Section: Miscellaneous

Original Research Article

ASSESSMENT OF KNOWLEDGE, ATTITUDE, AND PRACTICE (KAP) REGARDING ROAD SAFETY MEASURES AMONG TWO-WHEELER RIDERS IN A TERTIARY CARE TEACHING HOSPITAL

Bhoomika D. N.[1], Raghavendra B. K.[2], Siddu B. N.[3]

[1]Senior Resident, Department of Community Medicine, Bangalore Medical College and Research Institute, India.
[2]Assistant Professor Department of Radiation Oncology, Hassan Institute of Medical Sciences, India.
[3]Associate Professor, Department of Paediatrics, Sri Chamundeshwari Medical College Hospital and Research Institute, Channapatna, India.

Received *: 05/06/2026*
Received in revised form *: 26/07/2026*
Accepted *: 09/08/2026*

Corresponding Author:
Dr. Bhoomika D N,
Senior Resident, Department of Community Medicine, Bangalore Medical College and Research Institute, India.
Email: bhoomi1331@gmail.com

DOI: 10.70034/ijmedph.2026.3.374

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 2348-2357

ABSTRACT

Background: Two-wheeler riders are vulnerable road users because they have limited physical protection during road traffic crashes. Although knowledge of traffic regulations and favourable attitudes toward safety are important, they may not always translate into safe riding behaviour. Assessing knowledge, attitude and practice can help identify modifiable deficiencies and inform targeted road-safety interventions. The aim is to assess knowledge, attitude and practice regarding road-safety measures among two-wheeler riders in a tertiary care teaching hospital.

Materials and Methods: A hospital-based cross-sectional study was conducted among 120 two-wheeler riders aged 18 years or above. Participants were recruited using consecutive sampling and interviewed using a predesigned, pretested and structured questionnaire. Information regarding sociodemographic characteristics, riding profile, knowledge of traffic regulations, attitudes toward road safety and self-reported riding practices was collected. Separate knowledge, attitude and practice scores were calculated, with scores of at least 75% classified as satisfactory. Categorical variables were presented as frequencies and percentages, while continuous variables were summarised as mean and standard deviation. One-sample proportion z-tests, t-tests, chi-square tests and unadjusted odds ratios with 95% confidence intervals were used. A P value <0.05 was considered statistically significant.

Results: The mean knowledge score was 11.40±2.50 out of 15, and 77 (64.2%) participants had satisfactory knowledge (P=0.002). The mean attitude score was 39.80±5.60 out of 50, with 88 (73.3%) demonstrating a favourable attitude (P<0.001). However, the mean practice score was 7.30±2.30 out of 12, and only 61 (50.8%) participants reported good road-safety practices (P=0.855). Overall satisfactory KAP was observed in 49 (40.8%) riders, whereas 71 (59.2%) had unsatisfactory overall KAP (P=0.045). Awareness was highest regarding mandatory helmet use (90.8%), helmet use by both riders and pillion passengers (85.8%), alcohol-impaired riding (84.2%) and mobile-phone-related distraction (80.8%). Although 63.3% always wore a helmet, only 43.3% ensured helmet use by pillion passengers, 47.5% maintained a safe following distance and 51.7% consistently observed speed limits. Satisfactory overall KAP was significantly associated with age below 30 years (OR=3.10, 95% CI: 1.44-6.68), male sex (OR=2.54, 95% CI: 1.09-5.90), graduate-level education (OR=3.55, 95% CI: 1.57-8.04), possession of a valid driving licence (OR=4.46, 95% CI: 1.22-16.27), riding experience of at least five years (OR=2.53, 95% CI: 1.13-5.64) and formal driving training (OR=3.45, 95% CI: 1.61-7.41).

Conclusion: Two-wheeler riders demonstrated satisfactory knowledge and favourable attitudes, but their road-safety practices were comparatively

inadequate. The observed knowledge-practice gap, particularly concerning pillion helmet use, speed compliance, safe following distance and vehicle maintenance, requires targeted educational and behavioural interventions. Formal driving training, appropriate licensing, periodic safety education and consistent enforcement may improve compliance and reduce road traffic injuries.
Keywords: Road safety; Two-wheeler riders; Knowledge, attitude and practice.

INTRODUCTION

Road traffic injuries constitute a major and preventable public-health problem worldwide. Approximately 1.19 million people die annually because of road traffic crashes, while millions more sustain non-fatal injuries and long-term disability. Road traffic injuries are particularly important among young adults and are a leading cause of death in individuals aged 5-29 years. More than half of road traffic deaths involve vulnerable road users, including pedestrians, cyclists and motorcyclists.[1] The burden is disproportionately high in low- and middle-income countries because of rapid motorisation, mixed traffic conditions, inadequate infrastructure, inconsistent enforcement of traffic regulations and limited awareness regarding safe road use.[1,2] India carries a substantial share of this burden. According to the Ministry of Road Transport and Highways, 480,583 road accidents and 172,890 deaths were reported in India during 2023. Two-wheelers constituted the largest category of vehicles involved in road accident fatalities, highlighting the vulnerability of riders and pillion passengers.[3] Unlike occupants of enclosed vehicles, two-wheeler users have little physical protection and are therefore at greater risk of head injury, disability and death following a collision. Correct helmet use substantially reduces the risk of fatal and serious head injuries. Other essential safety behaviours include compliance with speed limits and traffic signals, possession of a valid driving licence, avoidance of alcohol-impaired riding, restriction of mobile-phone use while riding, avoidance of triple riding, regular vehicle maintenance and appropriate use of indicators, lights and mirrors.[1,2] However, knowledge of road-safety regulations does not always translate into favourable attitudes or consistent safe practices. A study among college students in Telangana demonstrated gaps between awareness of traffic regulations and their actual observance.[4] Similarly, a study among motorbike riders reported that although 62.9% possessed adequate knowledge and 73.0% had a favourable attitude, only 44.4% followed good road-safety practices.[5] This knowledge-practice gap may be influenced by perceived inconvenience, overconfidence, peer behaviour, weak enforcement, short travel distance and underestimation of personal risk. A tertiary care teaching hospital includes healthcare professionals, students, support staff, patients and attendants who frequently use two-wheelers. Assessing their knowledge, attitudes and practices can identify modifiable behavioural deficiencies and guide locally relevant educational, enforcement and injury-prevention interventions. Therefore, the present study was undertaken to assess KAP regarding road-safety measures among two-wheeler riders in a tertiary care teaching hospital.

Aim: To assess the knowledge, attitude and practice regarding road-safety measures among two-wheeler riders in a tertiary care teaching hospital.

Objectives

1. To assess the level of knowledge regarding traffic regulations and road-safety measures among two-wheeler riders.
2. To evaluate riders' attitudes and self-reported practices concerning helmet use and other road-safety measures.
3. To determine the association of KAP levels with selected sociodemographic, vehicle-related and riding-related characteristics.

MATERIALS AND METHODS

Source of data: Primary data were obtained from eligible two-wheeler riders attending or working at the selected tertiary care teaching hospital. The participants included hospital employees, healthcare professionals, students, patients' attendants and other eligible visitors who used a motorised two-wheeler. Information was collected directly from participants using a predesigned, pretested and structured questionnaire.

Study design: A hospital-based descriptive cross-sectional study was conducted.

Study location: The study was conducted within the premises of a tertiary care teaching hospital. Participants were approached at predetermined locations such as the two-wheeler parking area, outpatient department waiting areas, staff areas and student sections, without interfering with hospital services.

Study duration: The study was conducted over a period of six months. This period included one month for preparation and validation of the questionnaire, four months for participant recruitment and data collection, and one month for data entry, verification, analysis and report preparation.

Sample size: The sample size was calculated using the formula for estimating a single population proportion:

Where at a 95% confidence level, because no precise local estimate of satisfactory KAP was available, and the absolute precision.

The calculated sample size was rounded to 120 participants. Therefore, a total of 120 eligible two-wheeler riders were included in the study.

Sampling technique: Participants were recruited by consecutive sampling. Every eligible two-wheeler rider encountered at the selected data-collection sites during the study period was invited to participate until the required sample size of 120 was reached. Recruitment was undertaken on different days and at different times to improve the representation of various hospital-user categories.

Inclusion criteria

- Individuals aged 18 years or above.
- Individuals who rode a motorised two-wheeler either regularly or occasionally.
- Riders who had used a two-wheeler during the preceding six months.
- Hospital staff, students, patients' attendants or visitors available during the study period.
- Individuals who understood the study questions and provided written informed consent.

Exclusion criteria

- Pillion passengers who did not independently ride a two-wheeler.
- Individuals who had never ridden a motorised two-wheeler.
- Persons who were acutely ill, injured or unable to participate in an interview.
- Individuals unwilling to provide informed consent.
- Participants who had already taken part in the study.
- Questionnaires with substantial missing information, defined as more than 20% unanswered items.

Study tool: A predesigned, structured questionnaire was prepared after reviewing relevant literature, national traffic regulations and established road-safety recommendations. It consisted of the following sections:

- Section A: Sociodemographic information, including age, sex, education, occupation and participant category.
- Section B: Riding profile, including driving-licence status, type of two-wheeler, frequency of riding, riding experience, average daily travel and previous road traffic crash history.
- Section C: Knowledge regarding helmets, traffic signals, speed limits, road signs, mobile-phone use, alcohol-impaired riding, vehicle documents, lane discipline and emergency response.
- Section D: Attitudes toward helmet legislation, speed regulation, enforcement, penalties, pillion-rider safety and personal susceptibility to road traffic injuries.
- Section E: Self-reported practices, including helmet use, helmet fastening, use of BIS-certified helmets, mobile-phone use, signal compliance, speeding, triple riding, drink-riding and vehicle maintenance.

The questionnaire was reviewed by subject experts from Community Medicine, Emergency Medicine and/or Traffic Police for content validity. It was pretested among approximately 10% of the proposed sample in individuals who were not included in the final analysis. Necessary modifications were made to improve clarity, sequencing and comprehensibility. Internal consistency of the attitude and practice sections was assessed using Cronbach's alpha, with a value of ≥0.70 considered acceptable.

Scoring of KAP: Each correct knowledge response was assigned one point, whereas an incorrect or "do not know" response was assigned zero. Attitude items were rated using a three- or five-point Likert scale, with scoring reversed for negatively worded statements. Safe practices were assigned one point, while unsafe practices were assigned zero.

Separate knowledge, attitude and practice scores were calculated by summing the respective item scores. Scores were converted into percentages. A score of ≥75% was classified as satisfactory knowledge, favourable attitude or good practice, while a score below 75% was classified as unsatisfactory knowledge, unfavourable attitude or poor practice. The predetermined scoring criteria were applied uniformly to all participants.

Procedure and methodology: Approval was obtained from the Institutional Ethics Committee before commencement of the study. Permission was also obtained from the hospital administration and concerned departmental authorities. Potential participants were screened according to the eligibility criteria. The purpose, procedure, voluntary nature and confidentiality of the study were explained in the participant's preferred language.

Written informed consent was obtained before data collection. Each participant was interviewed individually using the structured questionnaire. When the participant was capable of completing the questionnaire independently, a self-administered format was used under the supervision of the investigator. For participants requiring assistance, questions were read aloud without prompting or influencing their responses. Each interview required approximately 10-15 minutes.

No personally identifying information was entered in the analytical dataset. A unique identification number was assigned to each questionnaire. At the end of data collection, participants were provided brief health education regarding correct helmet use, traffic-rule compliance, avoidance of distracted or alcohol-impaired riding and the importance of safe riding practices.

Data collection: Data were collected by the principal investigator or trained research personnel. The investigators were trained regarding participant selection, informed-consent procedures, standardised administration of questions and maintenance of confidentiality. Completed questionnaires were checked daily for completeness, consistency and legibility. Incomplete responses were clarified on the

same occasion wherever feasible without altering the participant's original response.

Data quality was maintained through pretesting, investigator training, use of standard definitions, daily scrutiny of forms, double-checking of entered data and periodic supervision of data collection.

Sample processing: No biological samples were collected or processed because the study was questionnaire-based. The "sample" consisted of completed questionnaires from the 120 participants. Each questionnaire was coded, scrutinised and entered into a password-protected electronic database. Responses were coded numerically, negatively framed items were reverse-scored, and KAP domain scores were calculated according to the predetermined scoring system. Forms containing substantial missing information were excluded according to the predefined criteria. Hard-copy questionnaires were stored securely, while the de-identified electronic dataset was used for statistical analysis.

Statistical methods: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics or equivalent statistical software. Categorical variables were summarised as frequencies and percentages. Continuous variables were assessed for normality using histograms and the Shapiro-Wilk test and were presented as mean with standard deviation or median with interquartile range, as appropriate.

Mean KAP scores were calculated with 95% confidence intervals. The chi-square test was used to assess associations between categorical variables and satisfactory knowledge, favourable attitude and good practice. Fisher's exact test was applied when expected cell frequencies were less than five. Independent-samples t-test or one-way analysis of variance was used to compare normally distributed mean scores, while the Mann-Whitney U or Kruskal-Wallis test was used for non-normally distributed data.

Pearson's or Spearman's correlation coefficient was used to examine relationships among knowledge, attitude and practice scores. Variables with a univariate p value <0.20 and variables considered epidemiologically important were entered into a multivariable binary logistic-regression model to identify independent predictors of good road-safety practice. Adjusted odds ratios with 95% confidence intervals were reported. Multicollinearity and model goodness-of-fit were assessed. All statistical tests were two-tailed, and a p value <0.05 was considered statistically significant.

Ethical considerations: Participation was voluntary, and written informed consent was obtained from every participant. Participants were permitted to withdraw at any time without any consequences. Confidentiality and anonymity were maintained throughout the study. No invasive procedure was performed, and participation involved minimal risk.

RESULTS

[Table 1] presents the overall knowledge, attitude and practice regarding road-safety measures among 120 two-wheeler riders. The mean knowledge score was 11.40 ± 2.50 out of 15 (95% CI: 10.95-11.85), which was not significantly different from the predetermined 75% cut-off of 11.25 (t=0.66, P=0.512). Overall, 77 (64.2%) participants had satisfactory knowledge, which was significantly higher than the reference proportion of 50% (z=3.10, P=0.002). The mean attitude score was 39.80 ± 5.60 out of 50 (95% CI: 38.79-40.81), significantly exceeding the 75% cut-off of 37.50 (t=4.50, P<0.001). A favourable attitude was observed among 88 (73.3%) riders, while 32 (26.7%) had an unfavourable attitude (z=5.11, P<0.001). In contrast, the mean practice score was 7.30 ± 2.30 out of 12 (95% CI: 6.88-7.72), which was significantly below the 75% cut-off of 9.00 (t=-8.10, P<0.001). Good road-safety practice was reported by 61 (50.8%) participants, whereas 59 (49.2%) demonstrated poor practice, with no significant difference from the reference proportion (z=0.18, P=0.855). The mean overall KAP score was 58.50 ± 8.80 out of 77 and was not significantly different from its 75% cut-off (t=0.93, P=0.355). Only 49 (40.8%) riders met the satisfactory criteria in all three KAP domains, whereas 71 (59.2%) had overall unsatisfactory KAP (z=2.01, P=0.045).

Table 1: Overall assessment of knowledge, attitude and practice regarding road-safety measures among two-wheeler riders (N=120)

KAP parameter	n (%) or Mean (SD)	95% CI	Test of significance	P value
Knowledge score, maximum 15	11.40 (2.50)	10.95-11.85	One-sample t=0.66†	0.512
Satisfactory knowledge	77 (64.2)	55.3%-72.2%	z=3.10‡	0.002*
Unsatisfactory knowledge	43 (35.8)	27.8%-44.7%	z=-3.10‡	0.002*
Attitude score, maximum 50	39.80 (5.60)	38.79-40.81	One-sample t=4.50†	<0.001*
Favourable attitude	88 (73.3)	64.8%-80.4%	z=5.11‡	<0.001*
Unfavourable attitude	32 (26.7)	19.6%-35.2%	z=-5.11‡	<0.001*
Practice score, maximum 12	7.30 (2.30)	6.88-7.72	One-sample t=-8.10†	<0.001*
Good road-safety practice	61 (50.8)	42.0%-59.6%	z=0.18‡	0.855
Poor road-safety practice	59 (49.2)	40.4%-58.0%	z=-0.18‡	0.855
Overall KAP score, maximum 77	58.50 (8.80)	56.91-60.09	One-sample t=0.93†	0.355
Overall satisfactory KAP§	49 (40.8)	32.5%-49.8%	z=-2.01‡	0.045*
Overall unsatisfactory KAP	71 (59.2)	50.2%-67.5%	z=2.01‡	0.045*

†Compared with the respective 75% score: knowledge=11.25, attitude=37.50, practice=9.00 and overall KAP=57.75.

‡One-sample proportion z-test against 50%.
§Participant satisfied the predetermined cut-off in all three KAP domains.
*Statistically significant.

Table 2: Knowledge regarding traffic regulations and road-safety measures among two-wheeler riders (N=120)

Correct knowledge statement	Correct response, n (%)	95% CI	One-sample z†	P value
Helmet use was mandatory for two-wheeler riders	109 (90.8)	84.3%-94.8%	8.95	<0.001*
Both rider and pillion passenger should wear helmets	103 (85.8)	78.5%-91.0%	7.85	<0.001*
Helmet straps should be securely fastened	94 (78.3)	70.1%-84.8%	6.21	<0.001*
BIS-certified helmets provided better protection	86 (71.7)	63.0%-79.0%	4.75	<0.001*
Mobile-phone use while riding increased crash risk	97 (80.8)	72.9%-86.9%	6.76	<0.001*
Alcohol-impaired riding increased crash risk	101 (84.2)	76.6%-89.6%	7.49	<0.001*
Speeding increased both crash risk and injury severity	82 (68.3)	59.6%-76.0%	4.02	<0.001*
Triple riding was prohibited and unsafe	79 (65.8)	57.0%-73.7%	3.47	0.001*
Understood common mandatory and warning road signs	77 (64.2)	55.3%-72.2%	3.10	0.002*
Lane changes should be indicated in advance	87 (72.5)	63.9%-79.7%	4.93	<0.001*
Safe following distance should increase with speed	74 (61.7)	52.7%-70.0%	2.56	0.011*
Recognised the legal consequences of riding without a licence	71 (59.2)	50.2%-67.5%	2.01	0.045*
Knew that overtaking from the left was generally unsafe	68 (56.7)	47.7%-65.2%	1.46	0.144
Knew the correct immediate response after a road crash	64 (53.3)	44.4%-62.0%	0.73	0.465
Knew the appropriate emergency-service contact number	66 (55.0)	46.1%-63.6%	1.10	0.273
Overall satisfactory knowledge	77 (64.2)	55.3%-72.2%	3.10	0.002*

†One-sample proportion z-test against a reference proportion of 50%.
*Statistically significant.

[Table 2] describes participants' knowledge regarding traffic regulations and road-safety measures. Knowledge was highest regarding mandatory helmet use, reported correctly by 109 (90.8%) participants, followed by awareness that both riders and pillion passengers should wear helmets in 103 (85.8%) and that alcohol-impaired riding increased crash risk in 101 (84.2%). Awareness of the dangers of mobile-phone use while riding was reported by 97 (80.8%), while 94 (78.3%) knew that helmet straps should be securely fastened. Knowledge regarding advance indication during lane changes and the protective value of BIS-certified helmets was reported by 87 (72.5%) and 86 (71.7%) participants, respectively. Awareness that speeding increased crash risk and injury severity was present in 82 (68.3%), while 79 (65.8%) recognised that triple riding was prohibited and unsafe. Common road signs were understood by 77 (64.2%), and 74 (61.7%) knew that safe following distance should increase with speed. All these proportions were significantly higher than 50% (P<0.05). However, comparatively lower and statistically non-significant levels of knowledge were found regarding unsafe left-side overtaking (56.7%, P=0.144), the appropriate emergency-service contact number (55.0%, P=0.273) and the correct immediate response after a road crash (53.3%, P=0.465). Overall, 77 (64.2%) riders had satisfactory knowledge, which was significantly higher than the reference proportion (z=3.10, P=0.002).

Table 3: Attitudes and self-reported practices concerning helmet use and other road-safety measures (N=120). 3A: Attitudes concerning road-safety measures

Favourable attitude statement	Agree/strongly agree, n (%)	95% CI	One-sample z†	P value
Helmet use was necessary even for short-distance travel	91 (75.8)	67.4%-82.6%	5.66	<0.001*
Pillion passengers should also wear helmets	84 (70.0)	61.3%-77.5%	4.38	<0.001*
Traffic rules should be followed even without police supervision	88 (73.3)	64.8%-80.4%	5.11	<0.001*
Strict penalties could improve road-safety compliance	86 (71.7)	63.0%-79.0%	4.75	<0.001*
Speed limits were necessary for preventing serious crashes	82 (68.3)	59.6%-76.0%	4.02	<0.001*
Answering a mobile phone while riding was unacceptable	79 (65.8)	57.0%-73.7%	3.47	0.001*
Riders should avoid riding after consuming any alcohol	93 (77.5)	69.2%-84.1%	6.02	<0.001*
Regular vehicle maintenance was essential for safety	76 (63.3)	54.4%-71.4%	2.92	0.003*
Road-safety education should be provided periodically	73 (60.8)	51.9%-69.1%	2.37	0.018*
Every rider was personally susceptible to a road crash	69 (57.5)	48.6%-66.0%	1.64	0.100
Overall favourable attitude	88 (73.3)	64.8%-80.4%	5.11	<0.001*

[Table 3A] presents participants' attitudes toward road-safety measures. The most favourable attitude was observed toward avoiding riding after alcohol consumption, with 93 (77.5%) participants agreeing with this statement (z=6.02, P<0.001). This was followed by the belief that helmets were necessary even for short-distance travel among 91 (75.8%) riders and that traffic rules should be followed even in the absence of police supervision among 88 (73.3%). Strict penalties were considered beneficial for improving compliance by 86 (71.7%), while 84 (70.0%) believed that pillion passengers should also wear helmets. The necessity of speed limits for preventing serious crashes was supported by 82

(68.3%), and 79 (65.8%) considered answering a mobile phone while riding unacceptable. Regular vehicle maintenance and periodic road-safety education were supported by 76 (63.3%) and 73 (60.8%) participants, respectively. These favourable responses were significantly higher than 50% (P<0.05). Although 69 (57.5%) participants believed that every rider was personally susceptible to a road crash, this proportion was not statistically different from 50% (z=1.64, P=0.100). Overall, 88 (73.3%) participants demonstrated a favourable attitude toward road safety (z=5.11, P<0.001).

Table 3B: Self-reported road-safety practices

Safe practice	Participants reporting safe practice, n (%)	95% CI	One-sample z†	P value
Always wore a helmet while riding	76 (63.3)	54.4%-71.4%	2.92	0.003*
Always fastened the helmet strap correctly	73 (60.8)	51.9%-69.1%	2.37	0.018*
Used a BIS-certified full-face or protective helmet	69 (57.5)	48.6%-66.0%	1.64	0.100
Ensured that the pillion passenger wore a helmet	52 (43.3)	34.8%-52.3%	-1.46	0.144
Never used a hand-held mobile phone while riding	84 (70.0)	61.3%-77.5%	4.38	<0.001*
Consistently obeyed traffic signals	79 (65.8)	57.0%-73.7%	3.47	0.001*
Consistently observed prescribed speed limits	62 (51.7)	42.8%-60.4%	0.37	0.715
Never rode after consuming alcohol	103 (85.8)	78.5%-91.0%	7.85	<0.001*
Avoided carrying more than one pillion passenger	91 (75.8)	67.4%-82.6%	5.66	<0.001*
Used indicators before turning or changing lanes	68 (56.7)	47.7%-65.2%	1.46	0.144
Maintained a safe following distance	57 (47.5)	38.8%-56.4%	-0.55	0.584
Undertook periodic maintenance of the two-wheeler	64 (53.3)	44.4%-62.0%	0.73	0.465
Overall good road-safety practice	61 (50.8)	42.0%-59.6%	0.18	0.855

†One-sample proportion z-test against a reference proportion of 50%.
*Statistically significant.

[Table 3B] shows the self-reported road-safety practices of the participants. The most commonly reported safe practice was never riding after consuming alcohol, observed among 103 (85.8%) participants (z=7.85, P<0.001). Avoidance of carrying more than one pillion passenger was reported by 91 (75.8%), while 84 (70.0%) stated that they never used a hand-held mobile phone while riding. Traffic signals were consistently obeyed by 79 (65.8%), and 76 (63.3%) reported always wearing a helmet. Correct fastening of the helmet strap was reported by 73 (60.8%). These practices were significantly more common than the 50% reference proportion (P<0.05). However, the use of a BIS-certified protective helmet was reported by only 69 (57.5%), and 68 (56.7%) consistently used indicators before turning or changing lanes. Periodic vehicle maintenance was undertaken by 64 (53.3%), while 62 (51.7%) consistently observed speed limits; none of these proportions differed significantly from 50% (P>0.05). Only 57 (47.5%) maintained a safe following distance, and 52 (43.3%) ensured helmet use by pillion passengers. Overall, 61 (50.8%) participants demonstrated good road-safety practices, which was not significantly different from 50% (z=0.18, P=0.855). The findings reveal important practice gaps, particularly in pillion-passenger helmet use, safe following distance, speed compliance and vehicle maintenance.

Table 4: Association of satisfactory overall KAP with sociodemographic, vehicle-related and riding-related characteristics (N=120

Characteristic	Total, n	Satisfactory KAP (n=49), n (%)	Unsatisfactory KAP (n=71), n (%)	Unadjusted OR (95% CI)	Test of significance	P value
Age group						
<30 years	64	34 (53.1)	30 (46.9)	3.10 (1.44-6.68)	χ^2=8.58	0.003*
≥30 years	56	15 (26.8)	41 (73.2)	Reference		
Sex						
Male	82	39 (47.6)	43 (52.4)	2.54 (1.09-5.90)	χ^2=4.85	0.028*
Female	38	10 (26.3)	28 (73.7)	Reference		
Educational status						
Graduate or above	73	38 (52.1)	35 (47.9)	3.55 (1.57-8.04)	χ^2=9.71	0.002*
Below graduation	47	11 (23.4)	36 (76.6)	Reference		
Valid driving licence						
Present	101	46 (45.5)	55 (54.5)	4.46 (1.22-16.27)	χ^2=5.86	0.015*
Absent	19	3 (15.8)	16 (84.2)	Reference		
Riding experience						
≥5 years	76	37 (48.7)	39 (51.3)	2.53 (1.13-5.64)	χ^2=5.29	0.021*
<5 years	44	12 (27.3)	32 (72.7)	Reference		
Formal driving training						
Received	50	29 (58.0)	21 (42.0)	3.45 (1.61-7.41)	χ^2=10.46	0.001*
Not received	70	20 (28.6)	50 (71.4)	Reference		
Previous road traffic crash						
Present	33	9 (27.3)	24 (72.7)	0.44 (0.18-1.06)	χ^2=3.46	0.063

Absent	87	40 (46.0)	47 (54.0)	Reference		
Average daily riding distance						
≥20 km/day	62	23 (37.1)	39 (62.9)	0.73 (0.35-1.51)	χ^2=0.74	0.389
<20 km/day	58	26 (44.8)	32 (55.2)	Reference		

KAP: knowledge, attitude and practice; OR: odds ratio; CI: confidence interval. Percentages were calculated row-wise. Pearson's chi-square test was used.
*Statistically significant.

[Table 4] demonstrates the associations between selected characteristics and satisfactory overall KAP. Riders aged below 30 years had significantly higher odds of satisfactory KAP than those aged 30 years or above (53.1% versus 26.8%; OR=3.10, 95% CI: 1.44-6.68; χ^2=8.58, P=0.003). Male riders were more likely to demonstrate satisfactory KAP than female riders (47.6% versus 26.3%; OR=2.54, 95% CI: 1.09-5.90; P=0.028). Participants educated to graduation level or above had 3.55 times higher odds of satisfactory KAP than those educated below graduation (52.1% versus 23.4%; 95% CI: 1.57-8.04; P=0.002). Possession of a valid driving licence was also significantly associated with satisfactory KAP (45.5% versus 15.8%; OR=4.46, 95% CI: 1.22-16.27; P=0.015). Riders with at least five years of riding experience had higher odds of satisfactory KAP than less-experienced riders (48.7% versus 27.3%; OR=2.53, 95% CI: 1.13-5.64; P=0.021). Similarly, participants who had received formal driving training demonstrated substantially better KAP than those without such training (58.0% versus 28.6%; OR=3.45, 95% CI: 1.61-7.41; χ^2=10.46, P=0.001). Riders with a previous road traffic crash showed lower odds of satisfactory KAP, but this association did not reach statistical significance (OR=0.44, 95% CI: 0.18-1.06; P=0.063). Average daily riding distance was also not significantly associated with satisfactory KAP (OR=0.73, 95% CI: 0.35-1.51; P=0.389).

DISCUSSION

Overall knowledge, attitude and practice: The present study assessed knowledge, attitudes and practices related to road safety among 120 two-wheeler riders attending or working in a tertiary care teaching hospital. Satisfactory knowledge was observed in 64.2% of participants, while 73.3% demonstrated a favourable attitude. However, only 50.8% reported good road-safety practices, and merely 40.8% met the satisfactory criteria in all three KAP domains. These findings demonstrate a clear knowledge-attitude-practice gap: riders were generally aware of road-safety measures and expressed favourable opinions, but their knowledge and attitudes were not consistently translated into routine safe behaviour.

The findings closely correspond with Phuyal et al. (2024),[1] who reported adequate road-safety knowledge among 62.9% and favourable attitudes among 73.0% of motorbike riders in Nepal, but good practices in only 44.4%. Sohal et al. (2024),[2] similarly found that 63.4% of commercial motorcyclists in Tanzania had high awareness, whereas 52.2% demonstrated poor safety practices. Both studies support the present observation that cognitive awareness alone may be insufficient to ensure behavioural compliance.

Conversely, Lawal et al. (2018),[3] reported considerably poorer findings among commercial motorcyclists in Sokoto, where 67.0% had poor knowledge, only 30.6% had a positive attitude and almost all demonstrated inappropriate safety practices. The comparatively better KAP in the present study may be attributed to its tertiary hospital setting, where participants were likely to have greater educational exposure, access to health information and awareness of the consequences of road traffic injuries. Differences in the study population, questionnaire content, scoring thresholds and enforcement environments should also be considered when comparing proportions across studies.

Jothula and Sreeharshika (2021),[4] reported that college students possessed reasonable awareness of basic road-safety regulations but showed deficiencies in actual compliance, particularly concerning helmet use, mobile-phone use and pillion riding. Cacodcar and Naik (2020),[5] also identified a mismatch between awareness and practices among college students in Goa. The mean practice score in the present study was significantly below the predetermined 75% cut-off, despite a mean attitude score significantly above its corresponding cut-off. This indicates that unsafe practices may be influenced by convenience, perceived invulnerability, social norms, discomfort, weak enforcement and overconfidence rather than lack of knowledge alone.

Knowledge regarding road-safety measures: Knowledge was highest regarding mandatory helmet use (90.8%), helmet use by riders and pillion passengers (85.8%), the risk associated with alcohol-impaired riding (84.2%) and mobile-phone-related distraction (80.8%). Awareness regarding correct fastening of the helmet strap was also relatively high at 78.3%. These findings indicate that highly publicised road-safety messages concerning helmets, alcohol and mobile phones had reached most participants.

Similar findings were reported by Phuyal et al. (2024),[1] who found that motorbike riders generally understood common road-safety measures, although risky behaviours such as drink-riding and mobile-phone use persisted. Helal et al. (2018),[6] in their study among medical students in Egypt, also

observed relatively good perception of basic traffic regulations but persistent risky practices. Jothula and Sreeharshika (2021),[4] found good awareness of common road signs, mandatory helmet use and the dangers of alcohol consumption and mobile-phone use while driving. These findings suggest that knowledge is strongest for road-safety issues that receive repeated attention through legislation, media campaigns and police enforcement.

In the present study, 71.7% knew that BIS-certified helmets provided better protection. Although this proportion was significantly above 50%, it was notably lower than general awareness that helmet use was mandatory. This difference is important because the protective value of a helmet depends on its quality, correct fit and proper fastening. Bachani et al. (2017),[7] reported that helmet awareness among Kenyan motorcyclists was considerably higher than observed helmet use, demonstrating that awareness of helmet benefits does not automatically ensure appropriate or consistent use. Their observational findings also showed markedly lower helmet use among passengers than drivers, paralleling the concern in the present study regarding pillion-passenger safety.

Knowledge of speeding, triple riding, road signs, lane-change indication and safe following distance ranged from 61.7% to 72.5%. These findings were moderately satisfactory but indicate that a substantial minority lacked essential operational knowledge. Cacodcar and Naik (2020),[5] likewise reported gaps in recognising and interpreting traffic signs among college students despite satisfactory general road-safety awareness. Lawal et al (2018),[3] documented even larger deficiencies among commercial riders, including poor recognition of zebra crossings and overtaking-related signs. The differences may reflect educational attainment, formal driving instruction and the intensity of traffic-safety enforcement.

The weakest knowledge areas in the present study involved unsafe left-side overtaking (56.7%), appropriate emergency-service contact numbers (55.0%) and the correct immediate response following a road crash (53.3%). These proportions were not significantly different from 50%. This pattern suggests that participants were better informed about preventing violations than managing emergencies after a crash. Gopaul et al (2016),[8] similarly emphasised that drivers' KAP is multidimensional and that deficiencies may persist in specific areas even when general road-safety awareness is adequate. Road-safety programmes in hospitals should therefore include first response, emergency activation, safe victim handling and Good Samaritan principles in addition to conventional messages about helmets and traffic regulations.

Attitudes toward road safety: A favourable overall attitude was observed in 73.3% of riders. The most strongly supported statements were avoidance of riding after alcohol consumption (77.5%), helmet use during short-distance journeys (75.8%) and adherence to traffic regulations even without police supervision (73.3%). More than two-thirds supported helmets for pillion passengers, strict penalties, speed limits and avoidance of mobile-phone use while riding.

The favourable attitude level was almost identical to the 73.0% reported by Phuyal et al. (2024).[1] It was higher than that reported by Lawal et al. (2018),[3] where less than one-third of commercial motorcyclists demonstrated a positive attitude toward protective measures. Differences may be related to occupation and educational profile: commercial riders may face pressure to complete more trips, work for longer hours and travel rapidly, whereas hospital-associated riders may have greater awareness of injury consequences.

Tajvar et al (2015),[9] found that drivers' attitudes toward traffic regulations were related to their actual driving behaviour and that inadequate attitudes were accompanied by risky practices. Gopaul et al. (2016).[8] also highlighted the importance of attitudes in compliance with road-safety regulations. The generally favourable attitudes in the present study therefore represent an opportunity for behavioural interventions; however, the lower practice scores show that favourable beliefs alone were insufficient.

Only 57.5% of participants believed that every rider was personally susceptible to a road crash, and this proportion was not significantly greater than 50%. This is a particularly important finding because riders may acknowledge that helmets, speed limits and traffic laws are valuable while simultaneously believing that a crash is unlikely to happen to them. Such optimistic bias can weaken the conversion of knowledge into behaviour. Helal et al. (2018),[6] reported substantial involvement in road injuries among medical students despite their road-safety awareness, demonstrating that educated individuals are not necessarily protected from risky behaviour.

Self-reported road-safety practices: The safest reported behaviours were avoidance of riding after alcohol consumption (85.8%), avoidance of carrying more than one pillion passenger (75.8%), non-use of hand-held mobile phones while riding (70.0%) and compliance with traffic signals (65.8%). Nevertheless, only 63.3% always wore a helmet, 60.8% consistently fastened the helmet strap and 57.5% used a BIS-certified protective helmet. Thus, although 90.8% knew that helmet use was mandatory and 75.8% believed it was necessary even for short journeys, consistent use was reported by only 63.3%. This difference provides direct evidence of a knowledge-practice gap.

The 63.3% helmet-use rate was comparable to the helmet compliance of 69.4% reported by Ndagire et al (2019),[10] among commercial motorcyclists in Kampala.[10] However, Ndagire et al. found that complete compliance with all assessed measures was extremely low, despite reasonable compliance with individual measures. Bachani et al (2017),[7] observed helmet-use prevalence of approximately 35%-37% in two Kenyan districts, substantially below the self-reported prevalence in the present

study. The discrepancy may partly reflect differences between observed and self-reported behaviour, because questionnaire-based studies are susceptible to socially desirable responses.

Only 43.3% of participants ensured helmet use by their pillion passenger. This was substantially lower than the proportion who agreed that pillion passengers should wear helmets (70.0%). Bachani et al (2017),[7] similarly observed that passengers were markedly less likely to wear helmets than motorcycle drivers. This indicates that helmet-promotion campaigns should explicitly address pillion passengers and should not focus exclusively on drivers.

Only 51.7% consistently observed speed limits, 47.5% maintained a safe following distance and 53.3% undertook periodic vehicle maintenance. These were among the weakest practices. Lawal et al (2018),[3] reported frequent speeding and deficiencies in indicator use among commercial motorcyclists, while Ndagire et al. (2019)[10] found very low overall compliance when multiple protective measures were considered together. Sohal et al (2024),[2] also found that good awareness coexisted with poor practices in slightly more than half of commercial riders. Collectively, these studies indicate that road-safety interventions need to extend beyond information delivery and include practical training, environmental facilitation, monitoring and consistent enforcement.

Factors associated with satisfactory KAP: Participants aged below 30 years had approximately three times greater odds of satisfactory KAP than older riders. A similar age-related pattern was reported by Phuyal et al (2024),[1] who found differences in risky behaviours such as mobile-phone use and speeding across age groups. The present finding could reflect greater exposure of younger participants to recent driving-licence curricula, social-media campaigns and institutional road-safety education. Nevertheless, young riders may still undertake risky behaviours despite higher knowledge; therefore, higher KAP scores should not be interpreted as proof of lower crash risk.

Male participants showed higher odds of satisfactory KAP than female participants. This finding may have been influenced by the larger number of male riders, differences in riding frequency and greater cumulative exposure to traffic regulations. However, sex-based associations have varied across studies. Bachani et al (2017),[7] and Ndagire et al (2019),[10] demonstrated that compliance is shaped by multiple contextual factors rather than sex alone. The wide confidence intervals in the present study also warrant cautious interpretation.

Graduates had 3.55 times greater odds of satisfactory KAP than participants educated below graduation. Sohal et al (2024),[2] similarly reported that higher education increased the likelihood of good road-safety practices. Tajvar et al (2015),[9] also found associations between driver characteristics, knowledge and practice. Higher education may improve comprehension of road signs, risk information and legal requirements and may facilitate access to certified helmets and safer vehicles.

Possession of a valid driving licence was associated with 4.46 times higher odds of satisfactory KAP. Licensed riders are likely to have received at least some exposure to traffic laws, road signs and competency testing. Helal et al (2018),[6] noted discrepancies between driving behaviour and licence possession among students, highlighting the importance of ensuring that riders undergo appropriate licensing and training before independently using a vehicle.

Riders with at least five years of experience had higher odds of satisfactory KAP than less-experienced riders. Experience may improve familiarity with road conditions, traffic rules and perceived consequences of unsafe behaviour. However, experience can also foster overconfidence; consequently, refresher education remains important. Phuyal et al (2024),[1] reported that increasing riding experience was associated with speeding behaviour, showing that experience does not uniformly produce safe practice.

Formal driving training showed a strong association with satisfactory KAP (OR=3.45). This agrees with Ndagire et al (2019),[10] who found that awareness that pre-riding training prevents crashes was associated with better compliance, and with Sohal et al (2024),[2] who reported that training in a driving institute increased the likelihood of high awareness. Formal training appears to be a modifiable determinant and should be strengthened through standardised instruction, practical testing and periodic refresher courses.

Previous crash involvement was associated with lower odds of satisfactory KAP, although the association did not reach statistical significance. This direction could mean that unsafe behaviour predisposed riders to crashes, but reverse causality cannot be excluded in a cross-sectional study. Similarly, daily riding distance was not significantly associated with KAP. These findings should be interpreted cautiously because KAP reflects reported awareness and behaviour rather than actual crash exposure, and the number of crash-exposed participants was relatively small.

CONCLUSION

The study demonstrated that two-wheeler riders had relatively satisfactory knowledge and favourable attitudes regarding road-safety measures; however, these did not consistently translate into safe riding practices. Satisfactory knowledge and favourable attitudes were observed in 64.2% and 73.3% of participants, respectively, whereas only 50.8% reported good road-safety practices. Only 40.8% fulfilled the satisfactory criteria across all three KAP domains. Awareness was particularly high regarding mandatory helmet use, alcohol-impaired riding and mobile-phone-related distraction. Important

deficiencies were identified in emergency response, pillion-passenger helmet use, maintenance of safe following distance, compliance with speed limits and periodic vehicle maintenance. Younger age, male sex, higher education, possession of a valid driving licence, longer riding experience and formal driving training were significantly associated with satisfactory overall KAP. These findings highlight the need for regular hospital-based road-safety education, practical rider training, promotion of certified and correctly fastened helmets for both riders and pillion passengers, and consistent enforcement of traffic regulations. Interventions should focus on converting existing knowledge and favourable attitudes into sustained safe riding behaviour.

Limitations: The study had several limitations. First, its cross-sectional design allowed the identification of associations but could not establish temporal or causal relationships between participant characteristics and satisfactory KAP. Second, the study was conducted at a single tertiary care teaching hospital with a relatively small sample of 120 riders; therefore, the findings may not be generalisable to all two-wheeler riders, particularly those in rural communities, commercial riders or individuals with different educational and socioeconomic backgrounds. Third, consecutive sampling may have introduced selection bias because riders available at the selected study locations and times might have differed from those who were not included. Fourth, riding practices were self-reported and were not verified through direct observation, traffic records or electronic monitoring. Consequently, recall bias and social-desirability bias may have resulted in overreporting of safe behaviours and underreporting of risky practices such as speeding, mobile-phone use and alcohol-impaired riding. Fifth, the classification of satisfactory KAP was based on predetermined scoring cut-offs, and the estimated prevalence could vary if different instruments or thresholds were used. Sixth, some potential determinants, including socioeconomic status, frequency of police enforcement, type and condition of roads, helmet cost and comfort, risk-taking tendency, peer influence and accessibility of certified helmets, were not evaluated in detail. Lastly, subgroup sizes were small for certain variables, resulting in relatively wide confidence intervals around some effect estimates. Larger multicentric studies incorporating direct observation and validated behavioural measurements are recommended.

REFERENCES

1. Phuyal S, Ghimire S, Adhikari A, Khadka D, Pahari S. Knowledge, attitude and practice on road traffic safety among the motorbike riders of Lalitpur metropolitan, Nepal. Int J Community Med Public Health. 2024;11(11):4168-75. doi: 10.18203/2394-6040.ijcmph20243270.
2. Sohal KS, Reuben S, Agbor AM. Awareness and practices of commercial motorcyclists regarding motorcycle crash-related risk factors and protective measures in Mbeya, Tanzania. Traffic Saf Res. 2024;8:e000064. doi: 10.55329/xqkh1519.
3. Lawal N, Oche MO, Isah BA, Yakubu A, Raji MO. Knowledge, attitude and compliance with safety protective measures and devices among commercial motorcyclists in Sokoto Metropolis, Northwestern Nigeria. J Adv Med Pharm Sci. 2018;16(1):1-9. doi: 10.9734/JAMPS/2018/39205.
4. Jothula KY, Sreeharshika D. Knowledge, attitude, and practice toward road safety regulations among college students in Telangana state. J Educ Health Promot. 2021;10:25. doi: 10.4103/jehp.jehp_442_20.
5. Cacodcar JA, Naik AV. A study to assess knowledge, attitude, and practices regarding road safety among college students in Goa. Int J Med Sci Public Health. 2020;9(10):616-20. doi: 10.5455/ijmsph.2020.02029202019012021.
6. Helal R, El-Khawaga G, El-Gilany AH. Perception and practice of road safety among medical students, Mansoura, Egypt. Osong Public Health Res Perspect. 2018;9(1):25-31. doi: 10.24171/j.phrp.2018.9.1.05.
7. Bachani AM, Hung YW, Mogere S, Akunga D, Nyamari J, Hyder AA. Helmet wearing in Kenya: prevalence, knowledge, attitude, practice and implications. Public Health. 2017;144 Suppl:S23-31. doi: 10.1016/j.puhe.2016.12.005.
8. Gopaul CD, Singh-Gopaul A, Sutherland JM, Chadee DD. Knowledge, attitude and practice among drivers in Trinidad, West Indies. J Transp Technol. 2016;6(5):405-19. doi: 10.4236/jtts.2016.65033.
9. Tajvar A, Yekaninejad MS, Aghamolaei T, Shahraki SH, Madani A, Omidi L. Knowledge, attitudes, and practice of drivers towards traffic regulations in Bandar-Abbas, Iran. Electron Physician. 2015;7(8):1566-74. doi: 10.19082/1566.
10. Ndagire M, Kiwanuka S, Paichadze N, Kobusingye O. Road safety compliance among motorcyclists in Kawempe Division, Kampala, Uganda: a cross-sectional study. Int J Inj Contr Saf Promot. 2019;26(3):315-21. doi: 10.1080/17457300.2019.1607395.