

Long Working Hours and the Co-Occurrence of Work-Related Musculoskeletal Symptoms and Occupational Stress among Ride-Hailing Drivers in Beijing, China

Zhihui Wang^{1,†}, Binshuo Hu^{1,†}, Xin Song¹, Xiaoshun Wang¹, Rui Guan², Hong Yu², Siyuan Wang³, Dongsheng Niu¹, Tenglong Yan^{1,*} and Xiaowen Ding^{1,*}

¹ Beijing Prevention and Treatment Hospital of Occupational Disease/Beijing Institute of Occupational Disease Prevention and Treatment, Beijing 100093, China

² Beijing Rehabilitation Hospital, Capital Medical University, Beijing 100144, China

³ School of Public Health, Hangzhou Medical College, Hangzhou 310013, China

* Correspondence: yantlyan@bjmu.edu.cn (T.Y.); dxwen1124@163.com (X.D.)

† These authors contributed equally to this work.

How To Cite: Wang, Z.; Hu, B.; Song, X.; et al. Long Working Hours and the Co-Occurrence of Work-Related Musculoskeletal Symptoms and Occupational Stress among Ride-Hailing Drivers in Beijing, China. *Work and Health* 2026, 2(4), 22. <https://doi.org/10.53941/wah.2026.100022>

Received: 22 May 2026

Revised: 5 September 2026

Accepted: 16 September 2026

Published: 10 October 2026

Abstract: Long working hours may be associated with adverse health outcomes among ride-hailing drivers. The study aims to examine the associations between long working hours, work-related musculoskeletal disorders (WMSDs) and occupational stress. Additionally, it explores the association between long working hours and the co-occurrence of WMSDs and occupational stress. A cross-sectional survey was conducted among 668 ride-hailing drivers in Beijing, China, from August to October 2024. WMSDs were assessed using the Nordic Musculoskeletal Questionnaire (NMQ). Occupational stress was assessed using the Job Content Questionnaire (JCQ). In this study, co-occurrence was defined as the joint classification of WMSDs and occupational stress in the same individual. Participants were categorized into groups of <55 and ≥55 working hours per week. Binary and logistic regression models were used to examine the associations between weekly working hours and health outcomes. Overall, 77.8% of participants worked ≥55 h per week. The prevalence of WMSDs and occupational stress was 53.0% and 56.4%, respectively. Weekly working hours ≥55 h were significantly associated with higher odds of occupational stress after full adjustment (aOR = 3.99, 95% CI: 2.59–6.13), but were not significantly associated with WMSDs (aOR = 1.12, 95% CI: 0.74–1.70). Occupational stress was associated with higher odds of WMSDs (aOR = 1.56, 95% CI: 1.11–2.18). Compared with drivers working <55 h per week, those working ≥55 h per week had higher odds of having one condition (aOR = 1.95, 95% CI: 1.21–3.14) and co-occurrence of occupational stress and WMSDs (aOR = 4.64, 95% CI: 2.57–8.36). The prevalence of co-occurrence was 37.9% in the ≥55 h group and 16.2% in the <55 h group. Long working hours were associated with occupational stress and with the co-occurrence of occupational stress and WMSDs among ride-hailing drivers. However, no independent association was observed between long working hours and WMSDs. These findings highlight the need for comprehensive occupational health interventions targeting ride-hailing drivers.



Keywords: long working hours; work-related musculoskeletal disorders; occupational stress; co-occurrence; ride-hailing drivers

1. Introduction

Working ≥ 55 h per week has been used as a threshold for long working hours in previous occupational health research [1]. Long working hours have been associated with adverse physical and psychological health outcomes. At the same time, long working hours also have a lasting impact on workers' psychological state and behavioral patterns through mechanisms such as deprivation of rest time, disruption of circadian rhythms, and increased psychological stress [1,2]. As a result, they lead to a series of psychophysiological issues, including occupational stress, sleep disorders, and chronic fatigue. Long working hours may also prolong exposure to ergonomic risk factors, such as prolonged sitting, repetitive tasks, awkward or static postures, and vibration. Longer exposure to these factors may increase cumulative biomechanical load and contribute to musculoskeletal symptoms [3]. In the transportation sector, particularly among emerging occupational groups like ride-hailing drivers, long working hours are prevalent. The enclosed vehicle-cabin environment, monotonous tasks, and uncertain income may further amplify the negative impacts on both physical and mental health [4].

WMSDs involve symptoms or disorders affecting muscles, joints, tendons, and other components of the musculoskeletal system. They are associated with prolonged occupational exposure to biomechanical risk factors, including repetitive movements, adverse postures, sustained physical loading, and vibration [5]. Among professional drivers, the risk of developing WMSDs is particularly pronounced due to prolonged sitting, repetitive motions, exposure to vehicle vibration, and ergonomic limitations [4]. Studies indicate that the prevalence of low back pain and neck and shoulder discomfort among professional drivers is significantly higher than in the general population [6]. WMSDs may reduce work ability and productivity and may increase healthcare use and related costs [3,7,8].

Occupational stress encompasses adverse physiological and psychological responses that arise when workplace psychosocial demands exceed an individual's coping capacity. It may also result from a mismatch between job demands and the individual's capabilities, resources, or needs [9]. Occupational stress has been associated with adverse psychological outcomes, including anxiety, depression, and emotional exhaustion [10]. In the context of the platform economy, ride-hailing drivers face multiple occupational pressures. These include algorithmic management, real time performance ratings, income instability, uncertain workloads, and job insecurity [4,11,12]. Such factors may increase work demands and reduce perceived control over work. As a result, ride-hailing drivers have gradually emerged as a new high risk occupational group in research on occupational stress.

The rapid development of the digital platform economy has led to substantial growth in ride-hailing work [13]. While this employment model offers flexible work opportunities, its unique characteristics pose significant threats to drivers' physical and mental health [4]. Such characteristics include extended driving hours, high levels of uncertainty, frequent social interactions, and constant performance pressure. Among these factors, extended working hours are considered a key occupational health risk. Long working hours may not only contribute to WMSDs but are also associated with occupational stress [14]. However, the existing evidence focuses primarily on traditional professional drivers, such as taxi and truck drivers. Research on the occupational health of workers in the emerging platform economy remains relatively limited [11]. In particular, few studies have examined the co-occurrence of WMSDs and occupational stress among ride-hailing drivers. Moreover, the association between long working hours and this joint outcome has not yet been systematically studied.

To address this research gap, the present study examines the associations between long working hours, WMSDs and occupational stress among ride-hailing drivers in Beijing. It also examines the association between long working hours and the co-occurrence of WMSDs and occupational stress. The study aims to provide a basis for developing occupational health interventions for ride-hailing drivers, thereby promoting improvements in the occupational health of the emerging workforce.

2. Methods

2.1. Participants

A cross-sectional study was conducted among ride-hailing drivers in Beijing, China, from August to October 2024. The Beijing Municipal Federation of Trade Unions allocates free physical examination slots based on the proportion of ride-hailing drivers in each district. Each district randomly selects eligible drivers to undergo physical examinations at the Beijing Rehabilitation Hospital. The study recruited participants who voluntarily agreed to complete a questionnaire during the physical examination period. The inclusion criteria were: (1)

Possession of a Beijing ride-hailing driver qualification certificate with current full-time or part-time engagement in ride-hailing operations; (2) Ages 18 to 60. The exclusion criteria were: (1) A history of diagnosed musculoskeletal disorders that could independently account for musculoskeletal symptoms (e.g., bursitis, carpal tunnel syndrome, epicondylitis, or meniscal injury) or orthopedic trauma (e.g., neck, shoulders, back, hips, lower limbs, knees, or feet); (2) Refusal to provide complete work hour records; (3) Individuals with hearing/speech impairments unable to complete the survey. For criterion (1), exclusion was applied only when the anatomical site affected by the previous disorder or trauma corresponded to the site of the currently reported musculoskeletal symptoms.

A total of 690 ride-hailing drivers voluntarily participated in the survey. Two were excluded due to incomplete questionnaire responses, and 20 were excluded because they met the predefined musculoskeletal disorder or trauma criterion. Finally, 668 participants were included in the analysis, representing 96.8% of the initial sample. The study protocol was approved by the Medical Ethics Committee of the Beijing Institute of Occupational Disease Prevention and Control (Approval No. C2024005). All participants provided written informed consent. The participant recruitment and exclusion process is shown in Figure 1.

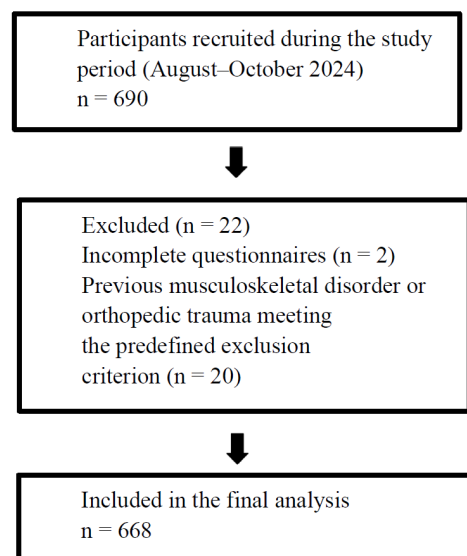


Figure 1. Flow diagram of participant recruitment and exclusion.

2.2. Questionnaire

Data were collected through face to face interviews conducted by standardized training interviewers, who recorded participants' responses. The questionnaire collected sociodemographic information and information on health related behaviors. Sociodemographic information included gender, age (<45 years and ≥45 years), ethnicity (Han and Other), household registration type (urban and rural), educational level (junior high school and below, high school and vocational high school and Associate's degree or higher), and monthly personal income (≤6000 RMB, 6001–10,000 RMB, and >10,000 RMB). Health related behaviors included sleep status (insufficient sleep and adequate sleep), dietary diversity score (DDS), smoking, alcohol consumption, and physical activity (regular and irregular). Daily sleep duration <7 h was defined as insufficient sleep, and ≥7 h as adequate sleep. DDS was calculated based on the number of food categories consumed, with 1 point assigned per category for a total score ranging from 1 to 9. In the present study, DDS < 5 was defined as insufficient dietary diversity, and DDS ≥ 5 was defined as adequate dietary diversity [15,16]. Smoking at least one cigarette per day was defined as smoking. Drinking alcohol at least once a month was defined as alcohol consumption. Physical activity lasting >30 min at least once per week was classified as regular physical activity. Weekly working hours were based on the average self-reported working hours since the participant began the job. Working hours referred to actual driving time and did not include break times. Participants were divided into two groups: working <55 h per week and working ≥55 h per week. Drivers who accurately reported 55 h per week were included in the ≥55 h per week group.

2.3. Long Working Hours

Based on the WHO/ILO Joint Estimates, ≥55 h per week was used as the threshold for long working hours [17]. A previous study among transportation industry workers in Beijing also used ≥55 h per week as the highest working-hour category [18]. Therefore, to ensure consistency with international standards and improve

comparability with previous studies, long working hours were defined as an average of ≥ 55 h per week. Weekly working hours were categorized into two groups: < 55 h/week and ≥ 55 h/week. The 55 h/week threshold was used as an operational benchmark rather than a biological or workforce-specific safe/unsafe boundary. The < 55 h/week category was used as the reference group and did not necessarily represent normal, short, or low-risk working hours.

2.4. WMSDs

WMSDs were assessed using the NMQ. It is a widely used international standardized instrument for assessing musculoskeletal symptoms in different body regions [19]. This scale has been translated into Chinese and has shown acceptable reliability and validity in occupational populations [20]. The operational case definition was adapted from case definitions previously used in National Institute for Occupational Safety and Health health hazard evaluations. A participant was classified as having self reported WMSDs if at least one of the nine body regions met all of the following criteria: (1) symptoms have been present for the past year; (2) symptoms began after starting the current job; (3) no history of musculoskeletal disorders or orthopedic trauma (affecting the location of symptoms); (4) symptoms occur every month or last for more than 7 days [21].

Musculoskeletal symptoms during the previous 12 months were assessed in nine body regions: neck, shoulder, upper back, lower back (lumbar), elbow, wrist/hand, hip/thigh, knee, and ankle/foot. WMSDs were identified based on self reported symptoms rather than clinical diagnosis. Although participants with pre-existing musculoskeletal disorders and major orthopaedic trauma (affecting the location of symptoms) were excluded, some musculoskeletal symptoms attributable to non-occupational causes may still have been classified as WMSDs. This may have led to an overestimation of the prevalence. Conversely, a healthy-worker effect may also have occurred, as drivers with more severe symptoms may have reduced their working hours or left driving work. This could have led to an underestimation of the observed associations between occupational exposures and WMSDs. Therefore, these two sources of bias may have affected different aspects of the findings and in different directions.

2.5. Occupational Stress

Occupational stress was assessed using the JCQ. This is a standardized measurement tool widely used internationally to evaluate psychosocial factors in the workplace and occupational stress [22]. The Chinese version of this scale has been translated and has previously demonstrated acceptable reliability and factorial validity in Chinese occupational populations [23].

The study used the Chinese version of the JCQ, which has been validated in previous research, to assess the occupational stress experienced by ride-hailing drivers since they began working in this field. The JCQ comprises three dimensions with 22 items: Job Demands (5 items), Job Control (9 items), and Social Support (8 items). Each item was rated on a 4-point Likert scale ranging from 1 to 4, with response options reflecting the frequency or degree of the situation described in each item. Negatively keyed items were reverse scored before calculating the corresponding dimension scores. Specifically, item 6.3 (“having enough time to complete the work”) in the job demands dimension and item 6.11 (“highly repetitive work”) in the job control dimension were reverse-scored (1 = 4, 2 = 3, 3 = 2, and 4 = 1). In the current sample, the Cronbach’s alpha coefficient for the JCQ total scale was 0.80. The Kaiser-Meyer-Olkin (KMO) value was 0.781, and Bartlett’s test of sphericity was statistically significant ($p < 0.001$). Subscale specific reliability and factor structure were not re-evaluated in the present sample. The score for dimension was calculated as follows:

$$\text{Dimension score} = \frac{\sum \text{item scores within the dimension}}{\text{number of items within the dimension}}$$

The Job Strain Index (JSI) was calculated as follows:

$$\text{JSI} = \frac{\text{Job Demands}}{\text{Job Control}}$$

JSI > 1 was used as an operational indicator of occupational stress in the present study. This threshold reflects relatively high job demands in relation to job control and was not interpreted as a clinical diagnostic cutoff.

2.6. Covariates

Covariates were selected based on previous studies and their potential roles as confounding factors. They included gender, age, ethnicity, household registration type, educational level, monthly personal income, sleep patterns, DDS, smoking, alcohol, and physical activity [18,24]. The definitions and classifications of each variable are described in Section 2.2.

2.7. Statistical Analysis

Data entry was performed using EpiData version 3.1 (EpiData Association, Odense, Denmark). Statistical analyses were conducted using IBM SPSS Statistics, version 24.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as frequencies and percentages [n (%)]. Differences between groups were examined using the chi-square (χ^2) test. When appropriate, post-hoc pairwise comparisons were performed with Bonferroni correction. Multivariable binary logistic regression analyses were conducted to assess the associations among long working hours, occupational stress, and WMSDs.

Three models with increasing levels of covariate adjustment were fitted. For the analysis of WMSDs, Model 1 included weekly working hours and occupational stress as independent variables. For the analysis of occupational stress, Model 1 included weekly working hours and WMSDs as independent variables. Model 2 was adjusted for sociodemographic characteristics, including gender, age, ethnicity, household registration type, educational level, and monthly personal income. Model 3 was further adjusted for lifestyle-related factors, including sleep patterns, DDS, smoking, alcohol, and physical activity. The mutually adjusted associations between occupational stress and WMSDs were interpreted as cross-sectional associations and not as evidence of temporal or causal relationships.

For the joint-outcome analysis, participants were classified into three mutually exclusive categories: 0 conditions, defined as neither occupational stress nor WMSDs; 1 condition, defined as either occupational stress or WMSDs but not both; and 2 conditions, defined as the co-occurrence of occupational stress and WMSDs. Multinomial logistic regression was used to examine the association between weekly working hours and the three category joint outcome, with 0 conditions as the reference category. The model was adjusted for the predefined sociodemographic and health related covariates. Subgroup analyses were conducted using the same adjustment strategy. Each subgroup model was adjusted for all predefined covariates except the corresponding stratification variable. Formal interaction tests were not performed, and no correction for multiple comparisons was applied to the subgroup analyses. Therefore, these analyses were considered exploratory. Formal assessments of multicollinearity, overall model fit, sparse-cell or separation issues, and assumptions specific to multinomial logistic regression were not performed. All tests were two-sided, with $p < 0.05$ considered statistically significant.

3. Results

3.1. Demographic Characteristics, Working Hours, WMSDs, and Occupational Stress

Table 1 presents the characteristics of the 668 ride-hailing drivers. Most participants were male (90.9%) and of Han ethnicity (96.1%). Participants aged <45 years accounted for 53.3% of the sample, and 70.4% had rural household registration. Only 19.9% had an associate's degree or higher. A total of 44.6% of participants reported a monthly personal income of 6001–10,000 RMB, and 34.4% reported an income >10,000 RMB. Insufficient sleep was reported by 29.9% of participants, and 71.7% had a DDS score ≥ 5 . Smokers and alcohol drinkers accounted for 46.9% and 34.1%, respectively. Regular physical activity was reported by 35.8% of participants. A total of 520 participants (77.8%) worked ≥ 55 h per week. The prevalence of WMSDs and occupational stress was 53.0% and 56.4%, respectively. WMSDs prevalence differed significantly by alcohol consumption ($p = 0.008$) and physical activity ($p < 0.001$). WMSDs were more common among alcohol drinkers and participants with irregular physical activity. Occupational stress differed significantly by household registration type ($p = 0.002$), educational level ($p = 0.001$), sleep pattern ($p = 0.002$), physical activity ($p = 0.001$), and weekly working hours ($p < 0.001$). Occupational stress was more common among participants working ≥ 55 h per week than among those working <55 h per week (64.0% vs. 29.7%). In contrast, WMSDs prevalence did not differ significantly between the two working-hour groups (54.2% vs. 48.6%, $p = 0.230$).

Table 1. Prevalence of WMSDs and occupational stress across demographic characteristics.

Characteristics	Total [n (%)]	WMSDs		Occupational Stress	
		n (%)	p	n (%)	p
Total	668 (100)	354 (53)		377 (56.4)	
Sex			0.856		0.511
Male	607 (90.9)	321 (52.9)		345 (56.8)	
Female	61 (9.1)	33 (54.1)		32 (52.5)	
Age (years)			0.918		0.427
<45	356 (53.3)	188 (52.8)		206 (57.9)	
≥ 45	312 (46.7)	166 (53.2)		171 (54.8)	
Ethnicity			0.130		0.500
Han	642 (96.1)	344 (53.6)		364 (56.7)	
Other	26 (3.9)	10 (38.5)		13 (50.0)	

Table 1. Cont.

Characteristics	Total [n (%)]	WMSDs		Occupational Stress	
		n (%)	p	n (%)	p
Household registration type			0.489		0.002 **
Urban	198 (29.6)	109 (55.1)		94 (47.5)	
Rural	470 (70.4)	245 (52.1)		283 (60.2)	
Level of education			0.517		0.001 **
Junior high school and below	289 (43.3)	160 (55.4)		183 (63.3) ^a	
High School and Vocational High School	246 (36.8)	124 (50.4)		136 (55.3) ^{a,b}	
Associate's degree or higher	133 (19.9)	70 (52.6)		58 (43.6) ^b	
Monthly personal income (RMB)			0.122		0.471
≤6000	140 (21.0)	73 (52.1)		76 (54.3)	
6001–10,000	298 (44.6)	147 (49.3)		176 (59.1)	
>10,000	230 (34.4)	134 (58.3)		125 (54.3)	
Sleep patterns			0.175		0.002 **
Lack of sleep	200 (29.9)	114 (57.0)		131 (65.5)	
Adequate sleep	468 (70.1)	240 (51.3)		246 (52.6)	
DDS			0.587		0.954
<5	189 (28.3)	97 (51.3)		107 (56.6)	
≥5	479 (71.7)	257 (53.7)		270 (56.4)	
Smoking			0.521		0.076
Yes	313 (46.9)	170 (54.3)		188 (60.1)	
No	355 (53.1)	184 (51.8)		189 (53.2)	
Alcohol			0.008 **		0.381
Yes	228 (34.1)	137 (60.1)		134 (58.8)	
No	440 (65.9)	217 (49.3)		243 (55.2)	
Physical activity			<0.001 ***		0.001 **
Regular	239 (35.8)	101 (42.3)		114 (47.7)	
Irregular	429 (64.2)	253 (59.0)		263 (61.3)	
Weekly working hours (hours)			0.230		<0.001 ***
<55	148 (22.2)	72 (48.6)		44 (29.7)	
≥55	520 (77.8)	282 (54.2)		333 (64.0)	

Note: Overall *p* values were calculated using the chi-square test. Post-hoc pairwise comparisons were conducted using Bonferroni correction. Different superscript letters indicate significant differences between groups (*p* < 0.05), whereas the same letters indicate no significant differences. A group with two letters (e.g., a,b) was not significantly different from groups sharing either letter. ** *p* < 0.01, *** *p* < 0.001.

3.2. Weekly Working Hours and WMSDs

Table 2 shows the associations of weekly working hours and occupational stress with WMSDs. In Model 1, participants working ≥55 h per week did not have significantly higher odds of WMSDs than those working <55 h per week (*OR* = 1.05, 95% *CI*: 0.72–1.55). The association remained non-significant after adjustment for demographic and socioeconomic factors in Model 2 (*OR* = 1.12, 95% *CI*: 0.74–1.68). Similar results were observed after further adjustment for lifestyle-related factors in Model 3 (*OR* = 1.12, 95% *CI*: 0.74–1.70).

Occupational stress was significantly associated with WMSDs. In Model 1, participants with occupational stress had higher odds of WMSDs than those without occupational stress (*OR* = 1.66, 95% *CI*: 1.21–2.29). The association remained significant in Model 2 (*OR* = 1.67, 95% *CI*: 1.20–2.32) and Model 3 (*OR* = 1.56, 95% *CI*: 1.11–2.18).

Table 2. Associations of weekly working hours and occupational stress with WMSDs.

Variables	Model 1	Model 2	Model 3
Working hours			
<55	Ref.	Ref.	Ref.
≥55	1.05 (0.72, 1.55)	1.12 (0.74, 1.68)	1.12 (0.74, 1.70)
Occupational stress			
No	Ref.	Ref.	Ref.
Yes	1.66 (1.21, 2.29) **	1.67 (1.20, 2.32) **	1.56 (1.11, 2.18) **

Note: Model 1 is the baseline model, which includes only two variables: weekly working hours and occupational stress; Model 2 adjusts Model 1 by incorporating gender, age, ethnicity, household registration type, educational level, and monthly personal income; Model 3 further adjusts Model 2 by incorporating sleep patterns, DDS, smoking, alcohol, and physical activity. ** *p* < 0.01.

3.3. Weekly Working Hours and Occupational Stress

Table 3 shows the associations of weekly working hours and WMSDs with occupational stress. Participants working ≥ 55 h per week had higher odds of occupational stress than those working < 55 h per week in Model 1 ($OR = 4.18$, 95% CI : 2.81–6.23). The association remained significant after adjustment for demographic and socioeconomic factors in Model 2 ($OR = 3.84$, 95% CI : 2.52–5.86). It also remained significant after further adjustment for lifestyle related factors in Model 3 ($OR = 3.99$, 95% CI : 2.59–6.13).

WMSDs were also significantly associated with occupational stress. The OR was 1.66 (95% CI : 1.21–2.29) in Model 1 and 1.67 (95% CI : 1.20–2.32) in Model 2. After further adjustment in Model 3, the association remained significant ($OR = 1.56$, 95% CI : 1.11–2.18).

Table 3. Associations of weekly working hours and WMSDs with occupational stress.

Variables	Model 1	Model 2	Model 3
Working hours			
<55	Ref.	Ref.	Ref.
≥ 55	4.18 (2.81, 6.23) ***	3.84 (2.52, 5.86) ***	3.99 (2.59, 6.13) ***
WMSDs			
No	Ref.	Ref.	Ref.
Yes	1.66 (1.21, 2.29) **	1.67 (1.20, 2.32) **	1.56 (1.11, 2.18) **

Note: Model 1 is the baseline model, which includes only two variables: weekly working hours and WMSDs; Model 2 adjusts Model 1 by controlling for gender, age, ethnicity, household registration type, educational level, and monthly personal income; Model 3 further adjusts Model 2 by controlling for sleep patterns, DDS, smoking, alcohol consumption, and physical activity. ** $p < 0.01$, *** $p < 0.001$.

3.4. Weekly Working Hours and Co-Occurrence of Occupational Stress and WMSDs

Table 4 shows the associations between weekly working hours and the number of conditions present. Participants with neither occupational stress nor WMSDs were used as the reference outcome group. Irregular physical activity was associated with higher odds of having one condition ($aOR = 2.43$, 95% CI : 1.60–3.68) and of having both conditions ($aOR = 2.76$, 95% CI : 1.75–4.38). Compared with participants working < 55 h per week, those working ≥ 55 h per week had higher odds of having one condition ($aOR = 1.95$, 95% CI : 1.21–3.14). They also had higher odds of having both occupational stress and WMSDs ($aOR = 4.64$, 95% CI : 2.57–8.36). The point estimate was numerically larger for two conditions than for one condition. No statistically significant associations were observed for gender, age, ethnicity, household registration type, educational level, monthly personal income, sleep pattern, DDS, smoking, or alcohol consumption.

Table 4. Associations between weekly working hours and the number of conditions (occupational stress and WMSDs) among ride-hailing drivers in Beijing.

Variables	Number of Conditions Present	
	1 Condition, aOR (95% CI)	2 Condition, aOR (95% CI)
Sex		
Male	Ref.	Ref.
Female	1.16 (0.56, 2.42)	1.39 (0.62, 3.15)
Age(years)		
<45	Ref.	Ref.
≥ 45	0.92 (0.59, 1.42)	0.96 (0.60, 1.54)
Ethnicity		
Han	Ref.	Ref.
Other	1.03 (0.39, 2.73)	0.57 (0.17, 1.95)
Household registration type		
Urban	Ref.	Ref.
Rural	0.64 (0.38, 1.07)	0.72 (0.40, 1.27)
Level of education		
Junior high school and below	Ref.	Ref.
High School and Vocational High School	0.92 (0.57, 1.48)	0.73 (0.44, 1.21)
Associate's degree or higher	0.65 (0.35, 1.20)	0.61 (0.31, 1.21)

Table 4. *Cont.*

Variables	Number of Conditions Present	
	1 Condition, aOR (95% CI)	2 Condition, aOR (95% CI)
Monthly personal income (RMB)		
≤6000	Ref.	Ref.
6001–10,000	0.89 (0.52, 1.52)	0.85 (0.47, 1.53)
>10,000	1.07 (0.61, 1.90)	1.00 (0.53, 1.87)
Sleep patterns		
Lack of sleep	Ref.	Ref.
Adequate sleep	1.04 (0.65, 1.66)	0.66 (0.40, 1.06)
DDS		
<5	Ref.	Ref.
≥5	0.85 (0.54, 1.35)	0.63 (0.38, 1.04)
Smoking		
Yes	Ref.	Ref.
No	1.05 (0.68, 1.62)	0.80 (0.50, 1.28)
Alcohol		
Yes	Ref.	Ref.
No	0.88 (0.56, 1.37)	0.73 (0.45, 1.18)
Physical activity		
Regular	Ref.	Ref.
Irregular	2.43 (1.60, 3.68) ***	2.76 (1.75, 4.38) ***
Weekly working hours (hours)		
<55	Ref.	Ref.
≥55	1.95 (1.21, 3.14) **	4.64 (2.57, 8.36) ***

Note: The reference outcome category was 0 conditions (neither occupational stress nor WMSDs). One condition indicates the presence of either occupational stress or WMSDs, but not both, whereas two conditions indicate the co-occurrence of occupational stress and WMSDs. Estimates are presented as adjusted odds ratios (aORs) with 95% confidence intervals (CIs).

** $p < 0.01$, *** $p < 0.001$.

3.5. Subgroup Analyses of Weekly Working Hours and Co-Occurrence of Occupational Stress and WMSDs

Table 5 presents exploratory subgroup analyses of the association between weekly working hours and the number of conditions present. The models were adjusted for the covariates included in the fully adjusted model, except for the corresponding stratification variable. Among male participants, working ≥55 h per week was associated with higher odds of having one condition (aOR = 1.76, 95% CI: 1.06–2.92) and both conditions (aOR = 3.78, 95% CI: 2.05–6.95). For co-occurrence, significant associations were observed in both age groups: among participants aged <45 years (aOR = 5.79, 95% CI: 2.58–12.99) and among those aged ≥45 years (aOR = 3.39, 95% CI: 1.41–5.13). Significant associations with co-occurrence were also observed in several other subgroups, including participants with rural household registration, lower educational attainment, adequate sleep, DDS ≥5, non-smokers, and non-drinkers. Some subgroup estimates were large and had wide confidence intervals. Some estimates could not be obtained in subgroups with small sample sizes. Therefore, these findings should be interpreted cautiously.

Table 5. Subgroup analyses of the association between weekly working hours and the number of conditions (occupational stress and WMSDs) among ride-hailing drivers in Beijing.

Variables	Number of Conditions Present	
	1 Condition, aOR (95% CI)	2 Condition, aOR (95% CI)
Sex		
Male ($n = 607$)	1.76 (1.06, 2.92) *	3.78 (2.05, 6.95) ***
Female ($n = 61$)	—	—
Age (years)		
<45 ($n = 356$)	2.67 (1.38, 5.14) **	5.79 (2.58, 12.99) ***
≥45 ($n = 312$)	1.38 (0.66, 2.86)	3.39 (1.41, 5.13) **
Ethnicity		
Han ($n = 642$)	1.88 (1.16, 3.06) *	4.62 (2.55, 8.40) ***
Other ($n = 26$)	—	—
Household registration type		
Urban ($n = 198$)	1.48 (0.69, 3.16)	3.56 (1.45, 8.78) **
Rural ($n = 470$)	2.48 (1.33, 4.65) **	5.99 (2.71, 13.26) ***

Table 5. Cont.

Variables	Number of Conditions Present	
	1 Condition, aOR (95% CI)	2 Condition, aOR (95% CI)
Level of education		
Junior high school and below (<i>n</i> = 289)	3.76 (1.55, 9.11) **	6.26 (2.32, 16.88) ***
High School and Vocational High School (<i>n</i> = 246)	1.15 (0.51, 2.57)	2.33 (0.90, 6.03)
Associate's degree or higher (<i>n</i> = 133)	1.77 (0.72, 4.38)	12.82 (3.21, 51.22) ***
Monthly personal income (RMB)		
≤6000 (<i>n</i> = 140)	2.33 (0.82, 6.63)	2.55 (0.73, 8.83)
6001–10,000 (<i>n</i> = 298)	1.99 (0.95, 4.15)	3.21 (1.35, 7.63) **
>10,000 (<i>n</i> = 230)	1.82 (0.73, 4.58)	19.21 (4.88, 75.56) ***
Sleep patterns		
Lack of sleep (<i>n</i> = 200)	0.95 (0.34, 2.67)	2.68 (0.85, 8.43)
Adequate sleep (<i>n</i> = 468)	2.47 (1.41, 4.33) **	5.43 (2.65, 11.13) ***
DDS		
<5 (<i>n</i> = 189)	2.84 (0.94, 8.55)	3.40 (0.94, 12.29)
≥5 (<i>n</i> = 479)	1.92 (1.11, 3.30) *	5.15 (2.64, 10.03) ***
Smoking		
Yes (<i>n</i> = 313)	1.15 (0.56, 2.37)	1.98 (0.88, 4.45)
No (<i>n</i> = 355)	2.91 (1.50, 5.65) **	12.04 (4.55, 31.87) ***
Alcohol		
Yes (<i>n</i> = 228)	0.75 (0.27, 2.06)	1.38 (0.45, 4.20)
No (<i>n</i> = 440)	2.89 (1.63, 5.12) ***	8.22 (3.87, 17.49) ***
Physical activity		
Regular (<i>n</i> = 239)	2.00 (0.94, 4.25)	5.73 (2.03, 16.23) **
Irregular (<i>n</i> = 429)	1.88 (0.98, 3.62)	4.66 (2.17, 10.02) ***

Note: Adjusted for gender, age, ethnicity, household registration type, level of education, monthly personal income, sleep patterns, DDS, smoking, alcohol, and physical activity, except for the corresponding stratification variable. The reference outcome category was 0 conditions (neither occupational stress nor WMSDs). One condition indicates the presence of either occupational stress or WMSDs, but not both, whereas two conditions indicate the co-occurrence of occupational stress and WMSDs. A dash (–) indicates that the estimate could not be obtained because of insufficient sample size. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.6. Prevalence of Occupational Stress and WMSDs by Weekly Working Hours

Figure 2 shows the distribution of the number of conditions according to weekly working hours. Overall, 23.7% of participants had neither condition, 43.3% had one condition, and 33.1% had both occupational stress and WMSDs. Among participants working <55 h per week, 37.8% had neither condition, compared with 19.6% among those working ≥55 h per week. This difference was statistically significant. The prevalence of co-occurrence was also significantly different between the groups. It was 16.2% in the <55 h group and 37.9% in the ≥55 h group. The prevalence of one condition was similar between the two groups (45.9% vs. 42.5%).

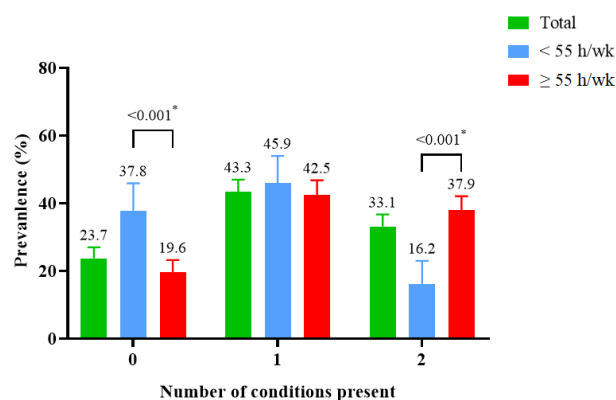


Figure 2. Prevalence of occupational stress and WMSD co-occurrence status among ride-hailing drivers according to weekly working hours. The categories 0, 1, and 2 indicate neither condition, either occupational stress or WMSDs, and both occupational stress and WMSDs, respectively. Bars represent the prevalence in the overall sample and among drivers working <55 and ≥55 h per week. Asterisks indicate statistically significant differences between the two working-hour groups (* $p < 0.001$).

4. Discussion

The study systematically analyzed the relationship between long working hours, WMSDs and occupational stress among ride-hailing drivers in Beijing. Overall, 77.8% of the drivers worked ≥ 55 h per week. The prevalence of WMSDs and occupational stress was 53.0% and 56.4%, respectively. These findings indicate a substantial burden of long working hours, physical and psychological health problems among ride-hailing drivers. Weekly working hours ≥ 55 h were significantly associated with higher odds of occupational stress, but no independent association was observed with WMSDs. Long working hours were also associated with the co-occurrence of occupational stress and WMSDs. The point estimate for the two-condition category was numerically larger than that for the one-condition category. Figure 2 showed that the prevalence of co-occurrence was 37.9% among drivers working ≥ 55 h per week, compared with 16.2% among those working < 55 h per week. The proportion of drivers without either condition was also significantly lower in the ≥ 55 h group (19.6% vs. 37.8%).

After adjusting for demographic, socioeconomic, and behavioral factors, long working hours remained significantly associated with occupational stress among ride-hailing drivers. Several mechanisms may explain this association. Long working hours increase work demands and reduce opportunities for rest, sleep, and psychological recovery. This may lead to individuals being in a state of continued resource depletion and thereby disrupting the balance between work demands and coping resources [25]. According to the Job Demand–Control model, high job demands combined with low job control may contribute to occupational stress [26]. Ride-hailing drivers may also face pressures related to algorithmic management, real-time order allocation, passenger ratings, income instability, and occupational uncertainty [11]. These factors may increase psychological strain and reduce perceived control over work. Previous studies have also linked long working hours with poorer mental health and greater psychological stress [27,28]. Inadequate recovery, burnout, and an unfavorable psychosocial work environment may further contribute to these effects [29,30]. Therefore, occupational stress among ride-hailing drivers may reflect the combined influence of long working hours, high job demands, insufficient recovery, limited work autonomy, and platform-based management.

Unlike occupational stress, long working hours were not significantly associated with WMSDs after adjustment for potential confounders. Drivers working ≥ 55 h per week had slightly higher odds of WMSDs, but the association was not statistically significant in the adjusted models. One possible explanation is that WMSDs among ride-hailing drivers may reflect multiple ergonomic and occupational exposures. These may include prolonged driving and sitting, awkward postures, inadequate seat ergonomics, insufficient rest breaks, whole-body vibration, and road conditions. These factors were not directly measured in this study. Their contribution therefore remains uncertain. Incomplete measurement of these exposures may also have resulted in residual confounding and may have attenuated the observed association between long working hours and WMSDs. Previous studies suggest that WMSDs are influenced by multiple occupational factors rather than by a single exposure. Shockey et al. reported that low back pain among U.S. workers was associated with physical, psychosocial, and organizational factors [31]. Psychosocial work factors may also contribute to WMSDs in addition to biomechanical exposures [32]. Future studies should combine objective ergonomic assessments with measures of the psychosocial work environment. This may help clarify the relative contributions of long working hours and ergonomic exposures to WMSDs among ride-hailing drivers.

Long working hours were associated with both the one-condition category and the co-occurrence of occupational stress and WMSDs. The point estimate was numerically larger for the co-occurrence category. Compared with drivers working < 55 h per week, those working ≥ 55 h per week had 1.95 times the odds of having one condition ($aOR = 1.95$, 95% CI : 1.21–3.14) and 4.64 times the odds of having both conditions ($aOR = 4.64$, 95% CI : 2.57–8.36). The point estimate was numerically larger for co-occurrence than for one condition alone. These findings suggest that long working hours may be associated with the co-occurrence of occupational stress and WMSDs. However, the difference between these estimates was not formally tested. Therefore, the findings should not be interpreted as evidence of a biological gradient or cumulative process. Few studies have examined the co-occurrence of WMSDs and occupational stress among ride-hailing drivers. Existing evidence suggests that precarious employment, high work intensity, and psychosocial stressors may contribute to both musculoskeletal and mental health problems [33,34].

A strength of the study is that it simultaneously examined the relationships between long working hours, occupational stress, and WMSDs, as well as the co-occurrence of occupational stress and WMSDs, within the same population. This provides a more comprehensive assessment of the association between long working hours and the physical as well as mental health of ride-hailing drivers. Furthermore, the analyses were adjusted for potential confounding factors, including demographic characteristics, socioeconomic factors, and lifestyle. These adjustments strengthened the robustness of the findings. Nevertheless, the study has several limitations. First, the

cross-sectional design does not establish temporal or causal relationships. Reverse causation cannot be excluded. For example, occupational stress may be associated with WMSDs, while musculoskeletal symptoms may also increase perceived occupational stress. Second, working hours, occupational stress, WMSDs, and several covariates were self-reported. This may have introduced recall and reporting bias. In addition, the assessment periods for occupational stress and WMSDs were not fully aligned, which may have introduced temporal misclassification. Third, some lifestyle factors included in the fully adjusted model, such as sleep and physical activity, may partly lie on the causal pathway. Therefore, some degree of overadjustment cannot be excluded. Finally, participants were recruited from a single hospital in Beijing during health examinations, and female drivers were underrepresented. This may have introduced selection bias and may limit the generalizability of the findings. Future multicenter prospective studies incorporating objective working-hour records and more representative samples are warranted to minimize potential bias and enhance the external validity of the findings.

5. Conclusions

The study found that long working hours, WMSDs, and occupational stress were common among ride-hailing drivers in Beijing. Weekly working hours ≥ 55 h were significantly associated with higher odds of occupational stress and with the co-occurrence of occupational stress and WMSDs. However, no independent association was observed between long working hours and WMSDs alone. The co-occurrence of WMSDs and occupational stress underscores the need for integrated occupational health interventions for ride-hailing drivers. Regular screening for musculoskeletal symptoms and occupational stress, combined with appropriate ergonomic and mental health support, may help reduce the burden of co-occurring health problems. Policies and workplace practices should promote reasonable working hours, adequate rest, and healthier working conditions.

Author Contributions

Conceptualization, Z.W., B.H., T.Y. and X.D.; Methodology, Z.W., B.H., T.Y. and X.D.; Investigation, X.S., X.W., R.G., H.Y. and S.W.; Formal analysis, Z.W. and B.H.; Writing—original draft, Z.W. and B.H.; Writing—review & editing, T.Y., X.D. and D.N. All authors have read and agreed to the published version of the manuscript.

Funding

The study was funded by the Capital's Funds for Health Improvement and Research (CFH), China (2024-4G-3105), Beijing High-level Innovation and Entrepreneurship Talent Support Program—Spring Bud Project (G202533324), Key Laboratory of Chemical Safety and Health, Chinese Center for Disease Control and Prevention (2025CDCKL01), and the Capital's Funds for Health Improvement and Research (CFH), China (2024-2-3102).

Institutional Review Board Statement

The study protocol was approved by the Medical Ethics Committee of the Beijing Institute of Occupational Disease Prevention and Control (Approval No. C2024005).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The de-identified data are available from the corresponding author upon reasonable request, subject to ethical and institutional restrictions.

Acknowledgments

The authors sincerely thank all participants for their time and valuable contributions to the study. We also thank all individuals who assisted with participant recruitment and data collection.

Conflicts of Interest

The authors declare no conflicts of interest.

Use of AI and AI-Assisted Technologies

No AI tools were utilized for this paper.

References

1. Pega, F.; Náfrádi, B.; Momen, N.C.; et al. Global, regional, and national burdens of ischemic heart disease and stroke attributable to exposure to long working hours for 194 countries, 2000–2016: A systematic analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury. *Environ. Int.* **2021**, *154*, 106595. <https://doi.org/10.1016/j.envint.2021.106595>.
2. Wong, K.; Chan, A.H.S.; Ngan, S.C. The effect of long working hours and overtime on occupational health: A meta-analysis of evidence from 1998 to 2018. *Int. J. Environ. Res. Public Health* **2019**, *16*, 2102. <https://doi.org/10.3390/ijerph16122102>.
3. Lopes, M.; Lages, M. Work-related musculoskeletal disorders: Prevalence and contributing risk factors—A narrative review. *Explor. Musculoskelet. Dis.* **2026**, *4*, 1007117. <https://doi.org/10.37349/emd.2026.1007117>.
4. Sun, L.; Zhao, Y.; Ran, X. Ride-hailing drivers' working conditions and social protection in China. *J. Asian Public Policy* **2026**, *19*, 140–155. <https://doi.org/10.1080/17516234.2024.2352809>.
5. National Institute for Occupational Safety and Health (NIOSH). Musculoskeletal Health Program. Available online: <https://www.cdc.gov/niosh/research-programs/portfolio/musculoskeletal.html> (accessed on 10 August 2026).
6. Tahernejad, S.; Makki, F.; Bameri, A.; et al. Musculoskeletal disorders among truck drivers: A systematic review and meta-analysis. *BMC Public Health* **2024**, *24*, 3146. <https://doi.org/10.1186/s12889-024-20611-9>.
7. Joseph, L.; Standen, M.; Paungmali, A.; et al. Prevalence of musculoskeletal pain among professional drivers: A systematic review. *J. Occup. Health* **2020**, *62*, e12150. <https://doi.org/10.1002/1348-9585.12150>.
8. Lee, P.; Xia, T.; Zomer, E.; et al. Exploring the health and economic burden among truck drivers in Australia: A health economic modelling study. *J. Occup. Rehabil.* **2023**, *33*, 389–398. <https://doi.org/10.1007/s10926-022-10081-4>.
9. European Commission Work-Related Stress Prevention. Available online: https://knowledge4policy.ec.europa.eu/health-promotion-knowledge-gateway/work-related-stress_en (accessed on 10 August 2026).
10. Wang, W.; Ren, H.; Tian, Q.; et al. Effects of occupational stress on blood lipids, blood sugar and immune function of doctors. *Iran. J. Public Health* **2019**, *48*, 825–833. <https://doi.org/10.18502/ijph.v48i5.1798>.
11. Matilla-Santander, N.; Lundh, F.; Kvart, S.; et al. What is known about the health of location-based and online web-based digital labour platform workers? A scoping review of the literature. *BMC Public Health* **2025**, *25*, 2635. <https://doi.org/10.1186/s12889-025-23916-5>.
12. Vignola, E.F.; Baron, S.; Abreu Plasencia, E.; et al. Workers' health under algorithmic management: Emerging findings and urgent research questions. *Int. J. Environ. Res. Public Health* **2023**, *20*, 1239. <https://doi.org/10.3390/ijerph20021239>.
13. Zhou, M.; Yin, J.; Tang, Y.; et al. What drives the drivers away? An empirical study on the factors influencing the turnover intention of full-time online ride-hailing drivers in China. *Transp. Res. Part A Policy Pract.* **2024**, *186*, 104134. <https://doi.org/10.1016/j.tra.2024.104134>.
14. Margerison, C.E.; Joachim, G.E.; Michling, T.R.; et al. Platform-Mediated Gig Work and Health: A Scoping Review. *Am. J. Ind. Med.* **2025**, *68*, 729–739. <https://doi.org/10.1002/ajim.70007>.
15. Ganpule-Rao, A.V.; Bhat, D.; Yajnik, C.S.; et al. Dietary diversity scores, nutrient intakes and biomarkers vitamin B₁₂, folate and Hb in rural youth from the Pune Maternal Nutrition Study. *Br. J. Nutr.* **2021**, *126*, 236–243. <https://doi.org/10.1017/s0007114520004018>.
16. Wang, Z.; Chen, Y.; Tang, S.; et al. Dietary diversity and nutrient intake of Han and Dongxiang smallholder farmers in poverty areas of Northwest China. *Nutrients* **2021**, *13*, 3908. <https://doi.org/10.3390/nu13113908>.
17. World Health Organization and International Labour Organization. *WHO/ILO Joint Estimates of the Work-Related Burden of Disease and Injury, 2000–2016: Global Monitoring Report*; World Health Organization and International Labour Organization: Geneva, Switzerland, 2021.
18. Hu, B.; Wu, Y.; Pan, Y.; et al. Association of long working hours and multi-site work-related musculoskeletal disorders among transportation industry workers in Beijing, China. *Int. Arch. Occup. Environ. Health* **2024**, *97*, 1063–1071. <https://doi.org/10.1007/s00420-024-02110-x>.
19. Kuorinka, I.; Jonsson, B.; Kilbom, A.; et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl. Ergon.* **1987**, *18*, 233–237. [https://doi.org/10.1016/0003-6870\(87\)90010-x](https://doi.org/10.1016/0003-6870(87)90010-x).
20. Fang, Y.; Li, S.; Zhang, Y.; et al. Test-retest reliability of Nordic Musculoskeletal Questionnaire in nurses. *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi* **2013**, *31*, 753–758.
21. Sauter, S.; Swanson, N.; Waters, T.; et al. Musculoskeletal discomfort surveys used at NIOSH. In *Handbook of Human Factors and Ergonomics Methods*; Stanton, N.A., Hedge, A., Brookhuis, K., et al., Eds.; CRC Press: Boca Raton, FL, USA, 2004; pp. 27–38. <https://doi.org/10.1201/9780203489925.ch4>.

22. Karasek, R.; Brisson, C.; Kawakami, N.; et al. The Job Content Questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *J. Occup. Health Psychol.* **1998**, *3*, 322–355. <https://doi.org/10.1037/1076-8998.3.4.322>.
23. Li, J.; Yang, W.; Liu, P.; et al. Psychometric Evaluation of the Chinese (Mainland) Version of Job Content Questionnaire: A Study in University Hospitals. *Ind. Health* **2004**, *42*, 260–267. <https://doi.org/10.2486/indhealth.42.260>.
24. VanderWeele, T.J. Principles of confounder selection. *Eur. J. Epidemiol.* **2019**, *34*, 211–219. <https://doi.org/10.1007/s10654-019-00494-6>.
25. Sonnentag, S.; Fritz, C. Recovery from job stress: The stressor-detachment model as an integrative framework. *J. Organ. Behav.* **2015**, *36*, S72–S103. <https://doi.org/10.1002/job.1924>.
26. Karasek, R.A. Job demands, job decision latitude, and mental strain: Implications for job redesign. *Adm. Sci. Q.* **1979**, *24*, 285–308. <https://doi.org/10.2307/2392498>.
27. Ma, X. Impact of long working hours on mental health: Evidence from China. *Int. J. Environ. Res. Public Health* **2023**, *20*, 1641. <https://doi.org/10.3390/ijerph20021641>.
28. Ochiai, Y.; Takahashi, M.; Matsuo, T.; et al. Characteristics of long working hours and subsequent psychological and physical responses: JNIOH cohort study. *Occup. Environ. Med.* **2023**, *80*, 304–311. <https://doi.org/10.1136/oemed-2022-108672>.
29. Yin, C.; Ji, J.; Cao, X.; et al. Impact of long working hours on depressive symptoms among COVID-19 frontline medical staff: The mediation of job burnout and the moderation of family and organizational support. *Front. Psychol.* **2023**, *14*, 1084329. <https://doi.org/10.3389/fpsyg.2023.1084329>.
30. Zadow, A.J.; Dollard, M.F.; Dormann, C.; et al. Predicting new major depression symptoms from long working hours, psychosocial safety climate and work engagement: A population-based cohort study. *BMJ Open* **2021**, *11*, e044133. <https://doi.org/10.1136/bmjopen-2020-044133>.
31. Shockey, T.; Alterman, T.; Yang, H.; et al. Workplace Psychosocial Factors, Work Organization, and Physical Exertion as Risk Factors for Low Back Pain Among US Workers: Data from the 2015 National Health Interview Survey. *J. Occup. Environ. Med.* **2024**, *66*, 467–474. <https://doi.org/10.1097/jom.0000000000003087>.
32. Bezzina, A.; Austin, E.; Nguyen, H.; et al. Workplace psychosocial factors and their association with musculoskeletal disorders: A systematic review of longitudinal studies. *Workplace Health Saf.* **2023**, *71*, 578–588. <https://doi.org/10.1177/21650799231193578>.
33. Badarin, K.; Mangot-Sala, L.; Matilla Santander, N.; et al. Precarious employment, strenuous working conditions and the long-term risk of diagnosed chronic musculoskeletal disorders. *Occup. Environ. Med.* **2024**, *81*, 595–602. <https://doi.org/10.1136/oemed-2024-109867>.
34. Park, S.; Lee, J.H. Precarious employment and increased incidence of musculoskeletal pain among wage workers in Korea: A cross-sectional study. *Int. J. Environ. Res. Public Health* **2021**, *18*, 6299. <https://doi.org/10.3390/ijerph18126299>.