

Sleep Quality and Physical Fatigue Among Online Motorcycle Drivers: Cross-Sectional Study

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Abstract

Background: Online motorcycle taxi drivers are at risk of occupational fatigue due to prolonged working duration, static posture, and insufficient recovery time. Poor sleep quality may impair neuromuscular performance and increase fatigue-related accident risk.

Objective: To analyze the relationship between sleep quality and physical fatigue among online motorcycle taxi drivers in the Special Region of Yogyakarta.

Methods: This analytical observational study used a cross-sectional design involving 100 online motorcycle taxi drivers selected using purposive sampling. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), while physical fatigue was objectively measured using a smartphone-based visual Reaction Time application. Data were analyzed using the Kolmogorov–Smirnov test and Spearman correlation analysis.

Results: Most respondents had poor sleep quality (87%). Physical fatigue was categorized as low in 72% of respondents, moderate in 24%, and severe in 4%. The mean PSQI score was 13.67 ± 4.84 , while the mean reaction time was 346.27 ± 88.82 ms. Spearman analysis demonstrated a statistically significant positive correlation between sleep quality and physical fatigue with $p = 0.016$, $r = 0.239$, and 95% CI = 0.04–0.42, indicating a weak association.

Conclusion: Poor sleep quality was significantly associated with increased physical fatigue among online motorcycle taxi drivers. These findings emphasize the importance of occupational physiotherapy interventions, including active microbreak exercises and sleep hygiene education, to reduce fatigue risk and improve driving safety.

Keywords

Sleep Quality; Fatigue, Physical; Occupational Fatigue; Reaction Time; Motorcycle Drivers

Introduction

Online motorcycle taxi services have become one of the fastest-growing digital transportation sectors in Indonesia because of their accessibility, flexibility, affordability, and efficiency in supporting community mobility. Increasing public dependence on ride-hailing transportation indirectly increases the workload and working duration of online motorcycle taxi drivers to meet consumer demands and maintain income targets.¹ In the Special Region of Yogyakarta, online motorcycle transportation is widely used due to high educational, tourism, and urban mobility activities.² These occupational conditions place online motorcycle taxi drivers at considerable risk of experiencing work-related health problems, particularly physical fatigue and musculoskeletal disorders.³

Physical fatigue is a physiological condition characterized by decreased physical performance and impaired ability of the neuromuscular system to maintain optimal work capacity after prolonged activity.⁴ Online motorcycle taxi drivers commonly maintain static sitting postures and repetitive upper extremity activities for extended periods during driving. Prolonged static muscle contractions increase intramuscular pressure and reduce blood circulation and oxygen delivery to muscle tissues, particularly in the neck, shoulders, upper extremities, and lower back.^{5,6} Reduced tissue oxygenation may promote accumulation of metabolic by-products such as lactate and hydrogen ions, which contribute to neuromuscular fatigue and impaired motor performance.⁷ Neuromuscular fatigue is associated with slower motor responses, reduced concentration, decreased alertness, and impaired coordination, thereby increasing the risk of occupational accidents and traffic injuries among drivers.⁸

Fatigue has become a major occupational and public safety concern worldwide.³ The World Health Organization reported that fatigue substantially contributes to road traffic accidents and work-related performance decline.⁹ In Indonesia, occupational fatigue among online motorcycle taxi drivers is increasingly concerning because many drivers work long hours with insufficient rest and irregular sleep schedules.¹⁰ Previous studies reported that online motorcycle taxi drivers frequently experience sleep deprivation, prolonged work duration, and inadequate recovery time, all of which may negatively affect physiological restoration and neuromuscular performance.¹¹ In addition, cumulative occupational exposure to traffic congestion, environmental heat, psychosocial stress, vibration, and economic pressure may aggravate physical fatigue and impair long-term occupational health among ride-hailing drivers. Despite these risks, occupational ergonomics and fatigue mechanisms among online motorcycle taxi drivers in Indonesia remain underexplored.³

Sleep quality is one of the most important physiological factors influencing recovery, cognitive performance, and neuromuscular function. Sleep is essential for tissue repair, energy restoration, hormonal regulation, and maintenance of cognitive and motor performance.¹² Adequate sleep supports anabolic processes through increased secretion of growth hormone and insulin-like growth factor-1, which facilitate muscle recovery and protein synthesis.¹³ Conversely, poor sleep quality impairs physiological recovery, increases cortisol secretion, disrupts neuromuscular coordination, and decreases central nervous system performance.¹⁴ Disturbed sleep patterns and insufficient sleep duration are also associated with slower reaction time, reduced concentration, impaired decision-making, and decreased driving performance. These physiological disturbances may reduce the ability of drivers to respond quickly to traffic situations, thereby increasing accident risk.¹⁵

From an occupational physiotherapy perspective, physical fatigue among online motorcycle taxi drivers is highly relevant because it involves prolonged static posture, repetitive biomechanical loading, neuromuscular strain, and decreased functional performance.³ Previous studies investigating fatigue among online motorcycle taxi drivers have predominantly used subjective self-report questionnaires, which are vulnerable to recall bias and perception bias.^{10,11} Evidence regarding the relationship between sleep quality and objectively measured physical fatigue using reaction time assessment among online motorcycle taxi drivers in Indonesia remains limited. Reaction time assessment was selected in this study because it provides an objective representation of neuromuscular response performance and motor processing speed associated with fatigue.¹⁶ Smartphone-based reaction time applications are considered practical, accessible, sensitive, and feasible for occupational field assessment compared with several laboratory-based fatigue measurements.¹⁷

Several studies have demonstrated that impaired sleep quality is associated with delayed reaction time and reduced neuromuscular performance among workers and drivers.^{15,16} However, most previous studies focused on subjective fatigue assessment or general occupational populations rather than online motorcycle taxi drivers specifically. In addition, evidence regarding occupational fatigue among ride-hailing drivers in Indonesia is still limited, particularly studies evaluating physical fatigue objectively through visual reaction time measurement. This study therefore provides scientific novelty by objectively assessing physical fatigue using smartphone-based visual reaction time assessment as an indicator of neuromuscular fatigue among online motorcycle taxi drivers in Indonesia. The study also contributes to occupational physiotherapy literature by exploring the relationship between sleep quality and motor response performance among informal transportation workers.

Understanding the relationship between sleep quality and physical fatigue has important implications for occupational physiotherapy, workplace ergonomics, and traffic safety prevention. Identification of fatigue-related factors may support the development of preventive interventions aimed at maintaining neuromuscular performance, reducing fatigue risk, improving work productivity, and enhancing driving safety among online motorcycle taxi drivers. Active microbreak exercises, ergonomic education, and occupational stretching programs may become important physiotherapy strategies to reduce physical fatigue during prolonged driving activities.¹⁸

Therefore, this study aimed to analyze the relationship between sleep quality and physical fatigue measured using reaction time among online motorcycle taxi drivers in the Special Region of Yogyakarta. The study hypothesized that poor sleep quality is significantly associated with increased physical fatigue and slower reaction time performance among online motorcycle taxi drivers.

Methods

This study used an analytical observational design with a cross-sectional approach to analyze the relationship between sleep quality and physical fatigue among online motorcycle taxi drivers in the Special Region of Yogyakarta. The independent variable in this study was sleep quality, whereas the dependent variable was physical fatigue measured objectively using reaction time assessment. The study was conducted from February 5–9, 2026 in several public areas commonly used by online motorcycle taxi drivers to wait for passengers, including university areas, shopping centers, train stations, and other public facilities in the Special Region of Yogyakarta. Data collection was performed during daytime working hours between 11:00 and 14:00 WIB to reduce variability related to circadian rhythm effects on reaction time performance.

The target population consisted of active online motorcycle taxi drivers working in the Special Region of Yogyakarta. Sample size determination used the Lemeshow formula because the total population size could not be identified with certainty. The sample calculation used a confidence level of 95% ($Z = 1.96$), estimated proportion of 0.5, and margin of error of 10%, resulting in a minimum sample size of 96 respondents. To anticipate incomplete responses and participant withdrawal, an additional 10% was added, resulting in 106 recruited respondents. Sampling was conducted using purposive sampling. Inclusion criteria included online motorcycle taxi drivers aged 20–60 years, actively working as their primary occupation, having worked for at least one hour on the day of data collection, and agreeing to participate by signing informed consent. Exclusion criteria included respondents with a history of chronic disease and respondents who did not complete the study procedures. A total of 106 respondents were initially recruited, of whom six respondents were excluded because three declined participation and three did not complete the data collection procedures. Therefore, the final analyzed sample consisted of 100 respondents.

The respondent selection process was systematically conducted to ensure consistency between recruitment and analysis procedures. Initially, active online motorcycle taxi drivers in the Special Region of Yogyakarta were identified and screened according to inclusion and exclusion criteria. Eligible respondents were subsequently invited to participate and completed all study procedures, including demographic data collection, Pittsburgh Sleep Quality Index (PSQI) interviews, and reaction time measurements. Respondents who withdrew participation or failed to complete the assessment procedures were excluded from the final analysis. No outlier data requiring exclusion were identified during statistical screening.

This study acknowledged several potential sources of bias and confounding factors. The use of purposive sampling may introduce selection bias because not all members of the target population had equal opportunities to participate. Furthermore, the cross-sectional design limits causal interpretation because sleep quality and physical fatigue were measured simultaneously. Reverse causality may therefore occur, whereby fatigue could also influence sleep quality. The possibility of healthy worker effect should also be considered because drivers experiencing severe fatigue or health problems may no longer be actively working during the study period, potentially leading to underestimation of fatigue severity. Several confounding variables, including caffeine intake, smoking habits, nutritional status, psychosocial stress, environmental heat exposure, workload, physical activity, and actual sleep duration, were not controlled in this study and may have influenced the findings.

Sleep quality was assessed using the Pittsburgh Sleep Quality Index. The PSQI is a standardized self-reported instrument used to evaluate sleep quality during the previous month and consists of seven components, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. Each component is scored from 0–3, resulting in a total score ranging from 0–21. Total scores ≤ 5 indicate good sleep quality, whereas scores > 5 indicate poor sleep quality. The Indonesian version of the PSQI demonstrated good validity with Item Content Validity Index values ranging from 0.92–1.00 and acceptable reliability with Cronbach's alpha of 0.803.¹³ Although the PSQI is widely used in sleep quality research, the instrument remains vulnerable to recall bias because respondents subjectively evaluate their sleep patterns over the previous month.

Physical fatigue was objectively measured using a smartphone-based visual Reaction Time application. In this study, physical fatigue was operationally defined as decreased motor response performance resulting from neuromuscular fatigue characterized by delayed visual reaction time. Reaction time assessment was selected because it objectively represents central nervous system processing speed and neuromuscular response performance associated with fatigue.¹⁶ The application used visual

color stimuli displayed on a smartphone screen and automatically recorded reaction time in milliseconds. Previous studies demonstrated acceptable reliability of smartphone-based reaction time applications with an intraclass correlation coefficient of 0.713 and significant validity for neurological and neuromuscular assessment. Additional validation studies also demonstrated acceptable reliability with Cronbach's alpha values ranging from 0.835–0.879.¹⁷

Reaction time measurement was standardized to minimize procedural variation. All respondents used the same smartphone device, namely Samsung M32 Android-based smartphone, to reduce variability caused by differences in screen refresh rate, touch latency, and operating system performance. Respondents were assessed while sitting comfortably and holding the smartphone in a relaxed position. The application initially displayed a blue screen, followed by a red waiting phase, and subsequently changed randomly into a green stimulus signal. Respondents were instructed to tap the screen as quickly as possible after the green stimulus appeared. Each respondent completed five repeated trials, and the application automatically calculated the average reaction time score. Respondents were also given a brief familiarization trial before formal assessment to reduce learning effects and improve measurement consistency. Reaction time values were categorized into low fatigue (>240–<410 ms), moderate fatigue (410–<580 ms), and severe fatigue (≥580 ms) based on previous validation studies.¹⁷ Despite previous evidence supporting the validity and reliability of smartphone-based reaction time assessment, external validation against laboratory-based neurophysiological gold-standard instruments has not yet been established and should therefore be interpreted cautiously.

Before data collection, enumerator training was conducted to standardize interview procedures, respondent instructions, and reaction time assessment protocols. Data collection began with demographic interviews, followed by PSQI assessment and reaction time measurements. Respondents were informed regarding study objectives, procedures, benefits, confidentiality, and participant rights before signing informed consent. Data confidentiality was maintained by anonymizing respondent identities throughout the study process.

Data analysis was performed using IBM SPSS Statistics version 25 for Windows. Descriptive statistics were used to summarize respondent characteristics, sleep quality scores, and reaction time measurements using frequencies, percentages, means, standard deviations, minimum values, and maximum values. Before inferential analysis, normality testing was conducted using the Kolmogorov–Smirnov test. Both sleep quality and physical fatigue variables were not normally distributed; therefore, Spearman correlation analysis was used to determine the relationship between sleep quality and physical fatigue. Statistical significance was established at $p < 0.05$. Correlation coefficients and 95% confidence intervals were also reported to describe the strength and precision of the association. Outlier screening was conducted using Z-score evaluation with a cutoff range of -3 to $+3$. No outlier data requiring exclusion were identified. This study only performed bivariate analysis and did not include multivariate regression analysis; therefore, the findings represent associative relationships rather than independent predictive effects after controlling for confounding variables.

This study received ethical approval from the Health Research Ethics Committee of Poltekkes Kemenkes Yogyakarta with approval number DP.04.03/e-KEPK.2/143/2026. All respondents voluntarily participated after receiving complete explanations regarding study procedures and ethical considerations. Participants were informed that they could withdraw from the study at any time without consequences.

Results

The participant recruitment and study flow are presented in Figure 1. Active online motorcycle taxi drivers in the Special Region of Yogyakarta were identified as the target population. Based on the Lemeshow sample size calculation with an additional 10% allowance for anticipated dropout, 106 respondents were recruited. Following eligibility assessment, 100 respondents fulfilled the predefined inclusion criteria. Six respondents were excluded, comprising three who were unwilling to participate and three who did not complete the study procedures. No outlier data were excluded. Consequently, 100 respondents were included in the final analysis.

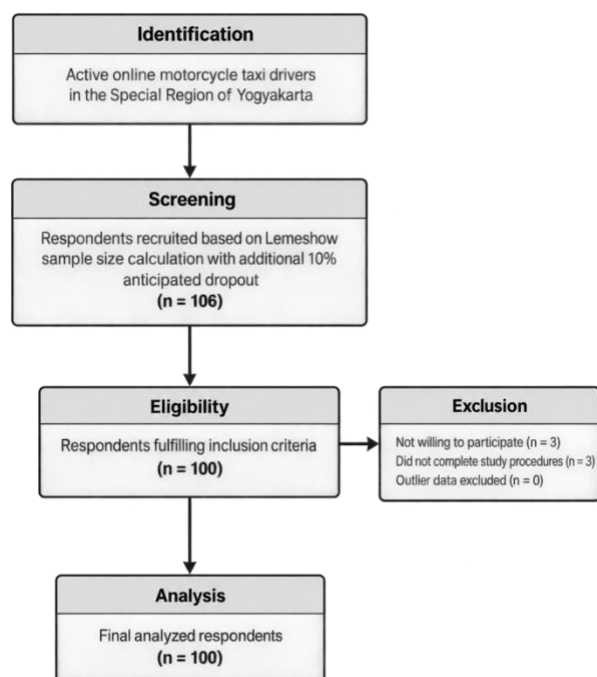


Figure 1. Participant Recruitment and Study Flow

The demographic and occupational characteristics of respondents are presented in Table 1 to provide an overview of the study population and occupational exposure related to physical fatigue risk among online motorcycle taxi drivers.

Table 1. Respondent Characteristics

Variable	n (%)
Age	
20–30 years	23 (23%)
31–40 years	42 (42%)
41–50 years	27 (27%)
51–60 years	8 (8%)
Sex	
Male	100 (100%)
Female	0 (0%)
Marital Status	
Married	79 (79%)
Unmarried	21 (21%)
Working Duration per Day	
7–9 hours	32 (32%)
10–12 hours	62 (62%)
13–14 hours	6 (6%)
Working Duration per Week	
5 days	4 (4%)
6 days	59 (59%)
7 days	37 (37%)
Years of Employment	
0.5–3 years	32 (32%)
4–6 years	27 (27%)
7–10 years	41 (41%)
Sleep Quality	
Good	13 (13%)
Poor	87 (87%)
Physical Fatigue	
Low	72 (72%)
Moderate	24 (24%)
Severe	4 (4%)

Table 1 demonstrates that most respondents were aged 31–40 years (42%), followed by 41–50 years (27%), indicating that the majority of participants were within productive working age groups. All respondents were male, reflecting the predominance of males in online motorcycle transportation occupations. Most respondents worked 10–12 hours per day (62%) and six days per week (59%), suggesting substantial occupational exposure and prolonged working duration. In addition, 41% of respondents had worked as online motorcycle taxi drivers for 7–10 years, indicating long-term occupational exposure to static posture, repetitive motor activity, and environmental stressors. Most respondents had poor sleep quality (87%), while physical fatigue was predominantly categorized as low (72%), followed by moderate (24%) and severe fatigue (4%).

To provide a clearer description of sleep quality and physical fatigue distribution, descriptive statistical analyses of PSQI scores and reaction time values were performed. These analyses were intended to illustrate the severity and variability of sleep quality impairment and neuromuscular response performance among respondents.

Table 2. Descriptive Statistics of PSQI Scores

Variable	Minimum	Maximum	Mean $\pm$ SD
PSQI Score	4	23	13.67 $\pm$ 4.84

Table 2 demonstrates that PSQI scores ranged from 4 to 23, with a mean value of 13.67 ± 4.84 . The average PSQI score exceeded the standard cutoff value of >5 , indicating that most respondents experienced poor sleep quality. The relatively large standard deviation suggests variability in sleep quality conditions among respondents.

Reaction time measurement results are presented in Table 3 to objectively describe physical fatigue levels based on neuromuscular response performance.

Table 3. Descriptive Statistics of Reaction Time Values

Variable	Minimum (ms)	Maximum (ms)	Mean $\pm$ SD (ms)
Reaction Time	242	646	346.27 $\pm$ 88.82

Table 3 shows that reaction time values ranged from 242 ms to 646 ms, with a mean value of 346.27 ± 88.82 ms. Based on the predefined classification criteria, the mean reaction time was categorized as low physical fatigue. However, the maximum value of 646 ms indicates that several respondents experienced severe fatigue characterized by substantially delayed motor responses. The relatively high standard deviation also indicates considerable variability in neuromuscular response performance among respondents.

Before inferential analysis, normality testing was conducted to determine the appropriate statistical approach for correlation analysis. The results of the Kolmogorov–Smirnov normality test are presented in Table 4.

Table 4. Kolmogorov–Smirnov Normality Test

Variable	p-value
Sleep Quality	0.000
Physical Fatigue	0.000

Table 4 demonstrates that both sleep quality and physical fatigue variables were not normally distributed because the significance values were below 0.05. Therefore, non-parametric Spearman correlation analysis was subsequently used to evaluate the relationship between sleep quality and physical fatigue.

To analyze the association between sleep quality and physical fatigue, cross-tabulation and Spearman correlation analyses were performed. The findings are presented in Table 5.

Table 5. Cross-tabulation and Spearman Correlation Analysis

Sleep Quality	Low Fatigue n (%)	Moderate Fatigue n (%)	Severe Fatigue n (%)
Good	13 (100%)	0 (0%)	0 (0%)
Poor	59 (67.8%)	24 (27.6%)	4 (4.6%)

Spearman correlation analysis showed $p = 0.016$, $r = 0.239$, and 95% CI = 0.04–0.42.

Table 5 demonstrates that all respondents with good sleep quality experienced low physical fatigue. In contrast, respondents with poor sleep quality showed higher proportions of moderate and severe physical fatigue. Spearman correlation analysis demonstrated a statistically significant positive association between sleep quality and physical fatigue with $p = 0.016$. The correlation coefficient value of $r = 0.239$ indicates a weak positive correlation, suggesting that poorer sleep quality was associated with slower reaction time and increased physical fatigue. The 95% confidence interval ranged from 0.04–0.42, indicating that the association remained within the weak correlation category. Although statistically significant, the weak correlation strength suggests that physical fatigue among online motorcycle taxi drivers may also be influenced by other occupational and physiological factors not evaluated in this study.

Discussion

This study demonstrated a statistically significant relationship between sleep quality and physical fatigue among online motorcycle taxi drivers in the Special Region of Yogyakarta. The findings showed that poorer sleep quality was associated with slower reaction time and increased physical fatigue, although the correlation strength was categorized as weak. These findings indicate that sleep quality contributes to neuromuscular performance and occupational fatigue among online motorcycle taxi drivers, while also suggesting the involvement of additional occupational and physiological factors affecting fatigue development.

Most respondents in this study experienced poor sleep quality, with a mean PSQI score of 13.67 ± 4.84 . This finding indicates that sleep disturbance is highly prevalent among online motorcycle taxi drivers. Long working duration, irregular work schedules, insufficient recovery time, and occupational stress may contribute to impaired sleep quality among drivers. Previous studies similarly reported that online motorcycle taxi drivers frequently experience inadequate sleep duration and disturbed sleep patterns because of prolonged work demands and economic pressure.^{11,19} Drivers often continue working for extended hours to increase income, thereby reducing opportunities for adequate rest and physiological recovery. Sleep deprivation and irregular sleep patterns may disrupt circadian rhythm regulation, impair hormonal recovery processes, and reduce central nervous system restoration, ultimately affecting occupational performance and fatigue levels.^{12,13}

The present study also demonstrated that most respondents experienced low physical fatigue based on reaction time classification, although moderate and severe fatigue categories were still identified among several respondents. The mean reaction time value of 346.27 ± 88.82 ms remained within the low-fatigue category; however, substantial variability was observed among respondents. This finding suggests that not all online motorcycle taxi drivers experience identical levels of neuromuscular fatigue despite similar occupational exposure. Differences in physical condition, work adaptation, recovery capacity, stress level, workload, and sleep quality may explain these variations.²⁰ In addition, online motorcycle taxi driving primarily involves prolonged static posture and repetitive low-to-moderate intensity activity rather than heavy dynamic physical labor. Consequently, some drivers may develop physiological adaptation to occupational demands despite prolonged work duration.²¹

The correlation analysis demonstrated a significant positive association between sleep quality and physical fatigue with $p = 0.016$ and $r = 0.239$. The positive correlation coefficient indicates that poorer sleep quality was associated with slower reaction time and increased physical fatigue. Physiologically, poor sleep quality impairs tissue recovery, hormonal balance, cognitive restoration, and neuromuscular function.¹² Sleep plays a critical role in maintaining central nervous system performance, motor coordination, and muscle recovery through anabolic hormonal regulation involving growth hormone and insulin-like growth factor-1.¹³ Conversely, inadequate sleep increases cortisol secretion, impairs neuromuscular coordination, decreases alertness, and slows information processing speed within the central nervous system.¹⁴ These physiological disturbances may result in delayed motor responses and impaired reaction time performance, thereby increasing fatigue-related occupational risk.^{15,17}

Neuromuscular fatigue may also explain the observed relationship between sleep quality and reaction time performance. Prolonged occupational activity combined with inadequate recovery may impair neural transmission efficiency between the central nervous system and skeletal muscles.⁷ Reduced neuromuscular efficiency may decrease motor response speed, impair coordination, and delay reaction time performance.¹⁵ In occupational settings requiring sustained alertness and rapid motor responses, such as motorcycle driving, impaired reaction time may substantially increase accident risk.^{9,15} Previous studies similarly demonstrated that sleep deprivation and fatigue are associated with delayed reaction time, impaired driving performance, and increased occupational accident risk among transportation workers and professional drivers.^{15,22}

Although the relationship identified in this study was statistically significant, the correlation strength was categorized as weak. This finding suggests that sleep quality is not the sole determinant of physical fatigue among online motorcycle taxi drivers. Several occupational and environmental factors may independently contribute to fatigue development. Drivers are frequently exposed to prolonged static posture, traffic congestion, vibration, environmental heat, psychosocial stress, workload pressure, and repetitive upper extremity activity during driving.^{23,24} These occupational stressors may contribute to muscular strain, impaired circulation, cumulative fatigue, and decreased neuromuscular performance even among drivers with relatively adequate sleep quality. Environmental heat exposure may further accelerate dehydration and cardiovascular strain, thereby increasing fatigue susceptibility.²⁵

The weak correlation strength identified in this study may also reflect the multifactorial nature of occupational fatigue. In addition to sleep quality, psychological stress, work intensity, nutritional status, physical activity level, smoking habits, caffeine consumption, and ergonomic posture may influence fatigue development among drivers.³ Furthermore, the present study only evaluated physical fatigue using reaction time assessment and did not assess mental fatigue, cognitive fatigue, or subjective fatigue perception comprehensively. Therefore, the findings should be interpreted as representing one dimension of occupational fatigue rather than total fatigue burden.

This study also identified several important methodological considerations. Sleep quality assessment using the PSQI relied on self-reported responses and therefore remained vulnerable to recall bias and subjective perception differences among respondents. Respondents may inaccurately estimate sleep duration, sleep disturbance frequency, or daytime dysfunction over the previous month. Additionally, although smartphone-based reaction time assessment demonstrated acceptable reliability and practicality for occupational field evaluation, external validation against laboratory-based neurophysiological gold-standard instruments remains limited.¹⁷ Device characteristics such as screen refresh rate, touch latency, and operating system processing may also influence reaction time measurements to some extent.

The cross-sectional design used in this study prevents determination of temporal or causal relationships between sleep quality and physical fatigue. Reverse causality remains possible because fatigue itself may impair sleep quality through discomfort, stress, and impaired physiological recovery. Additionally, the possibility of healthy worker effect should be acknowledged because drivers with severe fatigue or poor health conditions may no longer be actively working during data collection, potentially leading to underestimation of fatigue severity in the occupational population. The use of purposive sampling may also limit external validity because respondents may not fully represent all online motorcycle taxi drivers in Indonesia. Moreover, all respondents in this study were male, thereby limiting generalizability to female drivers and other occupational populations.

Despite these limitations, the findings provide important implications for occupational physiotherapy and workplace health promotion. Identification of sleep quality as a factor associated with physical fatigue highlights the importance of preventive interventions aimed at maintaining neuromuscular performance and occupational safety among online motorcycle taxi drivers. Active microbreak interventions involving stretching exercises may help reduce muscular tension, improve circulation, maintain flexibility, and reduce cumulative neuromuscular strain during prolonged driving activities. Short-duration stretching exercises performed periodically during work may also improve alertness and reduce fatigue accumulation.¹⁸ In addition, ergonomic education, workload management, sleep hygiene education, and occupational recovery strategies may contribute to fatigue prevention and improved driving safety among ride-hailing drivers.³

Future studies are recommended to use longitudinal or cohort designs to clarify causal relationships between sleep quality and occupational fatigue. Additional objective measurements such as electromyography, heart rate variability, or biochemical fatigue markers may further strengthen neuromuscular fatigue assessment. Future research should also involve female drivers, include multivariate analysis to control confounding variables, and evaluate mental fatigue and psychosocial factors comprehensively to improve understanding of occupational fatigue mechanisms among online motorcycle taxi drivers.

Conclusion

This study demonstrated a statistically significant relationship between sleep quality and physical fatigue among online motorcycle taxi drivers in the Special Region of Yogyakarta. Poor sleep quality was associated with slower reaction time and increased physical fatigue, although the strength of the association was categorized as weak. These findings indicate that sleep quality contributes to neuromuscular performance and occupational fatigue among online motorcycle taxi drivers, while suggesting that fatigue is also influenced by multiple occupational and physiological factors beyond sleep quality alone.³

From an occupational physiotherapy perspective, these findings emphasize the importance of preventive strategies aimed at reducing fatigue risk and maintaining driving safety. Active microbreak exercises, stretching programs, ergonomic education, sleep hygiene promotion, and workload management may help improve neuromuscular recovery and reduce cumulative fatigue during prolonged driving activities.^{3,18}

Because this study used a cross-sectional design, the findings should be interpreted as associative rather than causal relationships. Future studies are recommended to use longitudinal or cohort designs, involve more diverse participant characteristics, apply multivariate analysis to control confounding variables, and incorporate additional objective measurements of neuromuscular and mental fatigue to strengthen understanding of occupational fatigue among online motorcycle taxi drivers.

Author Contribution

Musyafa Adyatma: Conceptualization, Methodology, Investigation, Resources, Data Curation, Writing Original Draft

Nindha Prabaningrum: Supervision, Validation, Writing Review and Editing

Hilmi Zadah Faidullah: Supervision, Validation, Writing Review and Editing

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

Ethical approval for this study was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Yogyakarta, Indonesia, under ethical clearance number No. DP.04.03/e-KEPK.2/143/2026 dated February 05, 2026. All respondents provided written informed consent before participation. Confidentiality and anonymity of participant data were maintained throughout the study process. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and the 2016 CIOMS Guidelines.

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