



EXPLORING THE ROAD SAFETY MEASURES AND BEHAVIORAL PATTERNS AMONG MEDICAL STUDENTS IN PERAMBALUR DISTRICT, TAMIL NADU: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Road traffic accidents (RTAs) are a major public health concern, particularly among young adults. Despite increasing awareness, unsafe driving practices remain prevalent. This study assessed the knowledge, attitude, and practices (KAP) regarding road safety and their determinants among medical students in Perambalur district, Tamil Nadu.

Materials and Methods: An institution-based cross-sectional study was conducted among 507 MBBS students using stratified random sampling. Data were collected through a pre-tested, validated questionnaire assessing sociodemographic characteristics and KAP on road safety. Descriptive statistics were used to summarize the data. Associations were analyzed using Chi-square tests, and independent predictors were identified using binary logistic regression. A p-value <0.05 was considered statistically significant.

Results: The mean age of participants was 21.4 ± 1.7 years, with females comprising 67.7%. Adequate knowledge was observed in 48.5% of participants, while 72.4% demonstrated a positive attitude, and 59.2% exhibited good practices. Gender, year of study, driving experience, and method of learning to drive were significantly associated with all domains ($p < 0.05$). Male gender was associated with higher odds of good knowledge (AOR = 1.72), positive attitude (AOR = 1.69), and good practice (AOR = 1.64). Driving experience >1 year (AOR = 4.12) and formal training (AOR = 2.15) were strong predictors of good practices.

Conclusion: Although attitudes toward road safety were favorable, gaps persist in knowledge and practices. Experience and structured training play a key role in promoting safe behaviors, highlighting the need for targeted interventions.

Keywords: Road Safety, Medical Students, Road Traffic Accidents, Behavioral Patterns.

INTRODUCTION

Road traffic accidents (RTAs) are a major global public health concern, particularly among young adults aged 18–29 years, who are disproportionately affected due to risk-taking behavior and inadequate compliance with safety measures [1]. According to the World Health Organization, RTAs account for approximately 1.19 million deaths annually, with more than 90% occurring in low- and middle-income countries [2].

In India, RTAs are a leading cause of mortality among individuals aged 15–44 years, with over 1.5 lakh deaths reported in 2022 [3]. Contributing factors include poor adherence to traffic regulations, lack of awareness, and infrastructural challenges [3]. Although legislative measures such as the Motor Vehicles (Amendment) Act, 2019, have been implemented, compliance with safety practices like helmet and seat belt use remains inconsistent [4,5]. Medical students represent a critical subgroup, expected to model health-promoting behaviors. However, studies across India and other countries have reported gaps in road safety practices among medical students, including unsafe behaviors such as speeding, mobile phone use, and poor helmet compliance [6–14]. These findings highlight that knowledge alone may not translate into safe



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practices. With this background, the present study was conducted to assess the knowledge, attitude, and practices regarding road safety and to identify the associated determinants among medical students in Perambalur district, Tamil Nadu

MATERIALS AND METHODS

This institution-based cross-sectional study was conducted among MBBS students of a tertiary care teaching hospital in Perambalur district, Tamil Nadu. All willing students from the first year to the Compulsory Rotatory Medical Internship (CRMI) were included in the study. The sample size was calculated using the formula $n = Z^2pq/d^2$, assuming a 95% confidence level, 80% power, 5% precision error, and a prevalence of 58.3% for adequate knowledge on road safety based on a previous study by Jothula et al. [12]. After accounting for a 30% non-response rate, the final sample size was estimated to be 507. A total of 507 participants were included in the study.

Participants were selected using a systematic random sampling technique. To ensure proportional representation, approximately 20% of students were selected from each academic year. Data was collected using a pre-tested, semi-structured, and validated questionnaire administered by the principal investigator. The questionnaire consisted of four sections: sociodemographic details, knowledge, attitude, and practice (KAP) related to road safety. The knowledge section comprised 16 items, including the identification of six traffic signs and questions on road safety rules and regulations. The attitude section included 8 statements measured on a Likert scale, and the practice section consisted of 12 items assessing safe driving behaviors, along with 6 additional questions evaluating risk-related behaviors such as distractions while driving. The internal consistency of the questionnaire was assessed using Cronbach's alpha coefficient, which was found to be 0.78, indicating acceptable reliability.

Each correct response in the knowledge domain was awarded one mark, and incorrect responses were scored as zero. For the attitude domain, responses were dichotomized into positive and negative attitudes after appropriate reverse coding of negatively worded statements. Practice items were similarly categorized into safe and unsafe behaviors, with reverse coding applied where necessary.

Composite scores were calculated separately for knowledge, attitude, and practice domains. Participants scoring $\geq 50\%$ of the total score in each domain were classified as having adequate knowledge, positive attitude, and good practice, respectively, while those scoring $< 50\%$ were categorized as having poor knowledge, negative attitude, and poor practice. Participants scoring

$\geq 50\%$ of the total score in each domain were classified based on previously adopted cut-offs in Juthula et al. [12]

Data were entered into Microsoft Excel (Microsoft Corp., USA), coded, and analyzed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as frequencies, percentages, and mean \pm standard deviation.

Inferential statistics were performed using Pearson's Chi-square test or Fisher's exact test, as appropriate, to assess associations between categorical variables. Variables with $p < 0.05$ in bivariate analysis were included in binary logistic regression to identify independent predictors of knowledge, attitude, and practice. Adjusted odds ratios (AOR) with 95% confidence intervals were calculated. A p -value < 0.05 was considered statistically significant.

Ethical approval was obtained from the Institutional Ethics Committee (IEC No. IECHS/IRCHS/No. 557, dated August 6, 2024). Written informed consent was obtained from all participants before data collection.

RESULTS

A total of 507 participants were included in the study. The mean age of participants was 21.4 ± 1.7 years, and 343 (67.7%) were females [Table 1]. The history of road traffic accidents (RTAs) was reported by 132 (26.1%) participants. Among them, 11 (8.3%) reported three or more accidents. Minor injuries were reported in 113 (85.6%) participants, whereas 16 (12.1%) sustained major injuries such as fractures or head injuries [Table 2]. Awareness regarding the legal age for obtaining a major driving license was high (490; 96.6%), whereas only 202 (39.8%) participants correctly identified the legal age for obtaining a minor driving license. Knowledge regarding imprisonment and fines related to traffic violations was reported by 204 (40.2%) and 241 (47.5%) participants, respectively. Overall, 246 (48.5%) participants demonstrated adequate knowledge regarding road safety [Table 3]. A positive attitude toward possessing a valid driving license was observed among 487 (96.1%) participants. Only 244 (48.1%) participants demonstrated a positive attitude toward seat belt use [Table 5]. Regarding safe driving practices, compliance was highest for obeying traffic signals (354; 69.8%) and using indicators before turning (349; 68.8%). Avoidance of driving after alcohol consumption was reported by 504 (99.4%) participants, whereas avoidance of mobile phone use while driving was reported only by 156 (30.8%). [Table 6]. Gender showed significant association with knowledge ($\chi^2 = 10.21$, $P = 0.001$), attitude ($\chi^2 = 6.78$, $P = 0.009$), and practice ($\chi^2 = 6.34$, $P = 0.012$). Year of study was significantly associated

with knowledge ($\chi^2 = 12.36$, $P = 0.015$), attitude ($\chi^2 = 9.64$, $P = 0.047$), and practice ($\chi^2 = 14.22$, $P = 0.007$). Driving experience greater than one year was significantly associated with good knowledge ($\chi^2 = 11.45$, $P = 0.001$), positive attitude ($\chi^2 = 7.88$, $P = 0.005$), and good practice ($\chi^2 = 21.67$, $P < 0.001$). Formal driving training was also significantly associated with all three domains [Table 7].

Binary logistic regression analysis demonstrated that male gender was independently associated with good knowledge (AOR = 1.72; 95% CI: 1.20–2.46), positive attitude (AOR = 1.69; 95% CI: 1.08–2.64), and good practice (AOR = 1.64; 95% CI: 1.12–2.40). Participants in higher academic years demonstrated significantly greater odds of good knowledge and practice. Driving experience greater than one year was independently associated with good knowledge (AOR = 2.85; 95% CI: 1.62–5.01), positive attitude (AOR = 2.01; 95% CI: 1.20–3.37), and good practice (AOR = 4.12; 95% CI: 2.35–7.21). Participants trained through formal driving institutions demonstrated significantly higher odds of good knowledge (AOR = 2.47; 95% CI: 1.62–3.76), positive attitude (AOR = 1.88; 95% CI: 1.16–3.03), and good practice (AOR = 2.15; 95% CI: 1.38–3.35) [Table 8].

DISCUSSIONS

This study evaluated the knowledge, attitude, and practices (KAP) related to road safety among medical students and identified key behavioral and experiential determinants. While a considerable proportion of participants demonstrated adequate knowledge (48.5%) and positive attitudes (72.4%), the level of safe practices (59.2%) was comparatively lower, indicating a significant gap between knowledge, attitude, and practice, possibly due to behavioral, social, and environmental influences. Multivariable logistic regression analysis further highlighted that gender, academic progression, driving experience, and formal driving training were significant predictors across multiple domains. Male participants demonstrated significantly higher odds of good knowledge, positive attitude, and safe practices compared to females. Similar findings have been reported in previous studies, where increased exposure to driving among males contributed to better familiarity with traffic rules and safer practices [9,13].

Academic progression showed a consistent positive association with KAP outcomes. Senior students and interns (CRMI) demonstrated higher levels of knowledge, attitude, and practice compared to junior students. This trend is consistent with earlier studies, suggesting that increased exposure, clinical maturity, and real-life experiences contribute to improved awareness and behavioral adaptation

[10,14]. Driving experience emerged as the strongest predictor, particularly for safe practices. Participants with more than one year of driving experience had significantly higher odds of good knowledge, positive attitude, and safe practices. This finding aligns with previous studies indicating that experiential learning plays a critical role in reinforcing both cognitive and behavioral components of road safety [5,12]. The strong association observed emphasizes that repeated exposure to driving environments enhances risk perception and compliance with safety norms. Formal training through driving institutions was also significantly associated with improved outcomes across all domains. Participants who underwent structured training demonstrated better knowledge, more favorable attitudes, and safer practices compared to those who learned informally. This supports earlier findings that structured instruction improves both understanding and adherence to traffic regulations [8,11].

Residence was significantly associated only with practice, with urban participants demonstrating better adherence to safe driving behaviors. This may be attributed to greater exposure to traffic enforcement, infrastructure, and safety campaigns in urban areas [7]. However, the lack of association with knowledge and attitude suggests that environmental factors may influence behavior independently of awareness. RTA history showed a significant association with practice but not with knowledge or attitude. Participants without a history of accidents demonstrated better safety practices, which is consistent with an earlier study indicating that engagement in risky behaviors increases the likelihood of accidents [6]. Age was significantly associated only with attitude, with older participants (≥ 21 years) demonstrating more positive attitudes. This may reflect increased maturity and risk perception, although it did not translate into significant differences in knowledge or practice.

The findings of this study can be interpreted using established behavioral theories, particularly the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). According to the Health Belief Model, behavior is influenced by perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. Although participants in this study demonstrated adequate knowledge and positive attitudes, the relatively lower level of safe practices suggests that perceived barriers (e.g., inconvenience of helmet or seat belt use) and lower perceived susceptibility to accidents may limit the translation of knowledge into action. This explains the observed discrepancy between awareness and behavior. [15-17]

The Theory of Planned Behavior further supports this observation by emphasizing that behavior is determined not only by attitudes but also by

subjective norms and perceived behavioral control. While participants exhibited favourable attitudes toward road safety, actual practices may be influenced by peer behavior, social norms, and situational constraints. For instance, risky behaviors such as mobile phone use while driving may persist despite awareness due to habitual patterns or social influences. [18, 19] The strong influence of driving experience and formal training observed in this study aligns with the concept of perceived behavioral control in TPB, where individuals with greater skills and experience are more likely to engage in safe behaviors. Similarly, structured training may enhance both perceived competence and adherence to safety norms. [18, 19] The study is strengthened by its adequate sample size, stratified random sampling, and use of a validated questionnaire with acceptable reliability, enhancing internal validity. However, the cross-sectional design limits causal inference, and reliance on self-reported data introduces potential recall and social desirability bias. Additionally, the institution-based setting may limit generalizability, and residual confounding cannot be excluded.

CONCLUSION

The study demonstrates that attitudes toward road safety are relatively high, whereas knowledge and safe practices remain suboptimal. Gender, year of study, driving experience, and method of learning to drive were significantly associated with all domains ($p < 0.05$). Male gender was associated with higher odds of good knowledge (AOR = 1.72), positive attitude (AOR = 1.69), and good practice (AOR = 1.64). Driving experience > 1 year (AOR = 4.12) and formal training (AOR = 2.15) emerged as key determinants of behavior. These findings highlight the need for structured training interventions and behavior-focused strategies to bridge the gap between knowledge and practice.

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Table 1: Frequency distribution of Sociodemographic characteristics of the study participants (n=507)

Basic characteristics		Frequency (N)	Percentage (%)
Age (Mean ±S.D)		21.4 ± 1.7	
Gender	Male	164	32.4
	Female	343	67.7
Area of Residence	Urban	373	73.6
	Rural	134	26.4
Year of study	1 st year MBBS	101	20
	2 nd year MBBS	101	20
	3 rd year MBBS	101	20
	4 th year MBBS	102	20
	CRMI	102	20

Table 2: Frequency distribution of driving experience and Road Traffic Accidents among Medical College students (n=507)

Characteristics		Frequency	Percentage (%)
Driving Experience	>1 year	435	85.8
	≤ 1 year	72	14.2
Learnt driving	Friends/ family	298	58.8
	Training institutions	137	27.0
Have you ever had any RTA	Yes	132	26.1
	No	375	73.9
If yes, how many RTAs till now (n=132)	1	111	84.1
	2	10	7.6
	≥3	11	8.3
Extent of injury in the RTA (n=132)	Minor	113	85.6
	Major (Fracture/Head injury)	16	12.1
	Major injury to others or family members	3	2.4
Reasons for RTA* (n=132)	Overtaking the curve	55	41.7
	Over speeding	47	35.6
	Joining Service Road	32	24.2
	Drink and drive	12	9.1
	Vehicle Malfunction	9	6.8

*multiple responses.

Table 3: Frequency Distribution of knowledge on Road signs by the study participants (N=507)

Symbols	Correct answer	Frequency	Percentage (%)
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	Left turn prohibited	430	84.8
	No parking	424	83.6
	One way only	397	78.3
	Overtaking prohibited	386	76.1
	No entry	362	71.4
	Give way	260	51.3

Table 4: Frequency distribution of knowledge on road safety by the study participants (N=507)

Question	Frequency	Percentage (%)
Stipulated age to acquire a minor driving license	202	39.8
Age to acquire a major driving license	490	96.6
The imprisonment period for getting into a motor vehicle accident without documents	204	40.2
Fine to be paid for getting into a motor vehicle accident without documents	241	47.5
Highway speed limit for two-wheelers in Tamil Nadu	154	30.4
City speed limit on average in Tamil Nadu	61	12.0
Road Safety Signs	376	74.2
Overall score	246	48.5

Table 5: Frequency distribution of attitude to road safety measures among the study participants (N=507)

S. No	Statement	Positive Attitude n (%)	Negative Attitude n (%)
1	Having a driver's license for driving a vehicle should be mandatory	487 (96.1)	20 (3.9)
2	Wearing a seat belt is more of a disturbance than a safety benefit (<i>reverse-coded</i>)	244 (48.1)	263 (51.9)
3	One should not drive after consuming alcohol	453 (89.3)	54 (10.7)
4	Helmet use should not be mandatory (<i>reverse-coded</i>)	315 (62.2)	192 (37.8)
5	Road signs and symbols help reduce accidents	471 (92.9)	36 (7.1)
6	Carrying valid documents is not essential (<i>reverse-coded</i>)	303 (59.8)	204 (40.2)
7	Driving before obtaining a license is	297 (58.6)	210 (41.4)

	acceptable (reverse coded)		
8	Overall Score	367 (72.4)	140 (27.4)

Table 6: Frequency distribution of Practice to Road Safety Practices and Risk Behaviors Among the study participants (n=507)

S. No	Practice	Yes n (%)
Safe Driving Practices		
1	Carry driving license while driving	300 (59.2)
2	Wear a seat belt while driving a four-wheeler	288 (56.8)
3	Follow specified speed limits	235 (46.4)
4	Use a helmet while driving a two-wheeler	243 (47.9)
5	Obey traffic signals, lights, and signs	354 (69.8)
6	Check for pedestrians at the zebra crossing while crossing roads	209 (41.2)
7	Use indicators and check both sides before turning	349 (68.8)
8	Drive on the correct (left) side of the road	226 (44.6)
Risk Behavior		
1.	Overtake from the right side	249 (49.1)
2.	Blow the horn before overtaking	295 (58.2)
3.	Not distracted by high-intensity lights at night	353 (69.6)
4.	Do not use GPS while driving	197 (38.8)
5.	Do not use a mobile phone while driving	156 (30.8)
6.	Do not talk with co-passengers while driving	111 (21.9)
7.	Do not prefer driving when intoxicated	412 (81.3)
8.	Do not drink beverages while driving	455 (89.7)
9.	Do not eat while driving	464 (91.5)
10.	Do not drive after alcohol consumption	504 (99.4)
	Overall Practice Score	300 (59.2)

Table 7: Association of Knowledge, Attitude, and Practice with Selected Variables (N = 507)

Variable	Category	Knowledge n (%)	Attitude n (%)	Practice n (%)	χ^2 (K/A/P)	p-value (K/A/P)
Age	<21	118 (46.0)	175 (68.4)	150 (58.6)	2.84 / 4.91 / 0.08	0.092 / 0.027 / 0.776
	≥21	128 (50.9)	192 (76.5)	150 (59.8)		
Gender	Male	95 (57.9)	130 (79.3)	110 (67.1)	10.21 / 6.78 / 6.34	0.001 / 0.009 / 0.012
	Female	151 (44.0)	237 (69.1)	190 (55.4)		
Year of Study	1st year	40 (39.6)	65 (64.4)	50 (49.5)	12.36 / 9.64 / 14.22	0.015 / 0.047 / 0.007
	2nd year	45 (44.6)	68 (67.3)	55 (54.5)		
	3rd year	52 (51.5)	74 (73.3)	62 (61.4)		
	4th year	54 (52.9)	78 (76.5)	66 (64.7)		
	CRMI	55 (53.9)	82 (80.4)	67 (65.7)		
Residence	Urban	190 (50.9)	278 (74.5)	230 (61.7)	3.72 / 3.52 / 3.95	0.054 / 0.061 / 0.047
	Rural	56 (41.8)	89 (66.4)	70 (52.2)		
Driving Experience	>1 year	225 (51.7)	325 (74.7)	280 (64.4)	11.45 / 7.88 / 21.67	0.001 / 0.005 / <0.001
	≤1 year	21 (29.2)	42 (58.3)	20 (27.8)		

Learnt Driving	Friends/family	130 (43.6)	198 (66.4)	165 (55.4)	16.82 / 8.92 / 10.88	<0.001 / 0.003 / 0.001
	Training institutions	90 (65.7)	110 (80.3)	100 (73.0)		
RTA History	Yes	58 (43.9)	92 (69.7)	65 (49.2)	1.78 / 0.62 / 7.11	0.182 / 0.431 / 0.008
	No	188 (50.1)	275 (73.3)	235 (62.7)		

Table 8: Binary Logistic Regression Analysis for Knowledge, Attitude, and Practice (N = 507)

Variable	Category	Knowledge AOR (95% CI)	p-value	Attitude AOR (95% CI)	p-value	Practice AOR (95% CI)	p-value
Age	≥21	1.28 (0.91–1.80)	0.148	1.52 (1.03–2.23)	0.034	1.05 (0.74–1.49)	0.781
Gender	Male	1.72 (1.20–2.46)	0.003	1.69 (1.08–2.64)	0.021	1.64 (1.12–2.40)	0.011
Year of Study	2nd year	1.23 (0.75–2.01)	0.401	1.15 (0.70–1.90)	0.574	1.22 (0.75–1.97)	0.421
	3rd year	1.68 (1.02–2.76)	0.041	1.52 (0.91–2.53)	0.106	1.58 (0.97–2.56)	0.064
	4th year	1.74 (1.05–2.88)	0.031	1.71 (1.01–2.90)	0.045	1.74 (1.05–2.88)	0.031
	CRMI	1.81 (1.09–3.01)	0.022	1.94 (1.12–3.36)	0.018	1.82 (1.10–3.01)	0.020
Residence	Urban	1.32 (0.92–1.89)	0.128	1.36 (0.91–2.04)	0.132	1.41 (1.00–1.99)	0.048
Driving Experience	>1 year	2.85 (1.62–5.01)	<0.001	2.01 (1.20–3.37)	0.008	4.12 (2.35–7.21)	<0.001
Learnt Driving	Training institutions	2.47 (1.62–3.76)	<0.001	1.88 (1.16–3.03)	0.010	2.15 (1.38–3.35)	0.001
RTA History	No	1.21 (0.83–1.75)	0.309	1.15 (0.75–1.77)	0.516	1.74 (1.18–2.56)	0.005