

A Cross-Sectional Study of Diabetes Mellitus Profile among Bus Drivers of Surat City Depot, Gujarat, India

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Abstract:

Introduction: India is witnessing a growing burden of non-communicable diseases (NCDs), with type 2 diabetes mellitus emerging as a major public health challenge. Gujarat, with its oil- and sugar-rich diet, ranks second nationally in diabetes prevalence. Among high-risk occupational groups, professional bus drivers are particularly vulnerable due to sedentary lifestyles, poor dietary habits, and limited physical activity. **Objective:** To estimate the prevalence of diabetes among bus drivers. To determine risk factors associated with diabetes. **Methods:** This study was conducted from May to August 2023 at two major bus depots in Surat, Gujarat. Based on the NFHS-5 prevalence of diabetes and using universal sampling, a total of 321 eligible bus drivers were included. Data were collected via a pretested, semi-structured questionnaire. Data analysis was done using SPSS v26, Epi Info v3, and Excel 2019, applying univariate and bivariate analyses. **Results:** The majority were aged 31–40 years 167 (52%), belonged to socioeconomic Class 2 159 (50%), and had 0–5 years of job experience 188 (58%). About 45 (14%) reported health issues, primarily hypertension 13 (29%) and diabetes 12 (27%). Diabetes prevalence was significantly associated with education ($p < 0.001$), socioeconomic class ($p = 0.018$), and urban residence ($p = 0.04$). Diabetic drivers were older, had longer job tenures, and higher incomes ($p < 0.05$). **Conclusion:** There were significant associations between diabetes prevalence 30 (9.3%) and factors such as age, education, waist-to-hip ratio, residence, income and job tenure

Keywords: Bus drivers, Diabetes, Gujarat, Physical activity

Introduction:

India has experienced a shift in its disease patterns due to an epidemiological transition: mortality from communicable, maternal, neonatal, and nutritional diseases (CMNNDs) has significantly decreased, while non-communicable diseases (NCDs) and injuries have substantially increased their contribution to the overall disease burden and mortality.^[1] By 2021, global estimates from the Global Burden of Disease (GBD)

study indicate that non-communicable diseases accounted for approximately 63% of total disability-adjusted life years (DALYs) worldwide, while communicable, maternal, neonatal, and nutritional diseases contributed about 27% and injuries around 10%, reflecting a continued epidemiological transition toward chronic conditions.^[2] Additionally, increasing urbanization and globalization in the developing world are likely to lead to a higher prevalence of NCDs.^[3]

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Type 2 Diabetes Mellitus, which is often associated with lifestyle factors, has reached epidemic proportions. Several factors contribute to the development of diabetes, including genetics, lifestyle choices, and environmental factors. Healthcare costs associated with diabetes treatment, as well as the indirect costs related to lost productivity, are high. This can strain both national healthcare systems and individual households. Diabetes alone is responsible for 1.6 million deaths, making it the ninth leading cause of death globally.^[4]

According to a 2025 article summarizing the most recent International Diabetes Federation (IDF) “Diabetes Atlas”, India had about 89.8 million adults (age 20–79) with diabetes in 2024 - placing it among the countries with the largest diabetic adult populations worldwide.^[5]

Recognized as one of the affluent and developed states of India, Gujarat’s dietary habits—rich in oil and sugar—contribute to its high diabetes burden.^[6] It ranks second in the country for the highest number of diabetic patients, following Tamil Nadu.^[6] Although exact figures are not available, it is estimated that around 10% of Gujarat’s population, close to 50 lakhs, may have diabetes.^[6]

But beyond general population trends, professional bus drivers represent a particularly high-risk group. Health issues, particularly diabetes and its complications, can increase the risk of road accidents.^[7] Both diabetic neuropathy and retinopathy can impair muscle function and vision, and treatment side effects such as hypoglycaemia may cause increased reaction time, imbalance, and even loss of consciousness.^[8] These issues not only endanger drivers and others on the road but also lead to reduced work performance and increased absenteeism, adding to the societal financial burden.^[9]

It is crucial to address the chronic disease risk factors among drivers. They sit over three hours longer than office workers, consume unhealthy diets, and engage in minimal physical activity.^[10]

A study by Kohli P et al.^[11] revealed that 25.0% of drivers in Gujarat had visual function-threatening systemic diseases, with diabetes mellitus being the most

common pathology at 18.7%. Sudden hypoglycaemic episodes while driving have been experienced by 13 to 66% of drivers,^[11–13] and peripheral neuropathy affecting lower limb sensation further impairs their ability to control vehicle pedals.^[15]

Therefore, the present study aims to assess the burden of chronic disease and associated risk factors among drivers in order to better understand the extent of the problem and the contributing factors.

Methods:

A field based cross-sectional study was conducted from May to August 2023 at Bus Depot 1 and Depot 2, located in Sufi Baug, Mahidharpura, and Begampura areas of Surat, Gujarat.

Study Population and Sampling: A desk review identified a total of 373 bus drivers employed across both depots. Since the study population was finite and accessible, universal sampling was adopted, and all eligible drivers were approached for participation. Of these, 37 were unavailable or could not be contacted, and 15 were transferred during the study period. Therefore, data were collected from 321 bus drivers.

Inclusion Criteria: The participants were currently employed at the Surat bus depots and demonstrated a willingness to take part in the study. All eligible individuals provided informed consent prior to enrollment and agreed to undergo blood sample collection as part of the study protocol.

Exclusion Criteria: Individuals who were absent from duty or unwell during the study period were excluded. Additionally, those who could not be contacted despite three consecutive follow-up attempts through telephone calls or personal visits were also excluded from the study.

Ethics committee: ethical clearance was taken from the college ethics committee with reference number: - GMCS/ONLINE EC ID- Protocol number 720/23.

Data Collection: Data collection period was 4 months from 01/05/2023 to 30/08/2023. Following permission from depot authorities, daily lists of on-duty drivers were obtained. A minimum of five participants were

interviewed each day, covering various shifts. Data were collected using a pretested, semi-structured questionnaire capturing sociodemographic details, medical history (including diabetes and hypertension), lifestyle habits, occupational details, family history, treatment specifics, and associated costs.

Clinical Assessment: Random Blood Sugar (RBS) levels were measured using a glucometer. Diabetes was diagnosed according to the American Diabetes Association (ADA) Standards of Care 2023, using an RBS ≥ 200 mg/dL.^[16] RBS 140–199 mg/dL used as prediabetes cut off. Known and newly diagnosed diabetic individuals received counselling and were referred to the Department of Medicine at New Civil Hospital, Surat, for further management.

Socio-economic status was assessed using the Modified BG Prasad Classification, updated as per the Consumer Price Index for Industrial Workers (CPI-IW), based on the 2022 revision by Pandey et al.^[17]

Waist–Hip Ratio (WHR) was calculated by dividing waist circumference by hip circumference, and participants were classified according to WHO cut-off values. For men, a WHR of <0.90 was considered low, 0.90 – 0.99 moderate, and ≥ 1.00 high, as per the WHO Expert Consultation (2011) guidelines.

Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2), and participants were classified according to WHO criteria. Individuals with a BMI of less than 18.5 kg/m^2 were categorized as underweight, while those with a BMI between 18.5 and 24.9 kg/m^2 were considered to have normal weight. A BMI of 25.0 to 29.9 kg/m^2 was classified as overweight. Obesity was further categorized into three classes: Obese Class I (30.0 – 34.9 kg/m^2), Obese Class II (35.0 – 39.9 kg/m^2), and Obese Class III (≥ 40.0 kg/m^2), as per the WHO classification.^[18]

Physical exercise status was categorized based on the World Health Organization (WHO) recommendations for adult physical activity. Participants reporting at least 150 minutes of moderate-intensity aerobic physical activity per week, according to WHO Global Physical Activity Guidelines.^[19]

Frequency of consuming restaurant-prepared meals was assessed using a food frequency questionnaire approach commonly used in nutritional epidemiology. Participants were classified as None (no restaurant meals consumed), Occasional (infrequent consumption, less than once per week), or Regular (one or more restaurant meals per week), based on methods described in nutritional epidemiology literature.^[20]

Data Analysis: Data were entered into Microsoft Excel (2019). Descriptive statistics (frequencies and percentages) were generated using Microsoft Excel (2019). Inferential statistical analyses were performed using IBM SPSS Statistics version 26. Associations between categorical variables were analysed using the Chi-square test, while comparisons of means were performed using one-way analysis of variance (ANOVA). A 95% confidence interval was considered, and exact p-values were reported. A p-value <0.05 was considered statistically significant.

Result:

A total of 321 bus drivers from both depots in Surat participated in the study. All participants 321 (100%) were male. The largest age group was 31–40 years, representing 156 (52%) of participants, followed by 84 (26%) aged 51–60, 49 (15%) aged 41–50, and 21 (7%) aged 21–30. Half of the participants 159 (50%) belonged to Socio-economic Class 2, earning between 4,411 and 8,821 per month. Class 3 comprised 84 (26%) of participants with incomes between 2,647 and 4,410, and Class 1 included 69 (21%) with incomes above 8,822. Only 9 (3%) belonged to Class 4, earning between 1,323 and 2,646, and none fell into Class 5 (below 1,323).

The largest group of participants 188 (58%) had 0–5 years of job experience, followed by 67 (21%) with 21–25 years, 31 (10%) with 6–10 years, and 29 (8%) with over 26 years. A small proportion had 9 (3%) had 11–20 years of experience. The majority 208 (65%) slept 0–7 hours daily, while 113 (35%) slept 8–14 hours.

Most participants 276 (86%) did not report any health problems, while 45 (14%) did. Among those with health concerns, hypertension 13 (29%) and diabetes mellitus 12 (27%) were the most prevalent. Other issues, such as piles, affected 5 (11%) of participants, and 7 (15%) reported additional health concerns.

Table 1: Sociodemographic and Health-Related Profile of the Study Population (N = 321)

Variable	Participants, n (%)
Marital status	
Married	306 (95)
Unmarried	13 (4)
Separated	2 (1)
Family	
Nuclear	145 (45)
Joint	98 (31)
Third generation	78 (24)
Duty hours/week	
1-20 hours	10 (3)
21-40 hours	14 (4)
41-60 hours	218 (68)
61-80 hours	67 (20)
81-100 hours	12 (5)
Diet	
Mixed food	140 (44)
Vegetarian	181 (56)
No of tea/day	
None	24 (7)
1-5 times	279 (87)
6-10 times	18 (6)
Habit of paan	
Yes	209 (65)
No	112 (35)

Counselling was widely utilised, with 29 (88%) participants receiving counselling mainly at the time of diabetes diagnosis and during follow-up visits. The counselling was provided by healthcare professionals at government health facilities, focusing on lifestyle modification, medication adherence, and complication prevention. Awareness of diabetes-related complications was high, with 24 (73%) participants being informed, while 9 (27%) were not.

A large majority 28 (85%) purchased their medication from private sources. In addition, 31 (91%) bought medicine monthly. In terms of spending, 17 (52%) of participants spent 0-500 on medicine, 8 (24%) spent 501-1000, and 5 (15%) spent more than 1000.

Most participants 27 (87%) used private facilities for medical investigations. Additionally, 21 (68%) undergoing monthly tests, 6 (19%) every three months, 1 (3%) every six months, and 2 (6%) irregularly. The

majority 23 (77%) spent 0-500 on investigations, while 3 (10%) spent 501-1000, and 4 (13%) reported no costs.

Most participants 17 (85%) had been undergoing treatment for 0-7 years, 3 (15%) for 8-14 years.

Table 1 summarizes the majority of participants were married 306 (95%) and lived in nuclear families 145 (45%). Most reported working 41-60 hours per week 218 (67%). Dietary habits showed 181 (56%) were vegetarians, and 279 (87%) consumed tea 1-5 times daily. A significant portion 209 (65%) had a habit of chewing paan.

Among the study participants with known diabetes mellitus, the majority had a duration of illness of 0-7 years 17 (85%), while only 3 (15%) reported a duration of 8-14 years. Most participants were on oral hypoglycaemic agents 19 (95%), with a small proportion using Ayurvedic treatment 1 (5%). Treatment discontinuation was reported by nearly one-fourth of participants 5 (25%), whereas 15 (75%) were continuing treatment regularly. A family history of disease was present in 7 (35%) of participants, while 17 (65%) reported no such history. Only 4 (20%) of participants had Mediclaim coverage, and a large majority 16 (80%) were not covered by any health insurance.

In Table 2 a statistically significant association was observed between diabetes status and participants education level ($\chi^2=31.684$, $p<0.001$) and their work/housing class ($\chi^2=11.87$, $p=0.018$). Similarly, residence type showed a significant association with diabetes ($\chi^2=6.29$, $p=0.04$), with urban participants showing higher prevalence. However, lifestyle factors such as alcohol consumption ($\chi^2=2.72$, $p=0.25$), smoking ($\chi^2=2.83$, $p=0.24$), and paan chewing ($\chi^2=0.37$, $p=0.83$) did not show statistically significant associations.

Table 3 shows no statistically significant associations were found between diabetes status and sleeping time ($\chi^2=8.45$, $p=0.07$), BMI classification ($\chi^2=14.92$, $p=0.135$), physical exercise ($\chi^2=1.38$, $p=0.50$), or frequency of restaurant meals ($\chi^2=4.04$, $p=0.40$). Although higher proportion of diabetes observed among obese individuals and those with sedentary lifestyles, however, these differences did not attain statistical significance.

Table 2: Association Between Sociodemographic and Behavioural Correlates with Diabetes Status Among Participants (N = 321)

Variable	Disease			χ^2 value, p-value
	DM (30) n (%)	Normal (256) n (%)	Pre-DM (35) n (%)	
Education				
Primary education	8 (27.6)	16 (55.2)	5 (17.2)	31.684, <0.001
Secondary education	13 (14.0)	65 (69.9)	15 (16.1)	
Higher Secondary education	9 (6.7)	113 (84.3)	12 (9.0)	
Graduation	0 (0.0)	52 (94.5)	3 (5.5)	
Post-Graduation	0 (0.0)	10 (100.0)	0 (0.0)	
W/H Class				
High	13 (17.6)	55 (74.3)	6 (8.1)	11.87, 0.018
Low	10 (5.6)	152 (84.4)	18 (10.0)	
Moderate	7 (10.4)	49 (73.1)	11 (16.4)	
Residence				
Rural	14 (6.6)	177 (83.1)	22 (10.3)	6.29, 0.04
Urban	16 (14.8)	79 (73.1)	13 (12.0)	
Drinking (alcohol)				
Yes	9 (13.6)	48 (72.7)	9 (13.6)	2.72, 0.25
No	21 (8.2)	208 (81.6)	26 (10.2)	
Smoking				
Yes	5 (17.2)	20 (69.0)	4 (13.8)	2.83, 0.24
No	25 (8.6)	236 (80.8)	31 (10.6)	
Paan chewing				
Yes	21 (10.0)	165 (78.9)	23 (11.0)	0.37, 0.83
No	9 (8.0)	91 (81.3)	12 (10.7)	

Note. (χ^2 = chi-square value, W/H= WAIST / HIP Ratio, DM= Diabetes Mellitus)

Table 3: Association of Sleep Pattern, BMI, and Lifestyle Behaviours with Diabetes Status Among Study Participants (N = 321)

Variable	Disease			χ^2 value, p-value
	DM (30) n (%)	Normal (256) n (%)	Pre-DM (35) n (%)	
Sleeping time				
Day	1 (1.4)	63 (88.7)	7 (9.9)	8.45, 0.07
Night	29 (11.8)	190 (77.2)	27 (11.0)	
Not defined	0 (0.0)	3 (75.0)	1 (25.0)	
BMI class				
Normal	10 (6.0)	141 (84.9)	15 (9.0)	14.92, 0.135
Obese 1	5 (20.0)	18 (72.0)	2 (8.0)	
Obese 2	0 (0.0)	3 (75.0)	1 (25.0)	
Obese 3	0 (0.0)	2 (66.7)	1 (33.3)	
Overweight	14 (14.3)	70 (71.4)	14 (14.3)	
Underweight	1 (4.0)	22 (88.0)	2 (8.0)	
Physical exercise				
Yes	4 (12.5)	23 (71.9)	5 (15.6)	1.38, 0.5
No	26 (9.0)	233 (80.6)	30 (10.4)	
Restaurant's meal				
None	18 (12.7)	107 (75.4)	17 (12.0)	4.04, 0.4
Occasional	4 (8.0)	41 (82.0)	5 (10.0)	
Regular	8 (6.2)	108 (83.7)	13 (10.1)	

Note. χ^2 = chi-square value, BMI= Body Mass Index, DM= Diabetes Mellitus

Table 4: Association of Age, Income, Job Duration, and Medical Expenditures with Diabetes Status (N = 321)

Variables	Normal (256) (Mean ±SD)	Pre-DM (35) (Mean ±SD)	DM (30) (Mean ±SD)	f-value	P-value
Age (years)	39.9±8.4	45.5±8.4	49.5±8.5	22.134	.000
Per-capita income	6734±8618	7723±4251	9223±8130	3.129	.045
Driver job (years)	7.5±9.4	13.3±10.4	19.2±9.1	24.267	.000

(DM= Diabetes Mellitus)

In Table 4, a significant difference was observed in the mean age across the three glycaemic groups, with diabetic participants being older (Mean = 49.5 years) compared to pre-diabetic (45.5 years) and normal individuals (39.9 years) ($F=22.134$, $p=0.000$). Driver job duration also showed a significant increasing trend with glycaemic status ($F=24.267$, $p=0.000$), indicating longer job tenure among diabetic individuals. Per-capita income differed significantly across groups ($F=3.129$, $p=0.045$), with higher income seen among diabetics.

Discussion:

Present study demonstrates a significant association between educational level and diabetic status ($p < 0.001$), emphasizing the role of education in chronic disease prevention and the need for targeted health education interventions. In contrast, Kamal Batcha Mohamed Ali et al.^[18] found no significant association between education and diabetes ($p = 0.998$).

A statistically significant association was observed between waist-to-hip (W/H) ratio classification and diabetic status ($p < 0.05$), suggesting its potential utility as a predictor for cardiometabolic risk. These findings align with those of Gadekar R D et al.^[19] who also reported a significant association between W/H ratio and diabetes ($p < 0.001$).

A significant association was found between place of residence and diabetic status ($p < 0.05$), indicating the need for location-specific public health strategies to curb the diabetes burden. These findings are consistent with those of Mohamed Ali Kamal et al.^[18] who reported a significant association between residence and diabetes ($p = 0.010$).

Although tea intake is often associated with added

sugar consumption, and paan use is linked to tobacco exposure, both of which are known to influence glycaemic control and increase the risk of diabetes-related complications. But no significant associations were observed between lifestyle habits drinking ($p = 0.25$), smoking ($p = 0.24$), tea consumption ($p = 0.423$) and paan/tobacco use ($p = 0.83$) and diabetic status, suggesting these behaviours may not play a major role in diabetes risk within the studied population. These findings align with studies by D. Suresh Kumar et al.^[23] and Mohamed Ali Kamal et al.^[18] who also found no significant links between diabetes and these behaviours.

Sleep patterns did not show a significant association with diabetic status ($p = 0.07$), suggesting that sleep behaviour may not be independently associated with diabetes status in this population. Additionally, no significant difference was found in daytime sleep hours across groups ($p = 0.695$). These findings are consistent with Sravanthi G et al.^[21] who also reported no significant associations between sleep patterns and diabetes ($p = 0.327$).

BMI classification did not show a significant association with diabetes ($p = 0.135$), though trends were noted. However, Gadekar R D et al.^[19] reported a significant association between BMI and diabetes ($p < 0.01$), which was not observed in our study.

Physical exercise showed no significant association with diabetic status ($p = 0.50$). These findings are supported by Sravanthi G et al.^[21] who found no significant relationship between physical exercise and diabetes ($p = 0.809$).

The frequency of dining out showed no significant association with diabetic status ($p = 0.40$).

The analysis reveals a strong positive association

between increasing age and diabetes ($p < 0.001$), indicating that age is a major risk factor for both conditions. These findings are consistent with studies by D. Suresh Kumar et al.^[20] who reported a significant association between age and diabetes ($p < 0.001$).

A significant association was also observed between higher income levels and diabetes ($p < 0.05$), suggesting income may influence diabetes risk. These results differ from Tamilarasan M et al.^[22] who found no significant association between income and diabetes ($p = 0.103$).

No significant differences in healthcare costs were observed across diabetic groups ($p = 0.829$) indicating that disease-related expenses were relatively similar across categories.

Finally, a significant association was found between years spent in the driver profession and diabetes ($p < 0.001$), pointing to occupational exposure as a potential contributing factor. In contrast Mohamed Ali Kamal et al.^[18] reported no significant link between job duration and diabetes ($p = 0.053$).

Limitation:

The cross-sectional design limits the ability to assess changes in health outcomes over time and about causal relationships between risk factors and health conditions. Diabetes screening was conducted using only Random Blood Sugar (RBS) tests, laboratory tests like HbA1c or lipid profile assessments was not done.

Conclusion:

The prevalence of diabetes among the 321 male bus drivers assessed, the prevalence of diabetes was 30 (10%). Several socio-demographic and occupational variables showed statistically significant associations with diabetes status. Diabetes was more common among older drivers and those with lower educational attainment, higher waist-to-hip ratios, urban residence, higher income, and longer duration of employment, underscoring the influence of socio-demographic factors, central obesity, and occupational exposure.

Lifestyle and behavioural factors such as alcohol use, smoking, paan/tobacco consumption, physical activity, body mass index, sleep duration, and frequency of dining out were not independently associated with

diabetes in the present study. Although diabetes appeared more common among obese and physically inactive drivers, these associations were not statistically meaningful.

Recommendation:

Based on the observed prevalence of diabetes among bus drivers, routine screening and periodic health check-ups are recommended to ensure early detection and timely management. Drivers with higher age, lower education, central obesity, urban residence, and longer job tenure should be prioritized for targeted health education and lifestyle modification programs. Workplace interventions promoting physical activity and reducing sedentary behaviours are recommended to address key metabolic risks. Further studies with larger samples are needed to explore lifestyle factors that were not statistically significant in this study.

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Conflict of Interest: Nil

AI: AI-based language tools were used exclusively to enhance grammar and clarity; all analyses, interpretations, and conclusions are solely those of the authors.

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