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Work-Related Musculoskeletal Disorders Among City Bus Conductors in Kolkata: An Assessment of Ergonomic and Psychosocial Risk Factors

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Abstract: *Public bus services constitute a vital component of urban transportation in India, facilitating the daily mobility of a large section of the population. Bus conductors play an essential role in ensuring the smooth functioning of these services by performing duties such as issuing tickets, collecting fares, assisting passengers, and maintaining passenger flow. However, the nature of their work often involves prolonged standing, repetitive movements, awkward body postures, exposure to whole-body vibration, and extended working hours. These occupational demands may increase their vulnerability to work-related musculoskeletal disorders (MSDs), adversely affecting their physical health, work performance, and overall well-being.*

The study included 120 male city bus conductors. Musculoskeletal symptoms were assessed using a modified Nordic Musculoskeletal Questionnaire, while working postures were evaluated using the Rapid Entire Body Assessment (REBA) method. Linear correlation and regression analyses were performed to examine the relationship between body part discomfort (BPD) and REBA scores. The findings revealed that the participants reported working approximately 16–18 hours per day, with most of their working time spent standing. The highest prevalence of musculoskeletal symptoms was observed in the legs (85%), followed by the knees (74.2%), lower back (66.7%), and shoulders (54.7%). The occurrence of MSDs was significantly associated with several occupational factors, including whole-body vibration, awkward working postures, insufficient rest intervals between trips, and prolonged working hours. Psychosocial factors, particularly dissatisfaction with earnings and low job satisfaction, were also significantly associated with the prevalence of musculoskeletal symptoms. Furthermore, statistical analysis demonstrated a significant correlation between BPD and REBA scores ($p < 0.05$), suggesting an association between postural risk and musculoskeletal discomfort among bus conductors. The findings indicate that prolonged working hours, sustained awkward postures, excessive workload, and inadequate rest periods are important occupational risk factors associated with musculoskeletal disorders among city bus conductors. In addition, psychosocial stressors may further contribute to their occupational health concerns. Implementing appropriate ergonomic interventions, improving work schedules, ensuring adequate rest breaks, and addressing workplace psychosocial conditions may help reduce musculoskeletal discomfort and promote the health, safety, and well-being of bus conductors.

Keywords: *REBA, Correlations, Discomfort level, Health.*

1. INTRODUCTION

Kolkata is a densely populated city served by a large fleet of both government and non-government buses, which form a critical component of its public transportation system. Musculoskeletal disorders (MSDs) represent one of the most significant work-related health concerns in modern industrialized nations [1]. Bus driving is widely regarded as a highly stressful and physically demanding occupation. Drivers are responsible not only for operating the vehicle but also for ensuring the safety of passengers, maintaining the condition of the vehicle, and adhering to both traffic regulations and employer-imposed guidelines. In addition, professional driving typically involves long hours of continuous driving without adequate rest periods. Work-related musculoskeletal disorders (WMSDs) affect workers across numerous occupations, including those involved in operating and supporting large vehicle transport systems.

Several studies worldwide have reported a high prevalence of musculoskeletal problems among urban bus transport workers [2], [3].

The development of work-related musculoskeletal disorders (WMSDs) is influenced by a complex interplay of both physical and psychosocial risk factors [4], [5]. Physical risk factors often lead to increased mechanical loading on the musculoskeletal system of bus conductors, resulting in discomfort, pain, and, if persistent, chronic disorders. Additionally, psychosocial factors at the workplace have been shown to significantly contribute to musculoskeletal pain. Key psychosocial factors include high work demands, stress symptoms [6], lack of social support [7], psychological distress, perceived high workload, time pressure, limited job control, and insufficient support from colleagues [8].

Drivers are frequently exposed to poor road conditions, which exacerbate the physical demands of the job. Common occupational hazards include poor seating posture, time pressure, prolonged static sitting, and exposure to whole-body vibrations transmitted through the vehicle-road interface. These factors are often compounded by repetitive physical exertion, twisting motions, and constrained spaces—conditions that place significant biomechanical strain on the musculoskeletal system. Collectively, these stressors heighten the risk of developing work-related musculoskeletal disorders (WMSDs) among professional drivers.

In India, bus conductors often work under poor and highly stressful conditions. However, there is a notable lack of studies that specifically investigate the prevalence of WMSDs among this occupational group and the contributing factors behind the development of these disorders. The present study aims to address this gap by examining the prevalence and characteristics of work-related musculoskeletal problems faced by urban bus conductors in Kolkata.

2. METHODS

2.1. Bus conductors of Kolkata

Among the various types of buses operating in the city of Kolkata, non-government (private) buses constitute a significant portion of the public transport system [9]. The working schedule of bus conductors in these services reveals an alarming scenario. Conductors often work continuously for 16 to 18 hours a day, seven days a week, without any designated weekly off. Typically, they continue this strenuous routine for 15 to 20 consecutive days in a month, after which they may receive a short break of 4 to 5 days.

Their workday usually begins early in the morning and extends until nearly midnight. On average, they complete 5 to 6 round trips per day—each trip consisting of a journey from the depot to the destination and back. Unlike salaried employees, these conductors do not receive a fixed monthly wage. Instead, their earnings are commission-based, depending directly on the number of passengers they transport.

2.2. Selection of Subjects

In the present investigation, 120 male bus conductors, having more than one year of experience, of four different short distance buses (one full trip of the bus involves distance coverage of 36-50 km) were selected randomly.

2.3. Questionnaire Study

A detailed modified questionnaire, based on the Nordic Musculoskeletal Disorder Questionnaire (NMQ) [10], was administered to all participating bus conductors. The questionnaire consisted of objective, multiple-choice questions and was structured into the following key sections:

General Information: This section gathered demographic and background data, including age, years of work experience, and other relevant personal details.

Work Organization and Work Behaviors: Questions focused on the nature of the conductors' daily routines, working hours, rest periods, and job-related tasks.

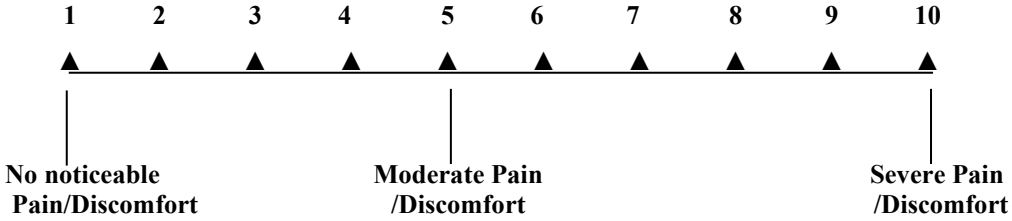
Musculoskeletal Symptoms: This section assessed subjective symptoms from the musculoskeletal system, focusing on the frequency, intensity, and location of pain or discomfort.

Work-Related Pain and Discomfort: Detailed questions were included to investigate the presence and extent of discomfort or pain associated with specific work-related postures and activities.

This structured approach facilitated a comprehensive understanding of the occupational exposure and physical strain experienced by the conductors.

2.4. Assessment of Discomfort Feeling

Pain intensity and discomfort were measured by utilizing the body part discomfort (BPD) scale [11]. The rating of each body part on a scale from 1 to 10 was done to indicate the level of discomfort.



2.5. Analysis of Working Posture

The habitual standing posture of an individual can significantly influence spinal loading, particularly during prolonged periods of standing [12–14]. Repeated adoption of awkward postures in the workplace has been closely associated with various types of musculoskeletal symptoms. Poor posture not only affects general health but also contributes to the early onset of fatigue, physiological stress, and cumulative trauma disorders [15].

To evaluate posture-related risks for work-related musculoskeletal disorders (WMSDs), the Rapid Entire Body Assessment (REBA) method was developed by Hignett and McAtamney in 2000 [16]. This tool provides a systematic approach to assessing whole-body postures and identifying high-risk movements that may contribute to the development of musculoskeletal disorders in occupational settings.

2.6. Statistical Analysis

Group differences between individuals with and without musculoskeletal disorders (MSDs) were analyzed using Student's t-test for continuous variables and the Chi-squ are (χ^2) test for categorical variables. Differences in workstation factors, work organization-related stressors, and psychosocial factors between the MSD and non-MSD groups were examined using a combination of the χ^2 test and Student's t-test. The strength and direction of these associations were further described using odds ratios (ORs) with 95% confidence intervals.

To assess the association between MSD occurrence in specific body regions and group membership, the Chi-square (χ^2) test was also applied. Additionally, Linear Correlation and Regression analyses were conducted to explore the magnitude and direction of the relationship between REBA scores (representing postural risk) and Body Part Discomfort (BPD) scores [17].

3. RESULTS

After performing the detailed questionnaire and successfully completing the physical assessment, results were analyzed.

The mean age of the bus conductors was 39.5 years (±8.7), their mean height was 164.4 cm (±5.0) and mean weight was 53.5 kg (±6.9). The mean values of physical parameters like BSA and BMI were 1.7 m^2 and 19.8 kg/m^2 respectively, which showed that all of them have a normal range of BSA and BMI. The minimum year of experience of the bus conductors was 1 year, and maximum was 30 years (**Table 1**).

Table 1: Demographic and workload profiles of bus conductors

	Conductors (n=120)		
	Range	**Mean**	**±SD**
Age (Years)	21-56	39.5	8.7
Height (Cm)	153-172	164.4	5.0
Weight (Kg)	42-73	53.5	6.9
BSA (m^2)	1.47-1.92	1.7	0.2
BMI (kg/m^2)	16.06-25.52	19.8	2.3
Years of Experience	1-30	18.5	7.8
Duration of work Per day (in hour)	16-18	16.8	0.8
Number of trips per day	4-6	4.9	0.7
Number of working days in a month	18-25	21.9	1.5

Volunteers were asked to identify body areas that had experienced discomfort in the past 12 months, 30 days, and 7 days. It was observed that the leg was the most affected region of the body. Maximum subjects reported suffering from pain in the leg, followed by knee, shoulder, and lower back, which may be because of prolonged standing posture and carrying heavy side bags containing many coins, currency notes, and tickets.

Further analysis of the questionnaire revealed that the maximum no of bus conductors reported discomfort throughout the year, mainly in the leg, knee, shoulder, and lower back region.

It was revealed from the BPD scale that the bus conductors rated their whole-body discomfort as 9, nearly intolerable pain **(Fig.2)**. In the present study, the 120 participating bus conductors were classified into two groups: those with musculoskeletal disorders (MSDs) and those without. Out of the total sample, 110 conductors (91.7%) reported experiencing MSDs.

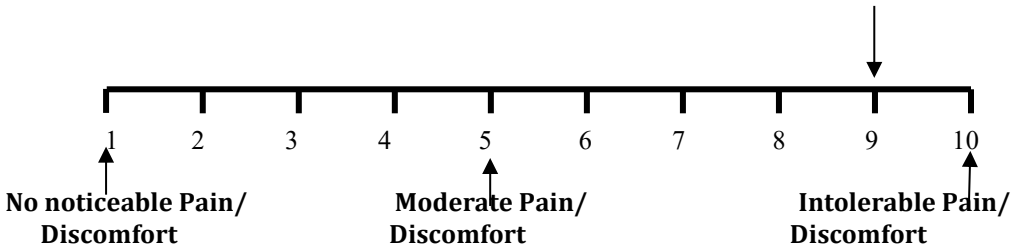


Fig 1: Discomfort feeling (pain) according to Borg scale (whole body)

Conductors with MSDs reported a significantly higher frequency of exposure to whole-body vibration (Odds Ratio [OR] = 2.7; 95% Confidence Interval [CI]: 1.0–7.4) and awkward working postures (OR = 3.4; 95% CI: 1.3–8.8). In terms of work organization-related stressors, a significantly greater proportion of affected individuals reported prolonged working hours (OR = 3.9; 95% CI: 1.3–11.69) and limited rest periods during the working day (OR = 3.5; 95% CI: 1.3–9.6).

However, no significant differences were observed between the MSD and non-MSD groups regarding other organizational stressors, including traffic congestion, lack of support from higher authorities or coworkers, exposure to passenger hostility, and inaccessibility to restrooms.

Among the psychosocial stress factors, two variables showed a significant association with MSDs: Dissatisfaction with earnings (OR = 4.8; 95% CI: 1.2–19.6) and Poor job satisfaction (OR = 3.6; 95% CI: 1.2–10.7) no significant group differences were found in relation to low job appreciation or family responsibilities **(Table 2)**.

Table 2: Self-perceive occupational risk factors due to workstation and work organization stress factors reported by non-government bus conductors

Predictors	Bus Conductors with MSD (n=100)		Bus Conductors without MSD (n=20)		χ^2	OR	95% CI	*P* Value
	n	%	*n*	%				
I. Workstation Factors								
1. Whole body vibration	77	77	11	55	3.1	2.7	1.0-7.4	0.07
2. Awkward posture	63	63	10	50	5.6	3.4	1.3-8.8	0.01
II. Work organization stressing factors								
1. Prolonged working time	88	88	13	65	5.0	3.9	1.3-11.68	0.02
2. Inadequate rest period during the working day	78	78	10	50	5.3	3.5	1.3-9.6	0.02

3. Traffic jam on bus route	55	55	7	35	1.9	2.3	0.8-6.1	0.16
4. Lack of support from the higher Authority	51	51	9	45	0.1	1.3	0.5-3.3	0.80
5. Lack of support from the co workers	42	42	10	50	0.2	0.7	0.3-1.9	0.68
6. Exposure to passenger hostility	35	35	5	25	0.4	1.6	0.5-4.8	0.54
7. Lack of accessibility to the restroom	38	38	6	30	0.1	0.7	0.3-1.9	0.72
III. Psychosocial factors								
1. Dissatisfaction regarding earning	**95**	**95**	**16**	**80**	**3.5**	**4.8**	**1.2-19.6**	**0.06**
2. Poor job satisfaction	**87**	**87**	**13**	**65**	**4.3**	**3.6**	**1.2-10.7**	**0.04**
3. Low job appreciation	49	49	14	6	2.2	0.4	0.1-1.1	0.14
4. Responsibility of the family	33	33	8	40	0.1	0.7	0.3-1.9	0.73

***p* value based on the $\chi^2$1. OR = odds ratio; 95% CI = 95% confidence interval for the OR. Statistically significant differences (P < 0.05)**

Different types of work postures are frequently adopted by conductors throughout the day, and they remain in a particular posture for at least 10 seconds to 3 minutes **(Table 3)**. It was evident from the analysis of posture that most of the postures adopted during work were awkward and hazardous, and needed necessary corrections soon.

Table 3: Analysis of working posture of the bus conductors

S. No	Figure	REBA Score	Action Category	BPD Score
1		7	Necessary	8
2		9	Necessary soon	9
3		8	Necessary soon	8
4		10	Necessary soon	9
5		9	Necessary soon	8

6		7	Necessary	7

Linear Correlation was performed to explore the magnitude and direction of association between the REBA score and the BPD score of working postures. By the statistical analysis, a significant ($p<0.05$) correlation between discomfort level and risk level of the individual working postures (r: 0.85, t: 3.266) was observed **(Table 4 & Fig. 2).**

Table 4: Linear correlation between REBA and BPD Score in different postures of bus conductors

Figure	REBA Score	BPD Score
1	7	8
2	9	9
3	8	8
4	10	9
5	9	8
6	7	7
r value	0.85	
t value	3.266	
Significant Level ($p<0.05$)		

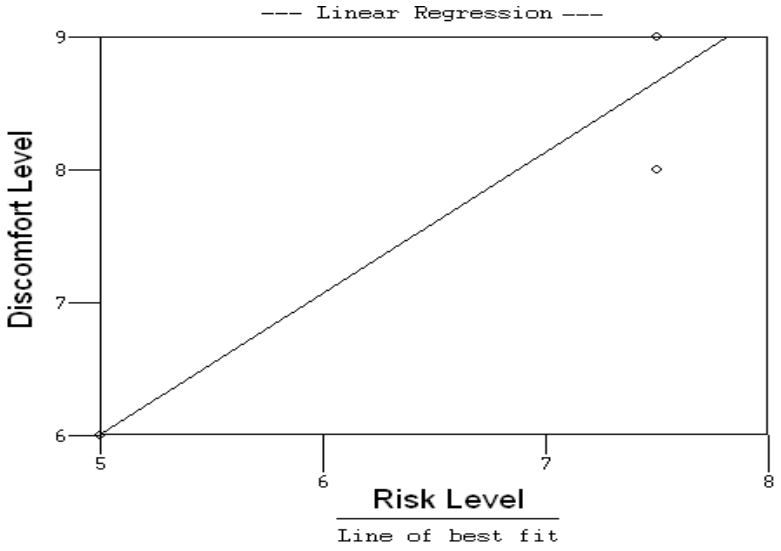


Fig 2: Linear regression between risk level and discomfort level in different postures of bus conductors

4. DISCUSSION

4.1. Prevalence and Nature of Musculoskeletal Disorder

Findings from the musculoskeletal disorder questionnaire (Figure 1) revealed that among all body regions, the leg was the most affected area. This can be attributed to the prolonged standing posture adopted by bus conductors, often with a noticeable tilt towards the left side (Table 3). During their routine tasks, conductors frequently lean and transfer most of their body weight onto the left leg while bending, maintaining this posture for durations ranging from 10 seconds to 3 minutes. Over the course of their extended 16–18-hour workdays, such repetitive and static loading results in persistent and severe leg pain.

Further analysis using the Body Part Discomfort (BPD) scale (Figure 2) confirmed high levels of pain intensity across multiple body parts. The overall body discomfort score was reported as 9, indicating nearly unbearable pain, particularly during both work and rest periods. Participants frequently reported maximum discomfort during rest, suggesting cumulative strain from their duties. Despite experiencing such significant physical distress, bus conductors continue to work under these conditions due to the economic necessity of earning a livelihood.

Statistical analysis from the present study revealed a significant association between the development of musculoskeletal disorders (MSDs) and various workstation factors, organizational stressors, and psychosocial conditions reported by bus conductors.

Conductors experiencing MSDs frequently reported exposure to whole-body vibration and the adoption of awkward working postures. In terms of work organization-related stressors, 83.3% of those with MSDs identified prolonged working hours—averaging 16 to 18 hours per day—as a primary concern. Additionally, the inadequate rest periods between trips, typically lasting only 15–20 minutes, were also cited as a contributing factor. Conductors typically complete 5–6 trips per day, each lasting between 1 hour 30 minutes to 2 hours.

These findings are consistent with previous studies that have linked heavy physical workload, frequent manual tasks, trunk rotation, whole-body vibration, and prolonged standing to an increased risk of MSDs [18–21]. The present study also found that specific physical tasks—such as working with hands at or above shoulder level, repetitive arm movements, and unsuitable or poorly designed work environments—further contributed to the development of MSDs. Similar outcomes have been observed in various occupational groups across other studies [22–25].

Importantly, a significant association was also found between MSDs and psychosocial stressors, including low job satisfaction and dissatisfaction with earnings. As conductors earn on a commission basis, their income is directly tied to the number of passengers who are often insufficient to meet basic living expenses. Consequently, they are compelled to increase their daily trips to improve earnings, further exacerbating physical and mental strain. This observation aligns with the findings of Davis and Heaney [26], who reported that job dissatisfaction was strongly and consistently associated with the development of MSDs.

Furthermore, the job of a bus conductor is not only physically demanding but also mentally stressful. They are expected to maintain a courteous relationship with passengers, provide real-time information about routes, stops, and fares, and manage tight schedules amidst dense urban traffic. Such expectations contribute to cognitive and emotional overload, increasing the risk to both physical and mental health. Conductors also face verbal and physical abuse and frequent humiliation from passengers, adding to their psychosocial burden. Similar correlations between psychosocial stressors and MSDs have been reported in studies involving professional transport workers [27, 28].

4.2. Posture Analysis

Bus conductors were found to adopt a range of working postures throughout the day, depending on the demands of their routine tasks. Six commonly observed postures were identified and assessed using the Rapid Entire Body Assessment (REBA) method. As presented in Table 3, the assessment revealed that most of these postures were ergonomically unfavorable and required corrective measures. Frequent adoption of awkward postures for prolonged periods may increase the risk of developing musculoskeletal disorders (MSDs). This risk may be further exacerbated by extended working hours, with conductors reportedly working approximately 16–18 hours per day, predominantly in a standing position.

A statistically significant correlation ($p < 0.05$) was observed between REBA scores and Body Part Discomfort (BPD) scores across the assessed postures (Table 4). This finding indicates an association between increased postural risk and musculoskeletal discomfort among bus conductors. The results are consistent with previous studies by Gangopadhyay et al. (2008, 2012) [29], [30], which reported that prolonged exposure to awkward working postures was associated with discomfort and pain in various body regions, potentially contributing to the development of MSDs. Collectively, these findings highlight the importance of ergonomic interventions, postural improvements, and appropriate work-rest schedules to reduce occupational musculoskeletal risks among bus conductors.

5. Conclusion

Prolonged working hours and excessive workload appear to be major occupational factors associated with the development of musculoskeletal disorders (MSDs) among bus conductors. The findings suggest that awkward working postures, extended periods of standing, and inadequate rest intervals may contribute substantially to musculoskeletal discomfort. Furthermore, psychosocial factors, including low job satisfaction, dissatisfaction with earnings, and work-related stress arising from multiple responsibilities, may further aggravate these occupational health concerns.

Collectively, these physical and psychosocial stressors can adversely affect conductors' health, work performance, and overall well-being, highlighting the need for effective ergonomic interventions and improved working conditions.

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Conflict of Interest

The authors report no conflict of interest**.**

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