Pakistan Journal of Occupational Therapy
Volume 01 No. 02
Page 05-11

ORIGINAL ARTICLE

Musculoskeletal Disorders and Occupational Hazards among Motorcyclist Delivery Workers in Pakistan

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Submission: 01 September 2025
Revision: 20 October 2025
Acceptance: 25 November 2025

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Abstract

Background: The fast-developing gig economy in Pakistan, which is a result of e-commerce and food delivery, is based on a substantial number of motorcycle delivery riders. These are workers engaged in the informal sector and are exposed to ergonomic hazards over a long period, but are not well represented in national occupational health surveillance. Musculoskeletal disorders (MSDs) are assumed to be caused by prolonged sitting and whole-body vibration, and repetitive lifting, but localized epidemiological data are lacking critically.

Methods: A cross-sectional survey was carried out in Karachi on 95 active delivery riders between March and May 2024. The participants were recruited through the use of convenience sampling of high-demand areas. A standardized, pilot-tested, structured questionnaire (Cronbach's 0.80) was used to assess socio-demographics, work patterns, ergonomic awareness and self-reported MSD symptoms over 12 months. Descriptive statistics, chi-square tests and binary logistic regression were used to analyze the data in order to get the odds ratio (OR).

Results: The 12-month prevalence of any MSD was 62.1 (59/95). The site that was the most affected was the lower back (41%), followed by the shoulders (28) and knees (24). There was a substantial dose-response correlation between the daily work hours and the prevalence of MSD. Individuals with a shift longer than 10 hours were also 1.8 times more likely to report MSDs (95% CI: 1.1- 3.0). Other correlates of significant interest ($p<0.05$) were sitting for over 6 hours, heavy load lifting (over 5 kg), low scores in ergonomic awareness and having rare rest breaks.

Conclusion: MSDs are very common in motorcycle delivery employees in Pakistan and are closely linked with long working hours and numerous ergonomic risk factors. This study highlights the fact that multi-level interventions, such as ergonomic education, the supply of protective equipment, controlled rest periods, and the official acknowledgement of health rights of gig workers, are necessary to provide a sustainable workforce.

Keywords: *Delivery Workers, Gig Economy, Motorcycle, Musculoskeletal Disorders, Occupational Health.*

Introduction

In South Asia, the core of this transformation is considered the digital revolution, especially the uncontrollable proliferation of e-commerce apps and food-delivery apps.[1] It represents the last-mile of the logistics chain and which have in South Asia transformed the urban labor landscape dramatically, with an estimated 250,000 motorcycle riders working in the Karachi, Lahore, and Islamabad metropolitan areas every day, occupying a precarious position of being in the gig-economy.[2] This division systematically exempts them from the protections established in formal labour legislation, e.g. the Pakistan Labour Act of 2018, and puts them in a position of not receiving any regulated working hours, health insurance, workers' compensation, or regular occupational health surveillance.[3-4]

Occupations that involve both a sustained loading of the muscles in still positions and exposure to whole-body vibration, repetitive motion, and manual handling are regularly related to a disproportionately concentrated workload of work-related musculoskeletal disorders (WMSDs)[5-6] all around the globe (motorcycle taxi (boda-boda) drivers in Uganda to food delivery couriers in China).[7-8] The pathophysiological pathway is well known: prolonged sitting imposes a static load on the muscles and reduces blood flow; whole-vibration from motorcycle engines transmits stress to the spine; and repetitive lifting in awkward postures strains the musculoskeletal system.[9-10]

The aggravating factors have a meeting point in the Pakistani context. Big cities such as Karachi are constantly ranked as one of the most congested cities in the world, as the piece-rate payment structure encourages delivery riders to work as many hours as possible on the road, without any enforced requirements of vehicle ergonomics, load handling gear, or a required rest period.[11] Even informal employment arrangements imply no established requirements on vehicle ergonomics, load handling devices, and the necessity of a rest period. Although such a workforce can be seen, and anecdotal reports of chronic pain are frequent, there is an imposing lack of scientifically rigorous, localised measurements of their health burden. Current national surveys and occupational health reports do not disaggregate this increasing worker population, making them statistically invisible.[12]

This essential information vacuum makes it difficult to develop evidence-based interventions, lobby for policy changes, and structure corporate social responsibility agendas by the platform companies. Any attempts made to ameliorate the working conditions will be generic and probably useless without knowledge of the precise prevalence, anatomical distribution, and determinants of MSDs in this population. Thus, the present study was planned to conduct a systematic research on occupational health issues of the motorcycle delivery workers in the largest city of Pakistan. The main aims were to: (1) measure the 12-month prevalence and the anatomical distribution of self-reported MSDs; (2) determine the main work-related and ergonomic risk factors that relate to the occurrence of MSDs; and (3) determine the perceived functional impact of those disorders on everyday activities and work performance. The outcomes will be used to create a basis of evidence that can guide specific health promotion, ergonomic interventions, and regulation frameworks that will safeguard this critical but susceptible urban labour force.

Methodology

Study Design and Setting

The study was a descriptive, cross-sectional study, taking place in Karachi, Pakistan, in a 3-month period (March to May 2024). The sampling was also strategically targeted on 6 high-order-volume commercial and residential areas known as key delivery hubs: Clifton, Gulshan-e-Iqbal, Saddar, Korangi, North Nazimabad, and Lyari.

Participant Eligibility

The following were included criteria: (1) Full-time employment as a motorcycle food-delivery rider with at least six months of continuous work experience; (2) must work at least five days per week; (3) age between 18 and 55 years. The exclusion criteria included the following: (1) a history of major musculoskeletal trauma, surgery or congenital deformity prior to starting the work as a rider; (2) having a systemic inflammatory disease (e.g., rheumatoid arthritis); and (3) refusal to give informed consent.

Sample Size and Sampling Technique

There was a convenience sampling technique. The sample size was determined to estimate a supposed prevalence of 50% of MSD with a 10% margin of error, with a confidence level of 95 with 100 being the target figure. One hundred riders were used, and only 95 of them returned the questionnaire, thus making the response rate 95%.

Instrument Development and Validation

A questionnaire in Urdu, the local language, was created in a structured and interviewer-administered format. It was based on three previously established tools: the Standardized Nordic Musculoskeletal Questionnaire (NMQ) to map symptoms,[13-14] and questions of prior researches on gig economy workers.[15]

The last tool consisted of four domains:

- ***Socio-demographics:*** Age, sex, education, monthly income, body mass index (BMI).
- ***Work Organization:*** The number of working hours daily and weekly, the number of daily and weekly delivery trips, the average weight of goods per delivery trip, frequency, and duration of the rest periods.
- ***Ergonomic Awareness:*** 5 items based on true/false questions evaluating the amount of knowledge a person has about proper lifting, ideal riding posture, and the significance of taking rest breaks (the range of possible answers is 0-5).
- ***Health Outcomes:*** A body map to report the location of any pains, aches or any discomfort over a period of more than 24 hours in the last 12 months (neck, shoulders, upper back, lower back, elbow, wrists/hands, hips/ thighs, knees, ankles/ feet). Other questions enquired on the effect of pain on both basic and work activities and missed days of work.

The questionnaire underwent a pilot test of 30 riders (not part of the study). The ergonomic awareness scale had a good internal consistency reliability (Cronbach's = 0.80). Slight wording alterations were done in response to pilot feedback to make the wording tighter.

Data Collection Procedure

The potential participants were approached by the trained research assistants at the usual meeting places (specific areas of delivery used in front of restaurants, petrol stations, and squares) during off-peak hours (e.g., mid-afternoon). The purpose and procedures of the study were discussed orally, and informed consent was signed in written form. The questionnaires were completed in a face-to-face manner in the privacy of a meeting, and it took about 15-20 minutes. No personal identifiers were captured in order to guarantee anonymity.

Operational Definitions

- **Primary Outcome (Any MSD):** Self-reported pain, ache, or other forms of discomfort in any of the nine body parts listed that lasts over 24 hours in the past 12 months.
- **Primary Exposure:** Work hours per day, which are divided into: 8 hours and less, 9-10 hours and more than 10.
- **Important Covariates:** Age (continuous), BMI (continuous), education level (categorical), monthly income (categorical), total sitting time (>6 hours/day), load weight per trip (>5 kg), ergonomic awareness score (low [<2]/high [>2]) and regularity of rest breaks (yes/no).

Data Analysis

The data were entered twice in EpiData software (v4.6) with the objective of reducing the number of entry errors and then exported to IBM SPSS Statistics (v29.0) to be analyzed. All the variables were summarized using descriptive statistics (frequencies, percentages, means, standard deviations, medians, interquartile ranges). The MSD prevalence was computed by body parts. Associations between MSD prevalence and categorical independent variables were evaluated using Chi-square tests (or Fisher's exact test where relevant) to evaluate the relationship between the two variables. Binary logistic regression was used to estimate crude and adjusted odds ratios (OR) with 95% confidence interval (CI) of the relationship between work-hour categories and any MSD, and factoring in the possible confounders (age, BMI, and ergonomic score). The p-value below 0.05 was taken to be significant.

Ethical Considerations

The Ziauddin College of Occupational Therapy, Ziauddin University, received ethical approval from the Institutional Review Board. Involvement was purely optional, and the respondents were informed of their freedom to pull out at any time without any penalty.

Results

Participant Characteristics

Table 1 summarizes the socio-demographic and work-related profiles of the 95 participants. The study population consisted of a large number of young people (mean age 27.4 +/- 4.6 years) and males (91.6%). The majority had finished secondary school (62.1%), and earned less than PKR 30,000 per month (approximately USD 110). The average work shift per day was 10 hours (IQR: 9-12 hours), and almost half (46.3) had a work shift exceeding 10 hours per day. Most of them carried loads of between 4-5 kg at a time (47.4%), their ergonomic awareness scores were low (2.1±1.2), and they did not take frequent rest periods (69.5%).

Table 1: Socio-demographic and Work-Related Characteristics of Delivery Riders (n=95)	
Variable	n (%) or Mean ± SD
Age (years)	27.4 ± 4.6
Gender	
Male	87 (91.6)
Female	8 (8.4)
Education	
≤ Secondary	59 (62.1)
> Secondary	36 (37.9)
Monthly Income (PKR)	
< 30,000	55 (57.9)
30,000 – 50,000	32 (33.7)
> 50,000	8 (8.4)
Body Mass Index (kg/m²)	23.1 ± 3.3
Daily Riding Hours	
≤ 8	18 (18.9)
9 – 10	33 (34.7)
> 10	44 (46.3)
Days Worked Per Week	6.3 ± 0.8
Load Lifted Per Trip (kg)	
≤ 3	34 (35.8)
4 – 5	45 (47.4)
> 5	16 (16.8)
Ergonomic Awareness Score (0-5)	2.1 ± 1.2
Takes Regular Rest Breaks	29 (30.5)

Prevalence and Distribution of Musculoskeletal Disorders

The 12-month prevalence of having at least one MSD was 62.1 (59 of 95 riders). The lower back was the most affected body part, as 41.1% of the total respondents reported this body part. This was then succeeded by the pains in the shoulder (28.4) and the knee (24.2). An anatomical map of MSDs distribution should be provided in a graphic form to illustrate these inequalities (Figure 1).

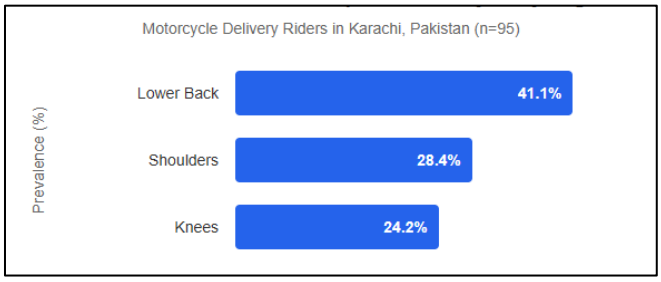

Figure 1 showing the 12-month prevalence of MSDs by body region among Motorcycle Delivery Riders

Correlation of Work Hours and MSD Risk

There was a significant relationship in the dose-response between the increasing work hours per day and the occurrence of MSDs (p=0.008). The prevalence increased, as indicated in Table 2, to 38.9% of people who worked 8 hours or less and 75% of those who worked more than 10 hours. Using the binary logistic regression model, the odds of a rider reporting an MSD were higher with more working hours (Adjusted OR = 3.6, 95% CI: 1.1-11.7) in the case of working over 10 hours than in a reference group (above 8 hours).

Table 2: Association Between Daily Work Hours and 12-Month MSD Prevalence

Work Hours (Daily)	MSD n (%)	Crude OR (95% CI)	Adjusted* OR (95% CI)
≤ 8 hours (Ref)	7 (38.9)	1.00	1.00
9 – 10 hours	19 (57.6)	2.13 (0.71 – 6.45)	1.93 (0.79 – 4.70)

> 10 hours	33 (75.0)	**4.84 (1.59 – 14.23)**	**3.60 (1.12 – 11.67)**

**Adjusted for age, body mass index, and ergonomic awareness score.*

In addition to these other factors, it was found through bivariate analysis that were significantly associated ($p<0.05$) with MSD prevalence; sitting, lifting loads heavier than 5 kg per trip, and low ergonomic awareness score (=2 out of 5) (OR=2.4).

Regarding the functional impacts, 36% of riders (n=34) said MSDs restricted their basic functions such as lifting objects, climbing stairs or standing on their feet. Even though the average number of workdays missed in the last month was 1.8 days, 12 riders (12.6% of the total sample) missed 3 days or more of work because of pain, meaning that the effect on livelihood is not quite trivial.

Discussion

This study presents the first systematic finding of a significant musculoskeletal disorders on motorcycle-based delivery workers in Pakistan, which found a 12-month prevalence of 62.1. This result places the health issue among Pakistani riders in an international context, which is similar to prevalence recorded among food delivery couriers in China (64%),[16] thirteen and body-boda drivers in Kenya (61%),[17] which implies that structural risks of platform work and motorcycle delivery are geographically independent.

Anatomical pain distribution is important in providing vital information to job-related ergonomic exposures. The high levels of lower back pain (41%), shoulder (28%), and knee (24%), pain can also be explained by the fact that the biomechanical characteristics of the job directly relate to the prevalence of MSDs: prolonged sitting in a forward-flexed sitting posture, repeated exposure to whole-body vibration caused by the motorcycle engine, and the jarring impact of riding through speed breakers, a common part of the Karachi roads, is directly correlated with the MSDs.[18-19]

The main and alarming conclusion of this study is that the dose-response between the risk of MSD and extended work shifts is strong.[20] The adjusted odds of having an MSD were almost four times higher in riders who worked over 10 hours a day than in riders who worked 8 hours and were less. Such an association is mechanically possible.[21] The piece-rate payment system is a strong economic deterrent to sit down, and so contributes to cumulative muscle fatigue, loss of postural stability and loss of the ability to absorb vibrational shocks, which are a characteristic effect in spite of our adjusted odds ratio (OR=3.6),[22] compared with professional bus drivers (OR=5.1), but has the disadvantage that delivery riders have more frequent opportunities to indulge in brief postural change during pick-ups and drop-offs, which provides intermittent though inadequate relief against the effects of the continuous process of being loaded up.[23]

The recognition of the modifiable risk factors, including heavy load lifting, lack of knowledge in ergonomics, and lack of rest breaks provide a clear agenda of intervention.[24] These do not necessarily belong to the job, and are the work organization and training functions. As an example, standardized delivery boxes with partitions given to riders could minimize awkward lifting and carrying, regular and brief breaks could be part of the delivery platform applications to enforce fatigue measures, as ride-hailing apps, and simple basic training courses on proper lifting methods and optimal positioning during the ride.

Strengths and Limitations

One major strength of the research is that it addresses a large and under-studied occupational group in a major South Asian economy with the use of validated instruments, adaptation and effective statistical confounder adjustment. Nevertheless, there are various shortcomings that should be taken into consideration. The cross-sectional design does not allow any inferences of causality; we are allowed to state associations only. The use of self-reported symptoms, common to epidemiological surveys, is subject to recall bias, and it is not comparable to a clinical diagnosis. Convenience sampling is a pragmatic approach that constrains the extrapolation of the results, and the low percentage of women who ride (8.4) does not allow a significant analysis by gender. Lastly, although sufficient to estimate prevalence, the sample size limited more complex multivariate cross-factorial analyses.

Clinical Implications

Platform companies should be encouraged or controlled to make ergonomic changes, safety gears, and develop human work algorithms. The policymakers must extend the protections of labour laws to gig economy workers, including limiting the number of hours worked and providing them with health protection. To protect their health efficiently, there is a need to act in a concerted multi-stakeholder effort.[26-27]

Conclusion

This study highlights that motorcycle delivery employees in Pakistan have to suffer a rate of work-related musculoskeletal disorders, which is strongly connected with the overly long working shifts, carrying heavy bags, and a deficiency of ergonomic knowledge and rest. These employees are the foundation of the contemporary urban service economy that works in a vacuum of regulation.

Longitudinal studies and objective exposure (e.g., accelerometers) need to be used in future research to determine causality and examine the effectiveness of specific interventions, e.g., adjustable motorcycle seats or systematic micro-break programs. Protecting the well-being of this very valuable workforce is not just a moral imperative, but an essential condition of a sustainable and efficient digital economy in Pakistan.

Author Contributions

Ria Makhija: Study conception and design, data collection, statistical analysis, manuscript preparation, and revision.
Muhammad Younis Khan: Literature review, data collection, data entry, and manuscript review.
Sagar: Methodology development, data analysis consultation, and manuscript review.
Bheesham Raj: Data collection, participant recruitment, and data verification.
Anum M. Usman: Statistical analysis, data interpretation, and manuscript editing.
Maria Naeem: Statistical analysis, data interpretation, and manuscript editing.

Acknowledgments

The authors would like to thank all participants for their voluntary participation.

Conflict of Interest

The authors declare no conflicts of interest in relation to this research study.

Funding Disclosure

This research was conducted as part of academic requirements and received no external funding. All costs associated with data collection and analysis were covered by the research team.

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