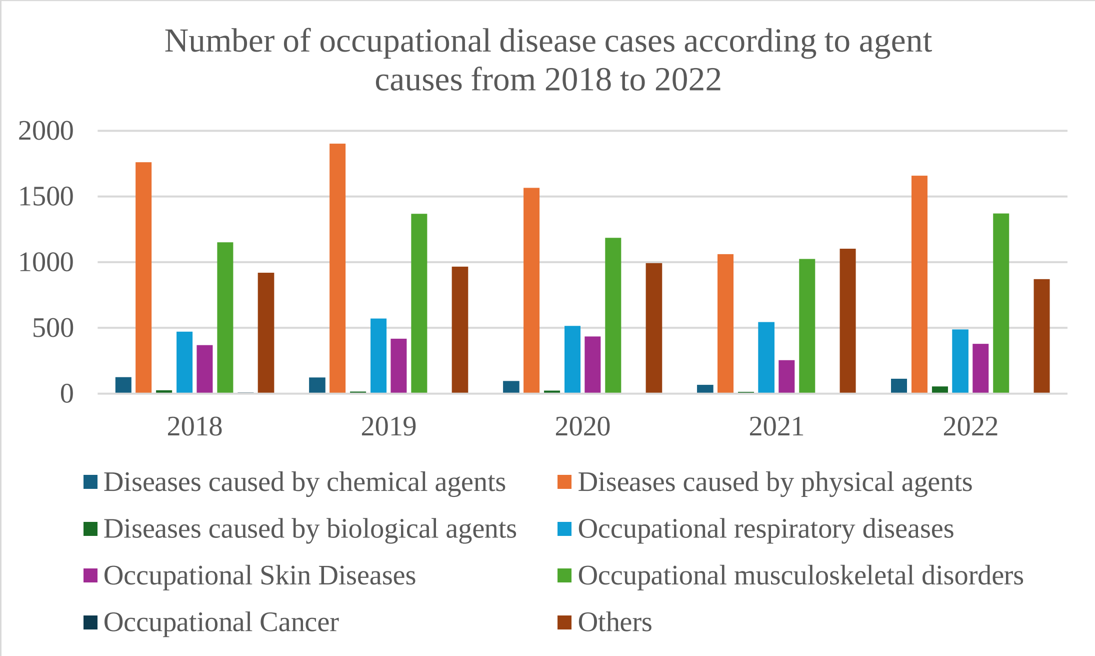


Figure 1.1: Number of Occupational Disease Cases According to Agent Causes from 2018 to 2022 (Social Security Organisation (SOCSO), 2019; 2020; 2021; 2022; 2023)

It is noteworthy that the occupational diseases statistics published by the Department of Occupational Safety and Health (DOSH) exclude self-employed persons such as e-hailing and taxi drivers, domestic workers, or self-employed persons in other industries. The data published only includes employees' data under companies which are registered with DOSH and submit JKKP 8 form annually. Meanwhile, SOCSO insures these individuals under the Self-Employment Social Security Act 2017 (Social Security Organisation (SOCSO), 2023). Thus, the number of work-related MSD cases reported by DOSH could differ from the number of cases covered by SOCSO.

The concomitant of the high prevalence of MSDs is the significant and increasing cost of compensation provided by SOCSO. A rising trend in the cost compensation for MSDs is evident, from approximately RM1 million in 2009 to RM3.5 million in 2014 as shown in Figure 1.2 (Department of Occupational Safety and Health (DOSH), 2017).

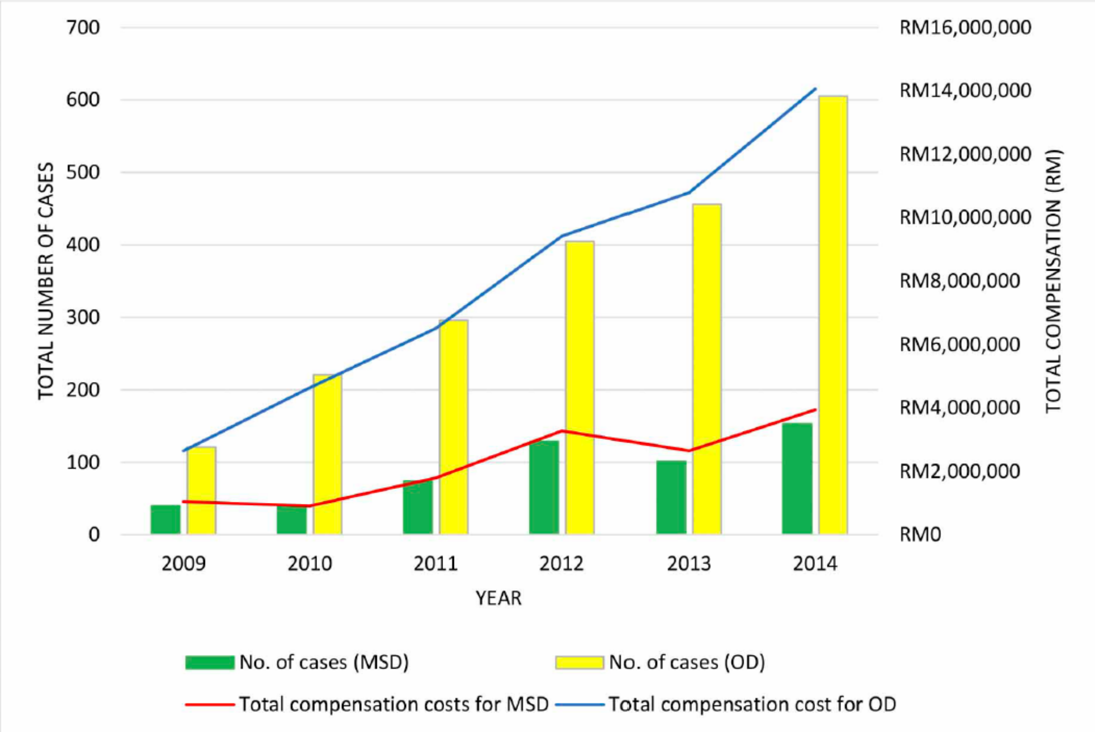


Figure 1.2: The Trend of Reported Musculoskeletal Disorders in Comparison to Other Occupational Disease Cases and Compensation Claims for Permanent Disability from 2009 to 2014 (Department of Occupational Safety and Health (DOSH), 2017)

Attributable to the notable risks associated with e-hailing driving, the prevalence and risk factors of MSDs in this population are flagged as a topic of investigative interest. Recent research reported that 164 out of 262 e-hailing drivers in Johor experienced lower back pain in the past 12 months (Radzlan, Naim Othman and Md Yusoff, 2023). Conversely, previous research has primarily focused on traditional taxi driving, which shares similar work conditions and vehicle usage with e-hailing driving. A study conducted by Syah et al. (2020) observed a substantial prevalence of back pain among taxi drivers, accounting for 75.4 % of the 443 drivers in Malaysia. Analogous studies have been undertaken in several other countries apart from Malaysia. In the capital city of Cameroon, Ngatcha Tchounga et al. (2022) recruited 151 adult male taxi drivers and identified an overall 86.8 % MSDs prevalence; 72.8 %, 42.4 %, and 29.1 % of taxi drivers reported lower back, neck, and knee pain, respectively. In Hungary, the corresponding prevalence of occupational MSDs were 61.4 %, 42.1 %, 34.1 %, and 25.0 % for lower back, upper back, neck, and knee pain, respectively (Szűcs, Ádám and Nagy, 2020). Nonetheless, a separate study carried out by Maduagwu et al. (2022) in Nigeria reported a lower overall MSDs risk of 21.2%, where only 34 % of drivers complained of musculoskeletal pain in the lower back, 18.9 % in the neck, 22.3 % in the upper back, 18.2 % in the shoulder and 14.9 % in the knee.

In light of the contradicting results of previous studies on taxi drivers, the interaction between risk factors and occupational MSDs is complex. It varies among countries owing to differences in topography, sociocultural lifestyles, and working environments. For instance, studies have shown that traffic congestion in urban areas leads to frustration and stress, which are critical psychosocial risk factors for work-related MSDs (Maduagwu et al., 2022; Pickard et al., 2022; Choy et al., 2023). In this context, Kuala Lumpur, the capital of Malaysia, is known for experiencing high traffic congestion due to its large number of private vehicles and limited use of public transportation (Idris, 2022). This phenomenon may yield higher prevalence rates of MSDs among drivers than in countries without significant traffic congestion issues.

Moreover, work-related MSDs could have negative impacts on e-hailing drivers by disrupting their ability to earn income as they are unable to perform optimally. These disturbances are accompanied by the compromising of drivers' performance and decision-making, which may lead to aberrant driving behaviour and an increased probability of road traffic accidents (Maduagwu et al., 2022). Lastly, the health systems and SOCSO in Malaysia may face a more significant financial burden due to the rising cases of drivers suffering from occupational MSDs, which may lead to an increased number of medical treatment and injury compensation claims.

Importantly, very limited research has been carried out on the population of e-hailing drivers in Malaysia. Henceforth, the lack of population-specific studies and the subsequent social and economic impacts emphasise the need for a thorough and localised investigation into the occurrence and associated risk factors of work-related MSDs among e-hailing drivers. These data are crucial for the relevant agencies in developing effective healthcare programs focused on preventive measures and medical care treatment.

Therefore, this study aimed to provide novel insight into the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers in Selangor and their associated risk factors by utilising validated and reliable questionnaires.

1.3 Significance of the Study

This study will contribute to the body of knowledge on occupational MSDs, specifically concerning the relatively understudied population of e-hailing drivers in Malaysia. By identifying and analysing the prevalence and associated risk factors of MSD symptoms, the study will advance the understanding of how sedentary work conditions, along with individual and psychosocial factors, engender these health issues.

Aside from filling critical gaps in existing knowledge, the study of musculoskeletal disorders (MSDs) among e-hailing drivers holds significant importance for multiple stakeholders, such as drivers, e-hailing companies, policymakers, ergonomists, researchers, and healthcare providers. Determining the specific risk factors for MSDs among e-hailing drivers can facilitate fostering a safety and health culture to safeguard their health. The findings provide information about the risk factors associated with their occupation and propose feasible interventions, such as ergonomic improvements and routine health examinations. Ultimately, mitigating these risks can lead to improved health outcomes and enhanced quality of life for the drivers.

Furthermore, the e-hailing industry is expected to gain substantial benefits from the findings of this study. Healthier drivers mean increased productivity and income, simultaneously augmenting the overall efficiency and profitability of e-hailing companies. Additionally, by prioritising driver health, companies can foster higher job satisfaction, which concurrently minimises the psychosocial risk factors of musculoskeletal disorders (MSDs). The virtuous cycle of enhancing driver health status and attaining economic benefits demonstrates the importance of investing in occupational health initiatives.

Most importantly, this research is aligned with the seventh strategy, programme number three under the Occupational Safety and Health Master Plan 2021 – 2025 – Strengthening OSH in Work-Related Road Safety (WRRS), Informal Sector, and Future Jobs. This strategy consists of four programmes:

i. Programme 1: Enhancing Awareness and Alertness of OSH Practices For Future Jobs.
ii. Programme 2: Enhancing Awareness and Alertness of OSH Practices In E-Hailing Services.
iii. Programme 3: Strengthening Management of Work-Related Road Safety (WRRS).
iv. Programme 4: OSH Improvement in Informal Sectors.

Engaging the e-hailing drivers in the investigation of their musculoskeletal health undoubtedly increases their awareness, knowledge and practices in the OSH field. Although the gig economy is frequently perceived as a sector of self-employed individuals, they are still obligated to ensure their jobs are safe and with minimal health risks for themselves and others (Department of Occupational Safety and Health, 2021). Furthermore, this study aids in achieving the ultimate goal of this strategy, which is to reduce accidents involving work-related road safety (WRRS). Research has shown that the probability of road accidents encountered by professional drivers is significantly affected by their tendency towards aberrant driving behaviour, which could be attributed to the occurrence of musculoskeletal disorders (MSDs) (Feng et al., 2020; Han and Zhao, 2020). Thus, the results of this study underscore the paramount importance of ensuring “Vision Zero” of WRRS.

1.4 Objectives of the Study

1.4.1 Research Aim

Given the lack of research regarding occupational musculoskeletal disorders (MSDs) and their detrimental effects on e-hailing industries, this study aims to identify the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers in Selangor and the associated risk factors.

1.4.2 Research Objectives

The research objectives of the study are as follows:

i. To identify the characteristics of individual, occupational, physical and psychosocial factors among e-hailing drivers in Selangor.
ii. To determine the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers in Selangor.
iii. To investigate the relationships between individual, occupational, physical and psychosocial factors with MSD symptoms among e-hailing drivers in Selangor.

1.4.3 Alternative Hypothesis

The alternative hypotheses of this study are:

i) There are significant relationships between individual, occupational, physical and psychosocial factors with MSD symptoms among e-hailing drivers.

1.5 Conceptual Framework

According to Figure 1.3, the dependent variable of this study is the prevalence of musculoskeletal disorder (MSD) symptoms in different body parts experienced by e-hailing drivers in Selangor. These symptoms are particularly observed in the neck, shoulders, upper back, elbows, lower back, wrists or hands, hips or thighs, knees and ankles or feet.

The independent variables are categorised into several key groups:

i. **Individual factors:** These include sociodemographic characteristics such as age, body mass index (BMI), highest education background, behaviours and habits such as smoking and exercising. pre-existing medical conditions, musculoskeletal history before joining the industry, trauma from road or work accidents and the length of service as e-hailing drivers.
ii. **Occupational factors:** These consist of job sedentary working environment affected by working days, working hours and rest days taken. Other factors include night shifts, frequency of breaks, stretching exercises or massages during breaks and naps taken while waiting for orders.
iii. **Physical factors:** These involve manual handling activities (e.g., lifting luggage) and the presence of seat support.
iv. **Psychosocial factors:** Job satisfaction and job stress are significant independent variables for psychosocial factors.

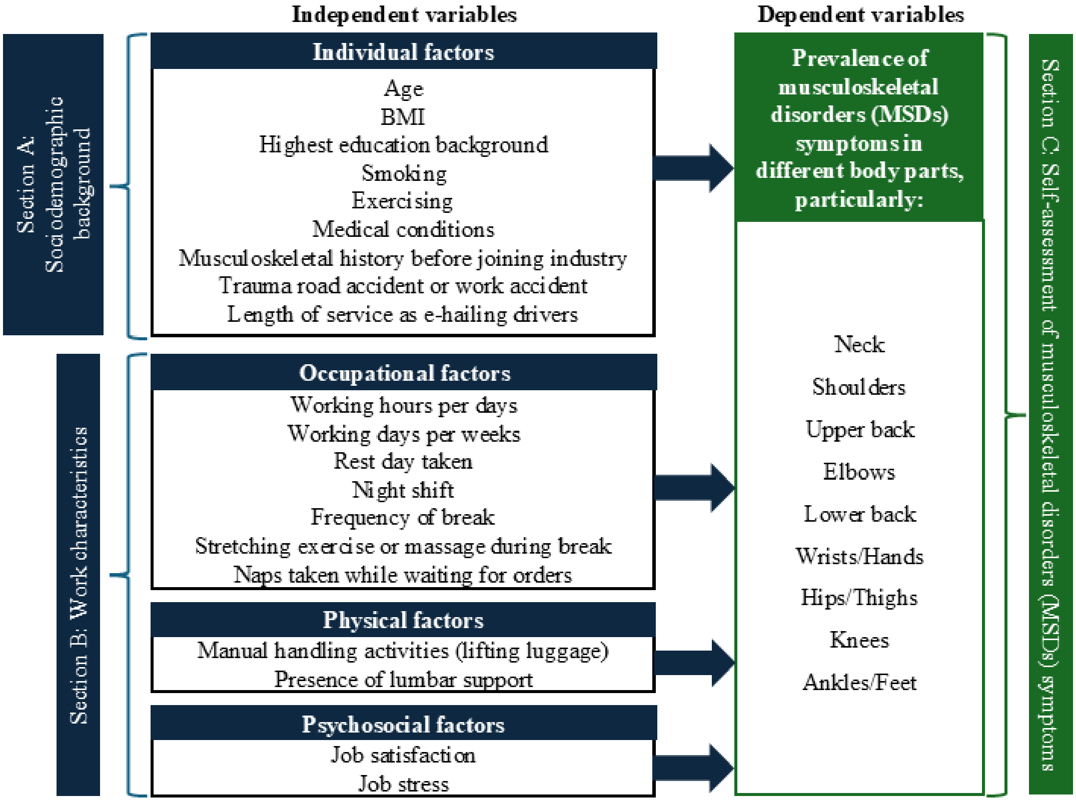


Figure 1.3: A Conceptual Framework of The Relationship Between Musculoskeletal Disorder (MSD) Symptoms Among E-hailing Drivers and The Associated Risk Factors

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter Overview

This chapter serves to establish a foundation of knowledge regarding the topic of interest by identifying, evaluating and comparing the literature. The chapter begins by exploring the emergence of the e-hailing industry, discussing the arising musculoskeletal disorders and analysing the risk factors for musculoskeletal disorders. This is followed by an overview of previous studies on occupational land vehicle drivers such as bus drivers, truck drivers, e-hailing drivers and taxi drivers.

2.2 E-hailing Drivers

2.2.1 Historical Development and Evolution of E-Hailing Services Globally and in Malaysia

E-hailing (electronic hailing) or ride-hailing is defined as a type of transportation which allows customers to book a ride anytime from a pick-up point to a particular targeted venue through mobile applications available on virtual devices such as smartphones (Md Isa et al., 2024). This new type of transportation has been introduced as a viable option for intra-city transportation (Arumugam, Ismail and Joeharee, 2020). Multiple renowned transportation network services (TNCs) in Malaysia, namely Grab, Maxim and AirAsia Ride, provide mobile applications where smartphone users submit trip requests to the drivers who are prepared to serve through the applications. While requesting rides, the fares and waiting times are listed along with the variations of the services, such as normal rides, six-seaters or saver vehicles with lower fares but longer waiting times. Most importantly, the TNCs facilitate the passengers in the process of payment, generally through credit cards, cash or other electronic payment tools (Cetin and Deakin, 2019). Consequently, these assigned drivers convey the passengers to the designated destination with their vehicles (Cetin and Deakin, 2019). After fare transactions by the passengers, the e-hailing service providers deduct a fixed portion of the fare received from the passengers and transfer the rest of the payment to the drivers (Md Isa et al., 2024). It has become an appealing mode of public transport owing to the door-to-door service, all-time (24/7) availability and safety features (Arumugam, Ismail and Joeharee, 2020).

The emergence of e-hailing can be traced back to the concept of carpooling, where a few people take the same vehicle to reach their destination. During World War II (1942–1945), the United States (U.S.) government compelled factories, companies and even churches to arrange ridesharing to the workplace when there was no other transportation available. The act of four workers sharing a ride in a car was a measure to conserve rubber for the war effort. This was when the first ridesharing program, namely the Car Sharing Club Exchange and Self-Dispatching System, took place (Chan and Shaheen, 2012).

In the late 1960s, the ridesharing program reemerged among large-scale employers as a solution to address traffic congestion and limited office parking supply. This direct method proved successful in that some companies doubled vehicle occupancy and alleviated parking lot overload. In the light of the energy crisis in the early 1970s, the focus of ridesharing has shifted from limited parking supply to energy conservation. Guidebooks on carpooling have been published, benchmarking the history of successful commuter ride-matching programs (Chan and Shaheen, 2012).

In the 1980s, the efforts to conserve energy faded, and the attention was redirected to air quality issues and traffic congestion. In the meantime, more dynamic ridesharing applications via telephone-based and Internet-based ride-matching programs have been widely spread along with the advancement in computerised technology. Nonetheless, the dynamic mode of instantly matching drivers and passengers has unfortunately failed due to the lack of enough users to make the system work effectively. This phase marked a move toward the establishment of early schemes even without developed and mature technology. Despite the little attention gained on the use of applications due to the decrement in gasoline prices, it still serves as the foundation of nowadays e-hailing services (Chan and Shaheen, 2012).

From 1999 to 2004, due to the failure that occurred in the previous phase, the limelight focus has been diverted to promote ridesharing among those who commute with a regular schedule. In this phase, online ride-matching rose along with the proliferation of the Internet, where private software companies offered their range of services to clients on a subscription basis via ride-matching platforms developed by them. On the other hand, this form of ridesharing required consistent arrangements on their schedules to find ride matches, and it lost the flexibility compared to private travel. It was challenging for online ride-matching to compete with commuter ride-matching programs sponsored by employers (Chan and Shaheen, 2012).

From 2004 onwards, the era of “Technology-Enabled Ride-matching” commenced, where the combination of Internet, mobile phones and social networking was integrated into ridesharing (Chan and Shaheen, 2012). While ridesharing services continue to flourish, people face hurdles in prearranging rides with others and express the desperate need for privacy and flexibility in commuting. According to the findings of Brown (2020), only one-third of the ride-hail users leveraged the ridesharing services offered by Uber and Lyft and only made one rideshare trip over three months of the study period. The study also found that people who live in multiracial areas book more ride-hailing services as contradictory than those who live in areas with monoracial dominance in the neighbourhood. This kind of demand gave birth to ride-hailing services, where passengers are able to hire their private driver for personal transportation instead of carpooling and sharing transport with others. While technically speaking, the business of ride-hailing can be realised owing to the convergence of the exceptional popularity of smartphones, software applications, Global Positioning System (GPS) technology and wireless networks (Brail, 2022).

In 2009, Uber was the first company to introduce e-hailing services in San Francisco, United States (Brown, 2020). Since that year, e-hailing companies began to expand swiftly and divert the share massively from other available transportation services across the globe. This phenomenon can be attributed mainly to two determinants, notably, dissatisfaction with taxi services and an urge to create additional income by making use of underused vehicles (Brail, 2022). Lyft was launched in 2012, while in the same year, the largest e-hailing firm in China, Didi, commenced operations as well (Sun and Edara, 2015; Wang, 2019). In Southeast Asia, Grab dominated the e-hailing market, establishing its influence in eight countries: Malaysia, Indonesia, Singapore, Thailand, Vietnam, Cambodia, Myanmar and the Philippines (Arumugam, Ismail and Joeharee, 2020).

In Malaysia, ride-hailing services are regulated by the Ministry of Transport (MoT). All service providers who seek to apply for e-hailing licences for their firms must register with the Companies Commission of Malaysia (SSM), the Cooperative Commission of Malaysia (SKM), and the Land Public Transport Commission (SPAD) (Arumugam, Ismail and Joeharee, 2020). To date, the number of registered e-hailing drivers is still escalating dramatically, with the lead firm in the e-hailing industry, Grab, reporting more than 300 000 drivers registered under them (Grab Authorised Alpha Driver, 2024). With the e-hailing regulations, effective on 12 October 2019, all e-hailing drivers are obligated to acquire a Public Service Vehicle (PSV) license, pass medical examinations and criminal background checks, have their vehicles undergo annual inspections at Computerised Vehicle Inspection Centres (PUSPAKOM), contribute to the Social Security Organisation (SOCSO), purchase e-hailing add-on insurance and equip their vehicles with safety tools such as a fire extinguisher (Arumugam, Ismail and Joeharee, 2020).

The late evolution of e-hailing in Malaysia can be traced back to the debut of Uber in 2013, then Grab in 2014, followed by MyTeksi (Md Isa et al., 2024). Since then, the burgeoning e-hailing market has attracted more ride-hailing service providers, reaching a total of 32 licensed e-hailing firms as of 7 August 2024, a number hitherto unprecedented (Land Public Transport Agency (APAD), 2024). However, Uber withdrew from the Malaysian market in March 2018, leaving Grab as the leading e-hailing company in the country. The goals of decreasing vehicle journeys and road congestion while satisfying the elevating transportation demand and minimising vehicle emissions propagate the influence of e-hailing in Malaysia (Md Isa et al., 2024).

Figure 2.1 illustrates the overall historical development and evolution of the e-hailing industry globally and in Malaysia.

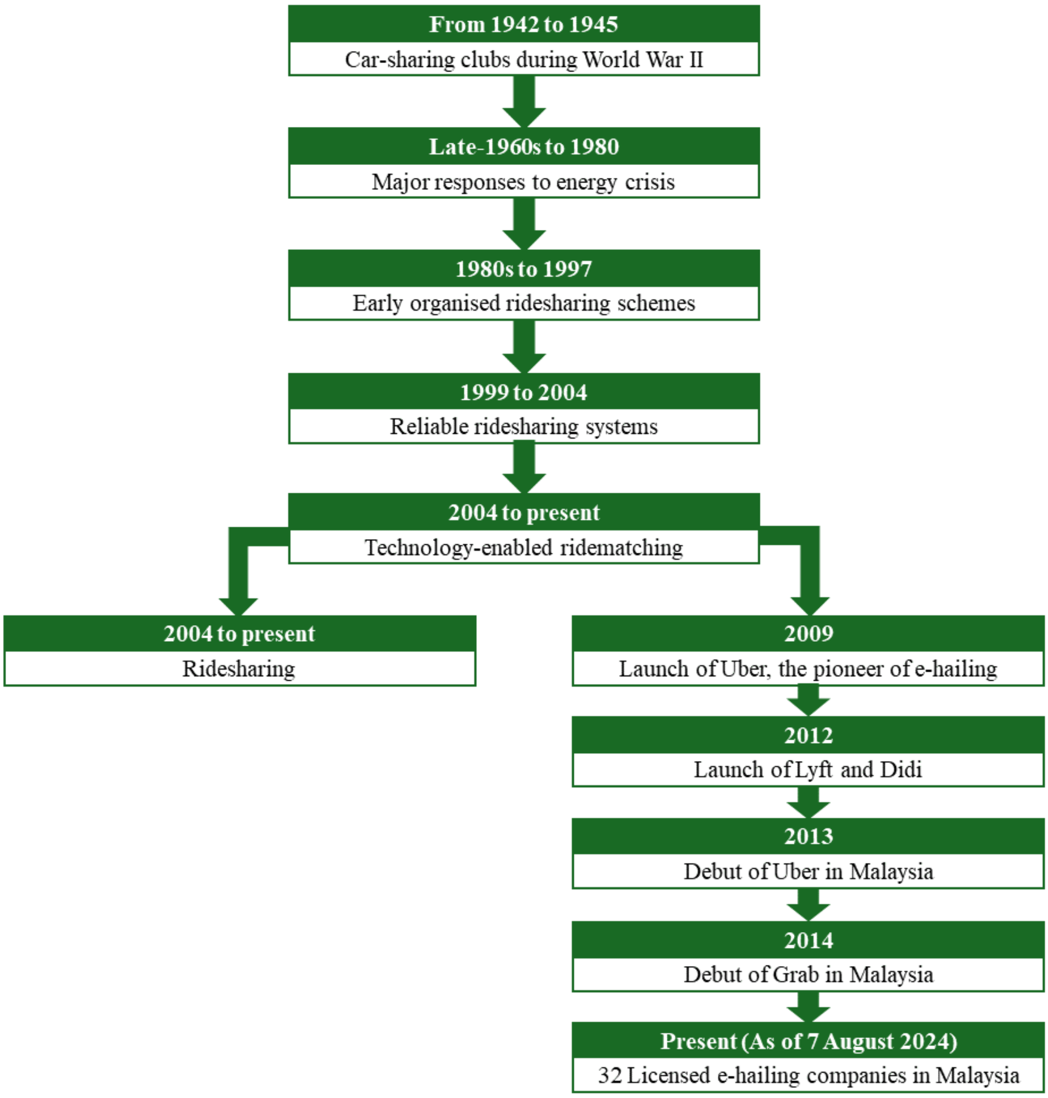


Figure 2.1: Historical Development and Evolution of E-hailing Services Globally and in Malaysia

2.3 Musculoskeletal Disorders (MSDs)

Musculoskeletal disorders (MSDs) have attained excessive attention globally for being the leading causes of illnesses and disability. In 2019, 322.75 million incidences, 117.54 thousand mortality and 150.08 million disability-adjusted-life-years (DALYs) of musculoskeletal disorders (MSDs) were reported in the Global Burden of Disease (GBD) in 204 countries and territories (Liu et al., 2022). The structural components of the human body, such as bones, joints, muscles and adjacent connective tissues, constitute the musculoskeletal system (Greggi et al., 2024). As musculoskeletal health is closely related to the performance of the locomotor system, any dysfunction of the system could underlie around 150 distinct diseases or conditions (World Health Organization, 2022).

In general, the occurrence of MSDs is characterised by the sensation of persistent pain and restriction in dexterity and mobility, leading to reduced capabilities to participate in society and perform daily tasks. The impairment might be either a sudden incident and only sustained for a short period, such as sprains, strains and fractures or chronic suffering, such as osteoarthritis and long-term lower back pain (Ngatcha Tchounga et al., 2022; Tang, 2022). In terms of the extent of the impact, individuals who encountered musculoskeletal disorders experienced pain or disability at specific parts of their bodies, such as Carpal Tunnel Syndrome on the wrist or widespread pain covering multiple body parts or systems, such as fibromyalgia (World Health Organization, 2022).

The incidence of MSDs is typically accompanied by other comorbidities as well, or vice versa. These co-existing medical conditions include cardiovascular disease, diabetes, pulmonary-related issues (e.g. asthma and chronic obstructive pulmonary disease) and kidney disease (Chen et al., 2018; Kumarathas et al., 2020; Minetto et al., 2020; Oliveira et al., 2020; Ziade et al., 2020; Alkhatatbeh et al., 2021; Deme et al., 2021; Kitas and Dimitroulas, 2021; Latiers et al., 2021; Rao et al., 2021; Squier et al., 2021; Heikkala et al., 2022; Nastri et al., 2022; Najafi et al., 2023; Ras et al., 2023; Ranaei et al., 2024). According to Cieza et al. (2020), MSDs are the main contributor to the demand for rehabilitation globally, accounting for nearly two-thirds of all adults requiring rehabilitation.

2.3.1 Occupational Musculoskeletal Disorders

Currently, millions of workers have been affected by work-related or occupational MSDs, leading to high expenditures on public health systems and companies. Regardless of hundreds of different conditions, these conditions can be represented by work-related pain in common (Greggi et al., 2024). The body districts impacted vary between different occupations, attributed to different job tasks, and can be aggravated by work activities (Choy, Mohd Rasdi and Wen, 2023). Some work tasks involve forceful and sustained exertions, awkward posture, static and sustained posture, repetitive motion and vibration, which expose the workers to a higher risk when two or more risk factors are concurrently (Department of Occupational Safety and Health (DOSH), 2017).

Occupational musculoskeletal disorders (MSDs) have been a major health problem in occupational settings. In the United States (US), 502 380 cases related to occupational musculoskeletal disorders (MSDs) that lead to at least one day away from work have been reported. This yielded an incidence rate of 25.3 MSDs per 10,000 full-time workers (U.S. Bureau of Labor Statistics, 2023). Meanwhile, in the United Kingdom, 473 000 workers reported MSDs, resulting in a 6.6 million loss of working days in 2022/23. Among all the body parts affected, 41 % of workers reported musculoskeletal problems in the upper limbs or neck, the same fraction of workers (41 %) reported MSDs in the back, and 17 % of workers reported MSDs in the lower limbs (Health and Safety Executive, 2023). In Australia, the number of compensation claims is used to represent work-related MSD cases. In 2015/16, 124 690 work-related MSD claims were accepted, and within this figure, 62 420 accepted compensation claims were classified as serious claims (Oakman, Clune and Stuckey, 2019). Similarly in Malaysia, work-related MSDs have always been among the top three of the eight occupational diseases reported by the Social Security Organisation (SOCSO) from 2018 to 2022 (Social Security Organisation (SOCSO), 2019; 2020; 2021; 2022; 2023).

2.4 Risk Factors of Musculoskeletal Disorders (MSDs)

2.4.1 Occupational Risk Factors

2.4.1.1 Sedentary Working Environment

The nature of e-hailing driving exposes the drivers to prolonged sedentary behaviour, typically involving excessive sitting with insufficient breaks and minimal physical activity, which can lead to musculoskeletal disorders (MSDs). In accordance with the official definition provided by World Health Organization (2020), any active state where the energy expenditure is 1.5 Metabolic equivalent of tasks (METs) or lower, usually while sitting, reclining or lying down, is considered sedentary behaviour. Common examples include desk-based office work, driving and watching television, which also applies to individuals who suffer from disability and remain in a sitting posture in a wheelchair. Various mechanisms contribute to these outcomes, including long working hours that correlate with extended sitting periods and escalating exposure to other occupational hazards such as twisting and awkward postures (Ervasti et al., 2021). Sustained sitting gradually and continuously overloads the joints, thus creating cumulative stress on soft tissues in the lumbar region. As a result, muscles become tense and experience spasms and the nerve and ligament are compressed (Kurtul & Güngördü, 2022; Abere et al., 2023). Moreover, limited sitting space and frequent exposure to whole-body vibration in vehicles heighten the risk of MSDs, especially when combined with prolonged sitting and improper posture (Kurtul and Güngördü, 2022). The absence of regular rest days to allow recovery of the strained body further magnifies the negative impact of sedentary work behaviour (Kurtul and Güngördü, 2022). Notably, rest is the most effective relief for MSDs, whereas continuous work without breaks exacerbates the condition (Szűcs, Ádám and Nagy, 2020).

2.4.1.2 Night Shift

Late-night driving has a noteworthy linkage with musculoskeletal discomfort, likely due to its impact on sleep. Sleep deprivation following late-night driving elevates catabolic hormones such as cortisol, which gradually breaks down protein and hinders muscle recovery after physical activity or injury (Lee et al., 2020). Alternative explanation elucidated by Matre et al. (2021) is that disrupted sleep may trigger low-level systemic inflammation and increased pain sensitivity, and thereby, individuals may suffer chronic pain in the body. Circadian rhythms also play a critical role in musculoskeletal health by influencing factors such as physical activity, feeding or fasting cycles, body temperature, or hormonal or neuronal control. Moreover, psychosocial stress attributed to night shift work may also be associated with musculoskeletal pain. Lee et al. (2020) indicated that psychosocial stress can be more significant for shift workers compared to day workers, who have a higher incidence rate of musculoskeletal outcomes in numerous occupational settings.

2.4.1.3 Work Breaks and Compensatory Exercise to Relieve Musculoskeletal Symptoms

Work breaks are of paramount importance to break the burden of sustained sitting postures on the musculoskeletal system. Research discovered that regularly switching the mode of sedentary work with sitting, standing or walking at work every hour can lower the risks of MSDs by over 30% (Putsa et al., 2022). This practice, often referred to as a "short active break", involves interrupting work activities with exercise to attenuate stress on the musculoskeletal system, especially muscles and joints and correct improper working postures (Vitoulas et al., 2022). Without breaks and exercises, workers are prone to sedentary postures for long periods, predominantly affecting the neck, shoulder, upper extremities, wrist, lumbar spine and back. Taking 2-to-3-minute breaks with light exercise every 30 minutes is strongly recommended as it provides both physical and mental health advantages without compromising productivity (Radwan et al., 2022). Additionally, stretching is deemed the most beneficial exercise for sedentary workers, who are e-hailing drivers in this research, followed by resistance and strengthening exercises (Vitoulas et al., 2022).

2.4.1.4 Short Naps While Waiting For Orders

Napping, often described as “short sleep”, refers to any sleep period that is less than half of any individual’s typical major sleep duration (Lastella et al., 2021). In general, the human body requires breaks for refreshment and recovery to return to its normal functioning level. Power naps for 15 to 30 minutes are beneficial in providing speedy recovery from fatigue, boosting energy levels and enhancing performance, alertness and cognitive function (Rafi et al., 2023). While direct evidence linking napping to a reduction in MSDs among e-hailing drivers is lacking, napping is known to relieve neuromuscular fatigue, suggesting that napping may counteract some of the physical strain associated with driving (Boukhris et al., 2024). Lecocq et al. (2020) defined neuromuscular fatigue as a reversible decrement in the ability of the body to generate power, force and speed. In this context, e-hailing drivers are susceptible to neuromuscular fatigue caused by prolonged periods of constrained posture while driving. This posture requires continuous coordination of muscles to maintain the stable position of the neck, limbs and trunk. Sustained muscle contractions can lead to discomfort and fatigue over time.

On the other hand, according to a study of MSDs among taxi drivers, drivers who frequently take naps in their vehicles reported a higher prevalence of MSDs even though it was not statistically significant. This is because drivers might engage in ergonomically unsound posture in the restricted space of a vehicle while napping (Ngatcha Tchounga et al., 2022). Given the contradictory findings and unclear mechanisms, further research is needed to investigate the relationship between napping practices and musculoskeletal health in this population.

2.4.2 Physical Risk Factors

2.4.2.1 Manual Handling of Luggage

E-hailing drivers frequently engage in manual handling of luggage that often requires bending their backs and adopting awkward postures to lift heavy or bulky items into the car trunk. Overexertion can lead to increased pain and discomfort, especially in the neck, upper extremities, lower back and knee (Brauer et al., 2020; Fyongo and Ramdhan, 2024). Biomechanical research indicates that individuals involved in luggage handling experience high lumbar muscle activity, with lumbar compression forces on the fourth and fifth lumbar disc often exceeding safety limits during lifting (Brauer et al., 2020). The shoulder is also frequently impacted as it endures substantial physical strain in awkward positions during luggage handling. What makes it even more concerning is that the shoulders are quite vulnerable to rotator cuff injuries. By repeatedly experiencing pushing and pulling forces while carrying heavy bags, the drivers could suffer injuries, including muscle pains, tendon tears and even fractures (Pirruccio and Kelly, 2020).

2.4.2.2 Poor Ergonomic Design of Vehicle Seats

Poor vehicle seat ergonomics complement and amplify the adverse effects of prolonged sitting in a sustained position, heightening the risk of musculoskeletal disorders (MSDs). Critical predictors such as the position of the steering wheel, mismatches between seat positioning and body dimensions, legroom and seat cushioning influence driver comfort (Pickard et al., 2022). In response to discomfort from poorly designed seats, the driver might adopt unnatural postures, such as leaning to one side, twisting and bending. These postures, when combined with neglecting seat comfort, exert mechanical stress on the spine and surrounding soft structures, undoubtedly causing MSDs. Moreover, road conditions such as uneven surfaces, excess speed bumps and seat vibrations during vehicle acceleration aggravate these issues (Choy, Mohd Rasdi and Wen, 2023).

Insufficient back support further increases the compressive load on the lower back, compelling the drivers to adopt unhealthy postures, such as forward head tilt and rounded shoulders. Sitting in seats without proper lumbar support for an extended duration imposes postural stress, which in turn elevates the risk of lower back pain and other musculoskeletal problems (Szűcs et al., 2020; Kurtul and Güngördü, 2022; Yitayal et al., 2022; Abere et al., 2023).

Abere et al. (2023) found out that drivers who lack access to adjustable seats face a higher likelihood of developing MSDs compared to those who leverage seats with adjustable seats along with back support. While poor vehicle ergonomics cannot solely lead to MSDs, they act as vital contributing factors to the pathogenesis of MSDs, especially when combined with prolonged sitting (Pickard et al., 2022).

To minimise the risk of MSDs, driver seats ought to consist of adjustable components such as shock absorbers to ensure whole-body vibration frequency within the range of 1-20 Hz, accompanied by backrests, lumbar support, headrests and armrests (Kurtul and Güngördü, 2022). In addition, drivers should properly adjust their seats to maintain the spine's natural 'S' curve, ensuring the head rests on the headrest and avoid sitting either too high or too low relative to the steering wheel (Abere, Yenealem and Worede, 2023).

2.4.3 Individual Risk Factors

2.4.3.1 Age

Driving involves a complex combination of cognitive and motor skills, which can deteriorate with age (Falkenstein, Karthaus and Brüne-Cohrs, 2020). Although the role of age as a definitive risk factor for MSDs remains debated, research suggests that younger drivers may face higher risks due to their relative lack of experience. This indicates a potential trade-off between driving experience and exposure to occupational hazards, such as whole-body vibration (Pickard et al., 2022). Conversely, other studies highlighted that ageing could weaken the integrity of articular and musculoskeletal structures, causing degenerative changes that can exacerbate work-related MSDs (Maduagwu et al., 2022).

Ageing is a natural process where most physiological functions may decline irreversibly and gradually. A range of health issues, including neurodegenerative diseases, musculoskeletal disorders, cardiovascular diseases and cancer, are the concomitant conditions with the ageing process (Li et al., 2021). Older adults are particularly at risk for degenerative musculoskeletal disorders. Osteoarthritis, for instance, is characterised by the degeneration of cartilage and adjacent bones, generally affecting the function of shoulders, fingers, hips and knees. This degeneration results in pain and restricted movement, limiting activities like walking and driving. The occurrence of osteoarthritis in the knee and ankle is quite problematic for drivers, as it can decelerate braking responses. Limitations of driving do not disappear even with the intervention of surgery or joint replacement (Falkenstein, Karthaus and Brüne-Cohrs, 2020). Most importantly, comorbidities related to ageing, such as congestive heart failure and chronic obstructive pulmonary disease (COPD), can also reduce mobility, restrict muscle and tendon function and worsen musculoskeletal problems (Minetto et al., 2020).

2.4.3.2 Body Mass Index (BMI)

Body Mass Index (BMI) is a common metric for evaluating physical fitness, calculated by dividing a person's weight in kilograms by the square of their height in meters. For most adults, an optimal BMI ranges from 18.5 to 24.9, with values below 18.5 indicating underweight, between 25 and 29.9 indicating overweight, and 30 or higher indicating obese (Alangari et al., 2022). Research by Ngatcha Tchounga et al. (2022) discovered that 47.5 % and 25.8 % of their participants were overweight and obese, respectively, and drivers with higher BMI levels exhibit a higher prevalence of MSDs. Overweight and obesity, apart from posing cardiovascular risks, are also widely known factors underlying lower back pain (LBP), with the abdominal fat amplifying mechanical stress on the vertebrae of the lumbar region and triggering a cascade of structural changes. These changes include increasing lumbar curvature and altering spinal alignment, contributing to the pathogenesis of lordosis (Saludes et al., 2022). Studies indicated that obese patients suffering from LBP often recover, provided that their body weight is reduced and maintained at an acceptable level, which happens to be most effective among the population with morbid obesity (BMI $\geq$ 40 kg/m^2) (Siddiqui et al., 2022).

Obesity not only exerts prolonged pressure on the lumbar region but also influences spinal health through biochemical and inflammatory pathways. As adipose tissue multiplies, it releases pro-inflammatory cytokines and adipokines, which can induce inflammation in the musculoskeletal system and lead to pain (Dzakpasu et al., 2021). Excess body weight degenerates the lumbar structure, comprising discs, joints and ligaments (Ngatcha Tchounga et al., 2022; Siddiqui et al., 2022).

Nonetheless, Ngatcha Tchounga et al. (2022) found the association between obesity and MSDs are less significant, particularly in men. This is possibly due to differences in muscle and fat ratio and distribution, exercise habits or gender-specific responses to weight gain, where heavier men are less susceptible to MSDs than women. Notably, physical activity among overweight and obese drivers may mitigate the risk of MSDs, suggesting that BMI alone may not be a definitive predictor of MSDs.

2.4.3.3 Highest Education Background

There is no direct association between drivers' highest educational attainment and the prevalence of MSDs. The study by Raghupathi and Raghupathi (2020) investigated the impact of education, focusing on various indicators such as life expectancy, potential years of life lost, infant mortality and mortality due to cancer. The results showed that individuals with higher educational levels tend to enjoy better health outcomes and longer life expectancy compared to those with lower educational attainment. This correlation is likely due to the foundational impact of education that enhances individuals' self-awareness regarding personal health and improves their access to healthcare resources. As a result, those with lower educational attainment often exhibit poorer health outcomes (Raghupathi and Raghupathi, 2020). However, Maduagwu et al. (2022) found that taxi drivers possessing a secondary education or higher reported a greater incidence of MSDs compared to their less educated counterparts. Although individuals with higher education may have been trained for other professions, economic difficulties, particularly the high unemployment rate in Nigeria, have forced them to resort to commercial driving as a means of financial support.

2.4.3.4 Medical Conditions

Musculoskeletal disorders (MSDs) are commonly associated with a range of comorbidities, including cardiovascular disease, hypertension, high cholesterol, diabetes, asthma, chronic obstructive pulmonary disease and kidney disease (Chen et al., 2018; Minetto et al., 2020; Ziade et al., 2020; Deme et al., 2021; Latiers et al., 2021; Squier et al., 2021; D'Onofrio et al., 2023; Najafi et al., 2023; Fyongo and Ramdhan, 2024). This relationship is largely driven by similar root causes such as lack of physical activity, malnutrition, insufficient sleep, elevated stress levels, smoking and consumption of alcohol (D'Onofrio et al., 2023; Najafi et al., 2023). Comorbidities affected by ageing, such as chronic obstructive pulmonary disease and congestive heart failure, can also restrict mobility, worsening the musculoskeletal system's progressive decline in function (Minetto et al., 2020). Moreover, hypercholesterolemia has been shown to impair Achilles tendon biomechanics, leading to a higher risk of injuries due to abnormal loading (Squier et al., 2021). Although a direct causal link has not been definitively established, the frequent coexistence of these conditions suggests that the presence of one may increase the likelihood of MSDs.

2.4.3.5 Job Tenure

Job tenure is closely linked to the prevalence of musculoskeletal disorders (MSDs) among professional drivers, with longer tenures associated with a higher risk. This connection is attributed to the cumulative exposure to occupational risk factors over time. In the study carried out in Hungary, Szűcs et al. (2020) found that 43 % of drivers had been working for more than 15 years, resulting in a higher incidence of MSDs. Since MSDs develop from prolonged exposure to different risk factors, the ongoing accumulation of these exposures over the years in their work environment likely accounts for the higher prevalence of MSDs.

2.4.3.6 Smoking

Current smoking is strongly related to pain across various body parts, especially in the spine and head. While short-term or single exposure to nicotine has demonstrated analgesic effects, prolonged exposure may paradoxically heighten sensitivity to pain, lower tolerance to pain and increase awareness of pain. Cigarette smoke can exacerbate pain perception by disrupting the metabolism of neurotransmitters such as serotonin, dopamine and norepinephrine, reducing sympathetic nervous system output and altering the endogenous opioid system. Additionally, smoking can cause damage to musculoskeletal and peripheral tissues through inflammatory and oxidative stress. A review examining the impact of cadmium (Cd) exposure from tobacco smoke on musculoskeletal disorders reveals a strong association between tobacco use and the onset of osteoarthritis, osteoporosis and rheumatoid arthritis. Elevated blood levels of Cd are linked to increased oxidative stress and inflammation, which accelerate cartilage breakdown. Cd inhaled through tobacco smoke adversely affects bone mineral density, contributing to osteoporosis by reducing antioxidant enzyme activity and promoting bone resorption. Additionally, in the context of rheumatoid arthritis, tobacco use worsens the citrullination process and heightens oxidative damage and inflammation (Fernández-Torres et al., 2022).

Besides, nicotine induces vasoconstriction, which diminishes blood flow and oxygen delivery to tissues, thereby impairing the metabolic and healing processes of intervertebral discs, bone and cartilage (Smuck et al., 2020). Individuals with chronic pain who smoke tend to experience more intense pain, as well as increased psychological distress and sleep disturbances, compared to their non-smoking counterparts. Persistent smoking not only impedes recovery but escalates these troubles. Moreover, during the early stages of smoking cessation, individuals are likely to face severe nicotine withdrawal symptoms and additional pain-related complications (Dai et al., 2021).

Notably, a meta-analysis conducted by Dai et al. (2021) found that knee pain uniquely had a negative correlation with smoking among chronic pain conditions, which means smokers had a lower risk of knee pain or knee osteoarthritis. Meanwhile, some other studies show discrepancies in these findings, possibly owing to different underlying mechanisms of knee pain or the impact of nicotine on cholinergic anti-inflammatory pathways.

2.4.3.7 Exercising

Studies found that any form of exercise is more beneficial than a sedentary lifestyle, as long as these practices are consistent. In healthy individuals, regular exercise promotes analgesia, which means a decrease in pain sensitivity, through mechanisms that involve the release of endogenous opioids and the inhibition of nociceptive pathways. Various theories explain how aerobic exercise can reduce pain sensitivity. The author proposed that aerobic exercise stimulates the release of endogenous opioids and beta-endorphins, resulting in hypoalgesia (Tan et al., 2022). However, these effects may not be immediate in those with chronic pain; they require time to overcome an initial surge in pain before relief is achieved (Tersa-Miralles et al., 2022). A review of the effects of aerobic exercise, such as walking or cycling, on musculoskeletal health concluded that regular aerobic activity at submaximal intensity, with gradual progression over 40 to 60 minutes, can effectively increase pain thresholds or reduce pain ratings of individuals suffering from musculoskeletal pain (Tan et al., 2022).

Exercise also plays a crucial role in slowing the physiological decline associated with both primary and secondary ageing. Musculoskeletal exercises, for example, resistance training, are useful in counteracting typical ageing processes and offering several clinical benefits. For example, resistance training promotes muscle mass and quality by stimulating the motor units, which leads to muscle fibre hypertrophy, enhanced neuromuscular control and increased strength. Additionally, this kind of training is effective in mitigating age-related bone mineral density loss and is recommended for preventing and treating osteoporosis (D'Onofrio et al., 2023)

Moreover, cytokines induced by exercise are integral to maintaining musculoskeletal health and addressing its associated pathologies. Inflammatory processes, which are characteristic of various musculoskeletal conditions like osteoarthritis, rheumatoid arthritis, psoriatic arthritis and tendinopathy, contribute to a complex interaction between the existing immune environment and the immune responses modulated by physical activity (Docherty et al., 2022)

2.4.4 Psychosocial Factors

Workplace psychosocial factors pose adverse effects on health, both physically and mentally. Psychosocial determinants leading to MSDs include job dissatisfaction and work stress, which typically arise from high psychological demands, limited job control, repetitive tasks, and inadequate social support MSDs (Gallagher and Barbe, 2022). The stress associated with job dissatisfaction affects both the nervous and endocrine systems and thus releases more inflammatory cytokines and catecholamines that cause vasoconstriction. Consequently, muscles become tenser and exert greater biomechanical stress on the musculoskeletal system, compromising the healing abilities of injuries stemming from the reduced blood supply and ongoing inflammation (Ngatcha Tchounga et al., 2022; Ruzairi et al., 2022; Choy, Mohd Rasdi and Wen, 2023). However, the outcome of musculoskeletal issues and the level of disability vary because of individual differences in stress responses and physical capabilities (Tang, 2020). Therefore, drivers who are dissatisfied with their jobs are more susceptible to muscle tension induced by stress, which is associated with pain in discs, tendons, ligaments, muscles and nerves. In contrast, drivers who are satisfied with their jobs report a lower prevalence of MSDs as they are better able to manage their job demands and control imbalances (Abere, Yenealem and Worede, 2023).

2.5 Previous Studies on Musculoskeletal Disorders Among Occupational Land Vehicle Drivers

Occupational driving is an occupation in which people drive a motor vehicle as their primary work activity (Joseph et al., 2020; 2023). There is an abundance of various occupations that fall under this broad category, typically depending on the types of vehicles driven. This includes but is not limited to bus drivers, truck drivers, taxi drivers and e-hailing drivers (Pickard et al., 2022). These drivers often encounter challenges while working, such as continuous time pressure, excessive physical demands and traffic congestion. These challenges could deteriorate their health and expose them to a higher risk of MSD manifestation (Choy, Mohd Rasdi and Wen, 2023; Joseph et al., 2023).

Research on musculoskeletal disorders (MSDs) among truck drivers is somewhat limited. However, the available studies indicate that the prevalence of MSDs over the past 12 months ranges from 72.9 % to 88.0 % (Sa-ngiamsak and Thetkathuek, 2022; Maciel et al., 2024). The lower back is the most commonly affected area, with a prevalence rate between 24.8 % and 72.0 %. Additionally, other frequently affected sites include the hips/thigh (9.0 %) and the shoulder (8.6 %), as well as the neck, which exhibits a prevalence rate ranging from 32.0 % to 67.3 %. The key risk factors contributing to MSDs among truck drivers consist of age, education level, years of driving experience, total driving hours and the distinction between long-distance and short-distance driving (Sa-ngiamsak and Thetkathuek, 2022; Shitu et al., 2022; Maciel et al., 2024).

In contrast, numerous studies have investigated MSDs among bus drivers, revealing a broad range in prevalence from as low as 21.2 % to as high as 95.8 % (Ekechukwu et al., 2021; Maduagwu et al., 2022). The most commonly reported MSD sites include lower back (34.0 % to 80.7 %), upper back (22.3 % to 54.1 %), neck (18.9 % to 81.9 %) and knee (29.5 % to 37.2 %). The predominant risk factors identified for MSDs in bus drivers are prolonged sitting, extended working hours, poor seat ergonomics, age, BMI, job-related stress and dissatisfaction (Pradeepkumar, Sakthivel and Shankar, 2020; Ekechukwu et al., 2021; Kasemsan et al., 2021; Chen, Alexander and Hu, 2022; Maduagwu et al., 2022; Sheth, Pagdhune and Viramgami, 2023).

Similarly, there is a significant body of research concerning MSDs among taxi drivers, although most studies tend to focus on lower back pain (LBP). Two studies examining the overall prevalence of MSDs among taxi drivers report prevalence rates between 55.0 % and 73.6 % (Szűcs, Ádám and Nagy, 2020; Aredo, 2024). Regarding LBP, which is the most frequently reported MSD, the prevalence ranges from 27.9 % to 85.7 % over the past 12 months and from 53.4 % to 75.4 % over the past 7 days. Determinants associated with LBP in taxi drivers include the presence of lumbar support, seat comfort, BMI, long job tenure and working hours, overweight and obesity, as well as job stress and satisfaction (Md Yusoff et al., 2020; Szűcs, Ádám and Nagy, 2020; Kurtul and Güngördü, 2022; Yitayal et al., 2022; Abere, Yenealem and Worede, 2023; Aredo, 2024).

While in the e-hailing industry, there are limited studies discussing the prevalence of MSDs among e-hailing drivers; only one pilot study focused on acute musculoskeletal pain among rideshare drivers which approximately 12 out of 35 drivers experienced acute pain most frequently in the lower back and neck; another study in Johor only assessed the prevalence of lower back pain with 82.1 % drivers experiencing it (Caban-Martinez et al., 2020; Radzlan, Naim Othman and Md Yusoff, 2023). The scarcity of related studies in e-hailing industries emphasises the indispensable need to conduct this research. Table 2.1 summarises previous studies from 2020 to 2024 on musculoskeletal disorders among occupational land vehicle drivers and their associated risk factors.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Caban-Martinez et al. (2020)	Pilot study, ride-share drivers in the United States (n = 35)	Neck, shoulders, wrists/hands, lower back, knees, ankles/feet	- Questions adapted from the US National Health Interview Survey - Nordic Musculoskeletal Questionnaire (NMQ)	- Self-reported prevalence of acute musculoskeletal pain was 33.0 %, with the most impacted areas including the lower back and neck. - Acute musculoskeletal pain was significantly associated ($p < 0.05$) with whether ridesharing is their primary job, prolonged working hours, and poor self-rated general health status.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	Design, Participant and Sample Size	Body part studied	Outcome Measure	Key Findings
Md Yusoff et al. (2020)	Quantitative cross-sectional design, elderly taxi drivers in Malaysia (n = 443)	Lower back	- Self-administered questionnaire - Rapid Upper Limb Assessment (RULA)	- Self-reported prevalence of LBPs was 75.4 % for the last 7 days. - LBP was significantly associated ($p < 0.05$) with BMI, smoking status, assisting passengers carrying luggage, the presence of lumbar support, the effect of the size of the seat for comfortable driving, the perception of suffering LBP due to seat design and long-distance driving, and score of RULA.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Pradeepkumar et al. (2020)	Quantitative cross-sectional design, bus drivers in South India (n = 301)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Nordic Musculoskeletal Questionnaire (NMQ)	- Self-reported prevalence of MSDs was 55.8 %, with the most impacted areas including knee (37.2 %), shoulder (24.2 %) and upper back (23.9 %). - MSDs were significantly associated ($p < 0.05$) with age, seat adaptability, prolonged sitting, bending body, active breaks, exercising, repetitive tasks, outside food dependency, exposure to vibration, job stress, adequacy of work breaks, drinking water and restrooms accessibility, BMI, current health status, shift timings, perception of the risk of driving job.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Szűcs et al. (2020)	Quantitative cross-sectional design, taxi drivers in Hungarian (n = 88)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Self-administered questionnaire - Visual Analogue Scale (VAS) - Roland-Morris Disability Questionnaire (RMDQ)	- Self-reported prevalence of MSDs was 73.9 %, with the most impacted areas including the lower back (61.4 %). - The average score for VAS was 5.94 out of 10. - The average score for RMDQ was 6.44 out of 24. - MSDs were significantly associated ($p < 0.05$) with poor design of driver's seat, and high frequency of feeling mental stress.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Ekechukwu et al. (2021)	Quantitative cross-sectional design - Commercial minibus drivers in Nigeria (n = 200) - Minibus conductors (n = 179)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Nordic Musculoskeletal Questionnaire (NMQ) - A content-validated Driving Work Station Assessment (DWSA) form	- Self-reported prevalence of MSDs was 95.8 %, with the most impacted areas including lower back (66.8 %) and upper back (54.1 %). - Bus drivers reported a higher prevalence of low back pain (85.0 % compared to 46.4 %), knee (25.0 % compared to 9.5 %), elbow (11.5 % compared to 3.9 %) and wrist (10.5 % compared to 3.4 %) than bus conductors. - MSDs were significantly associated ($p < 0.05$) with work duration, frequency of work, job dissatisfaction and job stress.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	Design, Participant and Sample Size	Body part studied	Outcome Measure	Key Findings
Kasemsan et al. (2021)	Quantitative cross-sectional design, professional bus drivers (n = 83)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Nordic Musculoskeletal Questionnaire (NMQ) - Neck disability index (NDI) - Oswestry disability index (ODI) - Shoulder pain and disability index (SPADI)	- The most impacted areas include the neck (81.9 %) and back (80.7 %). - Self-reported prevalence of LBPs in the last 7 days was 53.0 %.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Chen et al. (2022)	Quantitative cross-sectional design, bus drivers in the Taipei metropolitan area (n = 145)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Nordic Musculoskeletal Questionnaire (NMQ)	- Self-reported prevalence of MSDs was 78.3 %, with the most impacted areas including the neck (46.9 %), right shoulder (40.0 %), lower back (37.2 %) and left shoulder (33.8 %). - MSDs were significantly associated ($p < 0.05$) with poor design of the driver's seat, stress and stretching between trips.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Kurtul and Güngördü (2022)	Quantitative cross-sectional design, taxi drivers at taxi stands in Turkey (n = 447)	Lower back	- Self-administered questionnaire - Nordic Musculoskeletal Questionnaire (NMQ) - Back Pain Functional Scale	- The self-reported prevalence of LBPs was 49.7 % in the past 12 months. - LBP was significantly associated ($p < 0.05$) with BMI, no physical activity, long job tenure, no rest day taken per week, absence of lumbar support, and job dissatisfaction.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	Design, Participant and Sample Size	Body part studied	Outcome Measure	Key Findings
Maduagwu et al. (2022)	Quantitative cross-sectional design, commercial minibus drivers in Nigeria (n = 250)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Close-ended validated self-administered questionnaire - Nordic Musculoskeletal Questionnaire (NMQ)	- Self-reported prevalence of MSDs was 21.2 % with the most impacted areas including the lower back (34.0 %), upper back (22.3 %), neck (18.9 %), shoulder (18.2 %), ankle (17.0 %), hip/thigh (15.1 %), knee (14.9 %), wrist (7.5 %) and elbow (7.5 %). - MSDs were significantly associated ($p < 0.05$) with age, marital status, and educational level.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Ngatcha Tchounga et al. (2022)	Quantitative cross-sectional design, male professional taxi drivers in Cameroon (n = 151)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Self-administered questionnaire - Nordic Musculoskeletal Questionnaire (NMQ) - Global Physical Activity Questionnaire - Anthropometric parameters	- Self-reported prevalence of MSDs was 86.8 %, with the most impacted areas including lower back (72.8 %), neck (42.4 %) and knees (29.1 %). - MSDs were significantly associated ($p < 0.05$) with job dissatisfaction. - 62.9 % of drivers had low physical activity levels, and this was not associated with MSD occurrence.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Sa-ngiamsak and Thetkathuek (2022)	Quantitative cross-sectional design, deep-seaport container truck drivers in Thailand (n = 25)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Standardised Modified Nordic Musculoskeletal Questionnaire (NMQ)	- Self-reported prevalence of MSDs was 88 % in the past 12 months with the most impacted areas including lower back (72 %) and neck (32 %). - Neck pain was significantly associated ($p = 0.0028$) with long-distance drivers compared to short-distance drivers.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Shitu et al. (2022)	Quantitative cross-sectional design, heavy truck drivers in Nigeria (n = 150)	Neck	- Self-administered questionnaire	- The self-reported prevalence of neck pain was 67.3 %. - Neck pain was significantly associated ($p < 0.05$) with age, education level, driving experience in years, and total driving hours.
Yitayal et al. (2022)	Quantitative cross-sectional design, male taxi drivers in Mekelle city, Ethiopia (n = 294)	Lower back	- Self-administered questionnaire - Nordic Musculoskeletal Questionnaire (NMQ)	- The self-reported prevalence of LBPs was 27.9 % in the past 12 months. - LBPs were significantly associated ($p < 0.05$) with average daily hours of driving, the presence of lumbar support and a lack of ergonomic awareness.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	Design, Participant and Sample Size	Body part studied	Outcome Measure	Key Findings
Abere et al. (2023)	Quantitative cross-sectional design, taxi drivers from Gondar City, Ethiopia (n = 371)	Lower back	- Modified Nordic Musculoskeletal Questionnaire (NMQ)	- The self-reported prevalence of LBPs was 85.7 % in the past 12 months and 53.4 % for the last 7 days. - LBPs were significantly associated ($p < 0.05$) with prolonged working hours per day, absence of lumbar seat support, overweight/obese, drinking alcohol, and job dissatisfaction.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	Design, Participant and Sample Size	Body part studied	Outcome Measure	Key Findings
Radzlan et al. (2023)	Quantitative cross-sectional design, e-hailing drivers in Johor Bahru, Malaysia ($n = 262$)	Lower back	- Self-administered questionnaire - Rapid Upper Limb Assessment (RULA)	- Did not determine the prevalence of lower back pain (LBP) - LBP was significantly associated ($p < 0.05$) with the frequency of carrying passengers per day, rest day taken per week, assisting passengers carrying loads, the reason for becoming e-hailing drivers during Coronavirus Disease 2019 (COVID-19), the effect of income during COVID-19, working until late at night during COVID-19, experiencing LBP during past 12 months and last 7 days.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	Design, Participant and Sample Size	Body part studied	Outcome Measure	Key Findings
Sheth et al. (2023)	Quantitative cross-sectional design - Metropolitan transit bus drivers (n = 254) - Indoor desk job workers (n = 73)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Semi-closed, self-administered questionnaire - Modified Nordic Musculoskeletal Questionnaire (NMQ) - Anthropometric measurement and haematocrit estimation	- Self-reported prevalence of MSDs among bus drivers (49.2 %) was higher than administration staff (28.8 %) by two times with the most impacted areas also significantly higher than administration staff including lower back (36.6 % compared to 11 %), knee (29.5 % compared to 15.1 %) and hip (7.5 % compared to 1.4 %). - MSDs were significantly associated ($p < 0.05$) with age, smoking, BMI, and job profile of drivers compared to administration staff.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Aredo (2024)	Quantitative cross-sectional design, taxi drivers from five selected sub-cities in Addis Ababa (n = 371)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Nordic Musculoskeletal Questionnaire (NMQ)	- Self-reported prevalence of MSDs was 55 %, with the most impacted areas including lower back (24.8 %), hips/thigh (9.0 %) and shoulder (8.6 %). - MSDs were significantly associated ($p < 0.05$) with longer years of driving.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	**Design, Participant and Sample Size**	**Body part studied**	**Outcome Measure**	**Key Findings**
Maciel et al. (2024)	Quantitative cross-sectional design, truck drivers in the city of Uruguaiana, Brazil (n = 70)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Self-administered questionnaire Task Load Index Questionnaire - Nordic Musculoskeletal Questionnaire (NMQ)	- Self-reported prevalence of MSDs was 72.9 % in the past 12 months, with the most impacted areas including lower back (24.8 %), hips/thigh (9.0 %) and shoulder (8.6 %). - Lower back pain was significantly associated ($p < 0.05$) with mental workload and working hours. - MSDs in the neck, shoulders and lower back were significantly associated ($p < 0.05$) with working hours, particularly for the drivers who work more than 12 hours per day.

Table 2.1: Summary of Previous Studies on Musculoskeletal Disorders and Their Associated Risk Factors Among Occupational Land Vehicle Drivers (cont.)

Author	Design, Participant and Sample Size	Body part studied	Outcome Measure	Key Findings
Raza et al. (2024)	Quantitative cross-sectional design, heavy vehicle drivers randomly selected (n = 48)	Neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, ankles/feet	- Nordic Musculoskeletal Questionnaire (NMQ)	- Self-reported most impacted areas in the past 12 months, including lower back (56.0 %), knee (43.0 %) and neck (39 %). - LBPs were significantly associated ($p < 0.05$) with growing age, bad suspension system and improper body posture during working hours. - Knee pain was significantly associated ($p < 0.05$) with a bad suspension system and forceful exertion to lift the heavy load.

CHAPTER 3

METHODOLOGY

3.1 Chapter Overview

This section described the systematic procedures for conducting the research and provided a justification for the chosen methodologies, all with the ultimate goal of achieving the research aim and objectives.

3.2 Study Design

A cross-sectional study was conducted to determine the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers in Selangor and investigate the associated risk factors. A cross-sectional study was a type of observational study that involved observing or measuring both the exposure and outcome at a single point in time from a representative sample of a larger population (Pandis, 2014). The primary objective of this study design was to either describe the prevalence of an outcome (descriptive) or to determine potential associations between variables (analytical). This design was often used to compare exposure to risk factors between different groups within the sample. In public health settings and epidemiological research, cross-sectional studies played a critical role in planning healthcare services or developing prevention strategies (Kesmodel, 2018). The cross-sectional study was one of the most widely used study designs owing to its simplicity, time efficiency and relatively lower cost compared to cohort studies or randomised controlled trials. However, since data was collected at the same time point, it was difficult to determine temporal or causal relationships between the exposure and outcome, as the exposure must precede the outcome to establish causation (Pandis, 2014). Consequently, the results could only show associations, not causations. The study employed a quantitative approach using a survey as the primary data collection method.

3.3 Study Location

The research was conducted in Selangor, targeting e-hailing drivers via the distribution of questionnaires in various e-hailing drivers' waiting areas across the state of Selangor (Figure 3.1 & Figure 3.2).

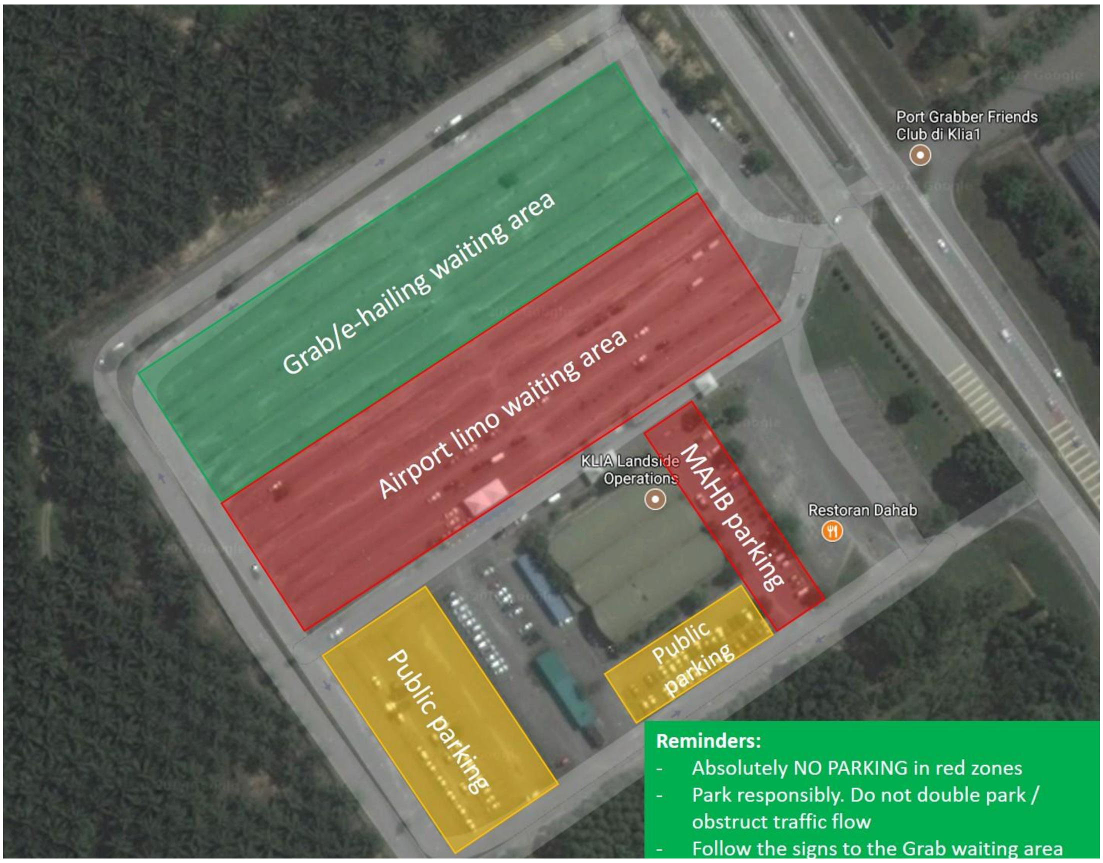


Figure 3.1: E-hailing Waiting Area at KLIA Landside Operations (Grab Driver Malaysia, 2018)

Figure 3.2: E-Hailing Waiting Area at Charter Field Town (Borneo Falcon, 2013)

Selangor was chosen due to its significant urbanisation and industrialisation, which drove the rapid development of public transportation systems. This development enhanced accessibility and served as a promising alternative to mitigate traffic congestion (Yahya, Mohd Safian and Burhan, 2021). Figure 3.3 showed the Geographic Information System (GIS) map illustrating the dense clustering of public transport in key areas such as Kuala Lumpur, Petaling Jaya and Shah Alam. This concentration fuelled a parallel increase in e-hailing services, making Selangor the most active region for the e-hailing industry in Malaysia.

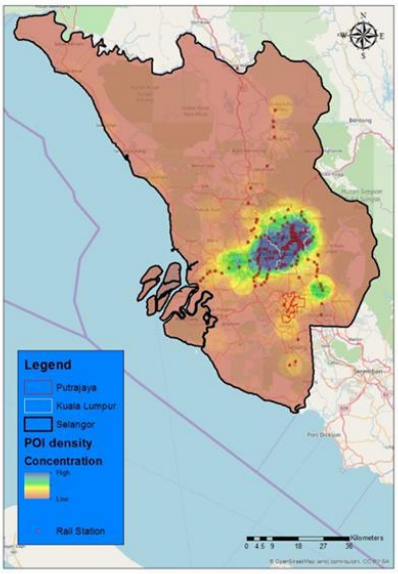


Figure 3.3: Distribution of Public Transport in Selangor (Yahya, Mohd Safian and Burhan, 2021)

3.4 Study Population

The study targeted e-hailing drivers who met the inclusion criteria. The requirements to participate in the study included the following:

i. Being aged between 18 and 69 years.
ii. Having at least one year of experience working as an e-hailing driver.
iii. Primary e-hailing driving area must be within the state of Selangor.
iv. Completed all questions in the questionnaire.
v. Participated voluntarily.
vi. Provided informed consent to participate in the research study in compliance with the Personal Data Protection Statement of UTAR.

3.5 Sampling Method

Homogeneous purposive sampling was utilised, where only e-hailing drivers who met all inclusion criteria were selected. This non-probabilistic sampling method allowed the deliberate selection of participants based on the inclusion criteria, ensuring that the chosen sample was relevant to the research objectives.

3.6 Sample Size

The sample size of the study was calculated using Cochran's Sample Size Formula (Cochran, 1963) by referring to a similar study conducted among 151 male professional taxi drivers in Cameroon. The overall prevalence of musculoskeletal symptoms was 86.8 %, with a confidence interval of 95 % and a margin of error of 5%. The following equation determined the required sample size:

$$n = z^2 p\,(1 - p) / d^2 \tag{3.1}$$

$$n = (1.96)^2 \times (0.87)\,(0.13) / (0.05)^2 = 173.76 = 174$$

where

n = sample size

p = prevalence of MSD in previous similar study (Ngatcha Tchounga et al., 2022)

d = margin of error

z = 95 % confidence limit

The calculated sample size was 174. Considering a 10 % non-response rate, the minimum sample size that would be recruited was 191 e-hailing drivers.

3.7 Instrumentation

Self-administered questionnaire was developed to investigate the prevalence of MSD symptoms and the associated risk factors among e-hailing drivers. This questionnaire consisted of three sections: Section A: Sociodemographic background, Section B: Work characteristics and Section C: Self-assessment of musculoskeletal disorder (MSD) symptoms.

Section A included sociodemographic data addressing individual and lifestyle factors such as primary working state, age, gender, height, weight, highest education background, smoking habits, exercise habits, medical conditions, road accident occurrence, history of MSDs before joining the e-hailing industry and length of service as e-hailing drivers.

Section B included work characteristics information pertaining to occupational, physical and psychosocial factors, such as average e-hailing driving hours per day, average e-hailing driving days per week, average rest day taken per week, working at night, frequency of breaks, stretching exercise during breaks, taking naps while waiting for orders, lifting luggage during work, presence of lumbar support, job satisfaction and job stress.

Section C consisted of a self-assessment of musculoskeletal disorder (MSD) symptoms using a Standardised Nordic Musculoskeletal Disorders Questionnaire. This standardised questionnaire was developed by Kuorinka et al. (1987) and could be self-administered or utilised during interviews. It served as a reliable tool for determining MSD prevalence, even though it did not represent a clinical diagnosis. This questionnaire was tested on specific populations, and its reliability and validity were deemed acceptable. Many recent similar studies employed this questionnaire as their instrument for assessing MSD symptoms (Caban-Martinez et al., 2020; Szűcs et al., 2020; Fatima et al., 2021; Kurtul and Güngördü, 2022; Maduagwu et al., 2022; Ngatcha Tchounga et al., 2022; Abere et al., 2023; Aredo, 2024). Completion of the survey was facilitated by a diagram of a human body map showing nine body parts: neck, shoulders, upper back, elbows, lower back, wrists or hands, hips or thighs, knees and ankles or feet. Respondents were asked to identify whether they experienced any discomfort or pain in these nine body parts in the past 12 months for chronic symptoms and past 7 days for acute symptoms, preventing them from performing daily work and home activities.

The construction of this questionnaire was based on the results of similar studies, where the significant associated risk factors varied in each study due to diverse topography, sociocultural lifestyles and working environments. Specifically, all of their questionnaire questions and the significant associations between different risk factors were meticulously analysed to decide whether the questions should be included in the questionnaire. This process ensured that the questionnaire was tailored to our research objectives and maintained its succinctness.

The questionnaire was distributed to the relevant experts in the occupational health and safety field for pre-testing and verification of the questionnaire. Subsequently, the prepared English questionnaire was translated into local languages, Malay and Chinese, to reach a broader e-hailing population. The questionnaire was then translated back into English by individuals fluent in both Malay and English or both Chinese and English to ensure its quality and consistency. Pilot testing was carried out on 5 % of the sample size of the e-hailing drivers to identify any confusion or ambiguity in the questionnaire. The questionnaire was then revised and corrected based on the feedback obtained from the pilot testing. Appendix A presented the survey questionnaire employed in this study.

3.8 Data Collection

Figure 3.4 depicted the process of data collection for this study. Following ethical approval by UTAR, the questionnaire was disseminated to participants physically at various e-hailing waiting areas. Prior to data collection, a brief explanation of the study's content and purpose was provided. Furthermore, an interviewer-administered method was implemented if participants preferred answering the questions verbally instead of completing the self-administered questionnaire. Participants were asked to submit the informed consent form along with the completed questionnaire, indicating their agreement to participate voluntarily. Participants could withdraw without restriction if they found participation inconvenient or lost interest.

The questionnaire was expected to take approximately 10 minutes to complete. The researcher's contact information was available on the first page of the questionnaire to address any questions the participants may have. The researcher reviewed submitted questionnaires daily during the collection period to ensure their validity. Throughout the process, participants' personal information remained confidential and would not be disclosed to any other party.

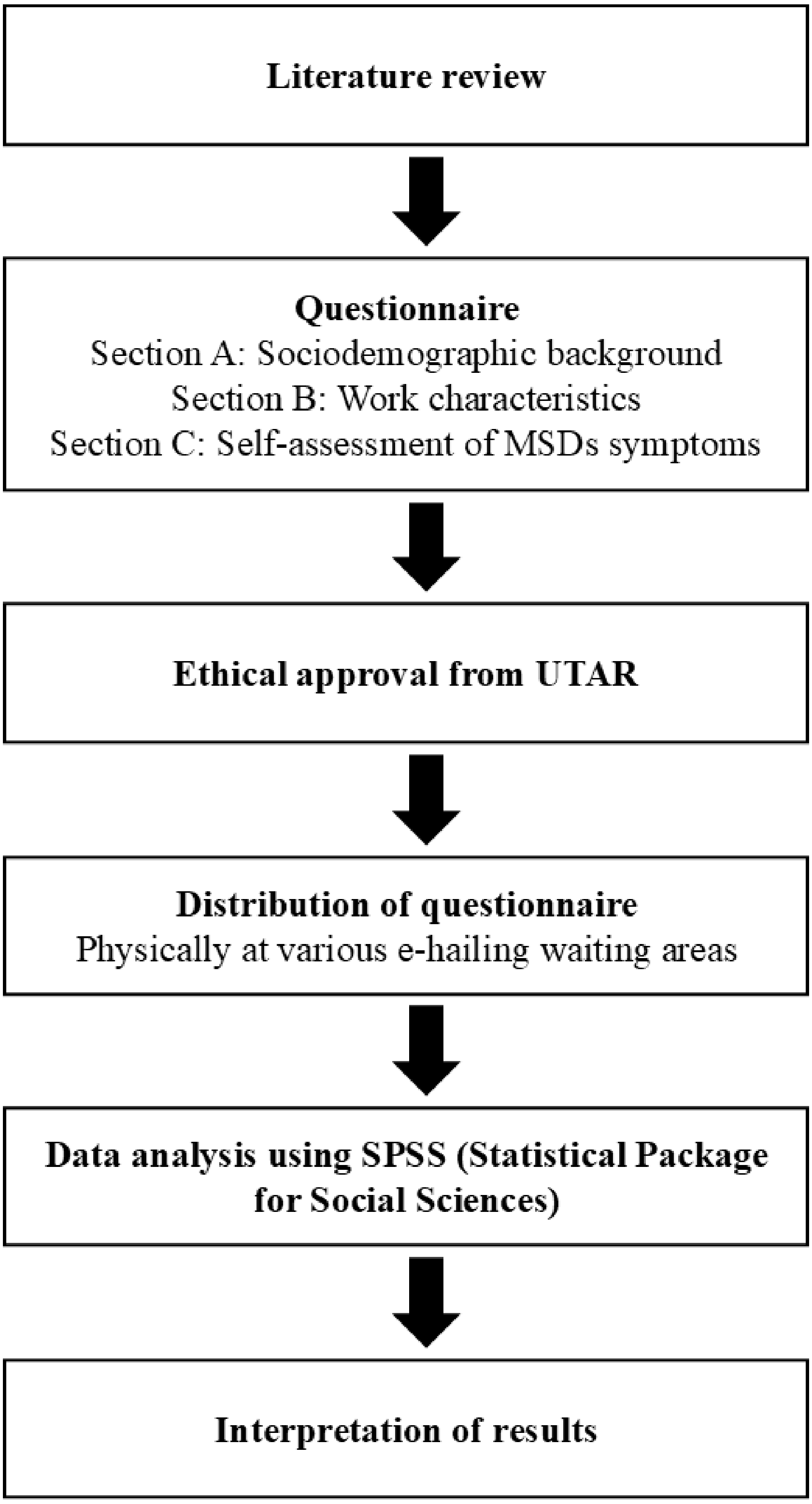


Figure 3.4: Research Procedure Flowchart

3.9 Data Analysis

3.9.1 Data Cleansing and Preparation

The data obtained from completed questionnaires were retrieved. At the initial design stage, the questionnaire was carefully designed to ensure all answer slots were filled in. Nonetheless, a data cleansing procedure was performed to identify and address any missing or invalid data. Incomplete data were managed through appropriate techniques, notably imputation or deletion, depending on the nature and the extent of the missing values (Karrar, 2022). Afterwards, the cleansed data were exported to the Statistical Package for the Social Sciences (SPSS) version 29.0.1.0 (170) for data analysis. Double-checking of the data was carried out to maintain data integrity and resolve any discrepancies.

3.9.2 Statistical Analysis

SPSS was an indispensable and valuable tool for organising and analysing statistical social science data. It was developed in the early 1980s and has since evolved to the latest version (version 29). This statistical package was well known for its simplicity, practicability, and familiarity with applied math consultants. This software contributed to the organised analysis of vast amounts of quantitative data into comprehensive and manageable forms (Nelson et al., 2022). A wide array of statistical techniques could be conducted using SPSS, including descriptive statistics (means, medians, frequencies), inferential statistics (chi-square tests, t-tests, Analysis of Variance (ANOVA)), a multiple regression analysis (regression models to identify risk factors) (Nelson et al., 2022).

As shown in Table 3.1, descriptive statistics were employed to summarise the data acquired and the characteristics of individual, occupational, physical and psychosocial risk factors. Notably, the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers was determined and reported as percentages with

95 % confidence intervals. Measures such as means, medians, frequencies and percentages were calculated to provide an overview of the dataset.

Meanwhile, inferential statistical tests assessed the associations between individual, occupational, physical and psychosocial factors and MSD symptoms. Among diverse statistical techniques, Chi-square tests and independent t-tests were used to examine the relationships between categorical variables.

Initially, separate binary logistic regression analyses were conducted for each variable that met the inclusion criteria, with age and BMI incorporated as covariates. Age and BMI were included because they were recognised contributors to musculoskeletal disorders (MSDs). By adjusting for these factors, the analysis aimed to minimise potential confounding, ensuring that the identified associations between independent variables and MSD symptom prevalence were not influenced by differences in age and BMI among participants (Szűcs, Ádám and Nagy, 2020). A p-value < 0.05 will be considered statistically significant. Binary logistic regression models were leveraged to identify significant risk factors associated with MSDs among e-hailing drivers. Variables with a p-value < 0.2 in the univariate analysis were included in the multiple regression model (Nelson et al., 2022). The selection criterion was applied to prevent the early exclusion of any potential risk factors (Hosmer, Lemeshow and Sturdivant, 2013). Lastly, multiple linear regression was performed to identify significant predictors associated with an increase in MSD scores, indicating the number of body parts affected by musculoskeletal disorder symptoms.

Table 3.1: Data Analysis Methods and Tests Respective to Each Study Objective

No.	Objective	Analysis conducted
1	To identify the characteristics of individual, occupational, physical and psychosocial factors among e-hailing drivers in Selangor.	Descriptive Statistics (Mean and standard deviation for numerical variable and frequency test for categorical variable)
2	To determine the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers in Selangor.	Descriptive Statistics (Frequency test)
3	To investigate the relationships between individual, occupational, physical and psychosocial factors with MSD symptoms among e-hailing drivers in Selangor.	Bivariate analysis (Chi-square test and independent t-tests)
		Multiple regression (Multiple linear or binary logistic regression)

3.10 Ethical Considerations

The research adhered to the highest ethical standards, and ethical approval was obtained from the Scientific and Ethical Review Committee of Universiti Tunku Abdul Rahman (UTAR). The approval was applied following the submission of the research proposal and the development of the questionnaire (Appendix B).

All procedures involving human participants were conducted in compliance with ethical guidelines. To ensure confidentiality, responses to the survey were collected anonymously. Participants' personal information was safeguarded and not disclosed.

Before participating in the study, individuals were provided with detailed information about its purpose, objectives, and measures to protect their personal data. Participants were required to provide informed consent by selecting “yes” or “no” to the following statement: “I hereby consent to my voluntary participation in this survey, which will be conducted anonymously,” in accordance with UTAR’s Personal Data Protection Statement.

The study took stringent measures to handle sensitive data responsibly, ensuring the safety and privacy of participants. All data was used solely for research purposes, and no information was disclosed beyond the scope of this research.

Participation in this study was entirely voluntary. Participants were informed that they could withdraw at any time without penalty, and their decision to participate or withdraw would not affect their relationship with the institution.

This study complied with all established ethical principles and regulations, ensuring that the rights and well-being of participants were protected throughout the research process.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Summary of Data Collection

Between 20 October 2024 and 6 January 2025, 188 completed survey questionnaires were collected from e-hailing drivers at different waiting areas near Kuala Lumpur International Airport, Selangor. Among these responses, 11 respondents were excluded as they did not meet the second inclusion criteria, shown as follows:

i. Being aged between 18 and 69 years.
ii. Having at least one year of experience working as an e-hailing driver.
iii. The primary e-hailing driving area must be within the state of Selangor.
iv. Completed all questions in the questionnaire.
v. Participated voluntarily.
vi. Provided informed consent to participate in the research study in compliance with the Personal Data Protection Statement of UTAR.

The remaining 177 responses were verified to be valid and consecutively analysed in order to fulfil the purpose of the study.

4.2 Individual Risk Factors

Table 4.1 showed the sociodemographic information of the 177 respondents, such as their age, gender, height, weight, highest education background, smoking habits, exercising habits, medical conditions, traumatic road or work accident history, experience of musculoskeletal pain or discomfort before joining the e-hailing industry and job tenure. In terms of geographical background, most of the respondents carried out e-hailing jobs in Selangor (100 %) and Wilayah Persekutuan Kuala Lumpur (72.9 %). From a total of 177 responses, the e-hailing drivers' ages ranged from 19 years old to 66 years old. Within this range, the majority of the respondents, where 58 of 177 respondents (32.8 %) aged between 31 and 40 years old, followed by 50 (28.2 %) respondents aged between 51 and 60 years old, while 43 (24.3 %) respondents aged between 41 and 50 years old, constituting a mean and standard deviation of 44.92 and 10.54.

According to Table 4.1, only 2 (1.1 %) respondents were female, while the remaining 175 respondents (98.9 %) were male. A possible reason for the difference was the disproportionate number of male drivers in the sample. The distribution of age and gender ran parallel to findings from other studies on drivers' profiles, where most e-hailing drivers were male (91 %) and primarily aged between 30 and 49 (Jamaluddin et al., 2021a). Meanwhile, the mean and standard deviation of height, weight and body mass index (BMI) of the respondents were 168.24 (7.43) cm, 77.41 (17.34) kg and 27.33 (5.72), respectively. In terms of BMI, 37.9 % of e-hailing drivers were overweight, while 25.4 % of them were classified as obese. This prevalence was slightly higher than the national civilian BMI statistics reported in the National Health and Morbidity Survey 2023, which found that 32.6 % of civilians were overweight and 21.8 % were obese (Ministry of Health Malaysia, 2024). The higher prevalence among e-hailing drivers could have been attributed to their sedentary work nature, which involved prolonged sitting and sustained postures while driving.

Table 4.1: Socio-Demographic of Respondents (n=177)

Variables	**N = 177**	
	n (%)	**Mean ± SD**
Working state		
Johor	3 (1.7)	
Kelantan	2 (1.1)	
Melaka	5 (2.8)	
Negeri Sembilan	7 (4.0)	
Pahang	3 (1.7)	
Perak	4 (2.3)	
Sabah	1 (0.6)	
Selangor	177 (100.0)	
W.P. Kuala Lumpur	129 (72.9)	
W.P. Putrajaya	19 (10.7)	
Age (years)		44.9 ± 10.5
Gender		
Male	175 (98.9)	
Female	2 (1.1)	
Height (cm)		168.2 ± 7.4
Weight (kg)		77.4 ± 17.3
Body Mass Index (BMI)		27.3 ± 5.7

SD = Standard deviation

Returned surveys from 177 respondents revealed that the respondents who had not attained any formal education (5) were half the number of those who had attended primary school (10). Meanwhile, the majority of respondents attended secondary school, with 81 out of 177 having fallen into this category. The remaining 81 (45.8 %) respondents pursued tertiary education, with 51 (28.8 %) having undertaken pre-university, technical or vocational school or college studies, 26 (14.7 %) had obtained undergraduate degrees and 4 (2.3 %) had completed postgraduate studies. This finding was similar to that of Jamaluddin et al. (2021), where the highest proportion of drivers (42.9 %) had attended secondary school, 33.7 % pursued post-secondary education, and 17.3 % obtained a university degree.

Pertaining to lifestyle habits, most e-hailing drivers (78.0 %) were smokers, either smoking cigarettes or vaping. Among them, the predominant group consisted of light smokers (40.1 %), followed by heavy smokers (23.2 %) and occasional smokers (14.7 %). Regarding exercise habits, nearly half of the respondents (47.5 %) did not engage in regular physical activity, which should have lasted at least 30 minutes each time. Among those who did, most exercised one to two times per week (26.6 %), while a smaller proportion exercised more than three times per week (19.2 %), and the smallest group participated in daily exercise (6.8 %). Since the debut of e-hailing services in Malaysia, which were Uber in 2013 and Grab in 2014, half of the respondents (49.7 %) have been active in this industry for more than five years, succeeded by those with three to five years of experience (30.5 %), while 35 respondents (19.8 %) joined within the past two years.

Table 4.1: Socio-Demographic of Respondents (n=177) (cont.)

Variables	**N = 177**
	n (%)
Highest education background	
No formal education background	5 (2.8)
Primary school	10 (5.6)
Secondary school	81 (45.8)
Pre-university, technical or vocational school or college	51 (28.8)
Undergraduate degree	26 (14.7)
Postgraduate degree	4 (2.3)
Smoking	
Never	39 (22.0)
Occasional	26 (14.7)
Light	71 (40.1)
Heavy	41 (23.2)
Exercising	
Not frequently exercise	84 (47.5)
1 – 2 times per week	47 (26.6)
> 3 times per week	34 (19.2)
Every day	12 (6.8)
Job tenure (years)	
1 – 2	35 (19.8)
3 – 5	54 (30.5)
> 5	88 (49.7)

As outlined in Table 4.2, the respondents' medical histories and current health conditions were presented. Fifty (28.2 %) respondents who completed the survey indicated that they had encountered various medical conditions, with the top three medical conditions being high cholesterol (14.7 %), hypertension (13.6 %) and diabetes (7.9 %). Besides, 67 out of 177 e-hailing drivers (37.9 %) had experienced a traumatic road or work accident before, suggesting that such incidents might have resulted in either temporary or permanent bodily harm. Apart from health issues, some e-hailing drivers had had pre-existing physical conditions before joining the industry, either due to their previous work exposure or personal circumstances. Many had experienced muscle pain and discomfort, primarily in the neck (36.2 %), lower back (31.6 %) and shoulders (28.8 %). On the other hand, one-third of the respondents reported no prior muscle discomfort before becoming e-hailing drivers.

Table 4.2: Medical History and Current Condition (n = 177)

Variables	**N = 177**
	n (%)
Medical conditions	
Cardiovascular disease	6 (3.4)
Hypertension	24 (13.6)
High cholesterol	26 (14.7)
Diabetes	14 (7.9)
Asthma	1 (0.6)
Herniated disc	3 (1.7)
Gout	1 (0.6)
Cancer	1 (0.6)
Have you ever had a traumatic road or work accident?	
Yes	67 (37.9)
No	110 (62.1)

Table 4.2: Medical History and Current Condition (n = 177) (cont.)

Variables	**N = 177**
	n (%)
Experiencing muscle pain in the body part before joining the e-hailing industry	
Neck	64 (36.2)
Shoulders	51 (28.8)
Elbows	7 (4.0)
Wrists or hands	27 (15.3)
Upper back	36 (20.3)
Lower back	56 (31.6)
Hips or thighs	26 (14.7)
Knees	40 (22.6)
Ankles or feet	27 (15.3)
None of the above	59 (33.3)

4.3 Occupational Risk Factors

Occupational risk factors that might have affected the prevalence of MSD symptoms consisted of average e-hailing driving hours per day, average e-hailing driving days per week, average rest days taken per week, working at night, frequency of breaks, stretching exercises during breaks and taking naps while waiting for orders. It can be seen from Table 4.3 that a vast proportion of respondents worked between nine to twelve hours per day (61.0 %) and 52.5 % worked every day, with mean and standard deviation values of 11.46 ± 2.78 working hours per day and 6.32 ± 0.93 working days per week, respectively. The working patterns observed among e-hailing drivers in this study demonstrated both similarities and differences when compared to previous studies. Radzlan, Naim Othman and Md Yusoff (2023) found that most e-hailing drivers in Malaysia worked more than eight hours per day and accumulated over 56 working hours weekly, typically taking only one rest day per week. In a study conducted by Abere, Yenealem and Worede (2023), among 371 participants, 265 taxi drivers (71.4 %) worked between ten to twelve hours per day, consistent with the current study's findings. Meanwhile, Kurtul and Güngördü (2022) reported that out of 447 drivers, 215 individuals drove between eight to twelve hours daily, and 54 respondents indicated that they did not take any rest days, while most (69.1 %) rested only once or twice weekly. In comparison, Yitayal et al. (2022) found that 50.3 % of their participants drove for 12 hours or more per day, suggesting that long working hours were a widespread occupational risk factor among e-hailing and taxi drivers across different regions.

During working hours, the prevailing number of e-hailing drivers (84.2 %) exhibited a tendency to work at night (7 p.m. to 12 a.m.). Among them, 54 (30.5 %) consistently worked night shifts, whereas 95 (53.7%) did so occasionally. This proportion was notably higher compared to Radzlan, Naim Othman and Md Yusoff (2023), where only 24.0 % of drivers worked late into the night, with more than half (51.9 %) preferring morning shifts. Similarly, findings by Md Yusoff et al. (2020) showed that less than half (38.1 %) of taxi drivers never worked during midnight, and only 23.9 % consistently worked into midnight. In contrast, a study conducted in Hungary involving 88 drivers revealed a more varied distribution, with 14 individuals not working night shifts at all, while the majority (84.1 %) took between one to three night shifts per week, indicating a less frequent engagement in nighttime work than the present study (Szűcs, Ádám and Nagy, 2020).

While working, nearly all e-hailing drivers (175 out of 177) took breaks, including toilet breaks, meal breaks, smoking breaks and rest breaks. Among them, 88 (49.7 %) took breaks three to five times per day, 57 (32.2 %) took breaks more than five times per day, while the remaining 30 (16.9 %) took only one to two breaks per day. Similarly, Szűcs, Ádám and Nagy (2020) demonstrated a varied break pattern in their study, where 46.6 % of drivers rested hourly, 27.3 % every two to three hours, and 15.9 % several times per hour, with 10.2 % reporting no breaks at all. Comparatively, Yitayal et al., (2022) found that 66.3 % of taxi drivers took breaks during taxi driving. Another study conducted in United States showed that only 5.7 % of drivers consistently took breaks outside their vehicles, while the majority (68.8 %) did so occasionally and 25.7 % rarely, suggesting that regular breaks were less common among their participants (Caban-Martinez et al., 2020).

To alleviate physical and mental fatigue caused by prolonged sedentary work, a significant number of e-hailing drivers (58.2 %) engaged in stretching exercises or massages during breaks. Additionally, 124 (70.1 %) drivers took short naps while waiting for e-hailing orders. In contrast, Radzlan, Naim Othman and Md Yusoff (2023) found that the majority of e-hailing drivers (87.0 %) did not take naps during breaks. Similarly, another study among taxi drivers showed that only a small portion (17.2 %) frequently took naps once or more per week, while most drivers (79.6 %) rarely engaged in napping activities (Ngatcha Tchounga et al., 2022). This implied that the napping behaviour observed among drivers in the current study was comparatively more common.

Table 4.3: Working Characteristics of Respondents (n=177)

Variables	**N = 177**	
	n (%)	**Mean ± SD**
Working hours per day (hours)		11.5 ± 2.8
Working days per week (days)		6.3 ± 0.9
Rest days per week (days)		0.7 ± 0.9
Frequency of working during nighttime hours		
Never	28 (15.8)	
Sometimes	95 (53.7)	
Always	54 (30.5)	
Frequency of work breaks		
No break time	2 (1.1)	
1 – 2 times	30 (16.9)	
3 – 5 times	88 (49.7)	
> 5 times	57 (32.2)	

SD = Standard deviation

Table 4.3: Working Characteristics of Respondents (n=177) (cont.)

Variables	**N = 177**	
	n (%)	**Mean ± SD**
Stretching exercises or massages during breaks		
Yes	103 (58.2)	
No	74 (41.8)	
Napping while waiting for e-hailing orders		
Yes	124 (70.1)	
No	53 (29.9)	

SD = Standard deviation

4.4 Physical Risk Factors

Physical risk factors referred to elements that could influence the physical demand placed on e-hailing drivers while performing their work, as well as their exposure to ergonomic risk factors such as awkward postures, forceful exertion, repetitive movements and static and sustained postures. As shown in Table 4.4, the physical risk factors assessed are frequency and estimated weight of luggage lifted per day, along with the presence of body support features in car seats. As part of their services, e-hailing drivers assisted passengers in loading and unloading luggage from their car trunks. Among those who performed this task, 53.7 % lifted luggage more than five times per day, followed by 55 (31.1 %) respondents who handled luggage three to five times per day and 23 (13.0 %) who did so only once or twice per day. Most respondents (45.8 %) estimated that the luggage they carried generally weighed between six and ten kilograms. Nevertheless, 71 (40.1 %) drivers reported handling luggage exceeding ten kilograms, while slightly over 10 % of respondents reported carrying lighter loads ranging from one to five kilograms.

When compared to previous studies, some differences are observed. Radzlan, Naim Othman and Md Yusoff (2023) found that 79.0 % of e-hailing drivers consistently assisted passengers with their luggage, although most (47.7 %) reported carrying lighter weights between one and five kilograms. This suggested that the drivers in the present study may be exposed to heavier lifting tasks compared to the previous study. Another study conducted in Malaysia revealed that a large proportion of drivers (98.2 %) consistently helped passengers with luggage, and nearly half (48.1 %) of them lifted items weighing more than 11 kilograms (Md Yusoff et al., 2020). These findings were relatively consistent with the present study. In addition, a study conducted in Turkey reported that 343 out of 447 taxi drivers reported lifting luggage during their work shifts, supporting this study that handling passengers' luggage was a common physical demand among drivers internationally (Kurtul and Güngördü, 2022).

Moreover, the survey results indicated that out of 177 respondents, 28.2 % had headrests in their car seats, 9.6 % used backrests for lumbar support, and 15.3 % had installed neck pillows for additional comfort. In comparison to other studies, distinct variations were identified. In a study by Abere, Yenealem and Worede (2023), 92 out of 371 drivers were reported to use adjustable chairs with back support, suggesting a higher utilisation of ergonomic seating aids compared to the current study. Similarly, in Turkey, among 447 drivers surveyed, 123 individuals reported having lumbar support features on their seats (Kurtul and Güngördü, 2022). Moreover, Yitayal et al. (2022) reported that nearly three-quarters (74.8 %) of their study participants used lumbar support while driving, indicating a relatively high adoption of ergonomic seating measures among the surveyed drivers.

Table 4.4: Physical Workload and Ergonomic Support Among E-hailing Drivers (n=177)

Variables	**N = 177**
	n (%)
Frequency of manual handling of luggage per day	
Never	4 (2.3)
1 – 2 times	23 (13.0)
3 – 5 times	55 (31.1)
> 5 times	95 (53.7)
Estimated weight of luggage handled	
I do/could not assist passenger in lifting their luggage.	4 (2.3)
1 – 5 kg	21 (11.9)
6 – 10 kg	81 (45.8)
> 11 kg	71 (40.1)
Presence of body part support in car seats	
Headrest	50 (28.2)
Backrest	17 (9.6)
Car neck pillow	27 (15.3)
None of the above	103 (58.2)

4.5 Psychosocial Factors

The final risk factors that contributed to the development of MSD symptoms were the psychosocial aspects, mainly including job satisfaction and work-related stress. Based on Table 4.5, 120 (67.8 %) of those surveyed reported being satisfied with their e-hailing jobs. However, 90 (50.8 %) experienced mental stress, potentially due to the pressure of sustaining their families' livelihood or dealing with challenging traffic and road conditions. These findings were somewhat consistent but showed slight variations when compared to previous studies. For example, Radzlan, Naim Othman and Md

Yusoff (2023) reported a notably higher level of satisfaction among e-hailing drivers working in Johor, with 93.9 % satisfied with their income and 93.5 % reporting minimal pressure from the company. This suggested that the drivers in the present study may have experienced relatively more financial or occupational stress compared to the e-hailing drivers in Johor. Similarly, Ngatcha Tchounga et al. (2022) found that while 65.6 % of taxi drivers were satisfied with their jobs, a higher proportion, 72.2 %, reported feeling stressed. This pattern reflected that job satisfaction did not necessarily mitigate work-related stress among drivers. In addition, a study conducted in Addis Ababa indicated that 77.9 % of drivers believed taxi driving to be a source of stress, while only 44.2 % expressed satisfaction with their job (Aredo, 2024). Compared to these findings, the current study suggested that although a moderate proportion of e-hailing drivers in Selangor expressed job satisfaction, work-related stress remained a considerable issue, aligning with trends observed among both e-hailing and traditional taxi drivers.

Table 4.5: Psychosocial Conditions of E-hailing Drivers

Variables	**N = 177**
	n (%)
Job satisfaction	
Yes	120 (67.8)
No	57 (32.2)
Work stress	
Yes	90 (50.8)
No	**87 (49.2)**

4.6 Prevalence of Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers

The results of the Nordic Musculoskeletal Questionnaire (NMQ) were presented in Table 4.6 and Figure 4.1. Among the 177 e-hailing drivers surveyed, 82.5 % reported experiencing musculoskeletal disorder (MSD) symptoms in at least one body region over the past twelve months. This finding indicated that the majority of e-hailing drivers had encountered aches, pain, discomfort, or numbness in some part of their body over the preceding year. The reported prevalence was relatively high and fell within the global range of MSD symptom prevalence among e-hailing and taxi drivers, which varied from 33 % (n = 35) to 87 % (n = 100) (Caban-Martinez et al., 2020b; Szűcs, Ádám and Nagy, 2020; Ngatcha Tchounga et al., 2022; Aslam and Shweta, 2023; Aredo, 2024). The variation in prevalence across different countries could have been attributed to differences in working conditions and individual characteristics, such as working regime, road conditions, job tenure, and body mass index (BMI) trends. A noteworthy factor investigated in other regions was alcohol consumption habits, which had been found to be significantly associated with MSD symptom prevalence in some studies (Kurtul and Güngördü, 2022; Abere, Yenealem and Worede, 2023). However, in Malaysia, alcohol consumption was prohibited for Muslims, which may have contributed to differences in the prevalence of MSDs compared to countries where alcohol consumption was more common.

The most commonly affected body regions were the neck (111, 62.7 %), lower back (96, 54.2 %), both shoulders (68, 38.4 %), one or both hips or thighs (67, 37.9 %), one or both knees (65, 36.7 %) and upper back (58, 32.8 %). The prevalence of MSD symptoms in other body regions was below 30 %. This finding contradicted other studies, which reported that the lower back was the predominant body region affected by MSD symptoms. Generally, the neck was identified as the second most affected area, where most complaints of discomfort were reported (Caban-Martinez et al., 2020b; Szűcs, Ádám and Nagy, 2020; Ngatcha Tchounga et al., 2022; Aslam and Shweta, 2023; Aredo, 2024). In the latest meta-analysis on MSDs among taxi drivers, Rezaei et al. (2024) analysed 11 studies involving 5,277 taxi drivers. The results showed that the highest prevalence of MSDs among taxi drivers was in the lower back (53.9 %). Meanwhile, 38.2 % of drivers experienced MSD symptoms in the neck, 35.0 %

in the shoulders, 18.3 % in the upper back and 14.1 % in the knees. One possible explanation for the differences in findings is that e-hailing drivers frequently adjust their head position to check GPS navigation, which may increase strain on their necks. Besides, differences in driving-related factors, such as seat ergonomics, driving habits and work conditions, could influence MSD prevalence in different body regions. In summary, despite variations in the prevalence of muscle pain, the neck, shoulders, upper back, lower back, and knees remained the prevalently reported pain areas among e-hailing and taxi drivers across multiple studies, aligning with the findings of this study (Caban-Martinez et al., 2020b; Szűcs, Ádám and Nagy, 2020; Ngatcha Tchounga et al., 2022; Aslam and Shweta, 2023; Aredo, 2024).

Furthermore, some respondents reported their symptoms interfered with their ability to perform routine work, particularly in the neck (23, 13.0 %), shoulders (24, 13.6 %), elbows (5, 2.8 %), wrists or hands (10, 5.6 %), upper back (16, 9.0 %), lower back (35, 19.7 %), one or both hips or thighs (18, 10.2 %), one or both knees (18, 10.2 %) and one or both ankles or feet (9, 5.1 %). During the seven days before respondents completed the survey, some respondents still experienced muscle discomfort, primarily in the neck (66, 37.3 %), shoulders (61, 34.5 %) and lower back (57, 32.2 %), implying that they had not yet recovered from their MSD symptoms and these symptoms could be chronic discomfort. The average MSD score calculated was 3.42 ± 2.72.

Table 4.6: Results of Nordic Musculoskeletal Questionnaire (n = 177)

Body Region	**Experienced MSD symptoms During the Past 12 Months**	**Routine Work Interfered due to MSD symptoms During the Past 12 Months**	**Experienced MSD symptoms During Last 7 Days**
	n (%)	**n (%)**	**n (%)**
Neck	111 (62.7)	23 (13.0)	66 (37.3)
Shoulder(s)			
Left	11 (6.2)		
Right	17 (9.6)		
Both	68 (38.4)		
One or Both	96 (54.2)	24 (13.6)	61 (34.5)
Elbow(s)			
Left	3 (1.7)		
Right	4 (2.3)		
Both	16 (9.0)		
One or Both	23 (13.0)	5 (2.8)	10 (5.6)
Wrist(s) or hand(s)			
Left	7 (4.0)		
Right	8 (4.5)		
Both	33 (18.6)		
One or Both	48 (27.1)	10 (5.6)	31 (17.5)
Upper back	58 (32.8)	16 (9.0)	40 (22.6)
Lower back	96 (54.2)	35 (19.8)	57 (32.2)
One or both hips or thighs	67 (37.9)	18 (10.2)	37 (20.9)
One or both knees	65 (36.7)	18 (10.2)	34 (19.2)
One or both ankles or feet	42 (23.7)	9 (5.1)	21 (11.9)
Overall prevalence	146 (82.5)		

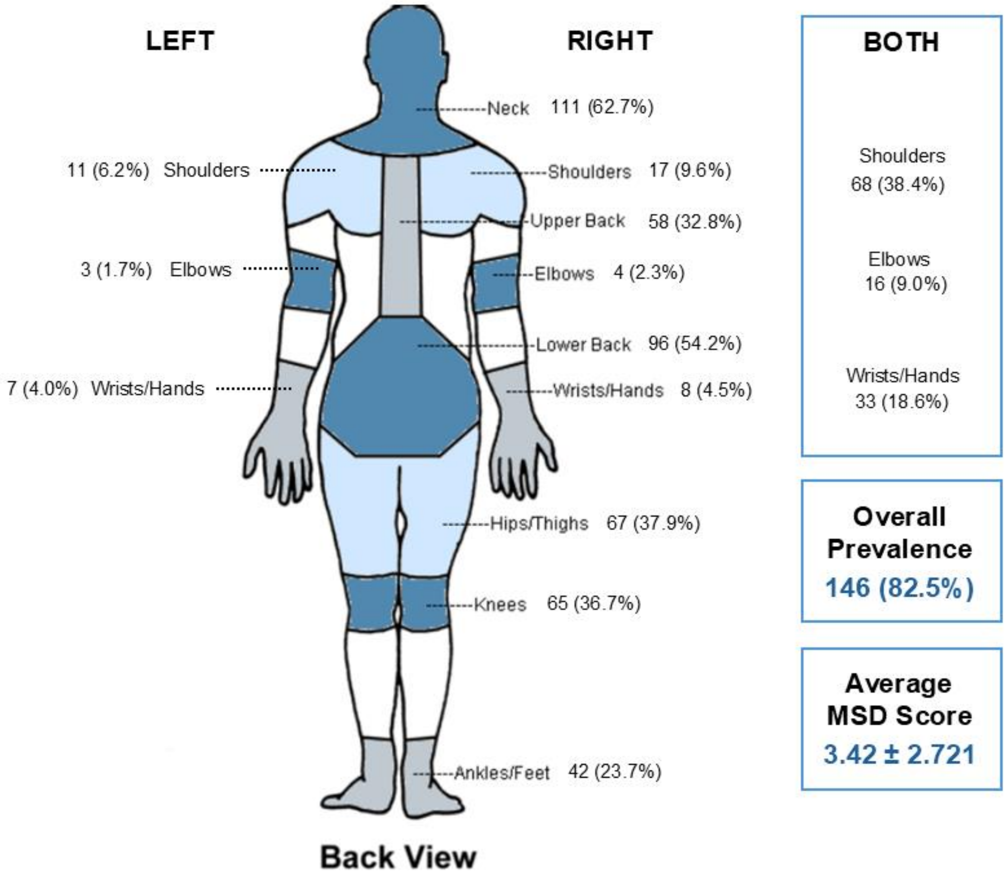


Figure 4.1: Presence of MSD symptoms on Each Body Region and Overall Prevalence During the Past 12 Months (n = 177)

4.7 Associations of Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers

A Chi-square test was conducted to examine the association between risk factors from different aspects - individual, occupational, physical and psychosocial factors - and the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers. Meanwhile, an independent t-test was performed to compare the respondents who reported MSDs with those who did not, focusing on continuous dependent variables such as age, height, weight, BMI, working hours per day, working days per week and rest days per week.

4.7.1 Associations of Individual Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers

Table 4.7 presented the results of the Chi-squared test analysis examining the associations between individual risk factors and the prevalence of MSD symptoms. Among the twelve individual risk factors, this study found that prior experience of muscle pain before joining the e-hailing industry was significantly associated with the prevalence of MSD symptoms (OR = 4.196, 95 % CI = 1.868 – 9.423, $p < 0.001$). Musculoskeletal pain was a common condition that affected nearly half of the general population. Many individuals experienced recurrent or persistent symptoms, which could lead to functional limitations, emotional distress and an increased risk for further complications. Given the chronic and recurrent nature of MSDs, individuals with a prior history of these symptoms were more susceptible to experiencing them again, which could have been attributed to biomechanical factors (El-Tallawy et al., 2021). For instance, impaired lumbar repositioning, which affects spinal stability and movement control, could induce the recurrence of more severe lower back pain. Research conducted by Saiklang et al. (2024) discovered that prolonged sitting exacerbated lumbar repositioning error (LPRE) and increased pain intensity, especially in individuals with chronic low back pain (CLBP). Those with CLBP exhibited significantly higher LPRE and pain levels after just 30 minutes of continuous sitting compared to asymptomatic individuals. Since prolonged sitting was a common occupational risk factor for e-hailing drivers, it might have contributed to the recurrence and persistence of MSDs. Besides, prolonged exposure to physical strain, sustained postures and lack of adequate recovery time could have exacerbated pre-existing conditions, further contributing to the recurrence of MSDs. Moreover, a study on Indian professionals working from home during the COVID-19 lockdown reported a strong correlation between pre-existing MSDs and the development of new symptoms (Gupta et al., 2023). This suggested that individuals with a history of musculoskeletal discomfort were at higher risk of experiencing recurring or worsening symptoms, particularly in occupations involving prolonged sitting.

Workers with a history of musculoskeletal disorders (MSDs) were at higher risk of symptom recurrence, especially in jobs involving prolonged sitting and repetitive movements, like e-hailing drivers (Choy, Mohd Rasdi and Wen, 2023). A meta-analysis by Chen et al. (2024) highlighted that drivers with a history of lumbar injury or lumbar disc herniation were significantly more likely to develop lower back pain (LBP) than healthy drivers, with adjusted odds ratios ranging from 3.6 to 13.5. This supported the current study's findings, where prior muscle pain contributed to a higher likelihood of MSD symptoms.

A Gradual Return-to-Work (GRTW) program helped mitigate this risk by allowing workers to recover while slowly increasing their workload, which reduced strain and reinjury (Maas, Koehoorn and Mcleod, 2021). However, e-hailing drivers were self-employed, which meant that such structured recovery programs were unavailable to them. Without proper workplace support, they might have continued working despite unresolved MSDs. This would engender persistent symptoms and a significant association between prior MSD experience and current MSD prevalence.

Notably, some studies included prior MSD history as a variable for analysis, while others excluded participants with previous MSDs to minimise potential bias. However, excluding such individuals may lead to an underestimation of MSD prevalence among professional drivers (Choy, Mohd Rasdi and Wen, 2023; Raza et al., 2024).

Apart from pre-existing MSDs conditions, the experience of encountering a traumatic work or road accident ($OR = 3.838$, 95 % $CI = 1.395 – 10.557$, $p = 0.006$) was also significantly associated with the prevalence of MSD symptoms. The finding was consistent with existing literature on the long-term musculoskeletal impact of traumatic injuries. While many individuals involved in road traffic crashes (RTCs) returned to work within a few months, a substantial proportion experienced prolonged disability, with some failing to return even after two years (Gane et al., 2021). This highlighted the potential for persistent MSD symptoms following accidents.

Road traffic injuries were a leading cause of musculoskeletal trauma, with minor to severe injuries including muscular strains, joint sprains, fractures and soft tissue contusions (Abedi et al., 2022). Beyond the immediate physical impact, these injuries often led to long-term pain and disability, aggravated by concerns about job security and compensation-related stress. Psychological factors also played a vital role in the development and persistence of MSD symptoms post-injury. Post-traumatic stress symptoms (PTSS), including hyperarousal, avoidance and intrusion, were shown to increase the risk of chronic pain and disability following traumatic musculoskeletal injuries (Jadhakhan, Evans and Falla, 2023). Individuals experiencing PTSS were more likely to develop heightened pain sensitivity, fear of movement and reduced pain self-efficacy, which further delayed recovery. Evidence suggested that PTSS and chronic pain were related, making early psychological intervention important for preventing long-term disability.

In addition to PTSS, other risk factors could also contribute to the persistence of musculoskeletal pain following injury sustained due to accidents. A systematic review of 18 studies identified high baseline pain intensity, fear-avoidant behaviours and medical comorbidities as key predictors of chronic pain (Alkassabi et al., 2022). Individuals with multiple chronic conditions, such as diabetes and hypertension, were associated with a higher likelihood of developing long-term musculoskeletal disabilities after encountering any traumatic road or work accidents. A study in Saudi Arabia further reinforced the link between injury severity and long-term musculoskeletal disability, showing that individuals with higher injury severity scores (ISS) were at significantly greater risk of developing high-grade disability (Elsherbini et al., 2024).

For e-hailing drivers, these insights were particularly relevant, as prolonged sitting, whole-body vibration and repetitive movements could exacerbate pre-existing trauma-related injuries. The lack of access to employer-sponsored healthcare and rehabilitation programs among gig workers further limited their ability to seek timely interventions. This increased the risk of chronic disability. Given these challenges, early intervention strategies, including post-accident rehabilitation programs and ergonomic vehicle modifications, should be implemented to reduce the burden of MSDs in this workforce.

None of the studies on MSD symptoms and risk factors among e-hailing drivers have considered this variable; hence, this finding represented a novel contribution to the field.

Table 4.7: Associations Between Individual Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)

Variables (Individual Risk Factors)		MSD symptoms		OR	95% CI	p-value
		Yes	No			
		n (%)	n (%)			
Gender [a]	Male	145 (82.9)	30 (17.1)	0.207	0.013 - 3.401	0.320
	Female	1 (50.0)	1 (50.0)			
BMI	Underweight and normal weight	53 (81.5)	12 (18.5)	1.108	0.499 - 2.460	0.801
	Overweight and Obese	93 (83.0)	19 (17.0)			
Highest education level	Primary and below	12 (80.0)	3 (20.0)	-	-	0.886
	Secondary	66 (81.5)	15 (18.5)			
	Tertiary	68 (84.0)	13 (16.0)			
Smoking	Yes	112 (81.2)	26 (18.8)	0.633	0.226 - 1.777	0.382
	No	34 (87.2)	5 (12.8)			
Exercising	Yes	74 (79.6)	19 (20.4)	0.649	0.294 - 1.433	0.283
	No	72 (85.7)	12 (14.3)			
Job tenure	1 – 2 years	25 (71.4)	10 (28.6)	2.305	0.968 - 1.003	0.055
	≥ 3 years	121 (85.2)	21 (14.8)			

[a] Tested using Fisher's Exact Test.

*p < 0.05

**p < 0.01

***p < 0.001

Table 4.7: Associations Between Individual Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177) (cont.)

Variables (Individual Risk Factors)		MSD symptoms		OR	95% CI	p-value
		Yes	No			
		n (%)	n (%)			
Medical conditions	Yes	43 (86.0)	7 (14.0)	1.431	0.574 - 3.570	0.440
	No	103 (81.1)	24 (18.9)			
Traumatic accident	Yes	62 (92.5)	5 (7.5)	3.838	1.395 - 10.557	**0.006****
	No	84 (76.4)	26 (23.6)			
Muscle pain before e-hailing job	Yes	106 (89.8)	12 (10.2)	4.196	1.868 - 9.423	**< 0.001 *****
	No	40 (67.8)	19 (32.2)			

*p < 0.05
**p < 0.01
***p < 0.001

Meanwhile, an independent t-test was conducted, as illustrated in Table 4.8, to assess the relationship between numerical individual risk factors and the prevalence of MSD symptoms. However, no significant associations were found between age, height, weight, BMI, and the dependent variable in this study.

Table 4.8: Independent t-test for Individual Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)

Variables (Individual Risk Factors)	**Prevalence of MSD symptoms**	**Mean value**	**t value**	**p-value**
Age [a]	Yes	45.05	- 0.384	0.702
	No	44.32		
Height (cm)	Yes	168.02	0.863	0.389
	No	169.29		
Weight (kg)	Yes	77.28	0.219	0.827
	No	78.03		
BMI	Yes	27.361	- 0.152	0.879
	No	27.189		

[a] Tested using Welch's t-test.

*p < 0.05

**p < 0.01

***p < 0.001

4.7.2 Associations of Occupational Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers

Table 4.9 illustrated the associations between various occupational risk factors and the MSD symptoms prevalence among e-hailing drivers. While none showed a statistically significant association with the prevalence of MSD symptoms, these factors contributed to an overall increased risk.

Table 4.9: Associations Between Occupational Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)

Variables (Occupational Risk Factors)		**MSD symptoms Yes n (%)**	**MSD symptoms No n (%)**	**OR**	**95% CI**	**p-value**
Working at night	Yes	124 (83.2)	25 (16.8)	1.353	0.498 - 3.676	0.553
	No	22 (78.6)	6 (21.4)			
Break time	< 2 times	29 (90.6)	3 (9.4)	0.432	0.123 - 1.521	0.181
	≥ 3 times	117 (80.7)	28 (19.3)			
Stretching during breaks	Yes	81 (78.6)	22 (21.4)	0.510	0.220 - 1.183	0.112
	No	65 (87.8)	9 (12.2)			
Napping while waiting for orders	Yes	103 (83.1)	21 (16.9)	1.141	0.496 - 2.623	0.757
	No	43 (81.1)	10 (18.9)			

*p < 0.05

**p < 0.01

***p < 0.001

In addition, Table 4.10 summarised the results of an independent t-test carried out to examine the association between continuous occupational risk factors and the occurrence of musculoskeletal disorder (MSD) symptoms. The findings demonstrated that none of the occupational variables analysed exhibited a statistically significant relationship with the MSD symptoms in this study.

Table 4.10: Independent t-test for Occupational Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)

Variables (Occupational Risk Factors)	**Prevalence of MSD symptoms**	**Mean value**	**t value**	**p-value**
Working hours per day	Yes	11.43	0.271	0.787
	No	11.58		
Working day per week	Yes	6.29	1.073	0.285
	No	6.48		
Rest day per week	Yes	0.71	- 1.073	0.285
	No	0.52		

*p < 0.05

**p < 0.01

***p < 0.001

4.7.3 Associations of Physical Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers

In reference to Table 4.11, Fisher's Exact Test identified a significant association between assisting passengers with lifting luggage and the prevalence of MSD symptoms (OR = 15.536, 95 % CI = 1.559 – 154.809, $p = 0.017$). This finding aligned with two studies on lower back pain (LBP) prevalence among e-hailing drivers in Johor, Malaysia, which highlighted how lifting luggage to the car bonnet significantly increased the risk of LBP ($\chi^2 = 12.42$, $p = 0.00$; $\chi^2 = 20.85$, $p = 0.00$) (Md Yusoff et al., 2020; Radzlan, Naim Othman and Md Yusoff, 2023). The act of lifting luggage, often done repetitively and in awkward postures, placed strain on the lower back, shoulders and upper limbs, contributing to musculoskeletal disorders (MSDs).

Studies on baggage handlers and ground-handling personnel in airports, who experienced similar occupational lifting demands, were also conducted. A 22-year cohort study on baggage handlers at an airport found that prolonged exposure to lifting tasks resulted in a 16 % increased incidence rate of LBP for every five years of employment (Brauer et al., 2020). Additionally, systematic reviews of airport baggage handlers highlighted lower back pain prevalence rates ranging from 32.6 % to 70 %, with MSDs mainly linked to biomechanical factors (awkward postures, heavy lifting, twisting motions, psychosocial and organisational factors (Thipsut and Kaewboonchoo, 2024).

Although e-hailing drivers may not lift luggage as frequently as baggage handlers, their lifting conditions were often unpredictable and ergonomically unfavourable. Unlike baggage handlers who had access to lifting equipment and structured training, e-hailing drivers must frequently twist their spines, lift from awkward angles and handle loads without assistance, all while adhering to tight schedules and providing good customer service. In some cases, drivers may have felt pressured to assist passengers to maintain positive ratings, which increased their likelihood of overexertion and injury.

Beyond occupational settings, general population studies also fortified the risks associated with luggage handling. Emergency department data in the United States indicated that, on average, 1811 luggage-associated shoulder injuries occurred annually, with lifting luggage accounting for 70.1 % of these injuries. The majority of injuries involved sprains, strains and muscle/ tendon tears, particularly among women and older adults (Pirruccio and Kelly, 2020). These findings were relevant to e-hailing drivers, as they frequently assisted passengers who struggled with handling their luggage independently. Furthermore, falls caused by heavy and unstable luggage could result in more severe injuries, such as shoulder dislocations, fractures and hip injuries, which can have long-term consequences (Thipsut and Kaewboonchoo, 2024).

Table 4.11: Associations Between Physical Risk Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)

Variables (Physical Risk Factors)		**MSD symptoms**		**OR**	**95% CI**	**p-value**
		Yes	**No**			
		n (%)	**n (%)**			
Lifting luggage per day [a]	Yes	145 (83.8)	28 (16.2)	15.536	1.559 - 154.809	**0.017***
	No	1 (25.0)	3 (75.0)			
Estimated weight of luggage	≤ 5 kg	18 (72.0)	7 (28.0)			0.129
	6 – 10 kg	65 (80.2)	16 (19.8)			
	> 11 kg	63 (88.7)	8 (11.3)			

[a] Tested using Fisher's Exact Test.

*p < 0.05

**p < 0.01

***p < 0.001

Table 4.12 presented the associations between body support features and the prevalence of MSD symptoms in different body parts among e-hailing drivers. The analysis revealed no significant associations between the use of headrests, car neck pillows and back rests with the MSD symptoms prevalence.

Table 4.12: Associations Between Body Support with Prevalence of MSD Symptoms in Each Body Region Among E-Hailing Drivers (n = 177)

Prevalence of MSDs in Body region	**Headrest**					**Car neck pillow**					**Back rest**				
	Yes, n (%)	**No, n (%)**	**OR**	**95% CI**	**p - value**	**Yes, n (%)**	**No, n (%)**	**OR**	**95% CI**	**p - value**	**Yes, n (%)**	**No, n (%)**	**OR**	**95% CI**	**p - value**
Neck															
Yes	32 (28.8)	79 (71.2)	1.080	0.547-2.132	0.824	17 (15.3)	94 (84.7)	1.013	0.434-2.365	0.977	9 (8.1)	102 (91.9)	0.640	0.234-1.748	0.381
No	18 (27.3)	48 (72.7)				10 (15.2)	56 (84.8)				8 (12.1)	58 (87.9)			
Shoulder(s)															
Yes	28 (29.2)	68 (70.8)	1.104	0.572-2.133	0.768	18 (14.6)	78 (85.4)	1.846	0.780-4.371	0.159	8 (8.3)	88 (91.7)	0.727	0.267-1.981	0.532
No	22 (27.2)	59 (72.8)				9 (11.1)	72 (88.9)				9 (11.1)	72 (88.9)			
Upper back															
Yes	18 (31.0)	40 (69.0)	1.223	0.615-2.435	0.565	13 (22.4)	45 (77.6)	2.167	0.943-4.978	0.064	6 (10.3)	52 (89.7)	1.133	0.397-3.232	0.815
No	32 (26.9)	87 (73.1)				14 (11.8)	105 (88.2)				11 (9.2)	108 (90.8)			

Table 4.12: Associations Between Body Support with Prevalence of MSD Symptoms in Each Body Region Among E-Hailing Drivers (n = 177) (cont.)

Prevalence of MSDs in Body region	Headrest					Car neck pillow					Back rest				
	Yes, n (%)	No, n (%)	OR	95% CI	p - value	Yes, n (%)	No, n (%)	OR	95% CI	p - value	Yes, n (%)	No, n (%)	OR	95% CI	p - value
Lower back															
Yes	23 (24.0)	73 (76.0)	0.630	0.326-1.217	0.168	19 (19.8)	77 (80.2)	2.252	0.928-5.461	0.068	11 (11.5)	85 (88.5)	1.618	0.571-4.586	0.362
No	27 (33.3)	54 (66.7)				8 (9.9)	73 (90.1)				6 (7.4)	75 (92.6)			
Overall															
Yes	45 (30.8)	101 (69.2)	2.317	0.836-6.422	0.099	24 (16.4)	122 (83.6)	1.836	0.516-6.529	0.422[a]	16 (11.0)	130 (89.0)	3.692	0.471-28.938	0.313[a]
No	5 (16.1)	26 (83.9)				3 (9.7)	28 (90.3)				1 (3.2)	30 (96.8)			

[a] Tested using Fisher's Exact Test.

4.7.4 Associations of Psychosocial Risk Factors in Developing Musculoskeletal Disorder (MSD) Symptoms Among E-Hailing Drivers

For psychosocial factors (Table 4.13), including job satisfaction and work stress, e-hailing drivers who were not satisfied with their job were 3.846 times more likely to experience MSDs compared to those who were satisfied (95 % CI = 1.277 – 11.628, p = 0.011). This association was statistically significant. This finding was consistent with previous research that also demonstrated a significant association between job dissatisfaction and MSD symptoms prevalence. For instance, one study reported that job dissatisfaction was associated with MSDs with an odds ratio of 3.3 (95 % CI = 0.9 – 12.5, p = 0.050) (Ngatcha Tchounga et al., 2022). Another study observed an even stronger relationship, where job dissatisfaction was linked to a 4.58-fold increased risk of MSDs (AOR = 4.58, 95 % CI = 1.39 – 15.2) (Abere, Yenealem and Worede, 2023). Similarly, a third study found that being undecided about job satisfaction significantly increased the odds of developing MSDs (OR = 2.34, 95 % CI = 1.15 – 4.92, p = 0.026) (Kurtul and Güngördü, 2022). These findings suggested a consistent trend across different studies, supporting the role of job satisfaction as a critical psychosocial risk factor for MSDs.

The underlying mechanism may be explained through stress-induced physiological changes. Prolonged dissatisfaction could lead to psychological stress, which activates both the nervous and endocrine systems. This process increased muscle tone and triggered the release of catecholamines, which caused vasoconstriction and the release of inflammatory cytokines. These biochemical responses contributed to an increased biomechanical load on the musculoskeletal system while impairing the body’s natural ability to repair micro-injuries due to reduced blood flow and heightened inflammation (Ngatcha Tchounga et al., 2022). Moreover, the resultant muscular tension is positively correlated with pain and discomfort in intervertebral discs, tendons, ligaments, and spinal nerves, which is a region frequently affected in driving occupations. In contrast, individuals who were satisfied with their jobs may have possessed better coping mechanisms and an improved ability to manage job demand-control imbalances, thereby reducing their risk of developing MSDs (Abere, Yenealem and Worede, 2023).

Table 4.13: Associations Between Psychosocial Factors with Prevalence of MSD Symptoms Among E-Hailing Drivers (n = 177)

Variables (Psychosocial Factors)		**MSD symptoms**		**OR**	**95% CI**	**p-value**
		Yes	**No**			
		n (%)	**n (%)**			
Job satisfaction	Yes	93 (77.5)	27 (22.5)	3.846	1.277 - 11.628	**0.011***
	No	53 (93.0)	4 (7.0)			
Work Stress	Yes	82 (91.1)	8 (8.9)	3.684	1.546 - 8.778	0.129
	No	64 (73.6)	23 (26.4)			

*p < 0.05

**p < 0.01

***p < 0.001

4.7.5 Adjusted Associations Between Individual, Occupational, Physical and Psychosocial Risk Factors and the Prevalence of MSD Symptoms Among E-hailing Drivers

In addition to univariate analysis (chi-square test), binary logistic regression was used to evaluate the impact of various variables on the likelihood of respondents experiencing MSD symptoms, as shown in Table 4.14 and Table 4.15. In this analysis, any variables with a p-value lower than 0.2 were included to identify significant predictors. This selection criterion ensured that no potential risk factors were prematurely excluded (Hosmer, Lemeshow and Sturdivant, 2013). Initially, individual binary logistic regression models were performed for each of the eight variables meeting the selection criterion, with age and BMI included as covariates. This was because age and BMI are well-established factors associated with the development of musculoskeletal disorders (MSDs). Adjusting for these variables helped to control for potential confounding effects, which ensured that the observed associations between the independent variables and the prevalence of MSD symptoms were not attributed to variations in age or BMI among the respondents (Szűcs, Ádám and Nagy, 2020). As shown in Table 4.15, the results indicated that traumatic accident experience (AOR = 3.839, $p = 0.009$), muscle pain prior to joining the e-hailing industry (AOR = 4.425, $p < 0.001$), lifting luggage per day (AOR = 16.618, $p = 0.017$) and lack of job satisfaction (AOR = 3.885, $p = 0.016$) were significantly associated with the prevalence of MSD symptoms. These findings were consistent with the bivariate chi-square analysis. The alignment between the Chi-square and logistic regression with covariate adjustment suggested that the associations found were both statistically valid and not confounded by age or BMI.

Table 4.14: Binary Logistic Regression Analysis of Factors Associated with Prevalence of MSD Symptoms Adjusted for Age and BMI

Variables	B	p-value	AOR [a]	95 % CI
Job tenure				
≥ 3 years	0.851	0.059	2.341	0.967 – 5.669
Traumatic accident				
Yes	1.345	**0.009***	3.839	1.395 – 10.565
Muscle pain before joining e-hailing				
Yes	1.487	**< 0.001*****	4.425	1.945 – 10.069
Break time				
< 3 times	0.824	0.202	2.280	0.642 – 8.097
Stretching or massages during breaks				
No	0.671	0.125	1.957	0.830 – 4.615
Lifting luggage per day				
Yes	2.810	**0.017***	16.618	1.643 – 168.079
Estimated weight of luggage		0.138		
6 – 10 kg	0.547	0.337	1.729	0.565 – 5.286
> 11 kg	1.187	0.053	3.279	0.986 – 10.899
Job satisfaction				
No	1.357	**0.016***	3.885	1.283 – 11.768

[a] Adjusted Odds Ratio (adjusted for age and BMI)

*p < 0.05

**p < 0.01

*** p <0.001

Subsequently, a multiple logistic regression model was performed to assess the predictive value of all eight variables simultaneously, adjusting for age and BMI. According to the Omnibus Test of Model Coefficients, the logistic regression model was statistically significant, χ^2 (11) = 47.041, p < 0.001. The model explained 38.6 %

(Nagelkerke R^2) of the variance in MSD symptoms and correctly classified 86.4 % of cases.

Among the eight variables analysed, as shown in Table 4.15, experiencing a traumatic work or road accident was associated with being 4.48 times more likely to exhibit MSD symptoms (95 % CI = 1.277 – 15.750, p = 0.019). Respondents with prior muscle pain before joining the e-hailing industry were 5.488 times more likely to experience MSD symptoms compared to those without it (95 % CI = 1.994 – 15.108, p < 0.001). Regarding psychosocial factors, job dissatisfaction emerged as a significant predictor of MSD symptoms. E-hailing drivers who were dissatisfied with their jobs had nearly five times higher odds of developing MSD symptoms than those who were satisfied (AOR = 4.913, 95 % CI = 1.356 – 17.794, p = 0.015). Interestingly, the absence of stretching or massages during breaks was also significantly associated with MSD symptoms (AOR = 3.011, 95 % CI = 1.032 – 8.787, p = 0.044). Conversely, no significant association was found between job tenure, frequency of breaks, manual handling and estimated weight of luggage (p-value > 0.05).

The results of the logistic regression analysis were largely consistent with those of the Chi-squared test and the logistic regression with covariate adjustment. However, a key difference was observed: while both the Chi-squared test and the logistic regression with covariate adjustment identified lifting luggage as a significant factor, the logistic regression analysis highlighted the absence of stretching or massages during breaks as a significant predictor of MSD symptoms.

The significant association between the absence of stretching or massages during breaks and the increased prevalence of MSD symptoms was further supported by evidence from a randomised controlled trial conducted among taxi drivers with non-specific chronic neck pain (Jeon et al., 2024). This study examined the effectiveness of self-stretching exercises combined with kinesio taping. In the experimental group, the participants performed self-stretching exercises three times a day, five days a week, for four weeks while also receiving kinesio taping during driving sessions. Meanwhile, the control group received kinesio taping only. The results revealed that the experimental group showed greater reductions in pain intensity both at rest and while driving, with pain scores decreasing from a mean of 4.91 to 3.69 while driving and from 4.41 to 3.78 at rest. In contrast, the control group exhibited less improvement, with pain while driving only reducing from 4.81 to 4.57 and pain at rest from 4.29 to 4.05. These findings indicated that consistent stretching exercises could have a meaningful impact on pain reduction.

A systematic review by Gasibat et al. (2023) highlighted the effectiveness of stretching exercises as a non-pharmacological intervention in reducing the prevalence of MSD symptoms. The review found that stretching, whether used alone or in combination with other ergonomic measures, significantly reduced pain, discomfort and work absence due to MSDs. Several studies covered in the review reported reductions in MSD symptom prevalence ranging from 2.4 % to 5 %. The reduction was more apparent among those who engaged in short duration but regular stretching routines. From these studies, stretching was believed to alleviate MSD symptoms through increased muscle oxygenation, which reduces fatigue and muscular tension. Moreover, it could activate peripheral muscle mechanoreceptors and trigger neural modulation pathways that lower pain perception. Stretching also contributed to improved flexibility and decreased hypertonicity, which together reduced strain on musculoskeletal structures. These findings were consistent with another systematic review by Vitoulas et al. (2022), which found that even a brief 5-minute standing and stretching routine effectively reduced discomfort and fatigue from prolonged sitting. These reviews concluded that incorporating a workplace stretching schedule with ergonomic adjustments could effectively manage and prevent MSDs, especially in occupations involving repetitive motions, poor posture or prolonged static positions, which exactly fits the e-hailing industry.

The significant reduction in musculoskeletal pain through regular stretching and massages has also been achieved in workers in other industries, including healthcare professionals (Alqhtani et al., 2023) and office workers (Kett and Sichting, 2020; Tersa-Miralles et al., 2022b; ÇiMen, 2023),

In terms of massage interventions, one study by Kett and Sichting (2020) discovered the effectiveness of roller massage in reducing muscle stiffness and discomfort following prolonged sitting periods. Kett and Sichting (2020) demonstrated that after a 4.5-hour sitting period, muscle stiffness significantly increased. However, an 8-minute roller massage following this period resulted in muscle stiffness values dropping from an average of 35.4 to 27.8, while those who only stood up without roller massage showed no such reduction. The underlying mechanisms may include the breakdown of muscle cross-bridges and increased intramuscular temperature, both contributing to reduced stiffness and discomfort.

Table 4.15: Multiple Logistic Regression Analysis of Factors Associated with Prevalence of MSD Symptoms

Variables	B	p-value	Exp(B)	95 % CI
Age	0.000	0.983	1.000	0.956 – 1.047
BMI	-0.017	0.701	0.983	0.902 – 1.071
Job tenure				
≥ 3 years	0.916	0.133	2.499	0.757 – 8.247
Traumatic accident				
Yes	1.501	**0.019***	4.484	1.277 – 15.750
Muscle pain before joining e-hailing				
Yes	1.703	**< 0.001*****	5.488	1.994 – 15.108
Break time				
< 3 times	0.975	0.185	2.652	0.627 – 11.226
Stretching or massages during breaks				
No	1.102	**0.044***	3.011	1.032 – 8.787
Lifting luggage per day				
Yes	2.927	0.054	18.680	0.946 – 368.842
Estimated weight of luggage		0.226		
6 – 10 kg	- 0.385	0.666	0.680	0.118 – 3.914
> 11 kg	0.642	0.456	1.900	0.352 – 10.267
Job satisfaction				
No	1.592	**0.015***	4.913	1.356 – 17.794

*p < 0.05

**p < 0.01

*** p <0.001

4.8 Associations Between Individual, Occupational, Physical and Psychosocial Risk Factors and the MSD score

Lastly, multiple linear regression was conducted to examine the relationship between various independent variables (IVs) and the dependent variable (DV), which was the MSD score among e-hailing drivers. This analysis aimed to identify significant predictors of the MSD score and assess the strength of these associations. Before the analysis, key assumptions were tested. Scatterplots confirmed linear relationships between the predictors and the MSD score. All Variance Inflation Factor (VIF) values were below 10, indicating no severe multicollinearity. The residuals were normally distributed based on the P-P plot, and no clear pattern in residual plots suggested homoscedasticity. For variable selection, the backward selection method was applied. Initially, all independent variables were included in the model, and non-significant predictors were removed one by one. The process continued until the model reached its highest adjusted R^2 value of 0.359, meaning that the final model explained 35.9 % of the variance in the MSD score.

According to Table 4.16, the final regression model included gender, smoking habits, experience of traumatic accident, experience of muscle pain before joining the e-hailing industry, taking naps while waiting for e-hailing orders, manual handling of luggage, the estimated weight of luggage, presence of body support, job satisfaction and work stress as predictors of MSD score. The overall model was statistically significant ($F (10, 166) = 10.838$, $p < 0.001$), confirming that the included predictors significantly explained the variance in the MSD score. Among the ten predictors, four were found to be statistically significant. The results revealed that work stress was the strongest predictor in this model, where drivers who reported feeling mentally stressed due to their e-hailing job had a 2.077-point higher MSD score on average compared to those who did not ($\beta = 0.383$, $p < 0.001$). The experience of muscle pain before joining the e-hailing industry was the second strongest predictor ($\beta = 0.298$, $p < 0.001$). Furthermore, taking naps while waiting for orders also emerged as a significant factor ($\beta = 0.167$, $p = 0.009$). Interestingly, smokers had a significantly lower MSD score than non-smokers ($\beta = - 0.131$, $p = 0.044$).

In addition to job dissatisfaction, which showed a significant association in the Chi-squared test, work stress also significantly contributed to higher MSD scores among e-hailing drivers. Both factors shared a similar mechanism, as stress-induced physiological changes increased muscle tone, inflammation and biomechanical load on the musculoskeletal system. This was due to the activation of the nervous and endocrine systems, which released catecholamines and inflammatory cytokines and impaired the body's ability to repair micro-injuries (Ngatcha Tchounga et al., 2022).

As previously discussed in the Chi-squared test analysis results, prior experience of MSD symptoms before joining the e-hailing industry was a significant factor contributing to the likelihood of experiencing MSD symptoms. In this multiple linear regression model, prior experience of muscle pain also showed a significant relationship with higher MSD scores.

In this study, taking naps while waiting for e-hailing orders was significantly associated with a higher MSD score, indicating greater discomfort among those who reported this habit. While napping was generally considered a restorative activity, its effects on musculoskeletal health appeared to be more complex in constrained environments. Previous literature highlighted that short naps could alleviate neuromuscular fatigue and improve alertness and cognitive performance (Rafi et al., 2023; Boukhris et al., 2024). However, the confined space and limited ergonomic support in vehicles may lead to awkward sleeping postures, which could place excessive strain on the spine and supporting musculature. A study among taxi drivers reported that frequent in-vehicle napping, although not statistically significant, was associated with a higher risk of MSDs. This was likely due to poor posture during naps (Ngatcha Tchounga et al., 2022). These postures may lead to excessive joint stress and muscular overload, potentially explaining the higher MSD scores observed in this study. Therefore, while napping may reduce mental fatigue, the physical constraints of vehicle environments may outweigh its benefits in terms of musculoskeletal health.

Interestingly, smokers in this study reported significantly lower MSD scores compared to non-smokers. Supporting this, a few studies highlighted that nicotine activated nicotinic acetylcholine receptors (nAChRs) in both the central and peripheral nervous systems, leading to the release of neurotransmitters that suppress nociceptive pain (Dai et al., 2021; Iida et al., 2022). A meta-analysis by Larowe and Ditre (2020) found small to moderate pain-reducing effects of nicotine, regardless of how it was administered and whether or not the individual had a history of smoking. These effects are thought to be mediated through the modulation of neurotransmitters such as dopamine and endogenous opioids, which influence pain threshold and tolerance. However, these articles emphasised the dual nature of smoking's relationship with pain. While nicotine may reduce pain acutely, chronic use and withdrawal have been linked to increased pain sensitivity and worsened outcomes, especially among those attempting cessation. Smokers with chronic pain are more likely to experience withdrawal-related hyperalgesia, and many reported smoking as a way to cope with pain despite long-term negative effects (Larowe and Ditre, 2020; Dai et al., 2021). These findings suggested that the lower MSD scores observed among smokers could reflect short-term analgesia rather than a true protective effect. Therefore, although nicotine might temporarily alleviate discomfort, its long-term use poses greater risks for pain management, cessation efforts and overall musculoskeletal health (Luo et al., 2023).

The equation of the multiple linear regression model is as follows:

$$\textit{MSD Score} = 2.458 - 0.860\,(\textit{Smoking}) + 1.713\,(\textit{Muscle Pain}) + 0.987\,(\textit{Napping}) + 2.077\,(\textit{Work Stress}) \qquad (4.1)$$

Table 4.16: Multiple Linear Regression Analysis of Factors Associated with MSD Score

Variable	B (Unstandardised Coefficient)	Std. Error	Beta (β) (Standardised Coefficient)	t	p-value	95 % CI Lower Bound	95 % CI Upper Bound	VIF
Constant	2.458	2.279		1.079	0.282	- 2.041	6.957	
Gender	- 2.520	1.571	- 0.098	- 1.604	0.111	- 5.623	0.582	1.028
Smoking	- 0.860	0.423	- 0.131	- 2.034	**0.044***	- 1.695	- 0.025	1.145
Traumatic accident	0.489	0.363	0.087	1.346	0.180	- 0.228	1.206	1.157
Muscle pain before joining e-hailing	1.713	0.376	0.298	4.553	**< 0.001*****	0.970	2.457	1.173
Napping while waiting for orders	0.987	0.374	0.167	2.642	**0.009****	0.250	1.724	1.091
Lifting luggage	1.174	1.178	0.064	0.997	0.320	- 1.152	3.500	1.142
Estimated weight of luggage	0.407	0.267	0.103	1.527	0.129	- 0.119	0.933	1.258

*p < 0.05

**p < 0.01

***p < 0.001

Table 4.16: Multiple Linear Regression Analysis of Factors Associated with MSD Score (cont.)

Variable	**B (Unstandardised Coefficient)**	**Std. Error**	**Beta (Standardised Coefficient)**	**t**	**p-value**	**95 % CI**		**VIF**
						Lower Bound	Upper Bound	
Presence of body support	0.353	0.355	0.064	0.995	0.321	- 0.347	1.054	1.141
Job satisfaction	- 0.361	0.401	- 0.062	- 0.900	0.369	- 1.153	0.431	1.309
Work stress	2.077	0.390	0.383	5.320	**< 0.001*****	1.306	2.848	1.420

*p < 0.05

**p < 0.01

***p < 0.001

4.9 Summary of Factors Significantly Associated with MSDs

A summary of key findings was presented in Table 4.17 and Figure 4.2. The Chi-squared test and binary logistic regression, adjusted for age and BMI, consistently identified prior muscle pain, traumatic accident experience, lifting luggage, and job dissatisfaction as significant factors. In the multiple logistic regression analysis, lifting luggage was found to be nearly significant, while the absence of stretching or massages during breaks was significantly associated with the prevalence of MSD symptoms. This supported the notion that these risk factors were true predictors of MSD symptom prevalence and would likely remain significant in future studies. The near-significance of lifting luggage may be attributed to the limited sample size in this study, which might have reduced the statistical power needed to establish significance. Additionally, the multiple linear regression model identified work stress, prior muscle pain, taking naps while waiting for orders and being a non-smoker as significant predictors of higher MSD scores.

Table 4.17: P-Values of Factors Significantly Associated with MSD Symptoms

Factors	**Chi-Square Test**	**Binary Logistic Regression (Adjusted for Age and BMI)**	**Multiple Logistic Regression**	**Multiple Linear Regression (MSD Score)**
Prior muscle pain before e-hailing	**< 0.001*** **	**< 0.001*** **	**< 0.001*** **	**< 0.001*** **
Traumatic work or road accidents	**0.006** **	**0.009** **	**0.019***	0.180
Lifting luggage per day	**0.017***	**0.017***	0.054	0.320
Job dissatisfaction	**0.011***	**0.016***	**0.015***	0.369
No stretching/massage during breaks	0.112	0.125	**0.044***	-
Work stress	0.129	-	-	**< 0.001*** **
Taking naps while waiting for orders	0.757	-	-	**0.009** **
Smoking status (non-smokers)	0.382	-	-	**0.004***

*p < 0.05

**p < 0.01

***p < 0.001

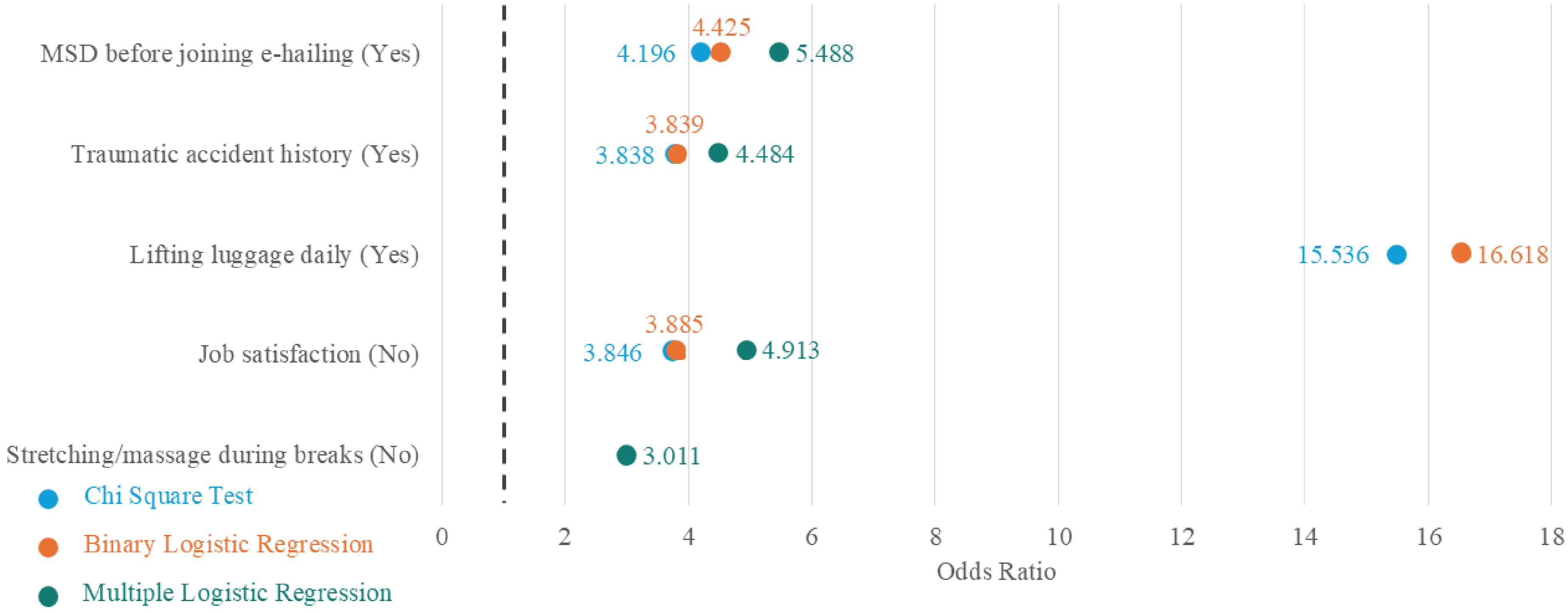


Figure 4.2: Odds Ratios of Factors Significantly Associated with MSD Symptoms

CHAPTER 5

CONCLUSION

5.1 Research Conclusion

Early identification and management of musculoskeletal disorder (MSD) symptoms are crucial to prevent the development of chronic conditions and deterioration in physical well-being among e-hailing drivers since they are frequently exposed to multiple risk factors during prolonged working hours. Therefore, recognising the early signs of MSDs and understanding their associated risk factors are vital steps in reducing the prevalence and severity of these symptoms. MSD symptoms commonly include discomfort or pain in body regions such as the neck, shoulders, lower back and knees. These symptoms can significantly impact a driver's quality of life and work performance. These issues may arise due to the cumulative effects of individual, occupational, physical and psychosocial factors. The findings from this study revealed that 82.5 % of respondents experienced MSD symptoms in at least one body region. Therefore, it is essential that both e-hailing platforms and the drivers themselves take proactive steps to mitigate these risks. Through reviewing the literature, analysing collected data and evaluating the results, the study has achieved its aim and objectives. Therefore, the key conclusions drawn from the study's outcomes are summarised as follows:

i. The study successfully identified the characteristics of individual, occupational, physical and psychosocial risk factors among e-hailing drivers in Selangor. Most respondents were male, aged 31 – 40, with high rates of overweight and smoking and limited physical activity. In terms of occupational factors, drivers commonly worked between nine to twelve hours daily, six days a week, with over 84 % working at night. Breaks were frequent, yet a significant number still experienced physical strain. More than half of the respondents engaged in stretching exercises or took naps during breaks to mitigate fatigue. Physically, many lifted heavy luggage (> 10 kg) daily and lacked proper ergonomic support in their vehicles. Psychosocially, while most were satisfied with their jobs, over half reported experiencing mental stress.

ii. The study successfully determined the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers in Selangor. 82.5 % reported experiencing MSD symptoms in at least one body region within the past year, with the neck, lower back and shoulders being the most commonly affected areas. Notably, some drivers indicated that their symptoms interfered with daily activities, and many continued to experience discomfort within the week leading up to the survey.

iii. This study also investigated the relationships between individual, occupational, physical and psychosocial factors with MSD symptoms among e-hailing drivers in Selangor. As summarised in Table 4.17, the Chi-squared test and binary logistic regression (adjusted for age and BMI) consistently identified prior muscle pain, traumatic accident experience, lifting luggage, and job dissatisfaction as significant factors. The multiple logistic regression model confirmed the significance of prior muscle pain, traumatic accident experience, and job dissatisfaction, while additionally identifying the absence of stretching or massages during breaks as a predictor. In contrast, lifting was no longer significantly associated with the prevalence of MSD symptoms. In terms of the multiple linear regression analysis, work stress, prior experience of muscle pain before joining the e-hailing industry, taking naps while waiting for orders and being non-smokers were associated with higher MSD score, where a higher score indicated that more body parts were suffering from MSD symptoms.

In summary, this study has achieved its aim and all three objectives by identifying the key risk factors, determining the prevalence and examining the relationships between multiple variables and MSD symptoms among e-hailing drivers. These findings highlight the urgent need for awareness and intervention strategies tailored to this occupational group. By understanding the contributing factors, stakeholders, including e-hailing companies and policymakers, can implement targeted preventive measures to promote musculoskeletal health and enhance the overall well-being of drivers in the industry.

5.2 Strengths and Limitations of the Study

5.2.1 Strength of the Study

One of the main strengths of this study lies in its focus on identifying the factors contributing to the prevalence of musculoskeletal disorder (MSD) symptoms among e-hailing drivers in Selangor, which is a topic that remains relatively understudied, especially in Malaysia. To date, only one similar study has been conducted in Johor, making this research a valuable addition to the limited body of knowledge.

Furthermore, the study utilised the Nordic Musculoskeletal Questionnaire, which is a well-established and validated instrument known for its high reliability in assessing MSD symptoms. The remaining sections of the questionnaire were developed based on the literature review and further validated by experts in Occupational Safety and Health (OSH).

Importantly, the findings from this study could contribute to the development of job-specific guidelines for addressing MSDs in the gig economy, promoting a healthier and more ergonomic working environment for e-hailing drivers.

5.2.2 Limitations of the Study

Despite its strengths, this study has several limitations that should be acknowledged:

i. Firstly, the cross-sectional design of the study limits the ability to establish causal relationships between risk factors and the development of musculoskeletal disorder (MSD) symptoms.
ii. The reliance on self-reported data, such as the prevalence of MSD symptoms and anthropogenic measurements, including height and weight, introduces the possibility of recall bias and subjective reporting. This may affect the accuracy of the findings.
iii. Furthermore, this study did not incorporate objective assessments such as ergonomic evaluation or postural analyses (e.g. Rapid Upper Limb Assessment) and did not consider additional risk factors like exposure to whole-body vibration, which may also contribute to MSDs.
iv. The generalisability of the findings is limited because the study focused solely on e-hailing drivers in Selangor, and almost all of the respondents were male, with only two females. As a result, gender-based comparisons and broader applications of the findings may not be feasible.
v. Lastly, the self-reporting approach to assess MSD symptoms, while useful for identifying trends, cannot serve as a clinical diagnosis and may not reflect the full extent of the condition.

5.3 Recommendations

5.3.1 Recommendations for Future Studies

For future studies, several recommendations can be made to enhance the validity of the comprehensiveness of the findings as follows:

i. Given that the current study was cross-sectional and based on a relatively small sample size from a single state, future research should consider analytical or longitudinal study designs with clinical assessments to better establish causal relationships and objectively identify MSD symptoms and their contributing factors. Continuous monitoring and follow-up studies are recommended, as the onset and progression of MSD symptoms among e-hailing drivers may have long-term health implications. Expanding the study to include a larger and more diverse sample across multiple regions or states would allow for comparative analysis and improve generalisability.
ii. Additional risk factors such as exposure to whole-body vibration should be included, as it may significantly contribute to the development of MSDs.
iii. Moreover, ergonomic aspects such as car seat design and its influence on driver comfort and health should be explored to offer valuable insights.
iv. The use of validated psychological assessment tools is also recommended to evaluate psychosocial factors on MSD symptoms in the e-hailing drivers.

5.3.2 Recommendations for Stakeholders

There are a few recommended measures that can be implemented, as shown below:

i. Implement regular health screenings and check-ups for e-hailing drivers, which include aspects of musculoskeletal health, to catch symptoms early and provide timely intervention.
ii. Encourage e-hailing platforms to integrate occupational health and safety and training into driver and refresher modules, covering topics like proper sitting posture, stretches during breaks and ergonomics in vehicle setup.
iii. Use ergonomic support tools, such as back supports or seat cushions. This could be useful in promoting better driving posture and reducing physical strain.
iv. Develop app-based wellness features within driver platforms to send reminders for breaks, stretching exercises or health tips based on their work hours and activity levels.
v. Establish feedback channels for drivers to report health and safety concerns anonymously, enabling platforms to gather insights about common ergonomic challenges and health risks experienced by drivers. Although drivers are self-employed and manage their own vehicles and schedules, the collected feedback can guide platforms in designing better health promotion campaigns, offering ergonomic education, and encouraging healthier driving practices. These initiatives can indirectly help drivers reduce the risk of musculoskeletal disorders (MSDs) by raising awareness, improving vehicle setup knowledge, and promoting better work-rest balance.

Although several recommendations have been adopted by e-hailing platforms, it is important to ensure that musculoskeletal health considerations are also integrated into these measures.

REFERENCES

Abedi, M., Gane, E., Aplin, T., Zerguine, H. and Johnston, V., 2022. Barriers and facilitators associated with Return to Work following minor to serious road traffic musculoskeletal injuries: A systematic review. *Journal of Occupational Rehabilitation*, 32(1), pp.13–26. https://doi.org/10.1007/s10926-021-09994-3.

Abere, G., Yenealem, D.G. and Worede, E.A., 2023. Prevalence and associated factors of low back pain among taxi drivers in Gondar City, Northwest Ethiopia: A community-based cross-sectional study. *BMJ Open*, 13(5). https://doi.org/10.1136/bmjopen-2022-069631.

Alangari, A.A., Almutairi, M.M., Alrrajeh, A.M., Aleidi, M.A., Alqarni, M.A., Almeneif, H.A., Alolaywi, H.K. and Almuklass, A.M., 2022. The relation between Body Mass Index and musculoskeletal injury. *Cureus*. https://doi.org/10.7759/cureus.28965.

Alkassabi, O., Voogt, L., Andrews, P., Alhowimel, A., Nijs, J. and Alsobayel, H., 2022. Risk factors to persistent pain following musculoskeletal injuries: A systematic literature review. *International Journal of Environmental Research and Public Health*, 19(15). https://doi.org/10.3390/ijerph19159318.

Alkhatatbeh, M.J., Almomani, H.S., Abdul-Razzak, K.K. and Samrah, S., 2021. Association of asthma with low serum vitamin D and its related musculoskeletal and psychological symptoms in adults: a case-control study. *npj Primary Care Respiratory Medicine*, 31(1). https://doi.org/10.1038/s41533-021-00239-7.

Alqhtani, R.S., Ahmed, H., Alshahrani, A., Khan, A.R. and Khan, A., 2023. Effects of whole-body stretching exercise during lunch break for reducing musculoskeletal pain and physical exertion among healthcare professionals. *Medicina (Lithuania)*, 59(5). https://doi.org/10.3390/medicina59050910.

Al-Shakhrit, A.K.S., Masri, K.A. and Othman, C.P., 2021. The social and economic impacts of e-hailing application in Malaysia: A review. *Construction*, 1(2), pp.40–44. https://doi.org/10.15282/cons.v1i2.6660.

Aredo, M.T., 2024. Assessment of prevalence of musculoskeletal disorder, health seeking behaviour and associated factors among taxi drivers in Addis Ababa. *World Journal of Public Health*, 9(1), pp.28–33. https://doi.org/10.11648/j.wjph.20240901.14.

Arumugam, V., Ismail, R. and Joeharee, M., 2020. A review and conceptual development of the factors influencing consumer intention towards e-Hailing service in Malaysia. *International Journal of Innovation, Creativity and Change*, [online] 11(11), pp.224–242. Available at: <www.ijicc.net>.

Aslam, P.A. and Shweta, K., 2023. Work related musculoskeletal disorders in occupational taxi drivers of Mahabaleshwar. *VIMS Journal of Physical Therapy*, [online] 5(1). https://doi.org/10.46858/VIMSJPT.5110.

Borneo Falcon, 2013. *Charter Field Town, Sepang*. [online] Available at: <https://borneotip.blogspot.com/2013/04/charter-field-town-sepang.html> [Accessed 8 January 2025].

Boukhris, O., Zghal, F., Trabelsi, K., Suppiah, H., Ammar, A., Jahrami, H., Hsouna, H., Abdessalem, R., Glenn, J.M., Chtourou, H. and Driller, M., 2024. The impact of a 40-min nap on neuromuscular fatigue profile and recovery following the 5-m shuttle run test. *Journal of Sleep Research*, 33(1). https://doi.org/10.1111/jsr.14052.

Brail, S., 2022. World cities of ride-hailing. *Urban Geography*, 43(1), pp.12–33. https://doi.org/10.1080/02723638.2020.1775030.

Brauer, C., Mikkelsen, S., Pedersen, E.B., Møller, K.L., Simonsen, E.B., Koblauch, H., Alkjær, T., Helweg-Larsen, K. and Thygesen, L.C., 2020. Occupational lifting predicts hospital admission due to low back pain in a cohort of airport baggage handlers. *International Archives of Occupational and Environmental Health*, 93(1), pp.111–122. https://doi.org/10.1007/s00420-019-01470-z.

Brown, A.E., 2020. Who and where rideshares? Rideshare travel and use in Los Angeles. *Transportation Research Part A: Policy and Practice*, 136, pp.120–134. https://doi.org/10.1016/j.tra.2020.04.001.

Caban-Martinez, A.J., Santiago, K.M., Louzado Feliciano, P., Ogunsina, K., Kling, H., Griffin, K. and Schaefer Solle, N., 2020a. *Acute musculoskeletal pain reported among rideshare drivers in the health/safety investigation among non-standard workers in the gig economy (H.I.N.G.E.) pilot study*. *Journal of Occupational and Environmental Medicine*, https://doi.org/10.1097/JOM.0000000000001849.

Caban-Martinez, A.J., Santiago, K.M., Louzado Feliciano, P., Ogunsina, K., Kling, H., Griffin, K. and Schaefer Solle, N., 2020b. Acute musculoskeletal pain reported among rideshare drivers in the health/safety investigation among non-standard workers in the gig economy (H.I.N.G.E.) pilot study. *Journal of Occupational and Environmental Medicine*, 62(5), pp.E236–E239. https://doi.org/10.1097/JOM.0000000000001849.

Cetin, T. and Deakin, E., 2019. Regulation of taxis and the rise of ridesharing. *Transport Policy*, 76, pp.149–158. https://doi.org/10.1016/j.tranpol.2017.09.002.

Chan, N.D. and Shaheen, S.A., 2012. Ridesharing in North America: Past, present, and future. *Transport Reviews*, [online] 32(1), pp.93–112. Available at: <http://www.tandfonline.com/openurl?genre=article&issn=0144-1647&date=2012&volume=32&issue=1&spage=93.>.

Chen, C., Xiao, B., He, X., Wu, J., Li, W. and Yan, M., 2024. Prevalence of low back pain in professional drivers: a meta-analysis. *Public Health*, 231, pp.23–30. https://doi.org/10.1016/j.puhe.2024.03.007.

Chen, Y.L., Alexander, H. and Hu, Y.M., 2022. Self-reported musculoskeletal disorder symptoms among bus drivers in the Taipei Metropolitan Area.

International Journal of Environmental Research and Public Health, 19(17). https://doi.org/10.3390/ijerph191710596.

Chen, Y.W., Coxson, H.O., Coupal, T.M., Lam, S., Munk, P.L., Leipsic, J. and Reid, W.D., 2018. The contribution of thoracic vertebral deformity and arthropathy to trunk pain in patients with chronic obstructive pulmonary disease (COPD). *Respiratory Medicine*, 137, pp.115–122. https://doi.org/10.1016/j.rmed.2018.03.007.

Choy, M.Y., Mohd Rasdi, H.F. and Wen, X.L., 2023. Risk factors associated with musculoskeletal disorders among professional drivers in Asian countries: A systematic review. *Jurnal Sains Kesihatan Malaysia*, 21(2), pp.143–155. https://doi.org/10.17576/jskm-2023-2102-11.

Cieza, A., Causey, K., Kamenov, K., Hanson, S.W., Chatterji, S. and Vos, T., 2020. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet*, 396(10267), pp.2006–2017. https://doi.org/10.1016/S0140-6736(20)32340-0.

ÇiMen, O., 2023. The efficiency of ergonomics, active break and stretching exercise program in office workers with chronic neck and back pain. *Journal of Experimental and Clinical Medicine (Turkey)*, 40(2), pp.329–332. https://doi.org/10.52142/omujecm.40.2.24.

Cochran, W.G., 1963. *Sampling Technique*. 2nd Edition ed. New York: John Wiley and Sons Inc.

Dai, Y., Huang, J., Hu, Q., Huang, L., Wu, J. and Hu, J., 2021. Association of cigarette smoking with risk of chronic musculoskeletal pain: A meta-analysis. *Pain Physician*, [online] 24(8), pp.495–506. Available at: <www.painphysicianjournal.com>.

Deme, S., Fisseha, B., Kahsay, G., Melese, H., Alamer, A. and Ayhualem, S., 2021. Musculoskeletal disorders and associated factors among patients with chronic kidney disease attending at saint paul hospital, addis ababa, Ethiopia.

International Journal of Nephrology and Renovascular Disease, 14, pp.291–300. https://doi.org/10.2147/IJNRD.S319991.

Department of Occupational Safety and Health, 2021. *Occupational Safety and Health Master Plan 2021 - 2025*. [online] Putrajaya, Malaysia. Available at: <https://www.dosh.gov.my/index.php/publication-ul/oshmp2025/4219-occupational-master-plan-2125/file> [Accessed 19 July 2024].

Department of Occupational Safety and Health (DOSH), 2017. *Guidelines On Ergonomics Rick Assessment At Workplace 2017_July Edited Rev.002*. [online] Available at: <https://www.dosh.gov.my/index.php/legislation/guidelines/ergonomic/2621-01-guidelines-on-ergonomics-risk-assessment-at-workplace-2017/file> [Accessed 9 July 2024].

Docherty, S., Harley, R., McAuley, J.J., Crowe, L.A.N., Pedret, C., Kirwan, P.D., Siebert, S. and Millar, N.L., 2022. The effect of exercise on cytokines: implications for musculoskeletal health: a narrative review. *BMC Sports Science, Medicine and Rehabilitation*, 14(1). https://doi.org/10.1186/s13102-022-00397-2.

D'Onofrio, G., Kirschner, J., Prather, H., Goldman, D. and Rozanski, A., 2023a. Musculoskeletal exercise: Its role in promoting health and longevity. *Progress in Cardiovascular Diseases*, 77, pp.25–36. https://doi.org/10.1016/j.pcad.2023.02.006.

D'Onofrio, G., Kirschner, J., Prather, H., Goldman, D. and Rozanski, A., 2023b. *Musculoskeletal exercise: Its role in promoting health and longevity*. *Progress in Cardiovascular Diseases*, https://doi.org/10.1016/j.pcad.2023.02.006.

Dzakpasu, F.Q.S., Carver, A., Brakenridge, C.J., Cicuttini, F., Urquhart, D.M., Owen, N. and Dunstan, D.W., 2021. Musculoskeletal pain and sedentary behaviour in occupational and non-occupational settings: a systematic review with meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*, 18(1). https://doi.org/10.1186/s12966-021-01191-y.

Ekechukwu, E.N.D., Useh, E., Nna, O.L., Ekechukwu, N.I., Obi, O.N., Aguwa, E.N., Arinze-Onyia, S.U., Abaraogu, U.O. and Utti, V.A., 2021. Ergonomic assessment of work-related musculoskeletal disorder and its determinants among commercial mini bus drivers and driver assistants (mini bus conductors) in Nigeria. *PLoS ONE*, 16(12 December). https://doi.org/10.1371/journal.pone.0260211.

Elsherbini, D.M.A., Ali, L.S., Allam, N.M., Elshorbagy, R.T., Eladl, H.M., Ibrahim, A.M., Elbastawisy, Y.M., Eldesoqui, M. and El-Sherbiny, M., 2024. Epidemiology and prevalence of musculoskeletal disabilities following motor vehicle accidents in Aljouf Region, Saudi Arabia. *Medicina (Lithuania)*, 60(10). https://doi.org/10.3390/medicina60101562.

El-Tallawy, S.N., Nalamasu, R., Salem, G.I., LeQuang, J.A.K., Pergolizzi, J. V. and Christo, P.J., 2021. Management of musculoskeletal pain: An update with emphasis on chronic musculoskeletal pain. *Pain and Therapy*, 10(1), pp.181–209. https://doi.org/10.1007/s40122-021-00235-2.

Ervasti, J., Pentti, J., Nyberg, S.T., Shipley, M.J., Leineweber, C., Sørensen, J.K., Alfredsson, L., Bjorner, J.B., Borritz, M., Burr, H., Knutsson, A., Madsen, I.E.H., Magnusson Hanson, L.L., Oksanen, T., Pejtersen, J.H., Rugulies, R., Suominen, S., Theorell, T., Westerlund, H., Vahtera, J., Virtanen, M., Batty, G.D. and Kivimäki, M., 2021. Long working hours and risk of 50 health conditions and mortality outcomes: a multicohort study in four European countries. *The Lancet Regional Health - Europe*, 11. https://doi.org/10.1016/j.lanepe.2021.100212.

Falkenstein, M., Karthaus, M. and Brüne-Cohrs, U., 2020. Age-related diseases and driving safety. *Geriatrics (Switzerland)*, 5(4), pp.1–28. https://doi.org/10.3390/geriatrics5040080.

Fatima, S., Fatima, A., Raj, U., Kumari, M., Anand, A., Chauhan, N. and Arora, S., 2021. Work related musculoskeletal disorders assessment in cab drivers. *Indian Journal of Forensic Medicine & Toxicology*, [online] 14(4), pp.7101–7105. Available at: <https://ssrn.com/abstract=3760721>.

Feng, Z., Zhan, J., Wang, C., Ma, C. and Huang, Z., 2020. The association between musculoskeletal disorders and driver behaviors among professional drivers in China. *International Journal of Occupational Safety and Ergonomics*, 26(3), pp.551–561. https://doi.org/10.1080/10803548.2018.1482088.

Fernández-Torres, J., Zamudio-Cuevas, Y., Martínez-Nava, G.A., Aztatzi-Aguilar, O.G., Sierra-Vargas, M.P., Lozada-Pérez, C.A., Suárez-Ahedo, C., Landa-Solís, C., Olivos-Meza, A., Del Razo, L.M., Camacho-Rea, M.C. and Martínez-Flores, K., 2022. Impact of Cadmium mediated by tobacco use in musculoskeletal diseases. *Biological Trace Element Research*, 200(5), pp.2008–2015. https://doi.org/10.1007/s12011-021-02814-y.

Fyongo, I.R. and Ramdhan, D.H., 2024. Musculoskeletal disorders affecting work performance among ground-handling personnel: A systematic literature review. *Journal of Industrial Hygiene and Occupational Health*, 8(2), pp.166–183. https://doi.org/10.21111/jihoh.v8i2.11732.

Gallagher, S. and Barbe, M.F., 2022. The impaired healing hypothesis: a mechanism by which psychosocial stress and personal characteristics increase MSD risk? *Ergonomics*, 65(4), pp.573–586. https://doi.org/10.1080/00140139.2021.1974103.

Gane, E.M., Plinsinga, M.L., Brakenridge, C.L., Smits, E.J., Aplin, T. and Johnston, V., 2021. The impact of musculoskeletal injuries sustained in road traffic crashes on work-related outcomes: A systematic review. *International Journal of Environmental Research and Public Health*, 18(21). https://doi.org/10.3390/ijerph182111504.

Gasibat, Q., Rani, B., Causevic, D., Spicer, S., da Silva, R.P., Xiao, Y., Changqing, X., Ahmad, N.B. and Rafieda, A.E., 2023. Impact of stretching exercises on work-related musculoskeletal disorders: A systematic review. *International Journal of Kinesiology and Sports Science*, 11(3), pp.8–22. https://doi.org/10.7575/aiac.ijkss.v.11n.3p.8.

Grab Authorised Alpha Driver, 2024. *How To Register Grab Driver In Malaysia (Updated 2024)*. [online] Available at: <https://grabdrivermy.com/> [Accessed 7 July 2024].

Grab Driver Malaysia, 2018. *Grab driver waiting at KLIA*. [online] Available at: <https://daftarpemandu-grab.blogspot.com/2018/06/blog-post.html> [Accessed 24 July 2024].

Greggi, C., Visconti, V.V., Albanese, M., Gasperini, B., Chiavoghilefu, A., Prezioso, C., Persechino, B., Iavicoli, S., Gasbarra, E., Iundusi, R. and Tarantino, U., 2024. Work-related musculoskeletal disorders: A systematic review and meta-analysis. *Journal of Clinical Medicine*, 13(13). https://doi.org/10.3390/jcm13133964.

Gupta, G., Jadhav, R.A., Nataraj, M. and Maiya, G.A., 2023. Effect of Covid-19 lockdown/ compulsory work from home (WFH) situation on musculoskeletal disorders in India. *Journal of Bodywork and Movement Therapies*, 33, pp.39–45. https://doi.org/10.1016/j.jbmt.2022.09.019.

Han, W. and Zhao, J., 2020. Driver behaviour and traffic accident involvement among professional urban bus drivers in China. *Transportation Research Part F: Traffic Psychology and Behaviour*, 74, pp.184–197. https://doi.org/10.1016/j.trf.2020.08.007.

Health and Safety Executive, 2023. *Work-related musculoskeletal disorders statistics in Great Britain, 2023*. [online] Available at: <https://www.hse.gov.uk/statistics/assets/docs/msd.pdf> [Accessed 14 August 2024].

Heikkala, E., Hagnäs, M., Jokelainen, J., Karppinen, J., Ferreira, P., Ferreira, M.L. and Mikkola, I., 2022. Association of musculoskeletal pain with the achievement of treatment targets for type 2 diabetes among primary care patients. *Primary Care Diabetes*, 16(4), pp.531–536. https://doi.org/10.1016/j.pcd.2022.04.006.

Hosmer, D.W.., Lemeshow, Stanley. and Sturdivant, R.X.., 2013. *Applied Logistic Regression*. 3rd edition ed. New Jersey, America: John Wiley and Sons Inc.

Idris, N., 2022. Minimizing the congestion index and mode share of traffic congestion in urban area. *Journal of Enterprise and Business Intelligence*, 2(1), pp.24–32. https://doi.org/10.53759/5181/jebi202202004.

Iida, H., Yamaguchi, S., Goyagi, T., Sugiyama, Y., Taniguchi, C., Matsubara, T., Yamada, N., Yonekura, H. and Iida, M., 2022. Consensus statement on smoking cessation in patients with pain. *Journal of Anesthesia*, 36(6), pp.671–687. https://doi.org/10.1007/s00540-022-03097-w.

Jadhakhan, F., Evans, D.W. and Falla, D., 2023. The role of post-trauma stress symptoms in the development of chronic musculoskeletal pain and disability: A systematic review. *European Journal of Pain (United Kingdom)*, 27(2), pp.183–200. https://doi.org/10.1002/ejp.2048.

Jais, A.S. and Marzuki, A., 2020. E-hailing services in Malaysia: current practices and future outlook. *Malaysia Journal of the Malaysia Institute of Planners*, 18(3), pp.128–141. https://doi.org/10.21837/pm.v18i13.780.

Jamaluddin, N., Syed, S.A., Rahim, M., Roslan, A., Haron, N.Z. and Jamaluddin, A., 2021a. Driver profile and travel distance among e-hailing drivers: An exploratory study. *International Journal of Road Safety*, [online] 2(1), pp.24–29. Available at: <https://ijrs.my/journal/article/view/28> [Accessed 21 April 2025].

Jamaluddin, N., Syed, S.A., Rahim, M., Roslan, A., Haron, N.Z. and Jamaluddin, A., 2021b. *International Journal of Road Safety Driver Profile and Travel Distance among e-Hailing Drivers: An Exploratory Study A R T I C L E I N F O*. [online] *International Journal of Road Safety*, Available at: <www.ijrs.my>.

Jeon, J.J., Jeon, S.H., Yang, K.J., Choi, H., Cho, H. young and Hahm, S.C., 2024. Self-stretching exercises with kinesio taping for management of chronic nonspecific neck pain in taxi drivers: A single-blind, randomized controlled trial. *Complementary Therapies in Medicine*, 80. https://doi.org/10.1016/j.ctim.2023.103010.

Joseph, L., Standen, M., Paungmali, A., Kuisma, R., Sitilertpisan, P. and Pirunsan, U., 2020. Prevalence of musculoskeletal pain among professional drivers: A systematic review. *Journal of Occupational Health*, 62(1). https://doi.org/10.1002/1348-9585.12150.

Joseph, L., Vasanthan, L., Standen, M., Kuisma, R., Paungmali, A., Pirunsan, U. and Sitilertpisan, P., 2023. Causal relationship between the risk factors and work-related musculoskeletal disorders among professional drivers: A systematic review. *Human Factors*, 65(1), pp.62–85. https://doi.org/10.1177/00187208211006500.

Karrar, A.E., 2022. The effect of using data pre-processing by imputations in handling missing values. *Indonesian Journal of Electrical Engineering and Informatics*, 10(2), pp.375–384. https://doi.org/10.52549/ijeei.v10i2.3730.

Kasemsan, A., Joseph, L., Paungmali, A., Sitilertpisan, P. and Pirunsan, U., 2021. Prevalence of musculoskeletal pain and associated disability among professional bus drivers: a cross-sectional study. *International Archives of Occupational and Environmental Health*, 94(6), pp.1263–1270. https://doi.org/10.1007/s00420-021-01683-1.

Kesmodel, U.S., 2018. Cross-sectional studies – what are they good for? *Acta Obstetricia et Gynecologica Scandinavica*, 97(4), pp.388–393. https://doi.org/10.1111/aogs.13331.

Kett, A.R. and Sichting, F., 2020. Sedentary behaviour at work increases muscle stiffness of the back: Why roller massage has potential as an active break intervention. *Applied Ergonomics*, 82. https://doi.org/10.1016/j.apergo.2019.102947.

Kitas, G.D. and Dimitroulas, T., 2021. Cardiovascular comorbidity in rheumatic and musculoskeletal diseases: Where we are and how can we move forward? *International Journal of Rheumatic Diseases*, 24(4), pp.473–476. https://doi.org/10.1111/1756-185X.14112.

Kumarathas, I., Harsløf, T., Andersen, C.U., Langdahl, B., Hilberg, O., Bjermer, L. and Løkke, A., 2020. The risk of osteoporosis in patients with asthma.

European Clinical Respiratory Journal, 7(1). https://doi.org/10.1080/20018525.2020.1763612.

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-S6rensen, F., Andersson, G. and J6rgensen, K., 1987. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied Ergonomics*, 18(3), pp.233–237. https://doi.org/10.1016/0003-6870(87)90010-x.

Kurtul, S. and Güngördü, N., 2022. Low back pain and risk factors among Taxi drivers in Turkey: a cross-sectional study. *Medicina del Lavoro*, 113(3). https://doi.org/10.23749/mdl.v113i3.12859.

Land Public Transport Agency (APAD), 2024. *Taxi and e-hailing services*. [online] Available at: <https://www.apad.gov.my/en/services/taxi-and-ehailing> [Accessed 7 July 2024].

Larowe, L.R. and Ditre, J.W., 2020. Pain, nicotine, and tobacco smoking: Current state of the science. *Pain*, 161(8), pp.1688–1693. https://doi.org/10.1097/j.pain.0000000000001874.

Lastella, M., Halson, S.L., Vitale, J.A., Memon, A.R. and Vincent, G.E., 2021. To nap or not to nap? A systematic review evaluating napping behavior in athletes and the impact on various measures of athletic performance. *Nature and Science of Sleep*, 13, pp.841–862. https://doi.org/10.2147/NSS.S315556.

Latiers, F., Vandenabeele, M., Poncin, W. and Reychler, G., 2021. Prevalence and risk factors of musculoskeletal pain in patients with chronic obstructive pulmonary disease: A systematic review. *Clinical Respiratory Journal*, 15(12), pp.1286–1301. https://doi.org/10.1111/crj.13443.

Lecocq, M., Lantoine, P., Bougard, C., Allègre, J.M., Bauvineau, L., Bourdin, C., Marqueste, T. and Dousset, E., 2020. Neuromuscular fatigue profiles depends on seat feature during long duration driving on a static simulator. *Applied Ergonomics*, 87. https://doi.org/10.1016/j.apergo.2020.103118.

Lee, H.E., Choi, M., Kim, H.R. and Kawachi, I., 2020. Impact of decreased night work on workers' musculoskeletal symptoms: A quasi-experimental intervention study. *International Journal of Environmental Research and Public Health*, 17(23), pp.1–9. https://doi.org/10.3390/ijerph17239092.

Li, Z., Zhang, Z., Ren, Y., Wang, Y., Fang, J., Yue, H., Ma, S. and Guan, F., 2021. Aging and age-related diseases: from mechanisms to therapeutic strategies. *Biogerontology*, 22(2), pp.165–187. https://doi.org/10.1007/s10522-021-09910-5.

Liu, S., Wang, B., Fan, S., Wang, Y., Zhan, Y. and Ye, D., 2022. Global burden of musculoskeletal disorders and attributable factors in 204 countries and territories: a secondary analysis of the Global Burden of Disease 2019 study. *BMJ Open*, 12(6). https://doi.org/10.1136/bmjopen-2022-062183.

Luo, Y., Yang, Y., Schneider, C. and Balle, T., 2023. The anti-nociceptive effects of nicotine in humans: A systematic review and meta-analysis. *Pharmaceuticals*, 16(12). https://doi.org/10.3390/ph16121665.

Maas, E.T., Koehoorn, M. and Mcleod, C.B., 2021. Does gradually returning to work improve time to sustainable work after a work-acquired musculoskeletal disorder in British Columbia, Canada? A matched cohort effectiveness study. *Occupational and Environmental Medicine*, 78(10), pp.715–723. https://doi.org/10.1136/oemed-2020-107014.

Maciel, E.T., Padilha, V.H., Graup, S. and Pinto, A.C.C. da S., 2024. Mental workload, musculoskeletal disorders, and associated factors among international transport truck drivers. *Revista Brasileira de Medicina do Trabalho*, 22(02), pp.01–09. https://doi.org/10.47626/1679-4435-2023-1083.

Maduagwu, S.M., Galadima, N.M., Umeonwuka, C.I., Ishaku, C.M., Akanbi, O.O., Jaiyeola, O.A. and Nwanne, C.A., 2022. Work-related musculoskeletal disorders among occupational drivers in Mubi, Nigeria. *International Journal of Occupational Safety and Ergonomics*, 28(1), pp.572–580. https://doi.org/10.1080/10803548.2020.1834233.

Matre, D., Christensen, J.O., Mork, P.J., Ferreira, P., Sand, T. and Nilsen, K.B., 2021. Shift work, inflammation and musculoskeletal pain - The HUNT Study.

Occupational Medicine, 71(9), pp.422–427. https://doi.org/10.1093/occmed/kqab133.

Md Isa, Y.B., Dahlan, N.H.M., Isa, Y.B.M. and Anuar, K.N.K., 2024. E-hailing services in Malaysia: A snapshot of legal issues and risks. *UCJC Business and Society Review*, 21(80), pp.658–695. https://doi.org/10.3232/UBR.2024.V21.N1.15.

Md Yusoff, I.S., Sabri, M.F., Yusoff, M., Wijekoon, R., Zuhairi, A. and Majid, A., 2020. The impact of an economic challenge on health through driving posture among elderly taxi drivers in Malaysia. *Article in Journal of Critical Reviews*, [online] 7(12), pp.3823–3830. Available at: <https://www.researchgate.net/publication/344336579>.

Minetto, M.A., Giannini, A., McConnell, R., Busso, C., Torre, G. and Massazza, G., 2020a. Common musculoskeletal disorders in the elderly: The star triad. *Journal of Clinical Medicine*, 9(4). https://doi.org/10.3390/jcm9041216.

Minetto, M.A., Giannini, A., McConnell, R., Busso, C., Torre, G. and Massazza, G., 2020b. *Common musculoskeletal disorders in the elderly: The star triad*. *Journal of Clinical Medicine*, https://doi.org/10.3390/jcm9041216.

Ministry of Health Malaysia, 2024. *National Health and Morbidity Survey (NHMS) 2023*. [online] KUALA LUMPUR. Available at: <https://mdes.org.my/wp-content/uploads/2024/10/report-nhms-2023-compressed.pdf> [Accessed 16 March 2025].

Najafi, F., Darbandi, M., Neya, S.K., Belasi, M.T., Izadi, N., Pasdar, Y. and Barzegar, A., 2023. Epidemiology of musculoskeletal disorders among iranian adults: results from a non-communicable disease cohort study. *BMC Musculoskeletal Disorders*, 24(1). https://doi.org/10.1186/s12891-023-06435-5.

Nastri, M.M.F., Lourenço, B., Queiroz, L.B., Silva, L.E.V. da, Lourenço, D.M.R., Castro, A.P.B.M., Silva, C.A. and Pastorino, A.C., 2022. Idiopathic musculoskeletal pain, musculoskeletal pain syndromes, and use of electronic devices in adolescents with asthma. *Jornal de Pediatria*, 98(3), pp.270–275. https://doi.org/10.1016/j.jped.2021.06.002.

Nelson, K., Christopher, F., Milton, N. and Kazaara, A.I., 2022. Teach yourself SPSS and STATA. *International Journal of Academic Pedagogical Research*, [online] 6(7), pp.84–122. Available at: <www.ijeais.org/ijapr>.

Ngatcha Tchounga, C.C., Azabji Kenfack, M., Guessogo, W.R., Mekoulou Ndongo, J., Bika Léle, E.C., Ayina Ayina, C.N., Temfemo, A., Bongue, B., Mandengue, S.H., Etoundi Ngoa, L.S. and Assomo Ndemba, P.B., 2022. Prevalence of musculoskeletal disorders among taxi drivers in Yaoundé, Cameroon: preventive effect of physical activity. *BMC Musculoskeletal Disorders*, 23(1). https://doi.org/10.1186/s12891-022-05971-w.

Oakman, Jodi., Clune, Sam. and Stuckey, Rwth., 2019. *Work-related musculoskeletal disorders in Australia 2019 : the latest research on work-related musculoskeletal disorders*. Canberra, Australia: Safe Work Australia.

Oliveira, C.B., Maher, C.G., Franco, M.R., Kamper, S.J., Williams, C.M., Silva, F.G. and Pinto, R.Z., 2020. Co-occurrence of chronic musculoskeletal pain and cardiovascular diseases: A systematic review with meta-analysis. *Pain Medicine (United States)*, 21(6), pp.1106–1121. https://doi.org/10.1093/pm/pnz217.

Pandis, N., 2014. Cross-sectional studies. *American Journal of Orthodontics and Dentofacial Orthopedics*, 146(1), pp.127–129. https://doi.org/10.1016/j.ajodo.2014.05.005.

Pickard, O., Burton, P., Yamada, H., Schram, B., Canetti, E.F.D. and Orr, R., 2022. Musculoskeletal disorders associated with occupational driving: A systematic review spanning 2006–2021. *International Journal of Environmental Research and Public Health*, 19(11). https://doi.org/10.3390/ijerph19116837.

Pirruccio, K. and Kelly, J.D., 2020. Shoulder injuries associated with handling luggage presenting to U.S. emergency departments: 2003-2017. *Work*, 66(3), pp.603–609. https://doi.org/10.3233/WOR-203202.

Pradeepkumar, H., Sakthivel, G. and Shankar, S., 2020. Prevalence of work related musculoskeletal disorders among occupational bus drivers of Karnataka, South India. *Work*, 66(1), pp.73–84. https://doi.org/10.3233/WOR-203152.

Putsa, B., Jalayondeja, W., Mekhora, K., Bhuanantanondh, P. and Jalayondeja, C., 2022. Factors associated with reduced risk of musculoskeletal disorders among office workers: a cross-sectional study 2017 to 2020. *BMC Public Health*, 22(1). https://doi.org/10.1186/s12889-022-13940-0.

Radwan, A., Barnes, L., DeResh, R., Englund, C. and Gribanoff, S., 2022. Effects of active microbreaks on the physical and mental well-being of office workers: A systematic review. *Cogent Engineering*, 9(1). https://doi.org/10.1080/23311916.2022.2026206.

Radzlan, R., Naim Othman, M.A. and Md Yusoff, I.S., 2023. The impact working environment on health problem among e-hailing drivers in Johor Bahru, Malaysia from ergonomic perspective during Pandemic COVID-19. *International Journal of Academic Research in Business and Social Sciences*, 13(18), pp.294–309. https://doi.org/10.6007/ijarbss/v13-i18/19966.

Rafi, M.A., Ahmad, N., Iqbal, M.M., Urooj, M., Naeem, M. and Anwar, A., 2023. Effects of power napping on the working population of Islamabad. *JRCRS*, 11(1), pp.18–22. https://doi.org/10.53389/JRCRS.2023110105.

Raghupathi, V. and Raghupathi, W., 2020. The influence of education on health: An empirical assessment of OECD countries for the period 1995-2015. *Archives of Public Health*, 78(1). https://doi.org/10.1186/s13690-020-00402-5.

Ranaei, H., Raeesi, V., Salmani, F., Khojasteh-Kaffash, S. and Saremi, Z., 2024. Musculoskeletal disorders in hemodialysis patients: prevalence, clinical symptoms, and associated factors. *Journal of Nephropharmacology*, 13(1). https://doi.org/10.34172/npj.2023.11656.

Rao, C.M., Singh, P., Maikap, D. and Padhan, P., 2021. Musculoskeletal disorders in Chronic Obstructive Airway Diseases: A neglected clinical entity. *Mediterranean Journal of Rheumatology*, 32(2), pp.118–123. https://doi.org/10.31138/mjr.32.2.118.

Ras, J., Soteriades, E.S., Smith, D.L., Kengne, A.P. and Leach, L., 2023. Association between cardiovascular and musculoskeletal health in firefighters. *Journal of*

Occupational and Environmental Medicine, 65(7), pp.E496–E505. https://doi.org/10.1097/JOM.0000000000002872.

Raza, M., Bhushan, R.K., Khan, A.A., Ali, A.M., Khamaj, A. and Alam, M.M., 2024. Prevalence of musculoskeletal disorders in heavy vehicle drivers and office workers: A comparative analysis using a machine learning approach. *Healthcare*, [online] 12(2560). Available at: <https://doi.org/10.3390/healthcare12242560> [Accessed 1 April 2025].

Rezaei, E., Shahmahmoudi, F., Makki, F., Salehinejad, F., Marzban, H. and Zangiabadi, Z., 2024. Musculoskeletal disorders among taxi drivers: a systematic review and meta-analysis. *BMC Musculoskeletal Disorders*, 25(1). https://doi.org/10.1186/s12891-024-07771-w.

Ruzairi, K.M., Jamaludin, B.S., Sukadarin, E.H. and Widia, M., 2022. A systematic review of risk factor associate with musculoskeletal disorder: Biomechanical and psychosocial factor. In: *Lecture Notes in Mechanical Engineering*. Springer Science and Business Media Deutschland GmbH. pp.661–680. https://doi.org/10.1007/978-981-16-4115-2_54.

Saiklang, P., Chatprem, T., Karoonsupcharoen, O., Saiklang, P. and Puntumetakul, R., 2024. The comparison of the effect of prolonged sitting on lumbar repositioning error in asymptomatic and chronic low back pain participants with seated sedentary behavior. *Trends in Sciences*, 21(3). https://doi.org/10.48048/tis.2024.7332.

Salim, S., Haziq, M.A., Osman, M.H., Mat Nor, A.H., Sarif, A.S., Zaminan, Z., Mohamad, M.Z.A.T., Shakir, M. and Azman, K.S., 2020. A review on the background of e-hailing drivers in Malaysia and their awareness with regulations. In: *IOP Conference Series: Earth and Environmental Science*. IOP Publishing Ltd. https://doi.org/10.1088/1755-1315/616/1/012046.

Saludes, R., Acevedo, P., García, I.Z., Gómez Carrión, Á., Martínez Sebastián, C., Núñez Fernández, A., Seco-Armell, I. and Sánchez-Gómez, R., 2022. Abdominal adiposity increases Lordosis and doubles the risk of low back pain. *Applied Sciences (Switzerland)*, 12(15). https://doi.org/10.3390/app12157616.

Sa-ngiamsak, T. and Thetkathuek, A., 2022. Short-distance versus long-distance deep-seaport container truck drivers' prevalence and perceived discomfort of musculoskeletal symptoms in the Thailand Eastern Economic Corridor. *International Journal of Occupational Safety and Ergonomics*, 28(3), pp.1779–1786. https://doi.org/10.1080/10803548.2021.1932313.

Shazwan Daud, M., Osman, S., Hashim, A.H. and Abd Rahim, H., 2023. A descriptive study on safety perception among ride-hailing car passengers in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 13(10), pp.869–878. https://doi.org/10.6007/ijarbss/v13-i10/18916.

Sheth, A., Pagdhune, A. and Viramgami, A., 2023. Prevalence of work-related musculoskeletal disorders (WRMSDs) and its association with modifiable risk factors in metropolitan bus transit drivers: A cross-sectional comparison. *Journal of Family Medicine and Primary Care*, 12(8), pp.1673–1678. https://doi.org/10.4103/jfmpc.jfmpc_532_23.

Shitu, A., Yunus Oyeyemi, A., Muhammad, A.S., Bello, U.M., Oyeyemi, A.L. and Jajere, A., 2022. Prevalence of neck pain among heavy truck drivers in Maiduguri north-eastern Nigeria. *Journal of the Nigeria Society of Physiotherapy*, [online] 21(1), pp.11–18. https://doi.org/10.5897/JNSP2021.0021.

Siddiqui, A.S., Javed, S., Abbasi, S., Baig, T. and Afshan, G., 2022. Association between low back pain and body mass index in Pakistani population: Analysis of the software bank data. *Cureus*. https://doi.org/10.7759/cureus.23645.

Smuck, M., Schneider, B.J., Ehsanian, R., Martin, E. and Kao, M.C.J., 2020. Smoking Is associated with pain in all body regions, with greatest influence on Spinal Pain. *Pain Medicine (United States)*, 21(9), pp.1759–1768. https://doi.org/10.1093/PM/PNZ224.

Social Security Organisation (SOCSO), 2019. *SOCSO Annual Report 2018*. [online] Putrajaya, Malaysia. Available at: <https://www.perkeso.gov.my/images/laporan_tahunan/LAPORAN%20TA

HUNAN%20_ANNUAL%20REPORT%202018.pdf> [Accessed 13 July 2024].

Social Security Organisation (SOCSO), 2020. *SOCSO Annual Report 2019*. [online] Putrajaya, Malaysia. Available at: <https://www.perkeso.gov.my/images/laporan_tahunan/AR_2019_FINAL.pdf> [Accessed 13 July 2024].

Social Security Organisation (SOCSO), 2021. *SOCSO Annual Report 2020*. [online] Putrajaya, Malaysia. Available at: <https://www.perkeso.gov.my/images/laporan_tahunan/Laporan%20Tahunan%202020.pdf> [Accessed 13 July 2024].

Social Security Organisation (SOCSO), 2022. *SOCSO Annual Report 2021*. [online] Putrajaya, Malaysia. Available at: <https://www.perkeso.gov.my/images/laporan_tahunan/Annual%20Report%EF%80%A2Laporan%20Tahunan%20PERKESO%202021(V2).pdf> [Accessed 13 July 2024].

Social Security Organisation (SOCSO), 2023. *SOCSO Annual Report 2022*. [online] Putrajaya, Malaysia. Available at: <https://www.perkeso.gov.my/images/laporan_tahunan/Laporan%20Tahunan%20PERKESO%202022.pdf> [Accessed 9 July 2024].

Squier, K., Scott, A., Hunt, M.A., Brunham, L.R., Wilson, D.R., Screen, H. and Waugh, C.M., 2021. The effects of cholesterol accumulation on Achilles tendon biomechanics: A crosssectional study. *PLoS ONE*, 16(9 September). https://doi.org/10.1371/journal.pone.0257269.

Sun, C. and Edara, P., 2015. Is getting an uber-lyft from a sidecar different from hailing a taxi?: Current dynamic ridesharing controversy. *Transportation Research Record*, 2536, pp.60–66. https://doi.org/10.3141/2536-08.

Szűcs, V.D., Ádám, B. and Nagy, K., 2020. Occupational risk factors for musculoskeletal disorders in Hungarian taxi drivers: a cross-sectional study. *European Journal of Occupational and Environmental Medicine* , 26, pp.1–2.

Tan, L., Cicuttini, F.M., Fairley, J., Romero, L., Estee, M., Hussain, S.M. and Urquhart, D.M., 2022. Does aerobic exercise effect pain sensitisation in individuals with musculoskeletal pain? A systematic review. *BMC Musculoskeletal Disorders*, 23(1). https://doi.org/10.1186/s12891-022-05047-9.

Tang, K.H.D., 2020. A review of psychosocial models for the development of musculoskeletal disorders and common psychosocial instruments. *Archives of Current Research International*, pp.9–19. https://doi.org/10.9734/acri/2020/v20i730207.

Tang, K.H.D., 2022. The prevalence, causes and prevention of occupational musculoskeletal disorders. *Global Academic Journal of Medical Sciences*, 4(2), pp.56–68. https://doi.org/10.36348/gajms.2022.v04i02.004.

Tersa-Miralles, C., Bravo, C., Bellon, F., Pastells-Peiró, R., Rubinat Arnaldo, E. and Rubí-Carnacea, F., 2022a. Effectiveness of workplace exercise interventions in the treatment of musculoskeletal disorders in office workers: A systematic review. *BMJ Open*, 12(1). https://doi.org/10.1136/bmjopen-2021-054288.

Tersa-Miralles, C., Bravo, C., Bellon, F., Pastells-Peiró, R., Rubinat Arnaldo, E. and Rubí-Carnacea, F., 2022b. *Effectiveness of workplace exercise interventions in the treatment of musculoskeletal disorders in office workers: A systematic review*. *BMJ Open*, https://doi.org/10.1136/bmjopen-2021-054288.

Thipsut, T. and Kaewboonchoo, O., 2024. Risk factors of work-related musculoskeletal disorders among airport baggage handlers: A Systematic Review. In: *Proceedings of the 11th National and International Conference on 'Research to Serve Society'*. [online] Samutprakarn, Thailand. pp.450–460. Available at: <https://has.hcu.ac.th/jspui/handle/123456789/3325> [Accessed 3 April 2025].

U.S. Bureau of Labor Statistics, 2023. *Employer-Reported Workplace Injuries and Illnesses, 2021-2022*. [online] Available at: <https://www.bls.gov/news.release/osh.nr0.htm> [Accessed 14 August 2024].

Vitoulas, S., Konstantis, V., Drizi, I., Vrouva, S., Koumantakis, G.A. and Sakellari, V., 2022. The effect of physiotherapy interventions in the workplace through active micro-break activities for employees with standing and sedentary work. *Healthcare (Switzerland)*, 10(10). https://doi.org/10.3390/healthcare10102073.

Wang, X., 2019. Research on development of China E-hailing industry. *SHS Web of Conferences*, 61, p.01032. https://doi.org/10.1051/shsconf/20196101032.

World Health Organization, 2020. *WHO guidelines on physical activity and sedentary behaviour*. [online] Available at: <https://www.who.int/publications/i/item/9789240015128> [Accessed 18 August 2024].

World Health Organization, 2022. *Musculoskeletal health*. [online] Available at: <https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions> [Accessed 13 August 2024].

Yahya, M.S.S. BIN, Mohd Safian, E.E. and Burhan, B., 2021. Spatial pattern and hotspots of urban rail public transport to public access using geospatial techniques in Selangor, Malaysia. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, 6(1), pp.234–244. https://doi.org/10.47405/mjssh.v6i1.634.

Yitayal, M.M., Ayhualem, S., Fiseha, B., Kahasay, G., Gashaw, M. and Gebre, H., 2022. Occupational lower back pain and associated factors among taxi drivers in Mekelle city, north Ethiopia: a cross-sectional study. *International Journal of Occupational Safety and Ergonomics*, 28(4), pp.2046–2051. https://doi.org/10.1080/10803548.2021.1952773.

Ziade, N., El Khoury, B., Zoghbi, M., Merheb, G., Abi Karam, G., Mroue', K. and Messaykeh, J., 2020. Prevalence and pattern of comorbidities in chronic rheumatic and musculoskeletal diseases: the COMORD study. *Scientific Reports*, 10(1). https://doi.org/10.1038/s41598-020-64732-8.

APPENDICES

APPENDIX A: Survey Questionnaire

The following contains the survey questionnaires that were used for this study.

Wholly owned by UTAR Education Foundation
(Co. No. 578227-M)
DU012(A)

PREVALENCE OF MUSCULOSKELETAL DISORDERS SYMPTOMS AMONG E-HAILING DRIVERS

PERSONAL DATA PROTECTION NOTICE

Please be informed that in accordance with Personal Data Protection Act 2010 (“PDPA”) which came into force on 15 November 2013, Universiti Tunku Abdul Rahman (“UTAR”) is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal information.

1. Personal data refers to any information which may directly or indirectly identify a person which could include sensitive personal data and expression of opinion. Among others it includes Name, Identity card, Place of Birth, Address, Education History, Employment History, Medical History, Blood type, Race, Religion, Photo, Personal Information and Associated Research Data.

2. The purposes for which your personal data may be used are inclusive but not limited to:
a) For assessment of any application to UTAR
b) For processing any benefits and services
c) For communication purposes
d) For advertorial and news
e) For general administration and record purposes
f) For enhancing the value of education
g) For educational and related purposes consequential to UTAR
h) For replying any responds to complaints and enquiries
i) For the purpose of our corporate governance
j) For the purposes of conducting research/ collaboration

3. Your personal data may be transferred and/or disclosed to third party and/or UTAR collaborative partners including but not limited to the respective and appointed outsourcing agents for purpose of fulfilling our obligations to you in respect of the purposes and all such other purposes that are related to the purposes and also in providing integrated services, maintaining and storing records. Your data may be shared when required by laws and when disclosure is necessary to comply with applicable laws.

4. Any personal information retained by UTAR shall be destroyed and/or deleted in accordance with our retention policy applicable for us in the event such information is no longer required.

5. UTAR is committed in ensuring the confidentiality, protection, security and accuracy of your personal information made available to us and it has been our ongoing strict policy to ensure that your personal information is accurate, complete, not misleading and updated. UTAR would also ensure that your personal data shall not be used for political and commercial purposes.

Consent

6. By submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and conditions in the Notice and our relevant policy.

7. If you do not consent or subsequently withdraw your consent to the processing and disclosure of your personal data, UTAR will not be able to fulfill our obligations or to contact you or to assist you in respect of the purposes and/or for any other purposes related to the purpose.

8. You may access and update your personal data by writing to us at yapjoyce0912@gmail.com (Joyce Yap).

Acknowledgment of Notice

** Tick (✓) any that apply.*		**Signature**
	I have been notified and that I hereby understood, consented and agreed per UTAR above notice.	
	I disagree, my personal data will not be processed.	Name: Date: H/P:

For researcher use

QUESTIONNAIRE INSTRUCTIONS

1. This questionnaire consists of three sections:
   SECTION A: SOCIODEMOGRAPHIC BACKGROUND AND LIFESTYLE HABITS
   SECTION B: WORK CHARACTERISTICS
   SECTION C: SELF-ASSESSMENT OF MUSCULOSKELETAL DISORDERS (MSDs) SYMPTOMS

2. You are required to answer all questions in this questionnaire.
3. To answer, please mark your response in the provided answer section.
4. The completed questionnaire should be returned to the researcher after all questions have been answered.

SECTION A: SOCIODEMOGRAPHIC BACKGROUND AND LIFESTYLE HABITS

1.1 In which state do you primarily drive for your e-hailing work? (Can tick more than one answer) — A 1.1

1. ☐ Johor	2. ☐ Kedah	3. ☐ Kelantan
4. ☐ Melaka	5. ☐ Negeri Sembilan	6. ☐ Pahang
7. ☐ Penang	8. ☐ Perak	9. ☐ Perlis
10. ☐ Sabah	11. ☐ Sarawak	12. ☐ Selangor
13. ☐ Terengganu	14. ☐ W.P. Kuala Lumpur	15. ☐ W.P. Labuan
16. ☐ W.P. Putrajaya		

1.2 Age : ☐☐ years — A 1.2

1.3 Gender : 1. ☐ Male 2. ☐ Female — A 1.3

1.4 Height : ☐☐☐ cm — A 1.4

1.5 Weight : ☐☐ kg — A 1.5

1.6 Education : — A 1.6
1. ☐ No formal education background
2. ☐ Primary school (e.g. UPSR)
3. ☐ Secondary school (e.g. SPM)
4. ☐ Pre-university, technical or vocational school or college (e.g. SPTM, UEC, A-level, foundation, diploma, etc.)
5. ☐ Undergraduate degree
6. ☐ Postgraduate degree (e.g. Master or Doctor of Philosophy)

For researcher use

1.7 Are you a smoker (cigarette or vape)? A 1.7

1. ☐ Heavy 2. ☐ Light 3. ☐ Occasional 4. ☐ Never

1.8 How often do you exercise (at least 30 minutes each time)? A 1.8

1. ☐ Every day 2. ☐ > 3 times per week
3. ☐ 1 - 2 times per week 4. ☐ Not frequently exercise

1.9 Do you currently have any of the following medical conditions? (Can tick more than one answer) A 1.9

1. ☐ Cardiovascular disease 2. ☐ Hypertension (High blood pressure)
3. ☐ High cholesterol 4. ☐ Diabetes
5. ☐ Asthma 6. ☐ Chronic obstructive pulmonary disease (COPD)
7. ☐ Kidney disease 8. ☐ Others, ________________
9. ☐ No medical conditions

1.10 Have you ever had a trauma road accident or work accident? A 1.10

1. ☐ Yes 2. ☐ No

1.11 Do you frequently experience muscle pain in any of the following body parts before joining the e-hailing industry? (Can tick more than one answer) A 1.11

1. ☐ Neck 2. ☐ Shoulder 3. ☐ Elbows
4. ☐ Wrists or hands 5. ☐ Upper back 6. ☐ Lower back
7. ☐ Hips or thighs 8. ☐ Knees 9. ☐ Ankles or feet
10. ☐ None of the above

1.12 How many years have you worked as an e-hailing driver? A 1.12

1. ☐ < 1 year 2. ☐ 1 - 2 years 3. ☐ 3 - 5 years 4. ☐ > 5 years

SECTION B: WORK CHARACTERISTICS

2.1 On average, how many hours do you work as an e-hailing driver per day? B 2.1

________________ hour(s) per day

2.2 On average, how many days do you work as an e-hailing driver per week? B 2.2

________________ day(s) per week

2.3 On average, how many days do you rest per week? B 2.3

________________ day(s) per week

For researcher use

2.4 How often do you work as an e-hailing driver at nighttime? (from 7 pm to 12 am)? B 2.4
1. ☐ Always 2. ☐ Sometimes 3. ☐ Never

2.5 How often do you leave your vehicle to take breaks during e-hailing working hours in a day? B 2.5
(e.g. toilet breaks, meal breaks, smoking breaks, rest breaks)
1. ☐ No break time 2. ☐ 1 - 2 times 3. ☐ 3 - 5 times 4. ☐ > 5 times

2.6 Do you do any stretching exercises or massages during your breaks? B 2.6
1. ☐ Yes 2. ☐ No

2.7 Do you take naps in the car while waiting for e-hailing orders? B 2.7
1. ☐ Yes 2. ☐ No

2.8 How often do you assist passengers to lift their luggage during work per day? B 2.8
1. ☐ Never 2. ☐ 1 - 2 times 3. ☐ 3 - 5 times 4. ☐ > 5 times

2.9 What is the estimated weight of the luggage you lift while assisting passengers? B 2.9
1. ☐ I do/could not assist passenger in lifting their luggage. 2. ☐ 1 - 5 kg
3. ☐ 6 - 10 kg 4. ☐ > 11 kg

2.10 Is there any headrest, backrest and/or car neck pillow on your seat? B 2.10
(Can tick more than one answer)
1. ☐ Headrest 2. ☐ Backrest 3. ☐ Car neck pillow 4. ☐ None

2.11 Are you satisfied with your e-hailing job? B 2.11
1. ☐ Yes 2. ☐ No

2.12 Do you feel mentally stressed due to your e-hailing job? B 2.12
1. ☐ Yes 2. ☐ No

SECTION C: SELF-ASSESSMENT OF MUSCULOSKELETAL DISORDERS (MSDs) SYMPTOMS

(Based on the Nordic Questionnaire (Kuorinka et al., 1987)

How to answer the questionnaire:

Picture: In this picture, you can see the approximate position of the parts of the body referred to in the table. Limits are not precisely defined, and certain parts are overlapped. You should decide for yourself in which part you have or had any symptom (if any).

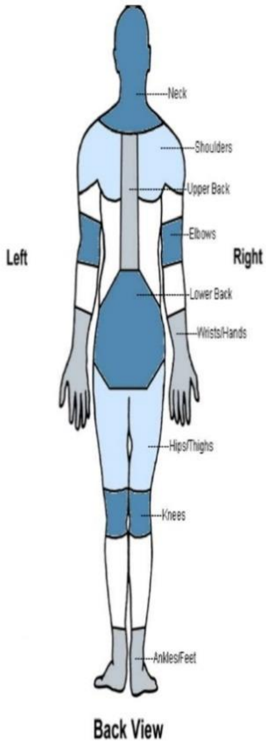


Table: Please answer by putting an "X" in the appropriate box - one "X" for each question. If you have any enquiries regarding the questionnaire, please ask the researcher. Note that column 1 of the questionnaire have to be answered even if you never have any symptom in any part of your body; if you answered yes in column 1, please proceed to columns 2 and 3.

Column 1	Column 2	Column 3
To be answered by everyone	**To be answered by those who have these symptoms**	
Have you faced any symptoms (ache, pain, discomfort, numbness) during **the past 12 months** in:	Are you prevented from **doing any routine work (at home or away from home) during the past 12 months** because of the symptoms?	Have you had trouble at any time during **the last 7 days**?
Neck ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Shoulders ☐ No ☐ Yes, right shoulder ☐ Yes, left shoulder ☐ Yes, both shoulders	☐ No ☐ Yes	☐ No ☐ Yes
Elbows ☐ No ☐ Yes, right elbow ☐ Yes, left elbow ☐ Yes, both elbows	☐ No ☐ Yes	☐ No ☐ Yes
Wrists/Hands ☐ No ☐ Yes, right wrist/hand ☐ Yes, left wrist/hand ☐ Yes, both wrists/hands	☐ No ☐ Yes	☐ No ☐ Yes
Upper back ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Lower back (small of back) ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Hips/Thighs ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Knees ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Ankles/Feet ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes

* Are the symptoms you are experiencing related to your work as an e-hailing driver?

☐ No ☐ Yes

UTAR UNIVERSITI TUNKU ABDUL RAHMAN

Wholly owned by UTAR Education Foundation (Co. No. 578227-M)
DU012(A)

BORANG KAJI SELIDIK KEJADIAN SIMPTOM GANGGUAN MUSKULOSKELETAL (SISTEM OTOT DAN TULANG) DALAM KALANGAN PEMANDU E-HAILING

NOTIS PERLINDUNGAN DATA PERIBADI

Harap dimaklumkan bahawa selaras dengan Akta Perlindungan Data Peribadi ("PDPA") yang dikuatkuasakan pada 15 November 2013, Universiti Tunku Abdul Rahman ("UTAR") kini tertakluk untuk memberikan notis dan memerlukan persetujuan berkaitan dengan pengumpulan, rakaman, penyimpanan, penggunaan dan pengekalan maklumat peribadi.

1. Data peribadi merujuk kepada sebarang maklumat yang secara langsung atau tidak langsung boleh mengenal pasti seseorang yang boleh merangkumi data peribadi sensitif dan pandangan seseorang. Antara lain, ia termasuk Nama, Kad Pengenalan, Tempat Lahir, Alamat, Sejarah Pendidikan, Sejarah Pekerjaan, Sejarah Perubatan, Jenis Darah, Bangsa, Agama, Foto, Maklumat Peribadi dan Data Penyelidikan Berkaitan.

2. Tujuan data peribadi anda digunakan termasuk tetapi tidak terhad kepada:
a) Untuk penilaian sebarang permohonan ke UTAR
b) Untuk memproses sebarang manfaat dan perkhidmatan
c) Untuk tujuan komunikasi
d) Untuk tujuan advertorial dan berita
e) Untuk tujuan pentadbiran am dan rekod
f) Untuk meningkatkan nilai pendidikan
g) Untuk tujuan pendidikan dan berkaitan dengan UTAR
h) Untuk membalas sebarang maklum balas terhadap aduan dan pertanyaan
i) Untuk tujuan tadbir urus korporat kami
j) Untuk tujuan menjalankan penyelidikan/ Kerjasama

3. Data peribadi anda mungkin dipindahkan dan/atau didedahkan kepada pihak ketiga dan/atau rakan kerjasama UTAR termasuk tetapi tidak terhad kepada ejen luaran yang dilantik untuk tujuan memenuhi tanggungjawab kami kepada anda berhubung dengan tujuan-tujuan tersebut serta semua tujuan berkaitan, serta dalam menyediakan perkhidmatan bersepadu, menyimpan dan mengekalkan rekod. Data anda mungkin dikongsi apabila dikehendaki oleh undang-undang dan apabila pendedahan perlu dilakukan untuk mematuhi undang-undang dan apabila pendedahan perlu dilakukan untuk mematuhi undang-undang yang berkenaan.

4. Sebarang maklumat peribadi yang disimpan oleh UTAR akan dimusnahkan dan/atau dipadamkan mengikut dasar pengekalan kami yang terpakai sekiranya maklumat tersebut tidak lagi diperlukan.

5. UTAR komited dalam memastikan kerahsiaan, perlindungan, keselamatan, dan ketepatan maklumat peribadi anda yang diberikan kepada kami, dan ini adalah polisi tegas kami yang berterusan untuk memastikan maklumat peribadi anda tepat, lengkap, tidak mengelirukan dan dikemas kini. UTAR juga akan memastikan bahawa data peribadi anda tidak akan digunakan untuk tujuan politik dan komersial.

Persetujuan

6. Dengan menyerahkan atau memberikan data peribadi anda kepada UTAR, anda telah bersetuju dan memberikan kebenaran untuk data peribadi anda digunakan mengikut terma dan syarat dalam Notis ini dan polisi yang berkaitan.

7. Jika anda tidak bersetuju atau menarik balik persetujuan anda terhadap pemprosesan dan pendedahan data peribadi anda, UTAR tidak akan dapat memenuhi tanggungjawab kami atau menghubungi anda atau membantu anda berhubung dengan tujuan tersebut dan/atau untuk sebarang tujuan lain yang berkaitan.

8. Anda boleh mengakses dan mengemas kini data peribadi anda dengan menulis kepada kami di yapjoyce0912@gmail.com (Joyce Yap).

Pengakuan Notis

** Tanda (✓) di petak yang berkenaan.*		**Tandatangan**
	Saya telah diberitahu dan dengan ini memahami, bersetuju dan memberikan kebenaran mengikut notis UTAR di atas.	
	Saya tidak bersetuju, data peribadi saya tidak akan diproses.	Nama: Tarikh: H/P:

Untuk kegunaan penyelidik

ARAHAN SOALAN

1. Borang soal selidik ini mengandungi beberapa bahagian iaitu:
   BAHAGIAN A: LATAR BELAKANG SOSIODEMOGRAFI DAN GAYA HIDUP
   BAHAGIAN B: CIRI-CIRI KERJA
   BAHAGIAN C: PENILAIAN KENDIRI GEJALA GANGGUAN MUSKULOSKELETAL (MSDS)
2. Anda diminta untuk menjawab semua soalan yang ada di dalam borang soal selidik ini.
3. Untuk menjawab, sila tanda jawapan anda di bahagian jawapan yang telah disediakan.
4. Borang soal selidik hendaklah dikembalikan kepada penyelidik setelah selesai menjawab semua soalan.

BAHAGIAN A: LATAR BELAKANG SOSIODEMOGRAFI DAN GAYA HIDUP

1.1 Di negeri manakah anda selalu memandu untuk kerja e-hailing? A 1.1
(Boleh tanda lebih daripada satu jawapan)

1. ☐ Johor	2. ☐ Kedah	3. ☐ Kelantan
4. ☐ Melaka	5. ☐ Negeri Sembilan	6. ☐ Pahang
7. ☐ Penang	8. ☐ Perak	9. ☐ Perlis
10. ☐ Sabah	11. ☐ Sarawak	12. ☐ Selangor
13. ☐ Terengganu	14. ☐ W.P. Kuala Lumpur	15. ☐ W.P. Labuan
16. ☐ W.P. Putrajaya		

1.2 Umur : ☐☐ tahun A 1.2

1.3 Jantina : 1. ☐ Lelaki 2. ☐ Perempuan A 1.3

1.4 Tinggi : ☐☐☐ cm A 1.4

1.5 Berat : ☐☐ kg A 1.5

1.6 Pendidikan : A 1.6
1. ☐ Tiada pendidikan formal
2. ☐ Sekolah rendah (contoh: UPSR)
3. ☐ Sekolah menengah (contoh: SPM)
4. ☐ Pra-universiti, sekolah teknikal atau vokasional atau kolej (contoh: SPTM, UEC, A-level, foundation, diploma, etc.)
5. ☐ Ijazah Sarjana Muda
6. ☐ Ijazah Sarjana atau Doktor Falsafah

Untuk kegunaan penyelidik

1.7 Adakah anda seorang perokok (rokok atau vape)? A 1.7

1. ☐ Berat 2. ☐ Ringan 3. ☐ Sekali-sekala 4. ☐ Tidak pernah

1.8 Berapa kerapkah anda bersenam (sekurang-kurangnya 30 minit setiap kali)? A 1.8

1. ☐ Setiap hari 2. ☐ > 3 kali seminggu
3. ☐ 1 - 2 kali seminggu 4. ☐ Tidak kerap bersenam

1.9 Adakah anda kini mempunyai mana-mana masalah kesihatan berikut? (Boleh tanda lebih daripada satu jawapan) A 1.9

1. ☐ Penyakit kardiovaskular (jantung) 2. ☐ Hipertensi (Tekanan darah tinggi)
3. ☐ Kolesterol tinggi 4. ☐ Diabetes (Kencing manis)
5. ☐ Asma 6. ☐ Penyakit Paru-paru Tersumbat Kronik (COPD)
7. ☐ Penyakit buah pinggang 8. ☐ Lain-lain, ________________
9. ☐ Tiada masalah kesihatan

1.10 Adakah anda pernah mengalami kemalangan jalan raya atau kemalangan kerja? A 1.10

1. ☐ Ya 2. ☐ Tidak

1.11 Adakah anda kerap mengalami sakit otot di mana-mana bahagian badan berikut sebelum bekerja sebagai pemandu e-hailing? (Boleh tanda lebih daripada satu jawapan) A 1.11

1. ☐ Leher 2. ☐ Bahu 3. ☐ Siku
4. ☐ Pergelangan tangan atau tangan 5. ☐ Bahagian atas belakang 6. ☐ Bahagian bawah belakang
7. ☐ Pinggul atau paha 8. ☐ Lutut 9. ☐ Buku lali atau kaki
10. ☐ Tiada yang di atas

1.12 Berapa lamakah anda telah bekerja sebagai pemandu e-hailing? A 1.12

1. ☐ < 1 tahun 2. ☐ 1 - 2 tahun 3. ☐ 3 - 5 tahun 4. ☐ > 5 tahun

BAHAGIAN B: CIRI-CIRI KERJA

2.1 Secara purata, berapa jam anda bekerja sebagai pemandu e-hailing sehari? B 2.1

________________ jam sehari

2.2 Secara purata, berapa hari anda bekerja sebagai pemandu e-hailing seminggu? B 2.2

________________ hari seminggu

Untuk kegunaan penyelidik

2.3 Secara purata, berapa hari anda berehat seminggu? B 2.3

________________ hari seminggu

2.4 Berapa kerapkah anda bekerja sebagai pemandu e-hailing pada waktu malam (dari 7 pm hingga 12 am)? B 2.4

1.☐ Sentiasa 2.☐ Kadang-kadang 3.☐ Tidak pernah

2.5 Berapa kerapkah anda keluar dari kenderaan untuk berehat semasa waktu bekerja sebagai pemandu e-hailing dalam sehari? (contoh: rehat tandas, rehat makan, rehat merokok, rehat untuk tidur) B 2.5

1.☐ Tidak rehat 2.☐ 1 - 2 kali 3.☐ 3 - 5 kali 4.☐ > 5 kali

2.6 Adakah anda melakukan senaman regangan atau urutan semasa rehat? B 2.6

1.☐ Ya 2.☐ Tidak

2.7 Adakah anda tidur sebentar di dalam kereta semasa menunggu pesanan e-hailing? B 2.7

1.☐ Ya 2.☐ Tidak

2.8 Berapa kerapkah anda membantu penumpang mengangkat bagasi mereka semasa bekerja dalam sehari? B 2.8

1.☐ Tidak pernah 2.☐ 1 - 2 kali 3.☐ 3 - 5 kali 4.☐ > 5 kali

2.9 Berapakah anggaran berat bagasi yang anda angkat semasa membantu penumpang? B 2.9

1.☐ Saya tidak/tidak dapat membantu penumpang mengangkat bagasi mereka. 2.☐ 1 - 5 kg

3.☐ 6 - 10 kg 4.☐ > 11 kg

2.10 Adakah terdapat penyandar kepala, penyandar belakang dan/atau bantal leher kereta pada kerusi anda? (Boleh tanda lebih daripada satu jawapan) B 2.10

1.☐ Penyandar kepala 2.☐ Penyandar belakang

3.☐ Bantal leher kereta 4.☐ Tiada

2.11 Adakah anda berpuas hati dengan pekerjaan e-hailing anda? B 2.11

1.☐ Ya 2.☐ Tidak

2.12 Adakah anda berasa tertekan dari segi mental disebabkan oleh pekerjaan e-hailing anda? B 2.12

1.☐ Ya 2.☐ Tidak

BAHAGIAN C: PENILAIAN KENDIRI GEJALA GANGGUAN MUSKULOSKELETAL (MSDS)

(Berdasarkan Soal Selidik Nordic (Kuorinka et al., 1987)

Cara untuk menjawab soal selidik:

Gambar: Dalam gambar ini, anda boleh melihat kedudukan anggaran bahagian tubuh yang dirujuk dalam jadual. Hadnya tidak ditakrifkan dengan jelas, dan beberapa bahagian bertindih. Anda harus memutuskan sendiri di bahagian badan mana anda mengalami masalah (jika ada).

Pandangan belakang

Jadual: Sila jawab dengan meletakkan "X" di dalam kotak yang sesuai - satu "X" untuk setiap soalan. Jika anda ragu-ragu tentang cara untuk menjawab, sila tanya penyelidik. Perhatikan bahawa lajur 1 dalam soal selidik mesti dijawab walaupun anda tidak pernah mengalami masalah pada mana-mana bahagian badan anda; lajur 2 dan 3 perlu dijawab jika anda menjawab ya dalam lajur 1.

Lajur 1	**Lajur 2**	**Lajur 3**
Untuk dijawab oleh semua orang	**Untuk dijawab oleh mereka yang pernah mengalami masalah**	
Adakah anda pada bila-bila masa **sepanjang 12 bulan yang lepas** mengalami masalah (kesakitan, ketidakselesaan, kebas) di:	**Sepanjang 12 bulan yang** lepas, adakah anda pada bila-bila masa **dihalang daripada melakukan kerja biasa anda** (di rumah atau di luar rumah) kerana masalah di:	Adakah anda mengalami masalah di mana-mana bahagian pada bila-bila masa **sepanjang 7 hari yang lepas?**
Leher ☐ Tidak ☐ Ya	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya
Bahu ☐ Tidak ☐ Ya, bahu kanan ☐ Ya, bahu kiri ☐ Ya, kedua-dua bahu	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya
Siku ☐ Tidak ☐ Ya, siku kanan ☐ Ya, siku kiri ☐ Ya, kedua-dua siku	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya
Pergelangan tangan/tangan ☐ Tidak ☐ Ya, pt/tangan kanan ☐ Ya, pt/tangan kiri ☐ Ya, kedua-dua pt/tangan	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya
Bahagian atas belakang ☐ Tidak ☐ Ya	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya
Bahagian bawah belakang ☐ Tidak ☐ Ya	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya
Satu atau kedua-dua pinggul/paha ☐ Tidak ☐ Ya	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya
Satu atau kedua-dua lutut ☐ Tidak ☐ Ya	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya
Satu atau kedua-dua buku lali/kaki ☐ Tidak ☐ Ya	☐ Tidak ☐ Ya	☐ Tidak ☐ Ya

* Adakah gejala yang anda alami berkaitan dengan pekerjaan anda sebagai pemandu e-hailing?

☐ Tidak ☐ Ya

电召车司机的肌肉骨骼疾病症状 (Musculoskeletal Disorders) 的患病率

个人资料保护通知

请注意，根据 2010 年《个人资料保护法》(“PDPA”)，该法于 2013 年 11 月 15 日生效，拉曼大学 (“UTAR”) 必须发出通知并要求为收集、记录、存储、使用和保留个人信息征得同意。

1. 个人资料指任何可直接或间接识别个人的信息，其中可能包括敏感个人资料和意见表达，内容包括但不限于姓名、身份证号、出生地、地址、教育背景、就业历史、医疗历史、血型、种族、宗教、照片、个人信息及相关研究数据。

2. 个人资料的用途包括但不限于以下用途:
a) 评估对 UTAR 的任何申请
b) 处理福利和服务
c) 用于沟通
d) 广告和新闻发布
e) 一般行政和记录用途
f) 提升教育价值
g) 教育及与 UTAR 相关的相关目的
h) 回应投诉和查询
i) 履行企业治理义务
j) 进行研究/合作

3. 您的个人资料可能会被转移或披露给第三方和/或 UTAR 的合作伙伴，包括但不限于相关的外包代理，以履行与您相关的义务以及提供综合服务、维护和存储记录。在法律要求和必要时，您的资料可能会被共享以遵守适用法律。

4. 如不再需要您的个人信息，UTAR 将根据我们的保留政策销毁和/或删除相关信息。

5. UTAR 致力于确保您提供的个人信息的保密性、保护、安全性和准确性，并严格遵循确保个人资料的准确、完整、不误导和及时更新的政策。UTAR 还将确保您的个人资料不会被用于政治或商业目的。

同意

6. 通过向 UTAR 提交或者提供您的个人资料，您已同意并且允许您的个人资料根据本通知的条款和我们的相关政策使用。

7. 如果您不同意或随后撤回同意处理和披露您的个人资料，UTAR 将无法履行与您相关的义务，联系您或为您提供帮助。

8. 你可以通过发送电子邮件至 yapjoyce0912@gmail.com (Joyce Yap) 来访问和更新您的个人资料。

确认通知

* *勾选(✓)所有适用的选项。*		签名
	我已被通知并且理解、同意并接受 UTAR 上述通知的条款。	
	我不同意，个人数据将不会被处理。	姓名: 日期: 电话号码:

供研究者使用

<u>问卷说明</u>

1. 本问卷由几个部分组成：
   部分A：个人背景与生活习惯
   部分 B：工作特性
   部分 C：肌肉骨骼疾病 (MSDs) 症状自我评估

2. 您需要回答本问卷中的所有问题。
3. 回答时，请在提供的答案区域记录您的答案。
4. 完成问卷后，请将问卷交还给研究员。

<u>部分 A：个人背景与生活习惯</u>

1.1 您主要在哪个州属进行电召车工作？（可勾选多个答案） A 1.1

1. ☐ 柔佛	2. ☐ 吉打	3. ☐ 吉兰丹
4. ☐ 马六甲	5. ☐ 森美兰州	6. ☐ 彭亨
7. ☐ 槟城	8. ☐ 霹雳	9. ☐ 玻璃市
10. ☐ 沙巴	11. ☐ 砂拉越	12. ☐ 雪兰莪
13. ☐ 登嘉楼	14. ☐ 吉隆坡	15. ☐ 纳闽
16. ☐ 布城		

1.2 年龄 : ☐☐ 岁 A 1.2

1.3 性别 : 1. ☐ 男 2. ☐ 女 A 1.3

1.4 身高 : ☐☐☐ cm A 1.4

1.5 体重 : ☐☐ kg A 1.5

1.6 学历 : A 1.6
1. ☐ 无正式教育背景
2. ☐ 小学(如 UPSR)
3. ☐ 中学 (如 SPM)
4. ☐ 大学预科、技术或职业学校或学院
   (如 SPTM, UEC, A-level, foundation, diploma, etc.)
5. ☐ 本科
6. ☐ 研究生 (如硕士或博士)

1.7 您是否吸烟 (香烟或电子烟)? A 1.7
1. ☐ 重度 2. ☐ 轻度 3. ☐ 偶尔 4. ☐ 从不

1.8 您多经常锻炼/运动 (每次至少30分钟)? A 1.8
1. ☐ 每天 2. ☐ 每周3次以上
3. ☐ 每周1 - 2 次 4. ☐ 不常锻炼/运动

1.9 您目前是否有以下任何疾病？（可勾选多个答案） A 1.9
1. ☐ 心血管疾病 2. ☐ 高血压
3. ☐ 高胆固醇 4. ☐ 糖尿病
5. ☐ 哮喘 6. ☐ 慢性阻塞性肺疾病 (COPD)
7. ☐ 肾病 8. ☐ 其他; ________________
9. ☐ 无医疗健康状况

1.10 您是否曾发生过创伤性交通事故或工作事故？ A 1.10
1. ☐ 是 2. ☐ 否

1.11 在加入电召车行业前，您是否经常感到以下任何部位的肌肉疼痛？(可勾选多个答案) A 1.11
1. ☐ 颈部 2. ☐ 肩膀 3. ☐ 肘部
4. ☐ 手腕或手部 5. ☐ 上背部 6. ☐ 下背部
7. ☐ 髋部或大腿 8. ☐ 膝盖 9. ☐ 脚踝或脚部
10. ☐ 以上均无

1.12 您从事电召车司机工作多少年了？ A 1.12
1. ☐ < 1 年 2. ☐ 1 - 2 年 3. ☐ 3 - 5 年 4. ☐ > 5 年

<u>部分 **B:** 工作特性</u>

2.1 您平均每天作为电召车司机工作多少小时？ B 2.1
________________ 小时/天

2.2 您平均每周作为电召车司机工作多少天？ B 2.2
________________ 天/周

2.3 您平均每周休息多少天？ B 2.3
________________ 天/周

供研究者使用

2.4 您在晚上（从晚上7点到凌晨12点）进行电召车工作的频率是？ B 2.4
1.☐ 经常 2.☐ 有时 3.☐ 从不

2.5 您每天进行电召车工作时离开车辆休息的频率是？（如如厕、用餐、吸烟、休息） B 2.5
1.☐ 没有休息时间 2.☐ 1 - 2 次
3.☐ 3 - 5 次 4.☐ > 5 次

2.6 您在休息时间是否会做任何拉伸运动或按摩？ B 2.6
1.☐ 是 2.☐ 否

2.7 您在等待电召车订单时，是否会在车内小睡？ B 2.7
1.☐ 是 2.☐ 否

2.8 您每天帮助乘客搬运行李的频率是多少？ B 2.8
1.☐ 从不 2.☐ 1 - 2 次 3.☐ 3 - 5 次 4.☐ > 5 次

2.9 您在帮助乘客搬运行李时，行李的重量预估是多少？ B 2.9
1.☐ 我没有/不能帮助乘客搬运行李 2.☐ 1 - 5 kg
3.☐ 6 - 10 kg 4.☐ > 11 kg

2.10 您的座椅上是否有头枕、靠背或车用颈枕？(可勾选多个答案) B 2.10
1.☐ 头枕 2.☐ 靠背 3.☐ 车用颈枕 4.☐ 没有

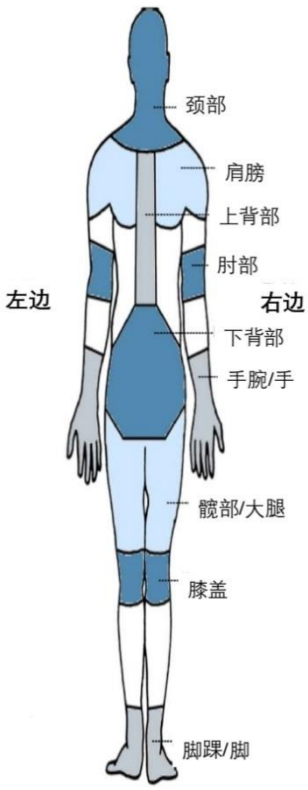
2.11 您对自己的电召车工作满意吗？ B 2.11
1.☐ 是 2.☐ 否

2.12 您是否因为电召车工作感到心理压力？ B 2.12
1.☐ 是 2.☐ 否

部分 C: 肌肉骨骼疾病 (MSDs) 症状自我评估
(根据Nordic Questionnaire (Kuorinka et al., 1987)

如何回答该问卷:

图片: 在这张图中，您可以看到问题中提到的身体部位的大致位置。界限并不明显某些部位可能会重叠。您应自行决定哪个部位曾经或现在有问题（如果有）。



背面图

表格: 请在相应的方框中填写 "X"。如果您对此问卷有任何疑问，请询问研究者。请注意，如果您从未在身体的任何部位出现过问题，请在问卷的第1栏填写"否"；如果您在第1栏回答了"是"，则需回答第2栏和第3栏。

第1栏	**第2栏**	**第3栏**
全部人必须回答	有不适的人必须回答	
在过去的**12**个月内，您是否在以下任何部位感到不适 (酸痛、疼痛、不适、麻木)?	在过去**12**个月内，您是否因这些不适而无法进行正常工作(无论是在家中或外出工作)?	在过去**7**天内，您是否在相关部位感到不适？
颈部 ☐否 ☐是	☐否 ☐是	☐否 ☐是
肩膀 ☐否 ☐是，右肩 ☐是，左肩 ☐是，双侧肩膀	☐否 ☐是	☐否 ☐是
肘部 ☐否 ☐是，右边肘部 ☐是，左边肘部 ☐是，双侧肘部	☐否 ☐是	☐否 ☐是
手腕/手 ☐否 ☐是，右手腕/手 ☐是，左手腕/手 ☐是，双侧手腕/手	☐否 ☐是	☐否 ☐是
上背部 ☐否 ☐是	☐否 ☐是	☐否 ☐是
下背部 ☐否 ☐是	☐否 ☐是	☐否 ☐是
一侧或双侧髋部/大腿 ☐否 ☐是	☐否 ☐是	☐否 ☐是
一侧或双侧膝盖 ☐否 ☐是	☐否 ☐是	☐否 ☐是
一侧或双侧脚踝/脚 ☐否 ☐是	☐否 ☐是	☐否 ☐是

* 您所经历的这些症状是否与您作为电召车司机的工作有关？

☐否 ☐是

Appendix B: Ethical Approval Letter

UNIVERSITI TUNKU ABDUL RAHMAN DU012(A)
Wholly owned by UTAR Education Foundation Co. No. 578227-M

Re: U/SERC/78-360/2024

11 September 2024

Dr Zafarullah Nizamani
Head, Department of Environmental Engineering
Faculty of Engineering and Green Technology
Universiti Tunku Abdul Rahman
Jalan Universiti, Bandar Baru Barat
31900 Kampar, Perak.

Dear Dr Zafarullah,

Ethical Approval For Research Project/Protocol

We refer to the application for ethical approval for your students' research project from Bachelor of Science (Honours) Environmental, Occupational Safety and Health programme enrolled in course UGNB4196. We are pleased to inform you that the application has been approved under Expedited Review.

The details of the research projects are as follows:

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
1.	Prevalence of Musculoskeletal Disorders Symptoms and Their Associated Risk Factors Among E-Hailing Drivers: A Cross-Sectional Study	Joyce Yap Chun Chee	Dr Lim Fang Lee	11 September 2024 - 10 September 2025
2.	The Relationships Between Musculoskeletal Disorder (MSD) Symptoms and Work Productivity Among Industrial Workers in Manufacturing Factory	Ooi Zi Feng		

The conduct of this research is subject to the following:

(1) The participants' informed consent be obtained prior to the commencement of the research;

(2) Confidentiality of participants' personal data must be maintained; and

(3) Compliance with procedures set out in related policies of UTAR such as the UTAR Research Ethics and Code of Conduct, Code of Practice for Research Involving Humans and other related policies/guidelines.

(4) Written consent be obtained from the institution(s)/company(ies) in which the physical or/and online survey will be carried out, prior to the commencement of the research.

Should the students collect personal data of participants in their studies, please have the participants sign the attached Personal Data Protection Statement for records.

Thank you.

Yours sincerely,

Professor Ts Dr Faidz bin Abd Rahman
Chairman
UTAR Scientific and Ethical Review Committee

c.c Dean, Faculty of Engineering and Green Technology
Director, Institute of Postgraduate Studies and Research

Kampar Campus : Jalan Universiti, Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia
Tel: (605) 468 8888 Fax: (605) 466 1313
Sungai Long Campus : Jalan Sungai Long, Bandar Sungai Long, Cheras, 43000 Kajang, Selangor Darul Ehsan, Malaysia
Tel: (603) 9086 0288 Fax: (603) 9019 8868
Website: www.utar.edu.my