Research Article

Road Safety Knowledge and Behaviour Among Young Drivers in a Semi-Urban Indian Setting: A Cross-Sectional Analysis of Undergraduate Medical Students

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Background: Road traffic injuries are a major public health concern, particularly among young adults. India accounts for a substantial proportion of global road traffic deaths despite having a relatively smaller share of the world's vehicles. Limited evidence exists regarding road safety awareness and driving practices among medical students in semi-urban India.

Methods: A descriptive cross-sectional study was conducted among 500 undergraduate medical students at a tertiary care teaching hospital in Saifai Block, Etawah, Uttar Pradesh, between September and October 2023. Census sampling was used to include consenting students with driving experience. Data were collected using a pre-tested self-administered questionnaire assessing sociodemographic characteristics, road safety awareness, and driving practices. Awareness and practice scores were categorized as good or poor using the mean score as the cut-off. Associations were assessed using chi-square tests, and multivariable logistic regression was performed to identify independent predictors of good awareness and practice.

Results: Of the 500 participants, 78.6% were aged 18–24 years, 69.2% were male, and 92.2% were two-wheeler users. Good road safety awareness was observed among 52.2% (95% CI: 47.8–56.6%) of participants, while 71.8% (95% CI: 67.9–75.7%) demonstrated good road safety practices. In multivariable analysis, male participants had significantly higher odds of good awareness than females (AOR = 3.04, 95% CI: 2.00–4.61), while four-wheeler users also demonstrated higher odds of good awareness (AOR = 2.26, 95% CI: 1.10–4.68). Participants aged 18–24 years had lower odds of good road safety practices than those aged >24 years (AOR = 0.56, 95% CI: 0.33–0.97). Human error was identified as the most commonly perceived cause of road traffic accidents.

Conclusion: Road safety awareness and practices among undergraduate medical students were associated with demographic and vehicle-related factors. The findings highlight the importance of targeted road safety education and behavioural interventions, particularly for younger drivers. Strengthening road safety promotion within medical institutions may contribute to safer driving practices among future healthcare professionals.

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Introduction

Road traffic injuries (RTIs) represent one of the most pressing and preventable public health challenges of the 21st century. Globally, approximately 1.19 million people die each year as a result of road traffic crashes, making RTIs the leading cause of death among individuals aged 5 to 29 years worldwide.[1] Low- and middle-income countries (LMICs) bear a disproportionate burden of this mortality, accounting for more than 90% of global road traffic deaths despite owning less than 60% of the world's vehicles.[2] The economic cost of road traffic crashes is estimated at approximately 3% of gross domestic product in most countries, translating to hundreds of billions of dollars in lost productivity, healthcare expenditure, and family welfare annually.[3]

India presents a particularly acute case. According to the Ministry of Road Transport and Highways (MoRTH), India recorded over 461,000 road accidents in

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2022, resulting in more than 168,000 deaths, averaging approximately 461 deaths per day.[4] This positions India as one of the countries with the highest absolute road traffic fatality burdens globally. The WHO South-East Asia Region, of which India is a part, accounts for 73% of all RTAs in the region, with India contributing disproportionately.[5] A critical demographic vulnerability is the productive age group of 18 to 45 years, which accounts for nearly 67% of all RTA fatalities in India, representing a catastrophic loss of human capital.[4]

Young drivers, broadly defined as those between 18 and 25 years, are recognised internationally as a high-risk group for RTAs due to a combination of limited driving experience, risk-taking behaviour, and incomplete neurological development of impulse-control pathways.[6] Contributing behavioural factors include non-use of helmets and seatbelts, speeding, driving under the influence of alcohol, and distracted driving (particularly mobile phone use).[7,8] In India, these behaviours are compounded by structural factors including poor road infrastructure, inadequate enforcement of traffic laws, and insufficient driver education.[9]

Undergraduate medical students represent a unique and strategically important population for road safety research. As future health professionals, they possess the potential to function as credible agents of behavioural change within their communities. At the same time, as young adults are primarily reliant on two-wheelers for transportation in semi-urban settings, they are themselves exposed to significant road safety risks. Despite this dual relevance, published data specifically examining road safety awareness and practice in this population within northern India remain limited. Most existing Indian studies are either hospital-based RTA audits or broad community surveys, and few have examined the within-group demographic determinants of road safety behaviour.[10,11]

The present study was therefore designed to address this gap. The objectives were: (i) to assess the level of awareness of road safety rules and the quality of self-reported driving practices among undergraduate medical students in a semi-urban area of Etawah District, Uttar Pradesh; (ii) to identify demographic factors (age, gender, vehicle type) significantly associated with awareness and practice scores; and (iii) to document participants' perceptions of the primary causes of road traffic accidents.

Methods

Study Design and Setting

This descriptive cross-sectional study was conducted at Uttar Pradesh University of Medical Sciences (UPUMS), a tertiary care teaching institution located in Saifai Block, Etawah District, Uttar Pradesh, India. The study was conducted over a two-month period, from September to October 2023. Etawah District represents a semi-urban administrative area with mixed rural-urban characteristics, providing an ecologically relevant setting for studying road safety in the Indian context.

Study Population and Eligibility Criteria

The target population comprised undergraduate (MBBS) medical students enrolled across all four academic years (first through final year). Eligible participants were required to (a) possess self-reported driving experience with two-wheelers, four-wheelers, or both, and (b) provide written informed consent prior to enrolment. Students who had never driven any motor vehicle or who declined consent were excluded. No age restrictions were applied beyond the standard MBBS admission age requirements.

Sample Size and Sampling Strategy

The total enrolled undergraduate student population at the time of the study was 800 (approximately 200 per academic year). Given the relatively small, enumerable study population, a census (universal) sampling approach was adopted; all eligible students meeting the inclusion criteria were invited to participate. Of 800 students, 500 consented and fulfilled the eligibility criteria, yielding a participation rate of 62.5%. This sample size was sufficient to detect a prevalence of good awareness of 50% with a 95% confidence interval and a margin of error of ± 4.4%, using the standard formula $n = z^2p(1-p)/d^2$.

Data Collection

Data were collected using a pre-tested, semi-structured, self-administered questionnaire distributed via Google Forms. The questionnaire comprised three sections:

Section I — Sociodemographic Profile

Age (in years), gender (male/female), and type of vehicle driven (two-wheeler/four-wheeler).

Section II — Awareness of Road Safety Rules

A series of multiple-choice items assessing knowledge of traffic signals, permissible blood alcohol concentration limits, speed regulations, licensing age requirements, and mandatory safety equipment.

Section III — Road Safety Practices

Questions capturing self-reported behaviour, including helmet and seatbelt use, mobile phone use while driving, adherence to speed limits, and alcohol use before driving.

A separate item captured participants' perceptions of the primary cause of road traffic accidents, with response options including: human error, lack of driver training or education, poor road conditions, adverse weather, and collision with animals.

The questionnaire was developed based on a review of previously published literature and was pre-tested for clarity and comprehensibility among a small group of students. Formal psychometric validation and reliability testing were not performed, which should be considered a limitation.

Scoring and Operational Definitions

Each correct response in Sections II and III was awarded one point; incorrect or missing responses were scored zero. An aggregate awareness score and an aggregate practice score were calculated for each participant. Participants scoring at or above the mean were classified as having 'good' awareness or practice; those scoring below the mean were classified as 'poor.' The mean score was selected as a pragmatic approach to categorise participants in the absence of previously validated cut-off values for the study instrument.

Statistical Analysis

Data were entered and cleaned in Microsoft Excel (version 2019) and analysed using SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY). Descriptive statistics frequency and percentage were computed for all sociodemographic variables and for categorical awareness and practice scores. The association between each demographic variable (age group, gender, vehicle type) and the dichotomised awareness or practice score was assessed using the Pearson chi-square (χ^2) test with the appropriate degrees of freedom. Significance was set at $p < 0.05$. Where applicable, results are presented with χ^2 statistics, degrees of freedom, and *p-values*. Prevalence estimates and logistic regression results were reported with 95% confidence intervals.

Ethical Considerations

The study protocol was reviewed by the Institutional Ethics Committee of UPUMS, Saifai, and exemption from ethical review was granted. Written informed consent was obtained from all participants prior to enrolment. Participation was entirely voluntary; students who declined were not penalised in any manner. All data were anonymised at the point of collection, stored on a password-protected server, and accessed only by the research team. The study was conducted in accordance with the Declaration of Helsinki (2013 revision) and the Indian Council of Medical Research (ICMR) National Ethical Guidelines for Biomedical and Health Research Involving Human Participants (2017).

Results

Sociodemographic Characteristics of Participants

A total of 500 undergraduate medical students participated in the study. Most participants belonged to the 18 to 24 years age group (78.6%), while 21.4% were aged 25 to 44 years. Male participants constituted 69.2% of the sample, and females accounted for 30.8%. Regarding vehicle usage, 92.2% reported using two-wheelers, while 7.8% used four-wheelers (Table 1).

Overall, 261 participants demonstrated good awareness regarding road safety practices, yielding a prevalence of 52.2% (95% CI: 47.8–56.6%). Good road safety practices were observed among 359 participants, corresponding to a prevalence of 71.8% (95% CI: 67.9–75.7%). Participants perceived human error emerged as the leading cause of road traffic accidents, followed by lack of training or education (Figure 1).

Factors Associated with Road Safety Awareness

Road safety awareness was significantly associated with age group and gender. Participants aged 25 to 44 years demonstrated a higher proportion of good awareness compared with those aged 18 to 24 years (61.7 *vs.* 49.6%, $p = 0.027$). Male participants exhibited significantly higher awareness levels than female participants (60.4 *vs.* 33.8%, $p < 0.001$). Vehicle type was not significantly associated with awareness scores ($p = 0.060$) (Table 2).

Factors Associated with Road Safety Practices

Road safety practice scores differed significantly according to age group. Participants aged >24 years

Table 1: Sociodemographic Characteristics of Study Participants (N = 500)

Variable	*Category*	*Frequency (n)*	*Percentage (%)*
Age Group	18–24 years	393	78.6
	>24 years	107	21.4
Gender	Male	346	69.2
	Female	154	30.8
Vehicle Type	Four-wheeler	39	7.8
	Two-wheeler	461	92.2

Table 2: Association between road safety awareness and sociodemographic variables

Variable	*Category*	*Poor awareness n (%)*	*Good awareness n (%)*	χ^2	*p-value*
Age group	18–24 years	198 (50.4)	195 (49.6)	4.906	0.027
	>24 years	41 (38.3)	66 (61.7)		
Gender	Male	137 (39.6)	209 (60.4)	30.307	<0.001
	Female	102 (66.2)	52 (33.8)		
Vehicle type	Four-wheeler	13 (33.3)	26 (66.7)	3.548	0.060
	Two-wheeler	226 (49.0)	235 (51.0)		

Table 3: Association between road safety practices and sociodemographic variables

Variable	*Category*	*Poor practice n (%)*	*Good practice n (%)*	χ^2	*p-value*
Age group	18–24 years	120 (30.5)	273 (69.5)	4.942	0.026
	>24 years	21 (19.6)	86 (80.4)		
Gender	Male	89 (25.7)	257 (74.3)	3.405	0.065
	Female	52 (33.8)	102 (66.2)		
Vehicle type	Four-wheeler	16 (41.0)	23 (59.0)	3.437	0.064
	Two-wheeler	125 (27.1)	336 (72.9)		

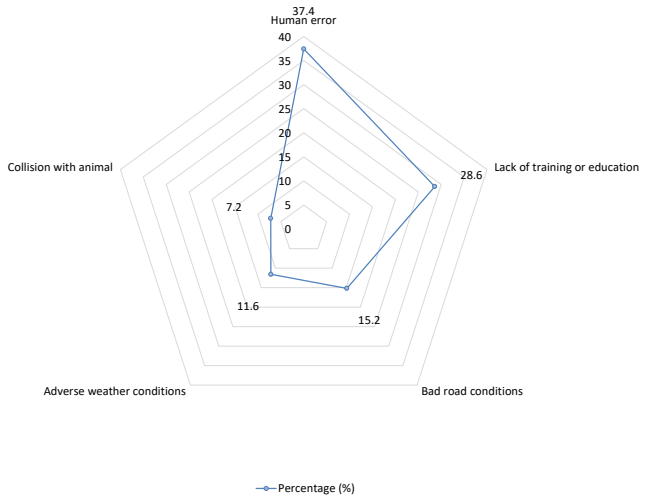

Figure 1: Perceived primary causes of road traffic accidents among undergraduate medical students

demonstrated a higher prevalence of good practices compared with those aged 18 to 24 years (80.4% *vs.* 69.5%, $p = 0.026$). No statistically significant associations were observed between practice scores and gender ($p = 0.065$) or vehicle type ($p = 0.064$) (Table 3). The overall distribution of participants with good and poor road safety awareness and practice is presented in Figure 2.

Multivariable Logistic Regression Analysis for Road Safety Awareness

A multivariable logistic regression model was developed to identify independent predictors of good road safety awareness. The overall model was statistically significant

Table 4: Multivariable logistic regression analysis of factors associated with good road safety awareness

Variable	*AOR*	*95% CI*	*p-value*
Male vs Female	3.04	2.00–4.61	<0.001
Age 18–24 vs >24 years	0.88	0.55–1.40	0.589
Four-wheeler vs Two-wheeler	2.26	1.10–4.68	0.027

(Omnibus $\chi^2 = 36.454$, $p < 0.001$), explaining 9.4% of the variance in awareness scores (Nagelkerke $R^2 = 0.094$). The Hosmer–Lemeshow test indicated good model fit ($\chi^2 = 1.584$, $p = 0.453$).

After adjustment for age and vehicle type, male participants had significantly higher odds of demonstrating good awareness than females (AOR = 3.04, 95% CI: 2.00–4.61, $p < 0.001$). Four-wheeler users had higher odds of good awareness compared with two-wheeler users (AOR = 2.26, 95% CI: 1.10–4.68, $p = 0.027$). Age was not independently associated with awareness after adjustment (Table 4).

Multivariable Logistic Regression Analysis for Road Safety Practices

A second logistic regression model was performed to determine predictors of good road safety practices. The model was statistically significant (Omnibus $\chi^2 = 10.645$, $p = 0.014$) and explained 3.0% of the variance in practice scores (Nagelkerke $R^2 = 0.030$). The Hosmer–Lemeshow goodness-of-fit test indicated an adequate model fit ($\chi^2 = 1.891$, $p = 0.595$).

Participants aged 18–24 years had significantly lower odds of demonstrating good road safety practices

Table 5: Multivariable logistic regression analysis of factors associated with good road safety practices

Variable	AOR	95% CI	*p-value*
Male *vs* Female	1.27	0.83–1.95	0.276
Age 18–24 *vs* >24 years	0.56	0.33–0.97	0.040
Four-wheeler *vs* Two-wheeler	0.50	0.25–0.99	0.047

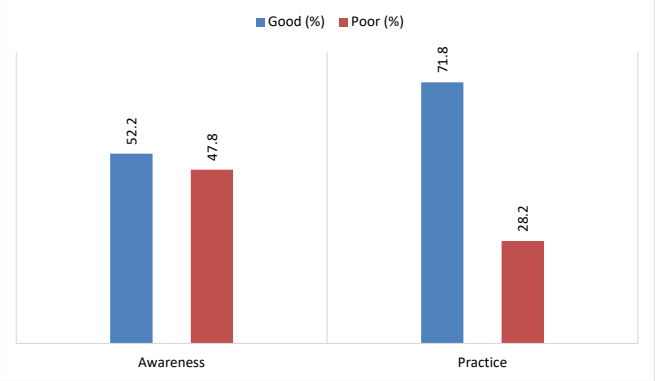

Figure 2: Distribution of good and poor road safety awareness and practice scores among undergraduate medical students (N = 500)

compared with those aged >24 years (AOR = 0.56, 95% CI: 0.33–0.97, $p = 0.040$). Similarly, four-wheeler users had lower odds of good practice scores than two-wheeler users (AOR = 0.50, 95% CI: 0.25–0.99, $p = 0.047$). Gender was not independently associated with practice scores (Table 5).

Discussion

This cross-sectional study assessed road safety awareness and self-reported safety practices among 500 undergraduate medical students in a semi-urban district of Uttar Pradesh, India. Overall, 52.2% of participants demonstrated good road safety awareness, while 71.8% reported good road safety practices. The findings indicate that awareness and practice are influenced by demographic and vehicle-related factors, although the strength of these associations varied after adjustment in multivariable analysis.

Overall Awareness and Practice

In the present study, slightly more than half of the participants demonstrated good road safety awareness, whereas nearly three-quarters reported good road safety practices. The awareness level observed in our study is broadly comparable with findings from previous Indian studies conducted among students and young adults. Trivedi *et al.*[12] reported good awareness among approximately 60% of participants, while Jothula and Sreeharshika[13] found substantial awareness of key traffic regulations among college students in Telangana. Although awareness levels were moderate, the relatively higher prevalence of good practices suggests that behavioural compliance may occur even in the absence of comprehensive knowledge of all road safety regulations.

Age and Road Safety Awareness and Practices

Age demonstrated a significant association with both awareness and practice scores in unadjusted analysis. Participants aged >24 years exhibited higher levels of awareness and better safety practices compared with those aged 18–24 years. This observation may be related to greater driving experience, increased exposure to traffic environments, and more frequent interaction with road safety regulations among older individuals.

However, after adjustment for gender and vehicle type, age was no longer independently associated with awareness. In contrast, age remained a significant predictor of safety practices, with participants aged 18–24 years showing lower odds of good practice scores than those aged >24 years. These findings suggest that while age-related differences in awareness may be partly explained by other demographic factors, practical road safety behaviours may continue to improve with increasing age and driving experience.

Gender Differences in Road Safety Awareness

A significant gender difference was observed in road safety awareness, with male participants demonstrating higher awareness levels than female participants. This finding remained significant after multivariable adjustment, with males having approximately three times higher odds of good awareness than females. Similar observations have been reported in previous studies from India, where male respondents often reported greater familiarity with traffic regulations and driving-related issues.[16]

One possible explanation is that male students may have greater exposure to independent vehicle use and driving experiences, which could increase familiarity with road safety rules. However, the present study did not directly assess driving frequency or exposure, and therefore this interpretation should be viewed cautiously. Notably, gender was not independently associated with safety practices, suggesting that awareness differences do not necessarily translate into differences in reported road safety behaviours.

Vehicle Type and Road Safety Behaviour

Vehicle type showed differing relationships with awareness and practice outcomes. In multivariable

analysis, four-wheeler users demonstrated higher odds of good awareness compared with two-wheeler users. This may reflect greater exposure to licensing procedures, traffic regulations, and formal driver training among four-wheeler users. Nevertheless, the relatively small number of four-wheeler users in the study should be considered when interpreting this finding.

Interestingly, four-wheeler users demonstrated lower odds of good practice scores than two-wheeler users after adjustment. One possible explanation is that two-wheeler riders may perceive themselves as more vulnerable on the road and therefore adopt safer behaviours. Alternatively, the finding may reflect differences in driving patterns, frequency of vehicle use, or exposure to traffic risks that were not measured in the present study. Further studies incorporating objective behavioural measures would be useful to better understand these associations.

Mobile Phone Use While Driving

A substantial proportion of participants reported that they did not use mobile phones while driving. This finding differs from reports from several community-based studies conducted in India, where mobile phone use while driving has been more common.[19] The difference may be related to the medical student population studied, which may possess greater awareness of injury risks and health consequences. However, because the data were self-reported, the possibility of social desirability bias cannot be excluded. Future studies employing direct observation or digital monitoring methods may provide more accurate estimates of distracted driving behaviours.

Perceived Causes of Road Traffic Accidents

Human error was identified as the most commonly perceived cause of road traffic accidents, followed by lack of training or education. These findings are consistent with the broader literature, which highlights human behavioural factors as major contributors to road traffic injuries. Participants may therefore recognise the importance of behavioural factors such as compliance with traffic regulations, attentiveness while driving, and responsible road use. Such perceptions are encouraging because they indicate awareness that many road traffic injuries may be preventable through behavioural and educational interventions.

Overall, the findings suggest that targeted road safety initiatives among medical students should focus not only on improving awareness but also on strengthening safe driving practices, particularly among younger students. Educational programmes incorporating practical demonstrations, behavioural training, and reinforcement of safe driving habits may contribute to improved road safety outcomes in this population.

Conclusion

This study found that road safety awareness and practices among undergraduate medical students were influenced by several demographic and vehicle-related factors. While just over half of the participants demonstrated good road safety awareness, a substantially larger proportion reported good road safety practices. Male students had significantly higher odds of demonstrating good road safety awareness, whereas participants aged >24 years exhibited better road safety practices than their younger counterparts. Vehicle type was also independently associated with both awareness and practice outcomes.

Human error was identified as the most commonly perceived cause of road traffic accidents, highlighting the importance of behavioural factors in road safety. This finding supports the need for educational and behavioural interventions aimed at improving compliance with traffic regulations and promoting safer road use.

Medical institutions are well positioned to strengthen road safety knowledge and encourage safe driving behaviours through structured educational initiatives, awareness campaigns, and integration of road safety concepts into student training programmes. Particular attention may be warranted for younger students, who demonstrated comparatively lower practice scores.

The findings should be interpreted in light of certain limitations, including the cross-sectional design, reliance on self-reported data, and the conduct of the study within a single medical institution, which may limit generalisability. Future multicentric studies employing prospective designs and objective measures of driving behaviour would help to better understand the determinants of road safety awareness and practices among young adults and support the development of evidence-based road safety interventions.

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