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Original Article

Prevalence Of Cervicalgia And Hand Paresthesia Among Motorcycle Riders: A Cross-Sectional Study

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ABSTRACT

Background: Motorcycle riders are exposed to prolonged static posture, forward head positioning, repetitive handlebar gripping, braking and clutch activity, and road vibration, which may contribute to cervical pain and hand sensory symptoms. Evidence on the concurrent burden of cervicalgia and hand paresthesia among local motorcycle riders remains limited. Objective: To determine the prevalence of cervicalgia and hand paresthesia and assess their association among male motorcycle riders. Methods: This cross-sectional observational study included 385 male motorcycle riders aged 18–50 years recruited through convenience sampling from rider-accessible locations different cities of Pakistan. Demographic and riding-related data were collected using a self-administered questionnaire. Cervicalgia was assessed using the Northwick Park Neck Pain Questionnaire, and hand paresthesia was assessed using the Kamath and Stothard Carpal Tunnel Questionnaire. Data were analyzed using SPSS version 31. Frequencies, percentages, means, and standard deviations were calculated, and Pearson's chi-square test was used to assess the association between cervicalgia and hand paresthesia. Results: The mean age of participants was 27.01 ± 8.05 years, and the mean riding duration was 9.05 ± 6.43 years. Cervicalgia was present in 377 participants (97.9%; 95% CI 96.0–98.9), while hand paresthesia was present in 326 participants (84.7%; 95% CI 80.7–87.9). Pearson's chi-square test showed no statistically significant association between cervicalgia and hand paresthesia ($\chi^2 = 8.441$, $p = 0.077$). Conclusion: Cervicalgia and hand paresthesia were highly prevalent among male motorcycle riders, but no statistically significant association was observed between the two conditions. Rider-focused ergonomic education, protective practices, rest breaks, posture correction, and early symptom screening may help reduce the burden of riding-related cervical and hand symptoms. Keywords: Cervicalgia, Hand Paresthesia, Motorcycle Riders, Neck Pain, Carpal Tunnel Symptoms, Ergonomics

INTRODUCTION

Motorcycles are widely used for daily transportation, occupational travel, delivery work, and leisure because they are relatively affordable, fuel-efficient, easy to park, and convenient for movement through congested urban roads. These advantages make motorcycles particularly common among working and middle-income populations; however, regular riding also exposes the rider to prolonged static posture, sustained forward inclination of the trunk and neck, continuous handlebar gripping, repetitive braking and clutch use, road vibration, and limited postural variation during travel. These biomechanical and ergonomic exposures may contribute to discomfort in the cervical spine, shoulder girdle, upper back, wrist, and hand, particularly among riders who travel for long durations or use motorcycles as part of their occupation (1).

Motorcycle riding requires sustained activation of postural muscles to stabilize the head, neck, trunk, and upper limbs during acceleration, braking, turning, and exposure to uneven road surfaces. Prolonged sitting without back support may alter lumbopelvic and spinal alignment, while forward head posture increases mechanical loading on the cervical region and may contribute to fatigue, stiffness, and pain. Experimental and observational evidence suggests that motorcycle riding can increase postural muscle demand and fatigue, particularly in muscles responsible for maintaining spinal and upper-body stability during riding (2,3). Occupational riders may be at particular risk because repeated exposure to fixed posture and vibration can accumulate across working hours and may reduce productivity, comfort, and functional capacity (4,5).

Cervicalgia in riders is clinically important because neck pain may arise from sustained cervical flexion, forward head posture, helmet-related loading, vibration exposure, poor ergonomic positioning, and prolonged static muscle activity. Although helmet use is essential for injury prevention, helmet weight and altered head-neck mechanics may increase cervical loading in some riders, especially when combined with long riding duration and poor posture (6,7). Previous studies have reported a high burden of musculoskeletal discomfort among motorcyclists, with frequent involvement of the neck, shoulders, upper back, and lower back (8). Among occupational and delivery riders, these symptoms may be further influenced by long working hours, limited rest breaks, traffic stress, exposure to uneven roads, and inconsistent use of protective or ergonomic equipment (9).

Hand paresthesia among motorcycle riders may occur through a different but overlapping biomechanical pathway. Sustained gripping of the handlebar, repetitive wrist and finger movements, vibration transmitted through the handlebar, and prolonged wrist flexion or extension may increase mechanical stress on the median and ulnar nerves. Compression or irritation of these nerves can produce sensory symptoms such as numbness, tingling, pins-and-needles sensation, discomfort, weakness, or altered hand function. Similar mechanisms have been described in cyclists and motorcyclists, where prolonged handlebar pressure and vibration exposure are associated with median and ulnar nerve symptoms, carpal tunnel-related complaints, reduced grip comfort, and upper-limb discomfort (10,11). Carpal tunnel syndrome and related hand symptoms have also been reported among motorcycle taxi drivers and workers exposed to repetitive gripping and vibration, suggesting that hand paresthesia may represent an underrecognized occupational and ergonomic problem in regular riders (12,13).

Although cervicalgia and hand paresthesia may both occur in motorcycle riders, their clinical relationship is not straightforward. Cervical symptoms may arise from local neck muscle strain, altered posture, cervical joint dysfunction, or nerve-root irritation, whereas hand paresthesia may result from peripheral nerve compression at the wrist, palm, or elbow, vibration exposure, or repetitive gripping. Upper-limb paresthesia can also occur in cervical radiculopathy or thoracic outlet-related conditions, making it important to distinguish whether neck pain and hand symptoms coexist as related manifestations or occur independently in riders (14). Existing literature has examined neck pain, musculoskeletal discomfort, helmet-related posture, carpal tunnel symptoms, and vibration-related hand complaints in different rider or worker populations, but fewer studies have assessed the concurrent prevalence of cervicalgia and hand paresthesia and their statistical association in regular motorcycle riders within the local Pakistani context (15–19).

This evidence gap is important because motorcycles are used extensively for commuting, education, work, and delivery services in Pakistan, yet preventive strategies for rider ergonomics, rest breaks, helmet fitting, handlebar posture, wrist positioning, and early rehabilitation require locally relevant symptom data. Estimating the prevalence of cervicalgia and hand paresthesia among motorcycle riders can help identify the magnitude of the problem, while assessing their association can clarify whether both conditions should be considered as linked clinical complaints or as separate outcomes requiring different preventive and therapeutic approaches. Therefore, this study aimed to determine the

prevalence of cervicalgia and hand paresthesia among male motorcycle riders and to assess whether a statistically significant association exists between these two conditions.

MATERIALS AND METHODS

This cross-sectional observational study was conducted to estimate the prevalence of cervicalgia and hand paresthesia and to assess their association among male motorcycle riders. The cross-sectional design was appropriate because the study focused on measuring the frequency of symptoms and evaluating the relationship between two categorical health outcomes at a single point in time rather than determining causality or temporal sequence. The study population consisted of male motorcycle riders aged 18 to 50 years who regularly used motorcycles for commuting, education, work, delivery, or leisure purposes. Data were collected over a period of six months after approval of the study synopsis.

Participants were recruited through non-probability convenience sampling from rider-accessible, including motorcycle parking areas and waiting lounges of Jinnah Hospital, the School of Paramedics, Foodpanda/Panda Mart rider stations in Saddar, and food delivery rider locations near hostels and thorough online surveys from different cities of Pakistan. Eligible participants included male motorcycle riders aged 18–50 years who rode regularly for at least one hour per day or approximately 8–9 hours per week, with or without helmet use and with or without additional safety gear such as gloves, jackets, or knee pads. Riders were eligible regardless of whether their riding purpose was work, school, college, university, delivery, or leisure. Individuals were excluded if they reported diabetes mellitus, tumor, systemic disease, degenerative disease, disability, vertebral fracture within the previous year, or occasional motorcycle use only.

Potential participants were approached at the recruitment sites and were informed about the study purpose, eligibility requirements, voluntary participation, confidentiality, and questionnaire-based data collection procedures. Written informed consent was obtained before participation. Participants then completed a self-administered questionnaire that collected demographic and riding-related information, including age, years of motorcycle riding, purpose of riding, helmet-use frequency, and use of safety gear. For participants who had difficulty understanding the questionnaire, the items were explained in their preferred language to improve comprehension and reduce response error while maintaining the original meaning of the questions.

Cervicalgia was assessed using the Northwick Park Neck Pain Questionnaire, and hand paresthesia was assessed using the Kamath and Stothard Carpal Tunnel Questionnaire. The Northwick Park Neck Pain Questionnaire was used to evaluate neck pain and related functional difficulty, while the Kamath and Stothard Carpal Tunnel Questionnaire was used to screen symptoms consistent with hand paresthesia and carpal tunnel-related complaints. Participants were classified according to their questionnaire responses into cervicalgia present or absent and hand paresthesia present or absent. Internal consistency of the tools in the study dataset was assessed using Cronbach's alpha, which was 0.784 for the 10-item Northwick Park Neck Pain Questionnaire and 0.724 for the 9-item Kamath and Stothard Carpal Tunnel Questionnaire, indicating acceptable reliability for the questionnaire-based assessment.

The primary outcome variables were the prevalence of cervicalgia and the prevalence of hand paresthesia among motorcycle riders. Cervicalgia was operationally defined as the presence of neck pain-related symptoms based on the Northwick Park Neck Pain Questionnaire classification used in the study, and hand paresthesia was operationally defined as the presence of hand sensory symptoms based on the Kamath and Stothard Carpal Tunnel Questionnaire classification used in the study. The main association variable was the relationship between cervicalgia status and hand paresthesia status. Additional descriptive variables included age, years of riding, purpose of riding, frequency of helmet use, and safety gear use.

Several steps were used to reduce bias and improve data quality. Eligibility criteria were applied before questionnaire completion to limit inclusion of riders with major medical conditions that could independently explain neck pain or paresthesia. Participants were recruited from multiple rider-populated locations rather than a single site to improve variability in riding purpose and exposure profile. Standardized questionnaires were used for symptom assessment, and clarification was provided when participants had language or comprehension difficulty. Completed forms were checked for completeness before data entry, and the dataset was reviewed for coding consistency before statistical analysis.

The sample size was calculated using Cochran's formula for prevalence studies at a 95% confidence level and 5% margin of error, resulting in a final sample size of 385 participants. The collected data were entered and analyzed using Statistical Package for the Social Sciences version 31. Continuous variables, including age and years of riding, were summarized using mean, standard deviation, minimum, and maximum values. Categorical variables, including purpose of riding, helmet-use frequency, safety gear use, cervicalgia status, and hand paresthesia status, were summarized using frequencies and percentages. The prevalence of cervicalgia and hand paresthesia was calculated as the proportion of participants classified as having each condition among the total sample.

The association between cervicalgia and hand paresthesia was assessed using Pearson's chi-square test because both variables were categorical. A p-value of less than 0.05 was considered statistically significant. The analysis was interpreted as an association analysis only, consistent with the cross-sectional design. No causal inference was made from the observed relationship. Ethical approval was obtained from Jinnah Postgraduate Medical Center, Karachi, Pakistan. Written informed consent was obtained from all participants before data collection, and participation was voluntary.

RESULTS

A total of 385 male motorcycle riders were included in the analysis. The mean age of participants was 27.01 ± 8.05 years, with an age range of 18 to 50 years. The mean duration of motorcycle riding was 9.05 ± 6.43 years, with a reported range of 0 to 35 years.

Table 1. Demographic and Riding Duration Characteristics of Participants

Variable	N	Mean ± SD	Minimum	Maximum
Age, years	385	27.01 ± 8.05	18	50
Years of riding	385	9.05 ± 6.43	0	35

The study population consisted predominantly of young adult riders, with a mean age of approximately 27 years. Participants had a mean riding experience of about 9 years, indicating that the sample included regular riders with substantial cumulative exposure to motorcycle-related postural and ergonomic stressors. The reported minimum riding duration of 0 years should be verified during final data cleaning, as it may represent riders with less than one complete year of riding experience.

Table 2. Riding Purpose, Helmet Use, and Safety Gear Use Among Participants

Variable	Category	n (%)
Purpose of riding	Work	219 (56.9)
	School	45 (11.7)
	College	62 (16.1)
	University	13 (3.4)
	Delivery	34 (8.8)
	Leisure	12 (3.1)
Frequency of helmet use	Always	156 (40.5)
	Often	43 (11.2)
	Sometimes	90 (23.4)
	Never	96 (24.9)
Safety gear used	Gloves	95 (24.7)
	Jacket	62 (16.1)

Variable	Category	n (%)
	Knee pads	3 (0.8)
	Other	10 (2.6)
	None	215 (55.8)

Work-related riding was the most common purpose of motorcycle use, reported by 219 participants (56.9%), followed by college-related riding in 62 participants (16.1%) and school-related riding in 45 participants (11.7%). Delivery riding accounted for 34 participants (8.8%). Helmet use varied across the sample: 156 participants (40.5%) reported always wearing a helmet, whereas 96 participants (24.9%) reported never using one. More than half of the participants, 215 riders (55.8%), reported using no safety gear, while gloves were the most commonly reported protective item, used by 95 riders (24.7%).

Table 3. Prevalence of Hand Paresthesia Among Motorcycle Riders

Outcome	Category	n (%)	95% CI
Hand paresthesia	Present	326 (84.7)	80.7–87.9
	Absent	59 (15.3)	12.1–19.3

Hand paresthesia was reported by 326 of 385 motorcycle riders, giving a prevalence of 84.7% with a 95% confidence interval of 80.7% to 87.9%. Only 59 participants (15.3%) were classified as not having hand paresthesia. This indicates a high burden of hand sensory symptoms among the sampled riders.

Table 4. Prevalence of Cervicalgia Among Motorcycle Riders

Outcome	Category	n (%)	95% CI
Cervicalgia	Present	377 (97.9)	96.0–98.9
	Absent	8 (2.1)	1.1–4.0

Cervicalgia was reported by 377 of 385 motorcycle riders, corresponding to a prevalence of 97.9% with a 95% confidence interval of 96.0% to 98.9%. Only 8 participants (2.1%) were classified as not having cervicalgia. The very high prevalence suggests that neck pain-related symptoms were common in this sample and should be interpreted in relation to the questionnaire classification method and the rider recruitment context.

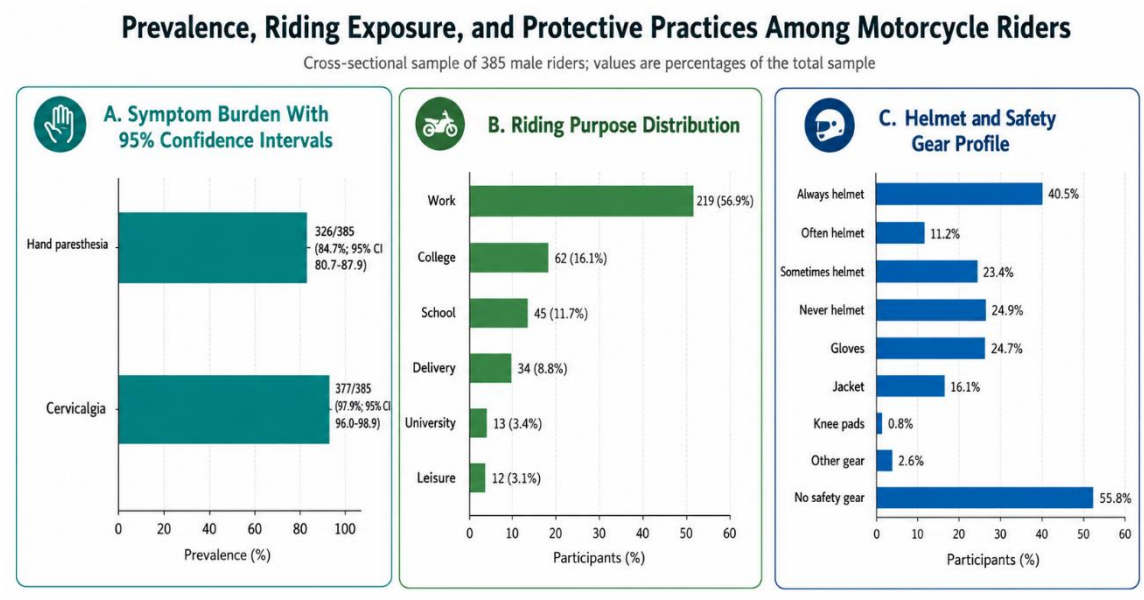

Figure 1 Prevalence, Riding Exposure, and Protective Practices Among Motorcycle Riders

The panelled figure demonstrates a high symptom burden among 385 male motorcycle riders, with cervicalgia affecting 377 participants (97.9%; 95% CI 96.0–98.9) and hand paresthesia affecting 326 participants (84.7%; 95% CI 80.7–87.9). Work-related riding represented the largest exposure category, accounting for 219 riders (56.9%), followed by college-related riding in 62 riders (16.1%), school-related riding in 45 riders (11.7%), and delivery riding in 34 riders (8.8%). Protective practice patterns showed that only 156 riders (40.5%) always used helmets, while 96 riders (24.9%) never used helmets and 215

riders (55.8%) reported using no safety gear. This combined exposure–protection profile suggests that the high prevalence of cervical and hand symptoms occurred in a rider population with substantial work-related riding exposure and limited protective gear use, although the available aggregate data do not permit causal inference or adjusted risk estimation.

Table 5. Association Between Cervicalgia and Hand Paraesthesia Among Motorcycle Riders

Variables	N	χ^2	p-value
Cervicalgia × hand paresthesia	385	8.441	0.077

Pearson's chi-square test showed no statistically significant association between cervicalgia and hand paresthesia at the 0.05 significance level, with $\chi^2 = 8.441$ and $p = 0.077$. Although both cervicalgia and hand paresthesia were highly prevalent, the available categorical association analysis did not demonstrate a statistically significant relationship between the two conditions. Therefore, based on the reported chi-square result, the findings suggest that neck pain-related symptoms and hand paresthesia may coexist frequently among motorcycle riders but were not statistically associated in this sample.

The results show a high overall burden of both cervicalgia and hand paresthesia among male motorcycle riders. Cervicalgia was more frequently reported than hand paresthesia, with prevalence estimates of 97.9% and 84.7%, respectively. Work-related riding was the dominant riding purpose, and more than half of the participants reported using no safety gear. The absence of a statistically significant association between cervicalgia and hand paresthesia suggests that these symptoms may reflect partly distinct biomechanical or ergonomic pathways, although this interpretation should remain cautious because the available analysis did not include the underlying 2×2 cross-tabulation, adjusted modelling, or control for potential confounders such as riding duration, daily riding hours, helmet use, wrist position, vibration exposure, or occupational riding status.

DISCUSSION

This cross-sectional study found a high burden of cervicalgia and hand paresthesia among male motorcycle riders, with cervicalgia reported in 377 of 385 participants (97.9%; 95% CI 96.0–98.9) and hand paresthesia reported in 326 participants (84.7%; 95% CI 80.7–87.9). These findings indicate that neck pain-related symptoms and hand sensory complaints were common in the sampled riders, particularly in a population where work-related riding was the dominant riding purpose and more than half of participants reported using no safety gear. Although both conditions were highly prevalent, Pearson's chi-square analysis did not show a statistically significant association between cervicalgia and hand paresthesia ($\chi^2 = 8.441$, $p = 0.077$). Therefore, the findings suggest that these symptoms may frequently coexist among motorcycle riders but were not statistically associated in the categorical analysis used in this study.

The high prevalence of cervicalgia observed in this study is consistent with biomechanical evidence that motorcycle riding exposes the cervical region to prolonged static posture, forward head positioning, sustained postural muscle activity, vibration, and limited movement variability. Motorcycle riders often maintain a flexed or forward-inclined neck position while monitoring road conditions, balancing the vehicle, and controlling the upper limbs. This sustained positioning may increase cervical muscle demand and contribute to fatigue, stiffness, and pain. Previous studies have reported neck pain and disability among two-wheeler riders and have suggested that prolonged riding duration, altered posture, and helmet-related loading may contribute to cervical discomfort (1,7,16,28). The present study reported a higher prevalence of cervicalgia than several previous studies, which may be related to differences in study population, recruitment sites, questionnaire-based classification, riding exposure, local road conditions, and inclusion of work-related riders.

The present findings also align with studies reporting musculoskeletal discomfort among motorcyclists, particularly in the neck, shoulders, upper back, and lower back. Karmegam et al. described muscle discomfort among high-powered police motorcycle riders, supporting the role of prolonged riding

exposure and postural demand in rider-related musculoskeletal symptoms (5). Afridi et al. also reported musculoskeletal discomfort and associated disability among adult male motorcyclists, indicating that riding-related musculoskeletal problems are not limited to one anatomical region or occupational subgroup (15). Tembhurne similarly reported riding-related musculoskeletal disorders and disability among motorcyclists, highlighting the cumulative physical demands of motorcycle use (29). The high cervicalgia prevalence in the present study may therefore reflect a combination of prolonged exposure, inadequate ergonomic awareness, and recruitment of riders from settings where regular or occupational riding was common.

Helmet use may also be relevant to cervical symptoms, although the present study did not conduct subgroup analysis by helmet frequency or helmet characteristics. Earlier studies have suggested that helmet weight and adjustment may influence cervical loading, craniovertebral angle, and neck discomfort among riders (7,12,28,32). In the present sample, 40.5% of riders reported always using helmets, while 24.9% reported never using helmets. These descriptive findings indicate variable protective behavior but do not establish whether helmet use increased or reduced cervicalgia risk. Helmet use remains essential for injury prevention, and any discussion of neck discomfort should not be interpreted as discouraging helmet use. Instead, the findings support the need for appropriately fitted, lighter, ergonomically suitable helmets and education on posture, rest breaks, and neck mobility exercises.

Hand paresthesia was also highly prevalent in this study, affecting 84.7% of participants. This finding may be explained by sustained handlebar gripping, repetitive braking and clutch operation, wrist positioning, and vibration transmission through the hands and forearms. These exposures can increase mechanical stress on the median and ulnar nerves and may contribute to numbness, tingling, or pins-and-needles sensations. Previous literature has described median and ulnar nerve problems among cyclists and riders exposed to prolonged handlebar pressure, with symptoms including paresthesia, discomfort, reduced grip tolerance, and hand weakness (6,10,34). Studies on motorcycle taxi drivers and mechanics have also associated repetitive hand use, vibration, and ergonomic strain with carpal tunnel-related symptoms and upper-limb complaints (8,13,14). The high prevalence in the present study may reflect regular riding exposure, limited use of gloves, and prolonged gripping without adequate rest or ergonomic adjustment.

Although cervicalgia and hand paresthesia can be clinically related through cervical radiculopathy or proximal nerve involvement, the lack of statistically significant association in this study suggests that the two symptom patterns may not necessarily share the same pathway in this sample. Cervicalgia may primarily reflect local cervical postural strain, muscle fatigue, or neck disability, whereas hand paresthesia may more strongly reflect peripheral nerve compression, vibration exposure, or repetitive wrist and hand activity. Brismée et al. emphasized that upper-extremity paresthesia may arise from different sources, including cervical, thoracic outlet, and peripheral nerve mechanisms, requiring careful differential assessment (26). Therefore, the absence of a significant categorical association does not rule out clinical overlap in individual riders; rather, it indicates that the available questionnaire-based classification did not demonstrate a statistically significant relationship at the group level (31).

The practical implication of these findings is that motorcycle riders may benefit from preventive strategies targeting both cervical and upper-limb symptoms. Ergonomic education should include neutral neck positioning, avoidance of prolonged static posture, appropriate handlebar reach, relaxed grip, wrist-neutral riding position, scheduled rest breaks, and stretching or mobility exercises for the cervical spine, shoulders, wrists, and hands. Use of suitable gloves may reduce direct handlebar pressure and vibration exposure, while properly fitted helmets may support safety without unnecessarily increasing cervical strain. For riders with persistent neck pain, paresthesia, weakness, nocturnal symptoms, or functional limitation, clinical screening should distinguish between cervical

radiculopathy, carpal tunnel syndrome, ulnar neuropathy, thoracic outlet-related symptoms, and local musculoskeletal pain.

This study has several limitations. First, the use of non-probability convenience sampling limits generalizability beyond the sampled riders. Second, the sample included only male riders aged 18–50 years, so the findings cannot be generalized to female riders, older adults, or adolescent riders. Third, symptoms were assessed using questionnaire-based classification rather than clinical examination, electrodiagnostic testing, cervical range-of-motion assessment, or nerve provocation tests. Fourth, the study did not adjust for potential confounders such as daily riding duration, occupational riding status, helmet weight, handlebar type, posture, vibration exposure, body mass index, mobile phone use, previous injury, and physical activity level. Fifth, the underlying cervicalgia × hand paresthesia cross-tabulation was not provided, which limits verification of chi-square assumptions and prevents calculation of odds ratios or adjusted estimates. Finally, the cross-sectional design prevents causal inference and cannot determine whether motorcycle riding preceded or caused the reported symptoms (27-31).

Despite these limitations, the study provides useful local evidence on the burden of cervical and hand symptoms among motorcycle riders. The findings highlight the need for ergonomic awareness, early screening, and preventive interventions for riders who use motorcycles for work, education, delivery, or routine commuting. Future studies should use probability-based sampling, include both male and female riders, collect detailed exposure variables, apply validated diagnostic thresholds, and consider multivariable analysis to identify independent predictors of cervicalgia and hand paresthesia. Longitudinal studies would be particularly useful for determining whether riding duration, vibration exposure, posture, and protective practices predict the onset or progression of symptoms over time.

CONCLUSION

This cross-sectional study found a high prevalence of cervicalgia and hand paresthesia among male motorcycle riders, with cervicalgia affecting 97.9% and hand paresthesia affecting 84.7% of participants. Although both symptoms were common, Pearson's chi-square analysis did not show a statistically significant association between cervicalgia and hand paresthesia, suggesting that these conditions may frequently coexist but may not necessarily reflect the same underlying mechanism in this sample. The findings support the need for rider-focused ergonomic education, appropriate helmet and safety gear use, scheduled rest breaks, posture correction, and early clinical screening for persistent cervical or hand symptoms. Because the study used a cross-sectional design and convenience sampling, the results should be interpreted as descriptive prevalence and association findings rather than evidence of causation.

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