

Evaluating the Extent of Postural Discomfort Experienced by the Auto Rickshaw Drivers of Vadodara City

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Abstract: Auto Rickshaw Drivers play a crucial role in urban transportation, yet their working conditions often expose them to significant postural discomfort. The objective of the present study was to assess the extent of postural discomfort experienced by CNG-operated Auto Rickshaw Drivers in Vadodara City. A descriptive research design was adopted using purposive convenience sampling. Data was collected from 120 Auto Rickshaw Drivers through a structured questionnaire and observation sheet. The findings revealed that 31.67 per cent of the respondents experienced high psychosocial stress due to passenger behavior, particularly when dealing with rude or difficult passengers. In terms of physical factors, 75.00 per cent of respondents always experienced postural discomfort due to frequent adjustments of the steering wheel, while 73.33 per cent reported persistent discomfort caused by seat design. Significant discomfort was also noted in specific body regions, such as the neck, ankles, legs, and hips, with 50.00 per cent of respondents reporting consistent discomfort from vibrations while driving. Regarding postures adopted, 46.66 per cent of respondents consistently maintained an arm posture with elbows bent at 120°, and 66.66 per cent sometimes drove with wrists slightly bent upwards. Additionally, 75.00 per cent sometimes adopted a trunk posture leaning to one side, and 71.66 per cent sometimes bent their neck sideways while driving. The study highlights the relationship between psychosocial stress, physical factors, and poor driving postures as major contributors to postural discomfort. The findings emphasize the need for ergonomic interventions and seat redesign to improve the health and working conditions of Auto Rickshaw Drivers.

Keywords: Auto Rickshaw Drivers · Postural Discomfort · Psychosocial Stress · Physical Factors · Postures · Ergonomics.

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I. INTRODUCTION

Urban transportation forms the backbone of daily commuting, particularly in expanding cities like Vadodara. Auto Rickshaw Drivers are an essential part of this system, providing accessible, affordable, and timely mobility to the public. However, while their service is indispensable, the occupational health challenges they face often remain overlooked. Among these challenges, postural discomfort stands out as a significant concern arising from the physical demands of their work environment ^[1].

Auto Rickshaw Drivers are routinely subjected to prolonged sitting, awkward body postures, repetitive upper-limb movements, and continuous exposure to whole-body vibrations ^[2]. Such working conditions lead to postural discomfort, manifesting as pain, stiffness, or muscular strain, primarily in areas such as the lower back, neck, shoulders,

and hips ^[3]. The absence of ergonomic support, particularly poorly designed seats that do not adequately support the lumbar spine, further aggravates these issues by promoting unhealthy postures during long driving hours ^[4].

Postural discomfort not only affects the immediate physical well-being of drivers but also hampers their efficiency and long-term health. Chronic postural strain, if left unaddressed, can escalate into musculoskeletal disorders (MSDs), leading to work absenteeism, decreased productivity, psychological distress, and in severe cases, permanent occupational disability ^[5].

In informal sectors like auto rickshaw driving, ergonomic awareness and healthcare support are minimal. This neglect, combined with long work hours and poor road conditions, accelerates the deterioration of physical health among drivers ^[6]. Despite these serious concerns, scientific

research specifically addressing postural discomfort among Auto Rickshaw Drivers in Indian cities like Vadodara remains limited.

Therefore, the present study aims to assess the extent of postural discomfort experienced by CNG-operated Auto Rickshaw Drivers of Vadodara City. It will also examine the influence of psychosocial stressors, physical factors, and adopted postures on their discomfort levels. The insights gained through this study are intended to drive ergonomic interventions and contribute to improving the occupational health and welfare of this vital workforce.

➤ Objective

To assess the extent of Postural Discomfort among the Auto Rickshaw Drivers in Vadodara.

➤ Hypothesis

The extent of Postural Discomfort experienced by the respondents varies with their Personal Variables (Age in years and Body Mass Index) and Situational Variables (Duration of Driving per day and Driving experience in years).

II. METHODOLOGY

A descriptive research design was employed to assess the extent of Postural Discomfort experienced by Auto Rickshaw Drivers in Vadodara City, specifically targeting CNG-operated Auto Rickshaw Drivers. A total of 120 drivers participated in the study, selected through a purposive sampling technique. The city was divided into four directional zones, North, South, East, and West and 30 drivers were randomly chosen from each zone to ensure a geographically representative sample. Data collection was carried out using a structured questionnaire that included the Postural Discomfort Survey Tool for Three-Wheeler Drivers (PDST), developed by the researcher. The PDST was divided into four sections: Individual Factors, which assessed the driver's personal habits such as exercise, smoking, tobacco consumption, and alcohol intake; Psychosocial Factors, which explored work-related stressors like hazardous conditions, traffic congestion, fatigue, and job dissatisfaction; Physical Factors, focusing on ergonomic aspects such as arm and wrist position, sitting posture, and vibration exposure; and Postures Adopted by the Drivers, which evaluated the alignment of the neck, back, trunk, and limbs, along with seat

comfort. To enhance understanding, hand-drawn images were included in the questionnaire to illustrate different postures and physical factors. The PDST used a 3-point Likert scale (Always, Sometimes, Never) to assess the frequency of discomfort, offering valuable insights into how various factors contribute to postural discomfort. For data analysis, descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize the data, while inferential statistics, including Analysis of Variance (ANOVA), were applied to examine relationships between factors such as age, years of experience, and daily working hours with the reported levels of postural discomfort. The study was also approved under the Ethical Research Committee of the Faculty of Family and Community Resource Management, The Maharaja Sayajirao University of Baroda, and it was granted ethical compliance number as IECHR/FCSc/M.Sc./10/2024/19. Ethical considerations were strictly followed, with all respondents providing informed consent and ensuring confidentiality, voluntary participation, and anonymity throughout the study.

III. RESULTS AND DISCUSSIONS

➤ Extent of Postural Discomfort Experienced by the Respondents

• Psychosocial Factors

The data from Table 1 revealed significant psychosocial stress factors experienced by Auto Rickshaw Drivers. The most prominent stressor was Passenger behavior, with 31.67 per cent of respondents reporting high stress due to rude or difficult passengers. Another major stress factor was the lack of sufficient rest or breaks, with 25 per cent of drivers experiencing high stress due to this, along with interactions with traffic police and other authorities. Stress due to potential illness or injury was reported by 30 per cent of drivers, reflecting concerns over its impact on their ability to work. A significant portion of drivers, 29.17 per cent, experienced very high stress due to physical discomfort while driving. Similarly, 23.33 per cent of respondents expressed very high stress related to earning money that only covered daily expenses. Additional notable stressors included competition with other drivers (20 per cent), long driving hours and heavy traffic (20 per cent), and safety concerns, all contributing to psychosocial strain on the drivers.

Table 1 Psychosocial Factors of the Respondents (n=120)

Sr. No.	Statements regarding Psychosocial Factors	Respondents (n=120)										Weighted Mean 5-1
		Very High		High		Moderate		Low		Very Low		
		f	%	f	%	f	%	f	%	f	%	
1.	Stress is experienced due to uncertainty in daily income.	12	10.00	20	16.67	24	20.00	22	18.33	42	35.00	2.48
2.	Long driving hours contribute to significant stress.	14	11.67	24	20.00	24	20.00	36	30.00	22	18.33	2.76
3.	Heavy traffic and congestion increase stress levels while driving.	18	15.00	24	20.00	30	25.00	28	23.33	20	16.67	2.93

4.	Passenger behavior, especially when rude or difficult, causes stress.	13	10.83	38	31.67	22	18.33	40	33.33	7	05.84	2.98
5.	Physical discomfort experienced while driving adds to stress.	35	29.17	17	14.17	22	18.33	34	28.33	12	10.00	3.23
6.	Safety concerns, such as the risk of accidents or crime, cause stress.	18	15.00	24	20.00	20	16.67	40	33.33	18	15.00	2.86
7.	Competition with other Auto Rickshaw Drivers for passengers increases stress.	24	20.00	12	10.00	26	21.67	32	26.66	26	21.67	2.8
8.	Earning enough money to cover daily expenses is a source of stress.	28	23.33	21	17.50	26	21.67	26	21.67	19	15.83	3.08
9.	The costs of maintaining and repairing the auto rickshaw contribute to stress.	20	16.67	22	18.33	24	20.00	28	23.33	26	21.67	2.85
10.	Driving in extreme weather conditions e.g., heat, rain elevates stress levels.	15	12.50	14	11.67	37	30.83	24	20.00	30	25.00	2.7
11.	Lack of sufficient rest or breaks during the workday leads to stress.	18	15.00	30	25.00	20	16.67	28	23.33	24	20.00	2.91
12.	Balancing work with family responsibilities contributes to stress.	18	15.00	24	20.00	26	21.67	30	25.00	22	18.33	2.88
13.	Interactions with traffic police or other authorities add to stress levels.	22	18.33	30	25.00	18	15.00	24	20.00	26	21.67	2.98
14.	Unpredictability in the number of passengers or trips per day causes stress.	20	16.67	28	23.33	28	23.33	18	15.00	26	21.66	2.98
15.	Worry about the potential impact of illness or injury on the ability to work contributes to stress.	36	30.00	16	13.33	16	13.33	32	26.67	20	16.67	3.13

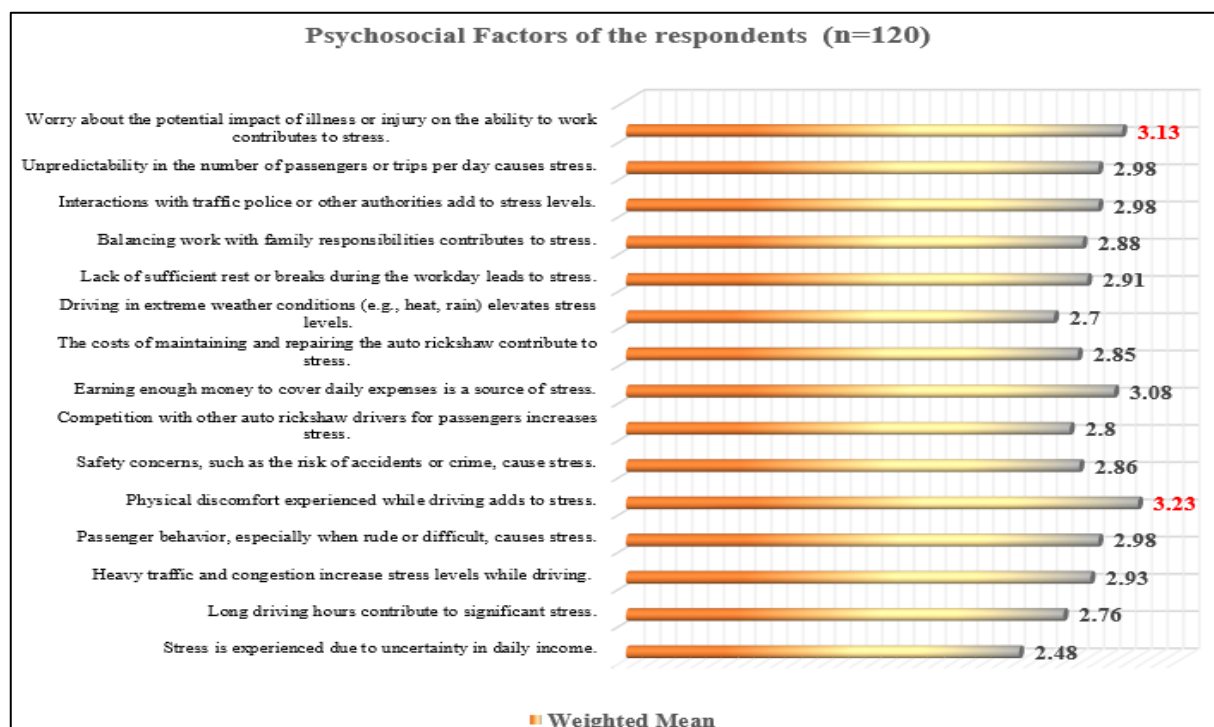


Fig 1 Psychosocial Factors of the Respondents

• *Extent of Postural Discomfort Experienced Due to Physical Factors of the Respondents*

The data revealed several key findings regarding postural discomfort experienced by Auto Rickshaw Drivers due to physical factors. 75 per cent of the respondents always experienced discomfort from frequent steering adjustments, while 70 per cent never experienced discomfort due to the presence of an armrest. Postural discomfort was notably high in the neck and trunk regions, with 45 per cent always experiencing discomfort due to neck tilting, and 36.67 per

cent always experiencing discomfort due to steering. 50 per cent of respondents always experienced discomfort in the ankles and feet, with a similar percentage reporting discomfort in their legs and hips. 50 per cent of respondents also reported postural discomfort due to vibrations, with 46.67 per cent experiencing severe vibrations while driving. Additionally, 53.33 per cent of drivers reported discomfort due to poor seat design, and 61.67 per cent never adjusted their seat for comfort, highlighting the critical role of ergonomic factors in contributing to postural discomfort.

Table 2 Postural Discomfort Experienced Due to Physical Factors of the Respondents (n=120)

Sr. No.	Statements regarding Postural Discomfort experienced due to Physical Factors of the respondents	Always		Sometimes		Never	
		f	%	f	%	f	%
A	Arm						
1.	Frequent adjustments of the seat while driving.	14	11.67	10	08.33	96	80.00
2.	Frequent adjustments of the steering while driving.	90	75.00	18	15.00	12	10.00
3.	Presence of an armrest or a place to rest the arm while driving.	10	08.33	26	21.67	84	70.00
B	Wrist						
1.	Steering wheel grip is comfortable.	38	31.67	42	35.00	40	33.33
2.	High force is applied to the steering wheel while driving.	32	26.67	64	53.33	24	20.00
3.	Discomfort is experienced in hands due to steering the auto rickshaw.	44	36.67	42	35.00	34	28.33
C	Trunk						
1.	Trunk is tilted while driving.	32	26.67	68	56.66	20	16.67
2.	Trunk bends to the side while driving.	20	16.67	82	68.33	18	15.00
D	Neck						
1.	Neck is tilted while driving.	54	45.00	48	40.00	18	15.00
2.	Neck bends to the side while driving.	52	43.33	50	41.67	18	15.00
E	Feet						
1.	Lack of feet support in the vehicle.	48	40.00	40	33.33	32	26.67
2.	Pain is experienced in the feet while driving.	58	48.34	40	33.33	22	18.33
3.	Discomfort is experienced in the ankles while driving.	60	50.00	42	35.00	18	15.00
F	Leg						
1.	Discomfort is experienced in the legs while driving.	62	51.67	30	25.00	28	23.33
2.	Fatigue in the legs after driving for an extended period.	54	45.00	42	35.00	24	20.00
3.	Feeling numbness in the legs while driving.	46	38.33	42	35.00	32	26.67
G	Hip						
1.	Frequent alignments of the hips are made.	48	40.00	48	40.00	24	20.00
2.	Frequent adjustments of the hip position are made while driving.	54	45.00	56	46.67	10	08.33
3.	Discomfort is experienced in the hips while driving.	62	51.67	38	31.66	20	16.67
H	Vibration Exposure						
1.	Feeling severe vibrations while driving.	56	46.67	46	38.33	18	15.00
2.	Vibrations while driving affect specific parts of the body.	60	50.00	44	36.67	16	13.33
I	Seat Design and Comfort Factors of the Work Station						
1.	Seat in the auto rickshaw is comfortable.	44	36.67	39	32.50	37	30.83
2.	Seat requires modifications.	44	36.67	44	36.67	32	26.66
3.	Seat provides adequate support for the back and thighs.	40	33.33	24	20.00	56	46.67
4.	Seat effectively reduces the impact of vibrations while driving.	34	28.33	26	21.67	60	50.00
5.	Seat can be easily adjusted to achieve a comfortable driving position.	24	20.00	22	18.33	74	61.67
7.	Seat is durable in terms of wear and tear.	39	32.50	37	30.83	44	36.67
8.	Seat design affects driving posture.	64	53.33	18	15.00	38	31.67
9.	Additional supports e.g., cushions, lumbar support are used to improve sitting posture.	46	38.33	42	35.00	32	26.67

• *Extent of Postural Discomfort Experienced Due to Postures Adopted While Driving by the Respondents*

The data on posture revealed several key patterns among the respondents. Regarding arm posture, 46.67 per cent always had their elbows bent at 120° with arms extended

forward, while 40% sometimes adopted this posture, and 33.33 per cent always had elbows bent at 90° and arms occasionally extended forward. In terms of wrist posture, 66.67 per cent sometimes had their wrist slightly bent upwards, and 65 per cent maintained a neutral wrist position

(straight). Additionally, 41.67 per cent sometimes bent their wrist downwards. For sitting posture, 46.67 per cent sometimes leaned backward, while 43.33 per cent always adopted an upright or slightly slouched posture. Furthermore, 30 per cent always leaned forward, and an equal percentage sometimes adopted a slightly slouched posture. When it came to trunk posture, 75 per cent sometimes leaned their trunk to one side, while 40 per cent always kept their trunk straight and aligned with the seat. As for neck posture, 71.67 per cent sometimes bent their neck to one side, and 61.67 per cent always maintained a neutral and aligned neck position. 48.33 per cent sometimes bent their neck slightly forward. For feet

posture, 55 per cent always rested their feet on the pedal, and 53.33 per cent always alternated foot positions. A similar percentage, 50 per cent, either always or sometimes hovered their feet above the pedal, and 45 per cent sometimes had their feet pointed slightly upwards. Lastly, regarding leg posture, 48.33 per cent always spread their legs apart, and 45 per cent sometimes kept their legs straight with knees slightly bent or bent at 90°. These findings highlight the variety of postures adopted by the respondents, with certain postures being consistently observed while others were adopted intermittently.

Table 3 Postural Discomfort Experienced Due to Postures Adopted While Driving by the Respondents (n=120)

Sr. No.	Postures adopted while Driving	Respondents (n=120)					
		Always		Sometimes		Never	
		f	%	f	%	f	%
A.	Arm Posture						
1.	 Bent at elbows at 90°	40	33.33	36	30.00	44	36.67
2.	 Bent at elbows at 120°	56	46.67	48	40.00	16	13.33
3.	 Arm Extended forward	56	46.67	40	33.33	24	20.00
B.	Wrist Posture						
1.	 Arm Extended forward	30	25.00	80	66.67	10	08.33
2.	 Neutral (Straight)	78	65.00	38	31.67	4	03.33
3.	 Slightly bent downwards	30	25.00	50	41.67	40	33.33
C.	Sitting Posture						
1.	 Upright with support	52	43.33	17	14.17	51	42.50
2.	 Slightly slouched	52	43.33	36	30.00	32	26.67
3.	 Leaning forward	36	30.00	14	11.67	70	58.33
4.	 Leaning backward	18	15.00	56	46.67	46	38.33
D.	Trunk Posture						

1.		Straight and aligned with the seat	48	40.00	62	51.67	10	08.33
2.		Leaning to one side	18	15.00	90	75.00	12	10
E. Neck Posture								
1.		Neutral and aligned	74	61.67	24	20.00	22	18.33
2.		Slightly forward	20	16.67	58	48.33	42	35.00
3.		Slightly backward	24	20.00	30	25.00	66	55.00
4.		Bent to one side	16	13.33	86	71.67	18	15.00
F. Feet Posture								
1.		Flat on the floor	38	31.67	34	28.33	48	40.00
2.		Resting on the pedal	66	55.00	48	40.00	6	05.00
3.		Hovering above the pedal	60	50.00	60	50.00	0	00.00
4.		Slightly pointed upwards	52	43.33	54	45.00	14	11.67
5.		Slightly pointed downwards	24	20.00	31	25.84	65	54.16
6.		Alternating between positions	64	53.33	50	41.67	6	05.00
F. Leg Posture								
1.		Straight with knees slightly bent	26	21.67	54	45.00	40	33.33
2.		Knees bent at 90°	52	43.33	54	45.00	14	11.67
3.		Legs spread apart	58	48.33	26	21.67	36	30.00

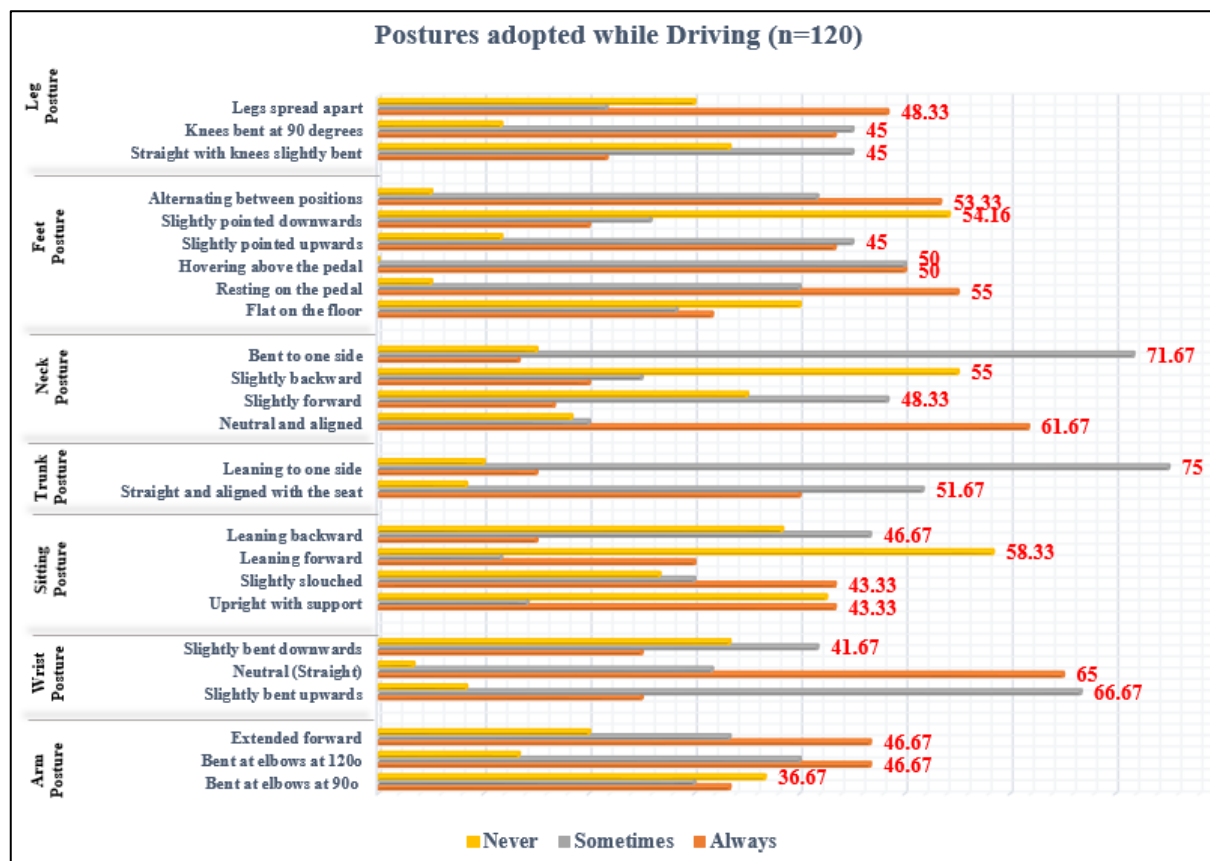


Fig 2 Postural Discomfort Experienced Due to Postures Adopted While Driving by the Respondents

➤ Testing of Hypothesis

The computed F-value for Personal Variables [Age (in years) and Body Mass Index] and their Situational Variable [Driving Experience (in years) and Duration of Driving (per day)] revealed that the F-value was significant for Age (in years) and Duration of Driving (per day), whereas it was not significant for Driving Experience (in years) and Body Mass Index. Thus, it can be concluded that the extent of Postural Discomfort experienced by the respondents varied significantly with Age and Duration of Driving, but did not vary with Driving Experience, and Body Mass Index. Hence, the null hypothesis HO1.2 was partially accepted.

Scheffe's test was conducted subsequently to identify specific group differences, and the results indicated that respondents in the age group of 41 to 55 years significantly differed in the extent of Musculoskeletal Discomfort experienced when compared to those in the 56 to 70 years age group.

➤ Design Development of an Ergonomic Solution for the Auto Rickshaw Drivers

The design and development of an ergonomic solution aimed at alleviating postural discomfort for the Auto Rickshaw Drivers was initiated based on research findings that identified prolonged driving hours, inadequate lumbar support, improper seating posture, and lack of appropriate cushioning as significant contributors to musculoskeletal and postural discomfort, especially in the lower back, neck, and shoulders. To address these issues, a new ergonomic seat was conceptualized with a primary focus on reducing physical

strain and improving overall comfort, particularly targeting key areas like the spine, neck, and lower extremities.

The design process began by collecting anthropometric data from 120 CNG-operated Auto Rickshaw Drivers using an anthropometric kit. The data was analyzed within the 5th to 95th percentile range to ensure the design could accommodate the majority of drivers. Key measurements taken included sitting height, shoulder breadth, thigh clearance, elbow rest height, knee height, popliteal height, hip breadth, and other dimensions essential for maintaining a neutral and comfortable seated posture during long hours of driving.

This data was then used to inform the dimensions, contours, and overall structure of the seat, ensuring an ergonomic fit to enhance comfort and minimize postural discomfort. After finalizing the design concept, a 3D model of the seat was created using SketchUp software, enabling the visualization of the ergonomic features, evaluation of its feasibility, and identification of potential areas for improvement before moving into the fabrication phase. This design marks a crucial step toward improving the driving environment by reducing postural discomfort and promoting better health outcomes for Auto Rickshaw Drivers.

IV. CONCLUSION

The findings of the study concluded that the Auto Rickshaw Drivers in Vadodara city experience significant postural discomfort, with the most affected areas being the

lower back, neck, shoulders, and legs. The discomfort was found to be associated with prolonged driving hours, improper seating posture, and continuous vibration exposure. Additionally, drivers who had longer durations of daily driving and those in the age group of 41 to 55 years reported greater postural discomfort compared to other groups. The study highlighted that poor ergonomic design, such as inadequate lumbar support and lack of seat cushioning, exacerbates the physical strain experienced by drivers. In response to these findings, the study led to the design and development of an ergonomic seat aimed at reducing postural discomfort. The seat design was based on anthropometric data collected from the drivers, ensuring that it addressed their specific needs for comfort and support. A 3D model of the seat was developed using SketchUp software to visualize the design, adjusting for better lumbar support, proper seat cushioning, and improved overall posture.

This research offers valuable insights into the postural challenges faced by Auto Rickshaw Drivers and provides a foundation for developing ergonomic interventions that can significantly improve their working conditions. The findings serve as an important resource for ergonomics students, researchers, vehicle manufacturers, and urban policymakers, offering them guidance on how to reduce postural discomfort and enhance the well-being of drivers through targeted ergonomic solutions and policy changes.

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