











Anthropometric Assessment of Lower Limb Dimensions among Van Drivers in Relation to Work Pattern and Load Bearing

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ABSTRACT

Background: Occupational workload affects health and performance, and anthropometry helps tailor ergonomic interventions to reduce musculoskeletal risk. Drivers face long hours, static postures, and high physical demands, often linked to musculoskeletal complaints, yet few studies examine how workload relates to lower limb dimensions. In Bangladesh, data on driver anthropometry are limited. This study explores the association between work exposure and lower limb measures among van drivers in Dhaka to inform ergonomic design and occupational health strategies. **Methods & Materials:** A cross-sectional study of 50 male van pullers in Dhaka (25–55 years, ≥ 5 years' experience) measured demographics, workload, and lower limb dimensions following ISAK guidelines. Data were analyzed descriptively, and Pearson correlation assessed associations between workload and limb measurements ($p < 0.05$, SPSS v27). **Results:** Among 50 male van pullers (mean age 39.0 ± 6.5 years; mean BMI 21.9 ± 2.7 kg/m²), lower limb measurements showed moderate variability (lateral tibial condyle to floor 44.8 ± 3.0 cm, total limb length 84.1 ± 5.5 cm, knee 30.7 cm, calf 32.3 cm, ankle 17.6 cm). Participants worked long hours (11.9 ± 2.4 /day, ~ 7 days/week, 11.6 ± 1.5 months/year), but correlations between daily working hours and lower limb dimensions were weak and non-significant ($r = 0.08$ – 0.14 , $p > 0.05$). **Conclusion:** Lower limb dimensions of Dhaka van pullers show moderate variability and appear largely unaffected by prolonged occupational workload.

Keywords: Anatomy, Anthropometry, Nutritional status, Van puller/ drivers, occupational workload, Girth

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INTRODUCTION

Occupational workload and human body dimensions are central to understanding how physical job demands influence health and performance outcomes in working populations. Anthropometry, the systematic measurement of human body dimensions, is widely applied in ergonomics and workplace design to assess human variability and inform ergonomic interventions that improve safety, comfort, and productivity across occupational settings. Anthropometric data guide the fitting of workstations, equipment, and tools to the physical attributes of workers, thereby reducing musculoskeletal strain and injury risk^[1].

Professional drivers are exposed to prolonged and repetitive physical workloads, including extended durations of driving, static postures, and complex task demands, which have been repeatedly linked with a high prevalence of

musculoskeletal complaints and disorders^[2, 3, 4]. Studies of urban transit operators show that increased physical workload—often quantified by duration of driving and cumulative exposure—correlates with higher prevalence of musculoskeletal symptoms, particularly in the back and neck regions^[5, 6, 7]. Similarly, evidence among international truck drivers indicates that longer work hours are associated with musculoskeletal symptoms across multiple anatomical regions, highlighting the impact of both physical and organizational workload factors on driver health^[8, 9]. Although these studies emphasize symptomatic outcomes, relatively few investigations have examined how workload exposures relate to morphological characteristics such as lower limb anthropometry, which may affect posture, biomechanical load distribution, gait, and overall functional capacity during work tasks.

Lower limb dimensions—including bone lengths and circumferences of the knee, calf, and ankle—not only reflect intrinsic anatomical variation but can also be influenced by habitual occupational activities. Anthropometric profiles vary substantially among occupational groups, suggesting that prolonged physical tasks and workload exposures may be associated with particular morphological patterns^[10]. Body segment measurements have been used in ergonomic research to tailor workplace and equipment design, yet there is a gap in literature specifically linking occupational workload to lower limb anthropometric variation among transport workers. Furthermore, research on driver anthropometry in Bangladesh remains limited, though some work has highlighted substantial differences in body dimensions of Bangladeshi drivers compared with other populations, underscoring the need for

localized anthropometric data in ergonomic planning.

In the context of Bangladesh, van drivers in urban settings such as Dhaka city often endure long working hours and high physical demands, but ergonomic research in this group is scarce. Understanding how occupational workload aligns with specific lower limb anthropometric measures can provide crucial insights for ergonomic assessment, vehicle design adaptation, and occupational health interventions. Therefore, this study aims to examine the association between occupational workload—operationalized through daily working hours, weekly workdays, and annual work exposure—and lower limb anthropometry among van drivers in Dhaka. The findings are intended to inform ergonomic strategies, contribute to a better understanding of occupational health risks in this understudied population, and support evidence-based design and policy recommendations.

METHODS & MATERIALS

Study Design and Sampling: This study was a cross-sectional descriptive study with analytical components, conducted to examine the lower limb anthropometry and occupational workload of van pullers in Dhaka city. A convenient sampling technique was used to recruit 50 participants between January 1, 2025, and August 31, 2025.

Study Population and Selection Criteria: The study population comprised 50 male van pullers aged 25–55 years, each with a minimum of five years of occupational experience. Participants were selected based on availability and willingness to participate. Individuals were excluded if they had a history of major lower limb trauma, musculoskeletal disorders, congenital anomalies, or any deformities affecting the lower extremities, to prevent

interference with accurate anthropometric measurement.

Ethical Considerations: Informed written consent was obtained from all participants prior to data collection. Confidentiality and privacy were strictly maintained, and participation was entirely voluntary. The study posed no physical, social, or legal risks, and all data collected were used exclusively for research purposes.

Variables: Demographic variables included age, body weight, stature, and body mass index (BMI). Occupational workload variables included working hours per day, working days per week, and working months per year. The primary outcome variables were lower limb anthropometric measures: lateral condyle of tibia to standing surface, total lower limb length, and circumferences of the knee, calf, and ankle.

Anthropometric Measurements: All measurements were performed following the International Society for the Advancement of Kinanthropometry (ISAK) guidelines. Participants were informed about the study objectives and provided voluntary consent before measurement. A single trained researcher conducted all measurements to reduce inter-observer variability, assisted by an assistant who recorded the data.

Lower limb lengths were measured using a segmometer:

Lateral condyle of tibia to standing surface was measured with participants in a standing position. Circumferences of the knee, calf, and ankle were measured using a non-elastic tape at standardized anatomical landmarks. Stature was measured using a stadiometer, and body weight was recorded using a calibrated digital scale. All measurements were taken twice, and the mean value was used in the analysis to ensure accuracy and reliability. Anatomical landmarks were carefully identified and

marked, with supplementary audio and photographic documentation used to maintain consistency.

Occupational Workload Assessment: Data on occupational workload were collected through structured interviews, which included the number of hours worked per day, days worked per week, and months worked per year. These variables provided quantitative insight into the physical demands of the van pullers' occupation.

Data Analysis: Descriptive statistics were used to summarize demographic, anthropometric, and occupational workload variables. Continuous variables were presented as mean \pm standard deviation (SD) or median and range, while categorical variables were reported as frequencies and percentages. The relationship between occupational workload and lower limb anthropometry was evaluated using **Pearson correlation analysis**. A p-value <0.05 was considered statistically significant. All statistical analyses were conducted using [insert software, e.g., SPSS version 27].

RESULTS

Demographic and Anthropometric Characteristics

The study included 50 van pullers with an age range of 25 to 55 years (mean \pm SD: 39.02 \pm 6.50 years). The majority of participants were aged 36–40 years (26%), followed by 41–45 years (18%). Body weight of the participants ranged from 44.05 to 81.55 kg, with a median of 55.70 kg, while stature ranged from 145 to 174 cm (mean \pm SD: 160.15 \pm 6.02 cm). The mean body mass index (BMI) was 21.91 \pm 2.73 kg/m², with most van pullers (78%) falling within the normal weight category (18.5–24.9 kg/m²), 14% overweight, and 8% underweight. No participants were classified as obese (BMI \geq 30 kg/m²) *Table I*.

Table I
Distribution of age, body weight, stature, and BMI of van pullers ($n = 50$).

Variable	Category	n (%)
Age (years)	25–30	5 (10)
	31–35	6 (12)
	36–40	13 (26)
	41–45	9 (18)
	46–50	5 (10)
	51–55	2 (4)
	Mean \pm SD	39.02 \pm 6.50
Body weight (kg)	71–80	3 (6)
	81–90	1 (2)
	Median (range)	55.70 (44.05–81.55)
Stature (cm)	145–154	9 (18)
	155–164	23 (46)
	165–174	18 (36)
	Mean \pm SD	160.15 \pm 6.02
	BMI (kg/m ²)	<18.5
18.5–24.9		39 (78)
25–29.9		7 (14)
\geq 30		0 (0)
Mean \pm SD		21.91 \pm 2.73

Lower Limb Anthropometry

Lower limb measurements demonstrated variability among the van pullers. The distance from the lateral condyle of the tibia to the standing surface ranged from 36 to 53 cm, with the majority (70%) falling between 42–47 cm (mean ± SD: 44.75 ± 2.96 cm).

Total lower limb length varied from 69 to 98 cm, with a mean of 84.12 ± 5.53 cm, and most participants (58%) measuring 79–88 cm. Knee girth was predominantly 28–31 cm (80%), with a median of 30.66 cm (range: 29.25–37.15 cm), while calf girth had a median of 32.33 cm (range: 29.35–

39.53 cm). Ankle girth measurements were mostly in the 17–19 cm range (72%), with a median of 17.55 cm (range: 17.50–24.65 cm). The medial condyle of tibia to medial malleolus distance had a median of 36.37 cm, with 56% of participants measuring between 36–40 cm (Table II).

Table II

Lower limb anthropometric measurements of van pullers (n = 50).

Trait	Measurement range (cm)	n (%)	Summary statistic
Lateral condyle of tibia to standing surface	36–41	7 (14)	Mean ± SD: 44.75 ± 2.96
	42–47	35 (70)	
	48–53	8 (16)	
Length of lower limb	69–78	8 (16)	Mean ± SD: 84.12 ± 5.53
	79–88	29 (58)	
	89–98	13 (26)	
Knee girth	28–31	40 (80)	Median (range): 30.66 (29.25–37.15)
	32–35	9 (18)	
	36–39	1 (2)	
Calf girth	29–32	31 (62)	Median (range): 32.33 (29.35–39.53)
	33–36	17 (34)	
	37–40	2 (4)	
Ankle girth	17–19	36 (72)	Median (range): 17.55 (17.50–24.65)
	20–22	11 (22)	
	23–25	3 (6)	
Medial condyle of tibia to medial malleolus	26–30	3 (6)	Median (range): 36.37 (26.43–39.60)
	31–35	19 (38)	
	36–40	28 (56)	

Occupational Workload

The occupational workload of the van pullers was considerable. Participants

reported working an average of 11.88 ± 2.43 hours per day, nearly 7 days per week (6.96

± 0.20), and approximately 11.62 ± 1.50 months per year (Table III).

Table III

Occupational workload characteristics of van drivers (n = 50).

Variable	Mean ± SD	Minimum	Maximum
Working hours per day	11.88 ± 2.43	5	16
Working days per week	6.96 ± 0.20	6	7
Working months per year	11.62 ± 1.50	4	12

Association Between Occupational Workload and Lower Limb Anthropometry

Correlation analysis revealed weak and non-significant associations between daily

working hours and lower limb anthropometric measures. Specifically, working hours per day showed a Pearson correlation of 0.14 with the lateral condyle of tibia to standing surface (p = 0.33), 0.08

with medial condyle of tibia to medial malleolus (p = 0.57), and 0.12 with total lower limb length (p = 0.40), indicating no statistically significant linear relationships (Table IV).

Table IV

Association between occupational workload and lower limb anthropometry among van drivers (n = 50).

Occupational workload variable	Anthropometric variable	Pearson r	p value
Working hours per day	Lateral condyle of tibia to standing surface	0.14	0.33
Working hours per day	Medial condyle of tibia to medial malleolus	0.08	0.57
Working hours per day	Total lower limb length	0.12	0.40

DISCUSSION

This study examined the relationship between occupational workload and lower limb anthropometry among van drivers in Dhaka city. The participants were predominantly of normal BMI, with moderate stature and body weight, reflecting a relatively uniform demographic profile consistent with other urban transport workers in South Asia [2]. Lower limb measurements indicated that most drivers had lateral condyle to standing surface lengths of 42–47 cm and total lower limb lengths of 79–88 cm, with knee, calf, and ankle circumferences reflecting lean morphology.

Despite the high occupational workload—nearly 12 hours per day, six to seven days per week—correlation analysis showed no significant associations between workload and lower limb dimensions. These findings align with prior research suggesting that static anthropometric characteristics, such as bone lengths and segmental circumferences, are largely established in adulthood and are minimally influenced by repetitive occupational exposure [11]. While physical workload may induce musculoskeletal strain and functional fatigue, it appears insufficient to produce measurable morphological changes in the lower limbs of adult drivers.

Comparative studies in transport and industrial workers support this observation, showing that while long hours and repetitive tasks contribute to musculoskeletal discomfort, they do not significantly alter static body dimensions [12]. In contrast, occupations involving dynamic, high-impact physical activity, such as manual load carriers or athletes, may exhibit subtle morphological adaptations over time [13]. This distinction highlights that the type and intensity of physical activity, rather than the duration alone, are critical for anthropometric changes.

From an ergonomic perspective, these findings emphasize that interventions should prioritize reducing functional strain rather than expecting occupational adaptation in limb morphology. Vehicle design, seating ergonomics, and scheduled breaks should consider the documented lower limb dimensions to minimize musculoskeletal risk. Furthermore, localized anthropometric data, as provided by this study, are essential for ergonomic planning in Bangladeshi urban transport contexts.

Therefore, occupational workload in Dhaka van drivers exerts a functional impact on musculoskeletal health without producing significant changes in lower limb anthropometry, underscoring the need for ergonomic interventions tailored to existing body dimensions.

CONCLUSION

Despite high occupational workload, lower limb dimensions of van drivers showed no significant relationship with work pattern or load exposure. These findings suggest that adult lower limb morphology is largely unaffected by prolonged driving. Ergonomic interventions should focus on functional strain reduction rather than morphological adaptation, with localized anthropometric data informing vehicle design and occupational health strategies.

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