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Research article

An investigation of traffic safety knowledge, behaviour and risk perception for schoolchildren: a case study of India

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School-going children in India are disproportionately vulnerable to traffic-related injuries due to behavioural, infrastructural, and systemic shortcomings. Despite growing awareness of road safety, a major gap persists in understanding how cognitive and social factors jointly influence children's safety orientation across different travel modes. This study examines the relationship between risk perception, safety attitudes, observed adult behaviours, and self-reported risky practices among Indian school children aged 12–18 commuting by two-wheelers, cars, auto-rickshaws, school buses, or private/state buses. Using a structured questionnaire, data were collected from 925 students across two Indian states through both online and offline surveys. Descriptive statistics, Exploratory Factor Analysis (EFA), and Multiple Regression Analysis were employed to identify latent constructs and assess the predictive influence of attitudinal, perceptual, and observational factors on children's safety behaviour. Although most students demonstrated adequate safety awareness, observed adult misbehaviour and permissive risk attitudes significantly predicted unsafe practices. Regression analyses revealed that adult rule violations (β = 0.099–0.307) and limited risk perception explained up to 50% of variance in risky acts. School bus users showed higher behavioural awareness and safer attitudes (β = 0.439), while two-wheeler, auto-rickshaw, and private/state bus commuters displayed greater risk-taking tendencies. The study concludes that children's traffic safety is shaped by cognitive, social, and environmental factors rather than knowledge alone. Mode-specific, context-sensitive interventions integrating behavioural education, parental and driver involvement, and structured supervision are essential to bridge the gap between awareness and safe action among young commuters.

1. Introduction

Road traffic crashes (RTCs) continue to pose a significant public health burden worldwide, particularly for children and young people. According to the *Global Status Report on Road Safety 2023* by the World Health Organization, there were an estimated 1.19 million road traffic deaths in 2021, corresponding to a rate of 15 deaths per 100,000 population across all age groups. Although this figure represents total fatalities globally, road traffic injury remains the leading cause of death among children and young people aged 5–29 years, and the 12th leading cause of death when all ages are considered (World Health Organization, 2023). Children are especially vulnerable to RTCs owing to their limited cognitive development, underdeveloped hazard perception skills, and reliance on adults for transportation (Assailly, 2015; Von Beesten & Bresges, 2022). In low- and

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middle-income countries such as India, the risk to school-aged children is intensified by rapid urbanisation, weak law enforcement, and substandard road infrastructure (Tetali et al., 2013; Ipingbemi & Aiworo, 2013).

Globally, the modes of transport used by children vary significantly depending on sociocultural and economic factors. In developed countries, children are more likely to travel by private cars or school buses, whereas walking and cycling are common in European countries due to well-established pedestrian infrastructure (Larsen et al., 2009). However, in developing countries like India, a large proportion of school children travel by two-wheelers, auto-rickshaws, and overcrowded private or public buses without adequate safety measures (Ipingbemi & Aiworo, 2013; Tetali et al., 2013). The patterns of school travel in India are shaped by a combination of infrastructural limitations and socioeconomic constraints.

In India, the safety of child commuters remains a critical concern. National records indicate that 16,130 fatalities occurred among children below 14 years in 2022, comprising nearly 10 percent of all road traffic deaths (National Crime Records Bureau, 2023). However, this figure aggregates all child road users, including pedestrians, cyclists, and two-wheeler riders, without distinguishing those who travel as passengers in motorised vehicles. Consequently, there is a lack of a more comprehensive understanding of the safety risks encountered by schoolchildren commuting as passengers, a category that has been insufficiently addressed in existing Indian road safety literature.

Although several studies have investigated children's safety as pedestrians (e.g. Zeedyk et al., 2001; Morrongiello & Barton, 2009), minimal empirical work has examined passenger students who travel daily on motorised modes such as school buses, private cars, and shared rickshaws. This knowledge gap is significant, given that such students often encounter risks arising not only from traffic conditions but also from vehicle overloading, driver negligence, and the absence of seatbelts or child restraints. Moreover, many existing studies have either focused on single factors—such as infrastructural challenges or individual behaviour—or have not clearly justified the selection of the factors examined. There is limited empirical grounding for understanding how a combination of individual, social, and environmental factors jointly shape schoolchildren's traffic safety outcomes.

Designing effective interventions requires a detailed understanding of how factors such as previous traffic experiences, knowledge of road safety rules, risk perception, attitudes towards safety, and observed misbehaviours influence students' commuting safety. Prior research indicates that risk perception and knowledge do not always lead to safe behaviours, particularly in the absence of enforcement and consistent adult modelling (Von Beesten & Bresges, 2022; Pitcairn & Edlmann, 2000). Children exposed to frequent misbehaviour by peers or drivers may become desensitised, normalising unsafe commuting environments. These findings suggest that a multifactorial perspective is needed to design comprehensive, evidence-based safety interventions.

In response to these limitations, the present study aims to explore the interrelations between students' commuting experiences, road safety knowledge, risk perception, attitudes, and their exposure to unsafe behaviours in the context of school travel. Specifically, this study investigates how these factors vary across transport modes such as auto-rickshaws, two-wheelers, school buses, public buses, and private vehicles. The study is geographically situated in a rapidly urbanising city in South India, selected due to its high traffic congestion, variety of school transport modes, and documented history of child-involved road crashes. The location offers an appropriate context for examining diverse commuting patterns and safety-related disparities among schoolchildren.

The scientific contribution of this study lies in its integrated and child-focused

approach. Unlike earlier research, this study focuses exclusively on students commuting as passengers, distinguishing them from pedestrians or independent cyclists. It provides empirical evidence that combines individual-level behaviour and perception data with broader environmental observations to construct a holistic understanding of school commuting risks. In doing so, it contributes to the discourse on child-centred mobility planning and supports the development of contextually appropriate, multi-level interventions tailored to India's urban school settings.

The remainder of the paper is structured as follows. The next section reviews existing literature on road safety behaviour and risk perception among children, including international and Indian contexts. The methodology section then outlines the research design, sampling strategy, data collection methods, and analytical techniques employed. This is followed by the results section, which presents empirical findings on children's commuting experiences, knowledge, and behaviours. The discussion section interprets these findings in relation to current road safety strategies and policy frameworks. Finally, the conclusion summarises the key implications, limitations, and avenues for future research.

2. Literature review

Traffic safety for school-going children is a pressing issue in developing countries such as India. This literature review examines the various psychological, socio-demographic, infrastructural, environmental, experiential, perceptual, and behavioural factors that influence their safety as passengers.

Children's traffic safety behaviours are shaped by multiple interrelated factors. Individual characteristics, such as age, knowledge of traffic rules, and risk perception, influence their decision-making abilities (Pitcairn & Edlmann, 2000; Trifunović et al., 2017). Social influences including parental supervision, peer behaviour, and modelling by adults further shape children's behaviours (Morrongiello & Barton, 2009; Assailly, 2015). Exposure to recurring unsafe practices by adults and peers can normalise risk-taking, especially in environments with weak enforcement of traffic regulations (Zeedyk et al., 2001; Ipingbemi & Aiworo, 2013).

Environmental and infrastructural factors are equally critical. Incomplete sidewalks, high traffic volumes, and poorly maintained pedestrian paths increase vulnerability (Larsen et al., 2009; Dumbaugh & Frank, 2007). In contrast, well-maintained pedestrian infrastructure, clearly marked crossings, and traffic calming measures enhance safety and promote active commuting (Leden et al., 2005).

Abbas et al. (1996) found that children's traffic behaviours are shaped by a combination of traffic exposure, cognitive ability, perceptual skill, attitudes, and road safety knowledge. This holistic perspective reveals the need to integrate multiple psychological dimensions.

Twisk et al. (2015) conducted a longitudinal study involving adolescents aged 12–16, focusing on both pedestrians and cyclists. Their analysis revealed age-specific predictors: among younger adolescents (12–13), hazard awareness, attitudes towards rules, carelessness, and personal responsibility modestly influenced risk-taking. In the older group (14–16), factors such as attitudes towards alcohol, relative self-confidence, and personal responsibility were more predictive. They clearly distinguish "errors", such as failing to signal or overlooking oncoming vehicles, from "lack of protective behaviour", like crossing unsafely. Notably, "lack of protective behaviour" predicted crash risk only for the younger cohort. Their study highlights that adolescent pedestrians and cyclists show different psychological risk patterns.

In many urban Indian contexts, schoolchildren commute by private cars, school buses, auto-rickshaws, and two-wheelers (Tetali et al., 2013; Ipingbemi & Aiworo, 2013). For instance, Tetali et al. (2013) reported that nearly 17 percent of Hyderabad's schoolchildren had experienced injuries, but

the data combined cyclists and passengers without disaggregation. Ipingbemi & Aiworo (2013) observed that poor pedestrian facilities and driver negligence increased child vulnerability, yet emphasis on passenger contexts was minimal. This highlights a critical gap: passenger children face unique risks—from overloaded vehicles and absent restraints to risky driving habits—that remain understudied.

Age, gender, and parental influence significantly affect risk behaviour. Guliani et al. (2015) found that boys walk more and face distinct parental safety perceptions compared to girls. Elliott & Baughan (2004) developed the ARBQ tool to identify influences such as unsafe crossing and dangerous play. Alonso et al. (2018) noted that students' self-reported risky behaviour correlated with misbehaviour observed in peers, aligning with Theory of Planned Behaviour, emphasising the role of social norms in shaping behaviour.

The gap between safety knowledge and action is well documented (Zeedyk et al., 2001; Von Beesten & Bresges, 2022). Studies such as Riaz et al. (2019) show that DUI-prevention education influenced attitudes among female students, but did not significantly affect other behavioural determinants. Technological and experiential learning tools, such as virtual reality (Purcell & Romijn, 2020) and gamified programs (Treviño-Siller et al., 2016; Chatzizisis et al., 2019), have shown promise in improving hazard recognition. However, there is limited evidence assessing their effectiveness specifically among passenger students across different transport modes. Community-based initiatives involving schools, parents, and local authorities, such as those described by Alonso et al. (2018), demonstrate the potential of social norm-based interventions but require further empirical evaluation.

Although infrastructure, cognition, socio-demographics, and interventions have been studied individually, few investigations have simultaneously considered all these dimensions among passenger children in motorised commutes. In Indian urban contexts, empirical research remains scant. Most prior work either fails to disaggregate user groups or to provide intervention guidance. We therefore propose an integrated framework, combining psychological, behavioural, social, infrastructural, and intervention-related factors to explain commuting risks and support the design of targeted safety measures. Table 1 provides an overview of the most relevant studies, highlighting their user groups, factors, methods, and outcomes.

Despite a growing body of literature addressing road safety among children, the majority of studies concentrate on pedestrian risks and active travel, often neglecting the distinct safety concerns faced by passenger students using motorised transport such as school buses, auto-rickshaws, private cars, or two-wheelers. This is a significant omission, particularly in developing contexts like India, where a large proportion of schoolchildren rely on such modes. Additionally, few studies adopt an integrated framework that considers psychological factors, traffic experiences, safety knowledge, perceived risks, and social influences in relation to these commuting modes. While interventions such as road safety education programmes, gamified learning, and virtual simulations have gained traction, their effectiveness in changing behaviours among passenger students remains insufficiently explored. Furthermore, the literature seldom links these behavioural determinants to the design of targeted interventions, especially within region-specific infrastructural and cultural constraints. This study seeks to fill these critical gaps by examining how the interplay of traffic experience, knowledge, attitudes, risk perception, and observed misbehaviours influences the safety of school-going passenger students across various transport modes in India, thereby providing empirical foundations for the development of context-specific, evidence-based road safety interventions.

Table 1. Summary of key studies on school travel safety

Study	Year	User group	Factors	Method	Main findings
Abbas et al.	1996	Pedestrian & Cyclists	Exposure, cognition, attitude	Survey	Multi-factor influences emphasised; need for education and enforcement
Ipingbemi & Aiworo	2013	Child pedestrians	Infrastructure, driver norms	Survey	Poor facilities and driver behaviour contribute to child vulnerability
Twisk et al.	2015	Pedestrian & Cyclists adolescents	Hazard awareness, errors, attitudes	Longitudinal	Age-specific predictors identified; behavioural categories defined
Tetali et al.	2016	School commuters	Mode-specific risk	Cross-sectional injury report	Higher risk for informal transport mode users
Alonso et al.	2018	Adolescents	Peer influence, knowledge	Survey	Peer misbehaviour tied to self-risk; social norm impacts
Riaz et al.	2019	Adolescents	DUI risk, attitudes	Intervention	Improved control in girls; narrow effect set
Purcell & Romijn	2020	Schoolchildren	VR training: hazard awareness	Pilot	VR improved hazard recognition but lacks broader validation

3. Research methodology

3.1 Study area

This study was conducted in two Indian states: Kerala and Maharashtra. These states were intentionally selected due to their distinct socio-economic, cultural, and infrastructural profiles, which offer a valuable contrast in understanding the school travel experiences of children. Kerala is noted for its high literacy levels, better enforcement of road safety measures, and relatively organised transport systems. Maharashtra, in contrast, comprises both highly urbanised areas, such as Mumbai and Pune, and several semi-urban and rural districts. This diversity provided an opportunity to explore traffic safety perceptions across a broader range of traffic environments and socio-cultural conditions. Figure 1 presents the data collection locations. The study focused on school-going children who regularly commute using one of five identified modes: auto-rickshaw, private or state bus, school bus, private two-wheeler, and private car, with the two private modes typically involving parental transport.

3.2 Participants and sampling

A total of 925 students participated in the study. The sample included students from classes 7 to 12, aged between 12 and 18 years. Gender representation was nearly equal, with 473 males and 452 females. The participants were recruited from a mix of public and private schools in both urban and semi-urban settings, selected through purposive sampling to capture diverse road exposure scenarios.

The sample size was determined based on recommendations for factor analysis, ensuring a minimum of 200 respondents per group and exceeding the standard 5–10 respondents per item ratio. Separate groups were established according to the students' primary mode of travel. Table 2 presents the sample distribution by travel mode, gender, state, locality type, and class. Students were surveyed using both online and offline methods. Of the total, 514 responses were collected from Maharashtra and 411 from Kerala. The sample was considered sufficient for conducting Exploratory Factor Analysis (EFA) on each travel mode group.

3.3 Questionnaire preparation

The questionnaire was developed after an extensive review of literature on child traffic safety and behavioural studies, alongside consultations with school administrators and road safety experts. The instrument comprised five key sections: socio-demographic details, traffic safety knowledge, risk perception, observed traffic behaviours by adults, and self-reported risky behaviours. Mode-specific adaptations were made to ensure contextual relevance, particularly concerning observed and performed behaviours.

A pilot study was conducted with 30 students to examine clarity, length, and response

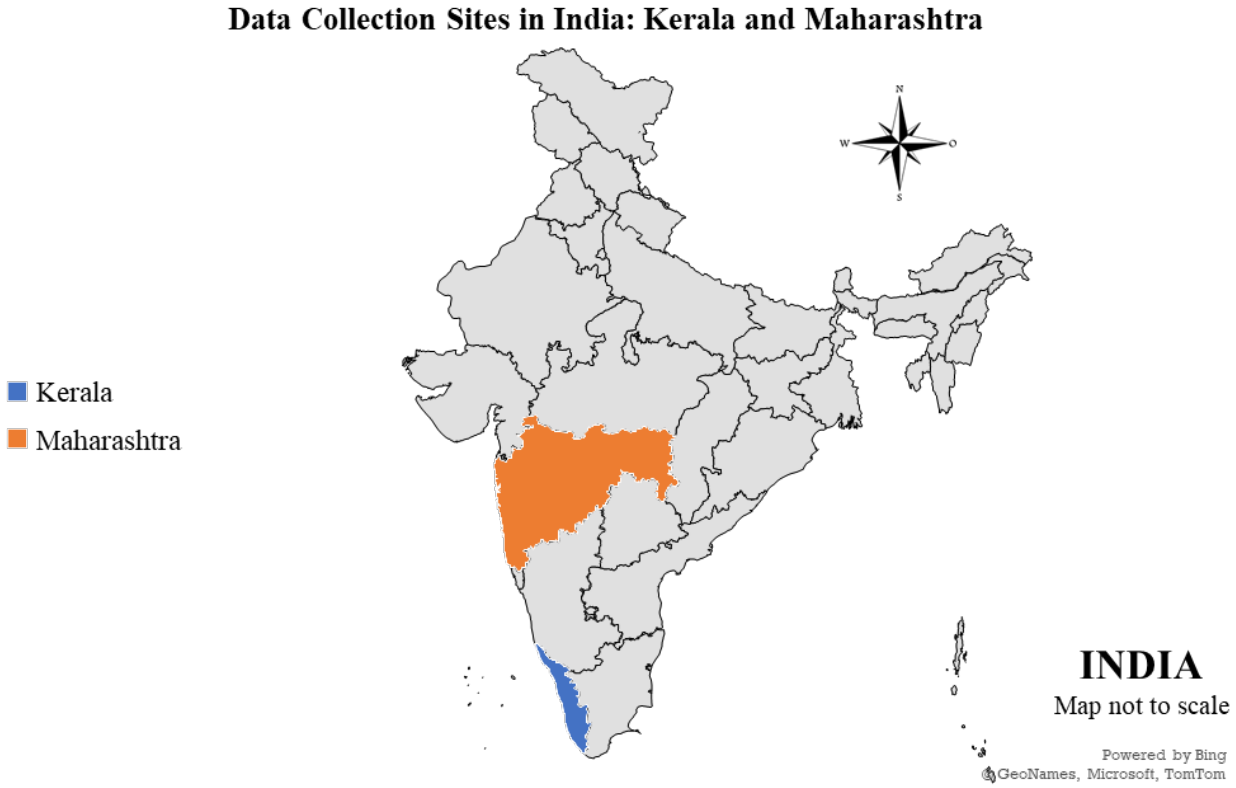

Figure 1. Data collection locations in India for present study

Table 2. Demographic profile and travel modes of student respondents

Demographic variables	Category	Number of students	Percentage (%)
Class	7th	35	4
	8th	231	25
	9th	140	15
	10th	116	12
	11th	221	24
	12th	182	20
Gender	Male	473	51
	Female	452	49
Locality	Maharashtra	514	56
	Kerala	411	44
Type of area	Village	283	30
	Town	413	45
	City	229	25
Travel mode	Private/State bus	194	21
	School bus	296	32
	Two-wheeler	176	19
	Car	111	12
	Auto-rikshaw	148	16

accuracy. Feedback indicated that some items were repetitive and difficult to interpret. As a result, the tool was shortened, certain items were reworded, and layout adjustments were made. The final version included a mix of question types: binary choices, multiple selections, and Likert-scale items. For example, road safety knowledge was assessed using items requiring identification of legal driving age, traffic signs, and traffic light meanings. Risk perception was measured using a five-point scale ranging from 'very high risk' to 'no risk'. Behavioural items asked students to report frequency of observing or engaging in specific actions, such as riding in overloaded vehicles or getting down before the vehicle stopped.

3.4 Data collection procedure

Data were gathered from selected schools in Kerala and Maharashtra using both online and offline methods. Offline surveys were conducted in classrooms with prior permission from school headmasters. Questionnaires were printed and distributed under supervision, with research assistants available to clarify doubts. In the online mode, Google Form links were shared through

school administrations. The digital version included mandatory fields to minimise missing responses. Efforts were made to ensure students did not submit multiple entries.

The study was conducted in adherence to ethical standards for school-based research. Written permission was obtained from school authorities before initiating data collection. Informed consent was obtained from school principals, and student assent was sought before participation. No personal identifiers, such as names or contact details, were retained beyond the data collection phase. All responses were anonymised before analysis. Participants were informed that their responses would remain confidential and would be used strictly for academic purposes.

Students completed the questionnaire under adult guidance, either in classrooms or at home with the help of parents. Offline surveys were typically administered in 30–40 minutes, while online completion times averaged 20–25 minutes. Both versions contained identical questions. Responses were entered into Google Sheets and later exported to Microsoft Excel for sorting and cleaning.

Separate sheets were prepared for each travel mode to facilitate disaggregated analysis. Data were checked for completeness, and inconsistent responses were flagged. Records missing key demographic data or containing ambiguous responses were removed before analysis. The final dataset comprised 925 valid entries.

3.5 Data coding and analysis

The data were coded prior to analysis. Responses to objective knowledge questions were coded as '1' for correct answers and '0' for incorrect ones. Items measured on five-point Likert scales were coded such that higher values indicated safer responses, depending on the nature of each question. This ensured consistency across variables and facilitated reliability and regression analyses.

Descriptive statistics were calculated for all key variables, including knowledge, risk perception, observed adult misbehaviour, and self-reported practices. Frequencies, percentages, means, and standard deviations were computed across various demographic and contextual categories such as age group, gender, travel mode, and state. These analyses provided an overview of the data distribution and helped identify patterns and variations in traffic safety perceptions and behaviours among school children using different travel modes.

Exploratory Factor Analysis (EFA) was conducted using IBM SPSS Statistics software to identify the underlying dimensions of the measured constructs. The analysis employed the Principal Component Analysis (PCA) extraction method with Varimax rotation and was performed separately for each travel mode (two-wheeler, auto-rickshaw, car, school bus and private/state bus). The suitability of data for EFA was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. Only components with eigenvalues greater than 1 and factor loadings above 0.3 were retained. After extraction, the reliability of each factor was examined using Cronbach's alpha values, and items were also reviewed logically to ensure conceptual consistency. Based on these checks, some items were modified or removed, and the finalised factors were retained for further statistical analyses.

Following the factor extraction and reliability assessment, multiple regression analysis was performed using IBM SPSS Statistics software to examine the relationship between the identified factors and relevant outcome variables. Factor scores were computed and used as predictors in the analysis. The regression models were evaluated for statistical significance and goodness of fit, and key assumptions such as multicollinearity, independence of residuals, and homoscedasticity were verified to ensure model validity. This analysis provided a clearer understanding of how the extracted factors contributed to variations in students'

traffic safety perceptions and behavioural patterns.

4. Descriptive analysis

4.1 Traffic safety education

4.1.1 Road traffic knowledge

To evaluate the students' knowledge of traffic regulations, signs, and signals, they were asked a series of questions about road safety. An impressive 94.7% of respondents correctly identified the legal driving age. Students' understanding of road signs varied, with 46.24% properly identifying the "School Ahead" sign and 92.15% correctly recognising the "Stop" sign. Furthermore, 89.9% of students recognised the "Cycle Prohibited" sign, while 97.5% recognised the "Pedestrian Crossing" sign.

4.1.2 Interest to study traffic safety related course

Comprehensive road safety education for children is critical for reducing accident risks and encouraging safe road behaviour. The statistics show that 80.63% of students are willing to learn road safety as part of their education, indicating a considerable interest in learning about traffic safety measures.

4.1.3 Sources of traffic safety information

Understanding where children learn about traffic safety helps identify important influences who shape their awareness and behaviour. Sources evaluated were parents, teachers, peers, television, newspapers, social media, and textbooks. According to the report, 69.3% of children rely on their parents for road safety advice, followed by teachers (47.2%) and social media (46%). Furthermore, 41% of pupils named television, 35% newspapers, 27% friends, and 16% textbooks as sources of traffic safety education.

4.2 Reported challenges among children using different school travel modes

4.2.1 Challenges faced by students commuting as passengers on two-wheelers

As shown in Figure 2, when travelling to school as passengers on two-wheelers, students identified "bad road conditions" as the most frequently encountered issue (reported by more than 50%), followed by "over speeding of other vehicles" (35%), "traffic congestion" (over 20%), "lack of zebra crossings" (less than 20%), and "insufficient traffic signage" (over 10%).

4.2.2 Challenges encountered by students commuting by auto-rickshaw

As shown in Figure 3, when commuting to school by auto-rickshaw, students reported facing several challenges, including "bad road conditions" (less than 25%), "traffic block" (more than 20%), "overcrowding" (10%), "lack of traffic signs at junctions" (5%), and "over speeding of the auto-rickshaw" (2%).

4.2.3 Challenges encountered by students commuting to school by car

As shown in Figure 4, when travelling to school as a passenger in a car, students reported experiencing several safety concerns, including "traffic congestion" (27%), "over speeding of other vehicles" (26%), "bad road conditions" (25%), "lack of proper traffic signs" (10%), "no proper place to stop and get down" (8%), and "lack of zebra crossings" (7%).

4.2.4 Challenges encountered by students commuting by school bus and private/state bus

As shown in Figure 5, students travelling by school bus reported several safety concerns, including "bad road conditions" (30%), "overcrowding" (17%), "over speeding of the bus" (14%), "lack of proper seating" (6%), and "difficulty crossing the road after getting down from the bus" (6%). Figure 6 presents the concerns raised by students commuting by private bus, with "overcrowding" being the

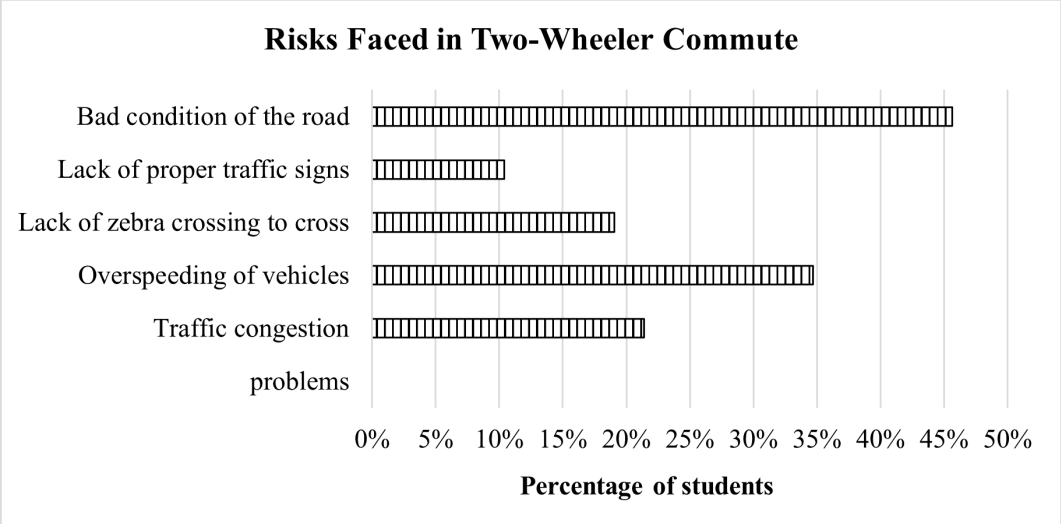

Figure 2. Critical road safety concerns for students commuting to school by two-wheeler

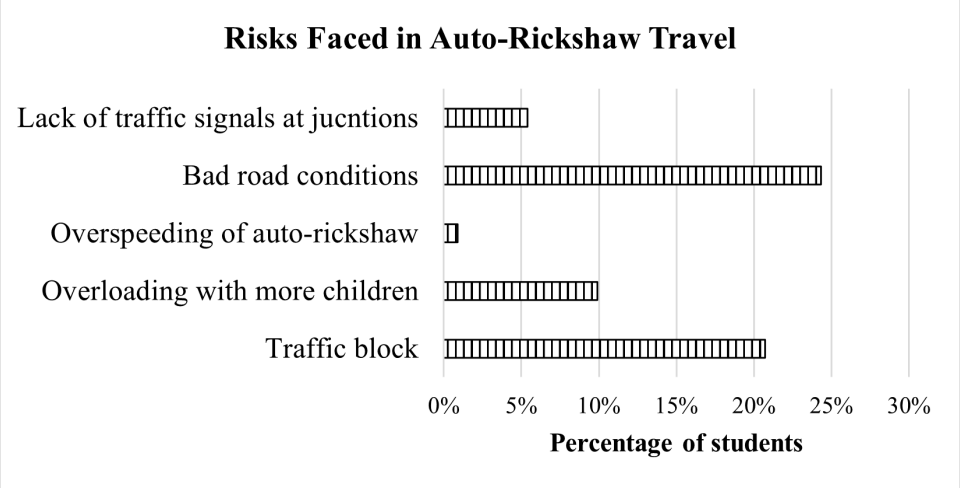

Figure 3. Critical road safety concerns for students commuting to school by auto-rickshaw

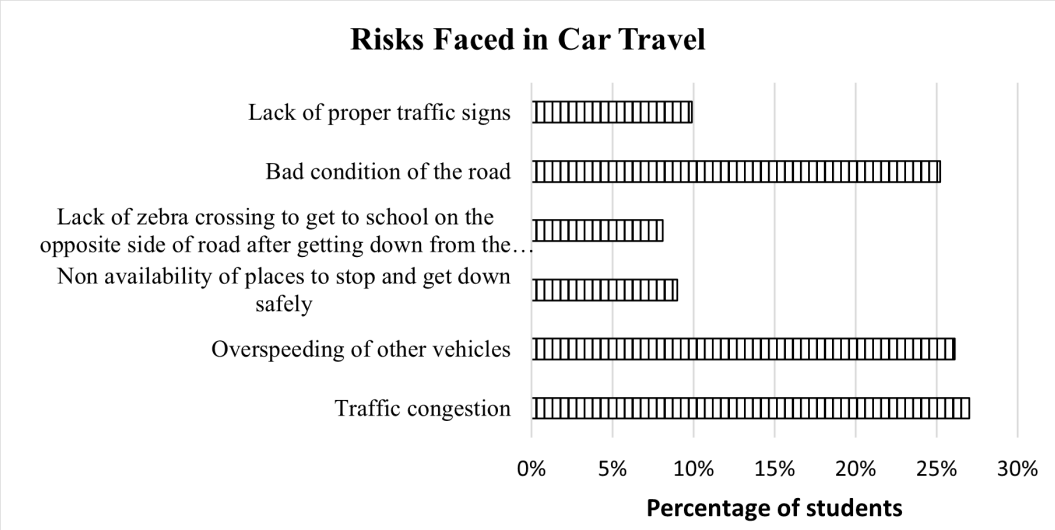

Figure 4. Critical road safety concerns for students commuting to school by car

most frequently reported issue (more than 50%), followed by ”bad road conditions” (over 20%), ”traffic block” (19%), ”bus stop far from school” (10%), and ”no shelter at the bus stop” (5%).

4.3 Traffic safety attitude of children across different travel modes

Among students commuting by two-wheelers, 65% strongly agreed that “You should always wear your helmet when travelling on a two-wheeler”. Half of the students strongly agreed and 35% agreed that “It is important to make sure that helmet is properly buckled before the journey”. About 70% disagreed or strongly disagreed with the notion that “travelling with more than two people on a two-wheeler is not dangerous when the driver is highly skilled”. Additionally, 75% agreed or strongly agreed that “The passenger should avoid unnecessary movement in order to avoid losing balance while traveling”.

For children commuting by auto rickshaw, over 80% agreed or strongly agreed that “over speeding of auto rickshaws can cause accidents”. More than 70% disagreed or strongly disagreed with “fun to put out body parts out of a moving auto rickshaw”. Around 70% did not believe that “there is no harm in carrying a greater number of passengers as long as the driver is able to drive”, and 85% agreed or strongly agreed that “I will not get down from the auto rickshaw before it is completely stopped”.

Among car passengers, up to 80% agreed or strongly agreed that “You should always wear your seatbelt when travelling in a car”. Around 65% disagreed or strongly disagreed with “There is no harm in playing the music in high volume inside the car”. About 85% agreed or strongly agreed that “It is safer to get down from the vehicle after making sure that no vehicle is coming near that side”, while over 80% disagreed or strongly disagreed that “It is fun to put out hands/head out of the window of a moving car”.

In the school bus group, around 50% agreed that “It is annoying to stand in queue before getting into the bus”. Nearly 70% disagreed with “getting out from a moving bus before it is completely stopped” or “putting hands/head out of the window of a moving bus”. More than 50% considered it “dangerous to cross the road behind the bus after getting down”.

For private/state bus users, over 70% disagreed with “to travel by hanging out from the door of an over-crowded bus when you are in a hurry to reach home”, and almost 80% disagreed with “It is not dangerous to put hands/head out of the window of a moving bus when there is not much vehicle on road”. Around 65% found it unsafe “to get out from a moving bus before it is completely stopped”, and more than 65% agreed or strongly agreed “to get into the bus in a queue”.

Across all modes, students largely displayed strong safety-oriented attitudes. Helmet and seatbelt use, opposition to protruding limbs from vehicles, and disembarking only after a full stop were consistently supported. While unsafe behaviours were generally rejected, minor variations existed across modes—students using private or public buses showed higher concern for queuing and overcrowding, whereas two-wheeler and car passengers placed greater emphasis on protective equipment. These findings highlight the need for mode-specific safety interventions, with reinforcement of core safety practices common across contexts. Comprehensive tabular data corresponding to each travel mode is included in the **Appendix** for reference.

4.4 Risk perception of children commuting by different modes of travel

The descriptive analysis of students’ responses highlighted notable patterns in perceived traffic risk across the five school travel modes. Among students commuting by two-wheelers, around 80% rated the situation of “carrying more than two people or opening umbrella on a moving two-wheeler” as involving “very high risk” to “high risk”. Furthermore, more than 85% perceived “hanging out dress near the wheel” within the same risk range.

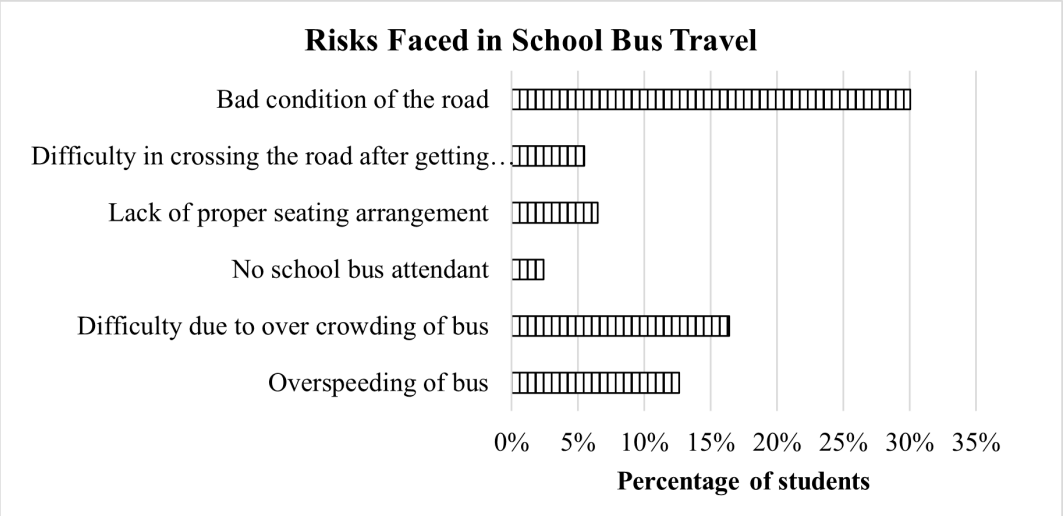

Figure 5. Critical road safety concerns for students commuting by school bus

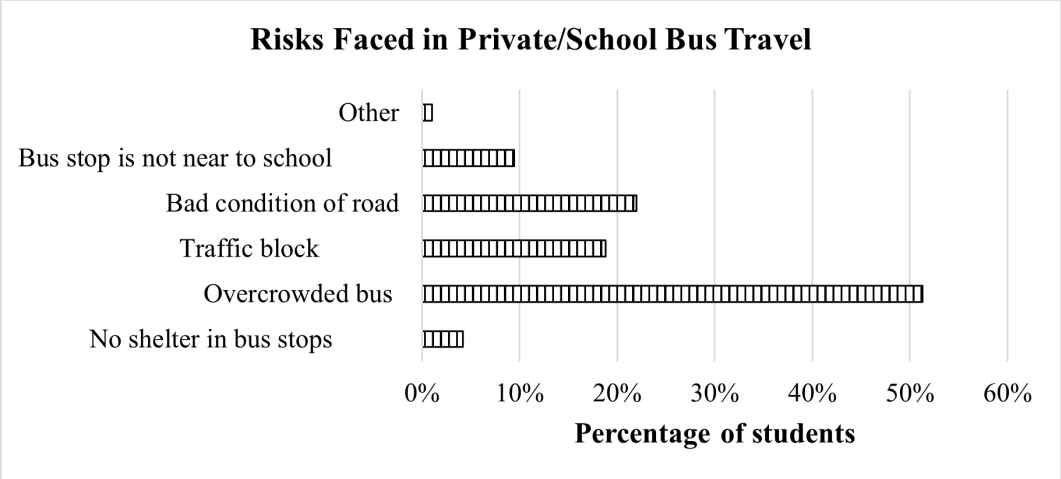

Figure 6. Critical road safety concerns for students commuting by private/state bus

Students commuting by auto rickshaw demonstrated even higher levels of concern, with over 90% categorising instances such as “overloading auto rickshaw with children”, “sitting in dangerous position”, and “putting body parts out of a moving auto rickshaw” as carrying “very high risk”, “high risk”, or “moderate risk”.

Similarly, children commuting by car reported high-risk awareness, with over 90% assigning “very high risk” to “moderate risk” to behaviours like “putting body parts out of moving car”, “opening doors without looking for any vehicles coming from sides”, and “distracting the drivers while driving”.

Students travelling via school bus and private/state bus also indicated high perceived risk for unsafe behaviours. Around 90% rated “putting body parts out of moving vehicle”, “overloading of vehicles”, and “running to catch moving bus” as “very high risk”, “high risk”, or “moderate risk”.

In comparative terms, students commuting by auto rickshaw and bus (school or private/state) exhibited consistently high levels of risk perception, possibly due to their exposure to more observable and collective risky practices. Two-wheeler and car commuters also demonstrated strong awareness, though with more emphasis on personal conduct within the vehicle context. Comprehensive tabular data corresponding to

each travel mode is included in the **Appendix** for reference.

4.5 Traffic risky behaviour of children by mode of travel

Descriptive findings highlight varied risky behaviours among students across different school travel modes. Among those commuting by two-wheelers, 55% "did not wear helmet" and 53% "did not buckling the helmet strap properly", while over 30% reported "getting down the auto rickshaw before it completely stops" and "distracted drivers by their activities". For students commuting by auto rickshaw, more than 55% "puts their heads and hands out of auto rickshaw", 45% "sits in dangerous positions", over 65% "travel on an overcrowded auto rickshaw", and 40% "getting down the auto rickshaw before it completely stops". Among those commuting by car, 85% "did not wear seatbelt", 45% "did activities that cause distractions to the driving person", 35% reported "putting their head or hands out of moving vehicle", and less than 20% "moved out from the vehicle before it is completely stopped". In the case of school bus and private/state bus commuters, around 30% "put their hands/head move out of a moving bus", 35% "climbed down from a moving bus before it is completely stopped", 55% "crossed the road from behind the bus after getting down", and 30% "push or shove others when they are boarding the bus".

A comparative overview indicates that risky behaviour was most prominent among car and auto rickshaw users, particularly in terms of "not wearing seatbelt" and "travelling in overcrowded vehicles". In contrast, children using school buses displayed relatively fewer in-vehicle risky behaviours but higher instances of dangerous acts while boarding or alighting. Comprehensive tabular data corresponding to each travel mode is included in the **Appendix** for reference.

4.6 Observed misbehaviours of other road users by mode of travel

Students reported observing various traffic misbehaviours among other road users during their school commute. Among those commuting by two-wheelers, 70% saw others "not wearing helmet", 60% observed "not wearing seat belt", 58% witnessed "using mobile phone while driving", and 30% reported seeing "driving vehicle after consuming alcohol". Children travelling by auto rickshaw noted even higher occurrences, with 85% observing both "not wearing helmet" and "not wearing seat belt", 80% witnessing "using mobile phone while driving", and 56% seeing instances of "driving vehicle after consuming alcohol". Similar trends were observed among car commuters, with 85% reporting "not wearing helmet" and "seat belt", 80% observing "mobile phone use while driving", and 56% witnessing "driving after alcohol consumption". For students commuting via school bus or private/state bus, 68% observed "not wearing helmet", 62% saw "not wearing seat belt", 67% reported "mobile phone use while driving", and 30% saw instances of "driving after consuming alcohol".

A comparative analysis suggests that children commuting by auto rickshaw and car were exposed to the highest levels of observed misbehaviours, particularly in terms of non-use of safety gear and mobile phone usage. Although slightly lower, students on school or state buses still frequently witnessed dangerous acts by other road users, reflecting the broader traffic environment's influence on children's perceptions. Comprehensive tabular data corresponding to each travel mode is included in the **Appendix** for reference.

5. Exploratory Factor Analysis (EFA)

5.1 Exploratory Factor Analysis procedure

To identify the latent dimensions shaping students' perceptions and behaviours related to traffic safety, Exploratory Factor Analysis (EFA) was carried out using responses from a structured questionnaire. Although the questionnaire was originally developed with items grouped into four conceptual domains—attitudes towards traffic safety (AT1–AT4), risk perception (PE1–PE3), observed misbehaviour

by adults or others (OM1–OM4), and self-reported risky behaviours (RB1–RB4)—EFA was undertaken to empirically validate the extent to which these theoretical groupings were reflected in the actual data. EFA is a widely used data reduction technique in behavioural and social sciences, capable of uncovering patterns of correlations among observed variables and grouping them into underlying factors or components. This method is particularly valuable when assessing the construct validity of context-specific instruments, such as those developed for traffic safety research in the Indian school context. The 15 Likert-type items included in the analysis were designed to capture the subjective travel-related experiences of students commuting by various modes, and EFA enabled a more objective, data-driven understanding of how these perceptions are structured.

The EFA was performed using Principal Component Analysis (PCA) as the extraction method, with Varimax rotation to achieve orthogonal (uncorrelated) factor solutions that maximise interpretability. A minimum eigenvalue threshold of 1.0 was adopted for factor retention, in line with Kaiser's criterion. The coefficient display format was set to suppress loadings below 0.30, ensuring that only meaningful item-factor relationships were reported. Prior to extraction, sampling adequacy was assessed through the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity, both of which confirmed the suitability of the data for factor analysis.

After extraction, the reliability of each factor was examined using Cronbach's alpha values to ensure internal consistency. Items were also reviewed logically to confirm conceptual coherence. Based on these checks, some items were modified or removed, and the finalised factors, with acceptable to high reliability were retained for subsequent statistical analyses.

5.1.1 Students commuting as passengers on two-wheelers

An Exploratory Factor Analysis (EFA) was carried out to uncover the underlying dimensions associated with students' traffic safety perceptions and behaviours during two-wheeler commutes. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.739, indicating a satisfactory level of inter-item correlation for factor analysis. Bartlett's Test of Sphericity was significant ($\chi^2 = 651.381$, $df = 105$, $p < .001$), confirming that the correlation matrix was not an identity matrix and was therefore suitable for EFA. Based on the criterion of eigenvalues greater than one, four components were extracted, accounting for a cumulative variance of 56.96 percent. Communalities for all items ranged from 0.30 to 0.78, demonstrating acceptable levels of shared variance among the included variables.

After extraction, the reliability of each factor was assessed using Cronbach's alpha, and items were reviewed logically for conceptual consistency. Based on these checks, some items were modified, and one item (OM1 – Observed adults not wearing a helmet) was moved from Observed Adult Risk Behaviour to Helmet Use Non-Compliance to improve internal consistency and ensure that each factor accurately represented a coherent construct. The finalised factors were retained for subsequent statistical analyses. Table 3 presents the rotated component matrix derived from the EFA conducted for students who commute to school as passengers on two-wheelers.

The rotated solution revealed four distinct components capturing students' perceptions and behavioural tendencies while commuting by two-wheeler. Factor 1, Protective Safety Attitude and Behaviour, includes items reflecting students' safety compliance (wearing and buckling helmets, avoiding unnecessary movement) and occasional risky behaviours (trying to get out before the vehicle stops, distracting the driver). Factor 2, Observed Adult Risk Behaviour, remained largely unchanged and includes

Table 3. Rotated component matrix for two-wheeler mode of travel

Factor name	Item code	Item description	Mean (SD)	Cronbach's α	Factor 1	Factor 2	Factor 3	Factor 4
Protective safety attitude and behaviour	RB3	How frequently do you try to get out of a vehicle before it has completely stopped?	4.31 (1.11)	0.711	0.707			
	AT2	To what extent do you agree: Helmets should be properly buckled before the journey	4.27 (0.86)		0.690			
	AT1	To what extent do you agree: One should always wear a helmet when riding a two-wheeler?	4.47 (0.83)		0.648			
	AT3	To what extent do you agree: Travelling with more than two people on a two-wheeler is safe if the driver is highly skilled.	3.27 (1.22)		0.628			
	RB4	How frequently do you do activities that might distract the driver?	4.36 (1.07)		0.531			
	AT4	To what extent do you agree: Passengers should avoid unnecessary movement to maintain balance.	4.01 (1.15)		0.494			
Observed adult risk behaviour	OM4	How often have you seen adults use a mobile phone while driving?	3.81 (1.27)	0.743		0.824		
	OM3	How often have you seen adults drive a car without wearing a seat belt?	3.92 (1.11)			0.769		
	OM2	How often have you seen adults drive after consuming alcohol?	4.44 (1.01)			0.752		
Helmet use non-compliance	RB1	How frequently do you travel without wearing a helmet?	3.9 6(1.14)	0.656			0.864	
	RB2	How frequently do you travel without buckling your helmet strap?	4.10 (1.08)				0.715	
	OM1	How often have you seen adults ride a two-wheeler without a helmet?	3.51 (1.32)				0.591	
Traffic risk perception awareness	PE3	Rate how risky it is if a shawl hangs near the wheel while riding a bike.	4.39 (0.85)	0.634				0.792
	PE1	Rate how risky it is to carry more than two passengers	4.01 (0.84)					0.762
	PE2	Rate how risky it is to open an umbrella while riding a two-wheeler.	4.17 (0.93)					0.686

items indicating exposure to unsafe adult behaviours such as mobile phone use, drink-driving, and neglecting seat belts. Factor 3, Helmet Use Non-Compliance, now includes the moved item OM1 along with self-reported lapses in helmet use, reflecting both personal and observed non-compliance. Factor 4, Traffic Risk Perception Awareness, retained items reflecting students' recognition of risk in specific actions, such as hanging clothing near wheels, carrying more than two passengers, or opening an umbrella while riding.

Overall, the factor structure continues to reflect a multidimensional understanding of two-wheeler safety, integrating attitudinal, observational, self-reported, and cognitive dimensions. The Cronbach's alpha values for all factors ranged from 0.634 to 0.743, confirming acceptable internal consistency

and reliability of the measurement instrument.

5.1.2 Students commuting to school by auto-rickshaw

Exploratory Factor Analysis was conducted on the responses of 156 students who reported commuting by auto-rickshaw. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.727, indicating moderate sampling adequacy, and Bartlett's Test of Sphericity was significant ($\chi^2 = 664.16$, df = 105, $p < .001$), confirming the suitability of the data for factor analysis. Based on eigenvalues greater than 1, three components were extracted, cumulatively explaining a substantial portion of the total variance. Communalities for the items ranged from 0.40 to 0.86, indicating an acceptable level of shared variance among the variables. Table 4 presents the rotated component matrix for students commuting by auto-rickshaw, showing the factor loadings, means, standard deviations, and Cronbach's alpha values for each item.

After extraction, the reliability of each factor was assessed using Cronbach's alpha, and items were reviewed logically for conceptual consistency. Based on these checks, the original five-factor structure was reduced to three factors to achieve a more coherent solution. Specifically, AT1 and AT4 (rule-following attitude items) were deleted due to low conceptual coherence, while OM2 (observed adults driving after alcohol) and AT2 (perceived fun in putting hands/head out) were moved to Factor 1 (Risk-Endorsing Behaviour and Attitude) to better align with students' personal risk-taking behaviours. Items with slightly lower loadings, such as AT2 (0.401), were retained because they conceptually contribute to the factor. Cronbach's alpha values were 0.734 for Factor 1, 0.773 for Factor 2, and 0.671 for Factor 3, indicating acceptable reliability.

Factor 1, Risk-Endorsing Behaviour and Attitude, comprises items reflecting students' engagement in unsafe practices, including sitting in dangerous positions (RB2), travelling in overloaded vehicles (RB3), putting head or hands out of a moving auto-rickshaw (RB1), getting down before the vehicle stops (RB4), carrying extra passengers if the driver can manage (AT3), and the perception that it is fun to put hands or head out of the vehicle (AT2). The inclusion of OM2 also contributes to capturing exposure to adult modelling of risky behaviour. Factor 2, Risk Perception and Safety Awareness, includes items representing students' cognitive recognition of danger, such as sitting in unsafe positions (PE2), extending body parts out of the vehicle (PE3), and overloading the auto-rickshaw (PE1). Factor 3, Observed Adult Risk Behaviour, contains items reflecting risky actions modelled by adults, including riding two-wheelers without helmets (OM1), not wearing seat belts in cars (OM3), and using mobile phones while driving (OM4). The Cronbach's alpha of 0.671 indicates acceptable reliability, given the diversity of behaviours captured in this factor. Overall, these three factors provide a comprehensive representation of students' safety perceptions and behaviours during auto-rickshaw commutes, integrating personal risk-taking tendencies, cognitive awareness of hazards, and observational learning from adult role models.

5.1.3 Students commuting to school by car

Exploratory Factor Analysis was conducted on the responses of 156 students who reported commuting by car. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.857, indicating meritorious sampling adequacy, and Bartlett's Test of Sphericity was significant ($\chi^2 = 783.074$, df = 105, $p < .001$), confirming the suitability of the data for factor analysis. Based on eigenvalues greater than 1, three components were extracted, cumulatively explaining 62.11% of the total variance. Table 5 presents the rotated component matrix for students commuting by car, showing the factor loadings, means, standard deviations, and Cronbach's alpha values for each item.

After extraction, the reliability of each factor was assessed using Cronbach's alpha, and

Table 4. Rotated component matrix for auto-rickshaw mode of travel

Factor name	Item code	Item description	Mean (SD)	Cronbach's α	Factor 1	Factor 2	Factor 3
Risk-endorsing behaviour and attitude	RB2	How frequently do you sit in a dangerous position in an auto-rickshaw?	4.33 (0.83)	0.734	0.702		
	AT3	To what extent do you agree: There is no harm in carrying extra passengers if the driver can manage?	3.79 (1.02)		0.673		
	RB3	How frequently do you travel in an overloaded auto-rickshaw?	3.86 (1.02)		0.631		
	RB4	How frequently do you get down from an auto-rickshaw before it has completely stopped?	4.40 (0.94)		0.600		
	RB1	How frequently do you put your head or hands out of a moving auto-rickshaw?	4.23 (0.84)		0.539		
	AT2	To what extent do you agree: It is fun to put hands or head out of a moving auto-rickshaw?	3.94 (0.96)		0.401		
Risk perception and safety awareness	PE2	Rate how risky it is to sit in a dangerous position in an auto-rickshaw.	4.28 (0.83)	0.773		0.863	
	PE3	Rate how risky it is to put hands or head out of a moving auto-rickshaw.	4.16 (0.88)			0.843	
	PE1	Rate how risky it is to overload an auto-rickshaw with children.	4.32 (0.79)			0.640	
Observed adult risk behaviour	OM1	How often have you seen adults ride a two-wheeler without a helmet?	3.33 (1.04)	0.671			0.835
	OM3	How often have you seen adults drive a car without wearing a seat belt?	3.38 (1.00)				0.781
	OM2	How often have you seen adults drive after consuming alcohol?	4.18 (0.92)				0.741
	OM4	How often have you seen adults use a mobile phone while driving?	3.29 (1.20)				0.636

items were reviewed logically for conceptual consistency. Based on these checks, OM2 (observed adults driving after alcohol) was moved from Factor 1 to Factor 3 due to lower loading, while all other items were retained. This adjustment better aligns the factors with students' personal risk-taking behaviours and observations of adults' unsafe practices. Cronbach's alpha values were 0.856 for Factor 1, 0.805 for Factor 2, and 0.780 for Factor 3, indicating acceptable reliability. Factor 1: Risk-Endorsing Behaviour and Attitude comprises six items (AT2, PE3, RB2, RB3, RB4, and AT4) capturing students' engagement in unsafe practices, such as distracting the driver, putting body parts outside the car, travelling without wearing a seatbelt, alighting before the car stops, or perceiving these behaviours as fun. Factor 2: Risk Perception and Safety Behaviour consist of five items (RB1, AT3, PE2, PE1, and AT1) representing students' own recognition of risks and safer behaviours, including wearing a seatbelt, alighting cautiously, and avoiding distracting actions inside the car. Factor 3: Observed Adult Risk Behaviour includes four items (OM4, OM3, OM1, and OM2) reflecting students' observations of adults' unsafe driving practices, such as using a mobile phone while driving, not wearing seatbelts, riding two-wheelers without helmets, and driving after consuming alcohol. Overall, these factor adjustments provide a more coherent representation of students' car commuting behaviours, highlighting both their personal risk-taking tendencies and the influence of observed adult behaviours.

5.1.4 Students commuting to school by school bus

Exploratory Factor Analysis was conducted on the responses of 156 students who reported commuting by school bus. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.761, indicating a satisfactory level for factor analysis, and Bartlett's Test of Sphericity was significant ($\chi^2 = 796.036$, $df = 105$, $p < .001$), confirming the suitability of the data for factor analysis. Based on eigenvalues greater

Table 5. Rotated component matrix for car mode of travel

Factor name	Item code	Item description	Mean (SD)	Cronbach's α	Factor 1	Factor 2	Factor 3
Risk-endorsing behaviour and attitude	AT2	To what extent do you agree: There is no harm in playing music at high volume inside the car.	3.75 (0.80)	0.856	0.756		
	PE3	Rate how risky it is to distract the driver while the car is moving.	4.04 (0.82)		0.751		
	RB2	How frequently do you do activities that might distract the driver?	4.30 (0.93)		0.748		
	RB3	How frequently do you put your head or hands out of a moving car?	4.39 (0.95)		0.639		
	RB4	How frequently do you get out of the car before it has completely stopped?	4.69 (0.77)		0.601		
	AT4	To what extent do you agree: It is fun to put hands or head out of the car window while moving.	4.19 (0.99)		0.553		
Risk perception and safety behaviour	RB1	How frequently do you travel without wearing a seatbelt?	3.45 (1.00)	0.805		0.747	
	AT3	To what extent do you agree: It is safer to get down from the car only when no other vehicle is nearby.	4.25 (0.86)			0.672	
	PE2	Rate how risky it is to open car doors without checking for nearby vehicles.	4.30 (0.85)			0.669	
	PE1	Rate how risky it is to put hands or head out of a moving car.	4.25 (0.93)			0.661	
	AT1	To what extent do you agree: You should always wear your seatbelt when travelling in a car.	4.36 (0.88)			0.618	
Observed adult risk behaviour	OM4	How often have you seen adults use a mobile phone while driving?	3.69 (0.99)	0.780			0.863
	OM3	How often have you seen adults drive a car without wearing a seat belt?	3.60 (1.10)				0.839
	OM1	How often have you seen adults ride a two-wheeler without a helmet?	3.41 (1.10)				0.737
	OM2	How often have you seen adults drive after consuming alcohol?	4.49 (0.78)				0.487

than 1, three components were extracted after reviewing Cronbach's alpha and conceptual consistency, accounting for a cumulative variance of 52.03%. Table 6 presents the rotated component matrix for students commuting by school bus, showing the factor loadings, means, standard deviations, and Cronbach's alpha values for each item.

Based on the item groupings and theoretical alignment, the following factor structure was identified. Factor 1: Risk Perception & Behaviour Awareness comprised items related to recognising unsafe actions around moving vehicles and risky behaviours after alighting from the bus (e.g. PE3, PE1, RB3, RB4). Factor 2: Observed Adult Risk Behaviour included items referring to traffic violations frequently seen in adults, such as driving under the influence, not using seat belts or helmets, and mobile phone usage while driving (OM1–OM4). Factor 3: Attitudes & Safety Perceptions captured students' beliefs and evaluations about bus travel safety norms (e.g. AT2, PE2, RB1, AT4). Finally, Factor 4: Self- Risky Behaviour consisted of items reflecting students' own engagement in or positive attitudes towards unsafe behaviours while commuting by bus, such as putting body parts out of the window or disembarking before a full stop (e.g. AT3, AT1, RB2). The factor loadings and conceptual clarity indicate that students' safety-related perceptions and behaviours while using school buses are shaped both by personal understanding and observed adult conduct.

After extraction, the reliability of each factor was assessed using Cronbach's alpha, and items were reviewed logically for conceptual consistency. Based on these checks, the original four-factor structure was reduced to three factors. Specifically, the Self-Risky Behaviour factor was merged into the Safety

Table 6. Rotated component matrix for school bus mode of travel

Factor name	Item code	Item description	Mean (SD)	Cronbach's α	Factor 1	Factor 2	Factor 3
Risk Perception and Behavioural Awareness	PE3	Rate how risky it is to run to catch a moving bus.	4.16 (0.95)	0.662	0.809		
	PE1	Rate how risky it is to put hands or head out of a moving bus.	3.93 (0.97)		0.751		
	RB3	How frequently do you cross the road from behind the bus after getting down?	4.03 (1.10)		0.573		
	RB4	How frequently do you push or shove others when boarding the bus?	4.29 (1.19)		0.476		
	AT4	To what extent do you agree: It is dangerous to cross the road behind the bus after getting down.	3.50 (1.26)		0.339		
Observed Adult Risk Behaviour	OM3	How often have you seen adults drive a car without wearing a seat belt?	3.52 (1.26)	0.659		0.795	
	OM4	How often have you seen adults use a mobile phone while driving?	3.72 (1.38)			0.790	
	OM2	How often have you seen adults drive after consuming alcohol?	4.32 (1.15)			0.620	
	OM1	How often have you seen adults ride a two-wheeler without a helmet?	3.23 (1.33)			0.577	
Safety Attitudes and Self-Regulatory Behaviour	AT2	To what extent do you agree: I don't feel it is safe to get out from a moving bus before it has completely stopped.	3.96 (1.14)	0.609			0.693
	PE2	Rate how risky it is to overload the bus.	4.17 (0.90)				0.666
	RB1	How frequently do you put your hands or head out of a moving bus?	4.51 (0.90)				0.571
	RB2	How frequently do you get down from a bus before it has completely stopped?	4.43 (0.96)				0.383

Attitudes factor to achieve a more coherent solution. Item AT3 was removed due to low conceptual alignment, and AT4, despite a lower loading (0.339), was retained to maintain theoretical consistency. Cronbach's alpha values were 0.662 for Factor 1, 0.659 for Factor 2, and 0.609 for Factor 3, indicating acceptable reliability.

Factor 1: Risk Perception and Behavioural Awareness comprises five items (PE3, PE1, RB3, RB4, and AT4) reflecting students' recognition of unsafe actions around moving buses, such as running to catch a bus, putting hands or head outside the vehicle, crossing the road behind the bus, or pushing others when boarding. Factor 2: Observed Adult Risk Behaviour includes four items (OM3, OM4, OM2, and OM1) representing students' observations of adult violations, including driving without seatbelts, using mobile phones while driving, driving after alcohol consumption, and riding two-wheelers without helmets. Factor 3: Safety Attitudes and Self-Regulatory Behaviour consists of four items (AT2, PE2, RB1, and RB2) capturing students' beliefs about safe bus travel and their own risk-regulatory behaviours, including avoiding putting hands or head outside the bus, getting down only when safe, and recognising risks from overloading. Overall, these factor adjustments provide a more coherent representation of students' school bus commuting behaviours, integrating personal awareness, observed adult behaviour, and self-regulatory safety attitudes.

5.1.5 Students commuting to school by private/state bus

Exploratory Factor Analysis was conducted on the responses of 156 students who reported commuting by private or state buses. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.804, indicating meritorious suitability of the data for factor analysis, and Bartlett's Test of Sphericity was significant (χ^2 = 835.274, df = 105,

$p < .001$), confirming the suitability of the correlation matrix for factor extraction. Based on eigenvalues greater than 1 and conceptual review, four components were retained after considering Cronbach's alpha and item coherence, jointly explaining 66.03% of the total variance. Table 7 presents the rotated component matrix for students commuting by private or state bus, showing factor loadings, means, standard deviations, and Cronbach's alpha values for each item.

After extraction, the reliability of each factor was assessed using Cronbach's alpha, and items were reviewed for conceptual consistency. Based on these checks, items AT3 and AT4 were removed from the Attitudes & Safety Beliefs factor due to low conceptual alignment. This resulted in a refined Factor 4 (Permissive Risk Attitude) containing only AT1 and AT2. The Cronbach's alpha for this factor was relatively low (0.520), reflecting the limited number of items and the diversity of concepts captured; however, it was retained due to its conceptual importance in representing students' permissive attitudes towards risky behaviours. Cronbach's alpha values for the other factors were 0.814 for Factor 1, 0.773 for Factor 2, and 0.752 for Factor 3.

Factor 1: Observed Adult Risk Behaviour includes four items (OM1, OM4, OM3, and OM2) representing students' observations of adult unsafe practices, such as not wearing helmets, using mobile phones while driving, driving under the influence, and not wearing seatbelts. Factor 2: Self-Risky Behaviour comprises four items (RB4, RB3, RB2, and RB1) reflecting students' own engagement in unsafe actions during bus travel, including climbing down from a moving bus, pushing others while boarding, hanging out of crowded doors, or putting hands/head outside the vehicle. Factor 3: Risk Perception Awareness consists of three items (PE1, PE3, and PE2) capturing students' recognition of hazardous behaviours while commuting by bus, such as running to catch a moving bus or attempting to get down before it stops. Factor 4: Permissive Risk Attitude includes two items (AT2 and AT1) reflecting students' tolerance or permissive attitudes towards unsafe behaviours, such as putting hands/head out of the bus window when few vehicles are on the road or disregarding queuing in overcrowded buses. Overall, these factor adjustments provide a clearer differentiation between students' personal risk-taking, risk awareness, observed adult behaviours, and permissive attitudes, offering a comprehensive understanding of safety perceptions during private/state bus commutes.

6. Multiple regression analysis

Multiple regression analysis was performed to examine the predictive influence of the extracted latent factors on children's traffic safety behaviours across five distinct school travel modes. Factor scores obtained from the exploratory factor analysis were used as independent variables, while mode-specific behavioural constructs served as dependent variables. The analysis aimed to quantify the extent to which perceptual, attitudinal, and observational factors contributed to variations in safety-related outcomes.

Each model was evaluated for statistical significance using the F-statistic, and the coefficient of determination (R^2) was used to assess the proportion of variance in the dependent variable explained by the predictors. To ensure the validity of results, assumptions of linear regression were verified, including the independence of residuals (using the Durbin–Watson statistic), the absence of multicollinearity (using Variance Inflation Factor, VIF), and homoscedasticity of residuals. Standardised regression coefficients (β) were interpreted to assess the relative strength and direction of influence of each predictor. The derived regression equations for each travel mode were then used to interpret how specific factors collectively shaped children's traffic safety behaviour in different commuting contexts.

Table 7. Rotated component matrix for private/state bus mode of travel

Factor name	Item code	Item description	Mean (SD)	Cronbach's α	Factor 1	Factor 2	Factor 3	Factor 4
Observed adult risk behaviour	OM1	How often have you seen adults ride a two-wheeler without a helmet?	3.43 (1.38)	0.814	.830			
	OM4	How often have you seen adults use a mobile phone while driving?	3.51 (1.37)		.807			
	OM3	How often have you seen adults drive a car without wearing a seat belt?	3.66 (1.30)		.803			
	OM2	How often have you seen adults drive after consuming alcohol?	4.32 (1.05)		.662			
Self-risky behaviour	RB4	How frequently do you hang out of the door in an overcrowded bus?	4.27 (1.09)	0.773		.842		
	RB3	How frequently do you push or shove others when boarding the bus?	4.46 (0.95)			.807		
	RB2	How frequently do you get down from a bus before it has completely stopped?	4.52 (0.89)			.616		
	RB1	How frequently do you put your hands or head out of a moving bus?	4.65 (0.79)			.530		
Risk perception awareness	PE1	Rate how risky it is to run to catch a moving bus.	4.35 (0.90)	0.752			.811	
	PE3	Rate how risky it is to get down from a moving bus.	4.13 (1.00)				.785	
	PE2	Rate how risky it is to hang out of the door of a moving bus.	4.39 (0.96)				.762	
Permissive risk attitude	AT2	To what extent do you agree: It is safe to put hands or head out of the window of a moving bus when few vehicles are on the road.	4.00 (1.26)	0.520				.828
	AT1	To what extent do you agree: It is unsafe to hang out of the door of an overcrowded bus to reach home quickly.	3.94 (1.17)					.759

6.1 Students commuting as passengers on two-wheelers

Multiple linear regression analysis was conducted to examine the influence of protective safety attitudes, observed adult risk behaviour, and risk perception awareness on helmet non-compliance among students commuting via two-wheelers. The overall regression model was statistically significant, F (3,169) = 38.824, p < .001, explaining 40.8 % of the variance in helmet non-compliance (Adjusted R^2 = 0.397). The Durbin–Watson statistic (1.680) indicated independence of residuals, and the highest Variance Inflation Factor (VIF = 1.175) confirmed the absence of multicollinearity among predictors.

The regression equation derived from the analysis was:

Factor 3_Helmet Use Non-Compliance = 0.757 + 0.264 (Factor 1_ Protective Safety Attitude and Behaviour) + 0.307 (Factor 2_ Observed Adult Risk Behaviour) + 0.183 (Factor 4_ Traffic Risk Perception Awareness)

All three predictors made statistically significant contributions to the model (p < .05), with observed adult risk behaviour showing the largest standardised coefficient (β = 0.307), followed by protective safety attitudes (β = 0.264) and risk perception awareness (β = 0.183). These results indicate that the combined influence of attitudinal, observational, and perceptual factors significantly predicts helmet non-compliance behaviour among two-wheeler commuters.

6.2 Students commuting to school by auto-rickshaw

The influence of risk perception awareness and observed adult risk behaviour on permissive risk-taking among auto-rickshaw

commuters was examined using multiple regression. The analysis revealed a statistically significant model (F (2,153) = 59.621, p < .001), which accounted for 43.8 % of the variance in permissive risky behaviour (Adjusted R^2 = 0.431). Multicollinearity was negligible (VIF ≤ 1.002) and residuals were independent.

The resulting regression equation was:

Factor 1_Risk-Endorsing Behaviour and Attitude = 1.845 + 0.380 (Factor 2_ Risk Perception and Safety Awareness) + 0.178 (Factor 3_ Observed Adult Risk Behaviour)

Among the predictors, Factor 2_ Risk Perception and Safety Awareness was the dominant contributor (β = 0.380), followed by Factor 3_ Observed Adult Risk Behaviour (β = 0.178). This indicates that children's evaluation of traffic risks is the primary factor influencing permissive behaviour in auto-rickshaw commutes, with adult risk modelling providing an additional, supporting effect.

6.3 Students commuting to school by car

The regression equation predicting permissive risky behaviour among auto-rickshaw commuters is:

Factor 1_Risk-Endorsing Behaviour and Attitude = 1.845 + 0.380 (Factor 2_ Risk Perception and Safety Behaviour) + 0.178 (Factor 3_ Observed Adult Risk Behaviour)

The model was statistically significant (F (2,153) = 59.621, p < .001) and explained 43.8 % of the variance in permissive risk-taking (Adjusted R^2 = 0.431). Multicollinearity diagnostics were acceptable (maximum VIF = 1.002), and the Durbin–Watson statistic (1.759) indicated independence of residuals.

Factor 2_ Risk Perception and Safety Behaviour showed the strongest standardised effect (β = 0.380, t = 6.085, p < .001), suggesting that lower perception of traffic risk strongly predicts children's permissive attitudes. Factor 3_ Observed Adult Risk Behaviour also contributed significantly (β = 0.178, t = 3.048, p = 0.003), indicating that observational exposure to adult risk behaviour reinforces children's tendency to adopt risky practices in auto-rickshaws.

6.4 Students commuting to school by school bus

Safety attitudes and self-regulatory behaviour among school bus commuters were examined in relation to risk perception and behavioural awareness, as well as observed adult risk behaviour. The regression model was statistically significant (F(2,290) = 121.544, p < .001), explaining 45.6 % of the variance (Adjusted R^2 = 0.452; Durbin–Watson = 1.859; max VIF = 1.010). The regression equation was:

Factor 3_Safety Attitudes and Self-Regulatory Behaviour = 2.154 + 0.439 Factor 1_Risk Perception and Behavioural Awareness + 0.099 Factor 2_Observed Adult Risk Behaviour

Factor 1_Risk Perception and Behavioural Awareness emerged as the strongest predictor (β = 0.439, t = 9.330, p < .001), highlighting that higher awareness of traffic risks is closely associated with safer attitudes and self-regulatory behaviour. Factor 2_Observed Adult Risk Behaviour also contributed significantly, though to a lesser extent (β = 0.099, t = 2.641, p = 0.009), indicating that exposure to adult misbehaviour modestly affects children's safety practices within the structured school bus environment.

6.5 Students commuting to school by private/state bus

For private and state bus users, it was hypothesised that self-reported risky behaviour would be influenced by a combination of observed adult risk behaviour, risk perception awareness, and permissive attitudes. The regression model was statistically significant (F (3,187) = 62.333, p < .001) and explained 50% of the variance in risky behaviour (Adjusted R^2 = 0.492), with multicollinearity within acceptable limits (maximum VIF = 1.112). The resulting regression equation was:

Factor 2_Self-Risky Behaviour = 1.836 + 0.240 Factor 1_Observed Adult Risk Behaviour + 0.283

Factor 3_Risk Perception Awareness + 0.133 Factor 4_Permissive Risk Attitude

All three predictors contributed significantly, with observed adult risk behaviour and risk perception awareness showing slightly stronger effects, while permissive risk attitudes also had a meaningful influence. These results indicate that in bus travel, children's engagement in risky behaviour reflects a combined effect of cognitive appraisal, permissive attitudes, and observational learning from adult behaviours.

Table 8 presents the results of multiple regression analyses for each travel mode, showing how EFA-derived factors predict children's traffic safety behaviours, with all models demonstrating significant explanatory power ($p < .001$).

7. Discussion

This study explored school children's perceptions of traffic safety in the Indian context by examining their attitudes, risk awareness, observed behaviours of adults, and self-reported risky actions across different travel modes: two-wheeler, auto rickshaw, car, school bus, and private/state bus. Through descriptive analysis, Exploratory Factor Analysis (EFA), and Multiple Regression Analysis, the study identified distinct patterns in how students experienced and internalised traffic-related behaviours. The findings contribute to the growing body of evidence on school travel safety by demonstrating how children's perceptions and behaviours vary according to the mode of travel, and how adult behaviour, infrastructure, and children's own actions influence their safety orientation.

The results revealed a high prevalence of observed misbehaviours among adult road users, particularly in motorised two-wheeler and auto rickshaw contexts. Children frequently reported witnessing adults not wearing helmets and seatbelts, using mobile phones while driving, or driving under the influence. This aligns with earlier Indian studies highlighting the normalisation of such violations among urban commuters (Tiwari et al., 2023; Goyal & Verma, 2022; Priye & Manoj, 2020; Dandona et al., 2006). The regression results further confirm that exposure to adult risky behaviour is a significant predictor of children's own unsafe practices across all modes of travel, with standardised coefficients ranging from $\beta = 0.099$ (school bus) to $\beta = 0.307$ (two-wheeler), indicating the consistent modelling effect of adult behaviour on child safety outcomes. These findings support the social learning framework, which posits that children's observation of adult rule-breaking behaviours can influence their own permissive attitudes towards traffic norms (Bandura, 1977).

Self-reported risky behaviour emerged as a significant factor across multiple modes, particularly for two-wheeler and private/state bus commuters, with regression analyses showing that protective safety attitudes, risk perception, and permissive risk attitudes collectively explain 40–50% of variance in children's engagement in unsafe practices. This suggests that children not only observe but also emulate risky behaviours, especially in informal or unregulated transport settings. By contrast, students using school buses exhibited higher levels of Risk Perception and Behavioural Awareness, and regression results indicated that this factor was the strongest predictor of safe behaviour ($\beta = 0.439$), highlighting the protective role of structured travel environments and adult supervision.

Attitudinal differences were also apparent. Children commuting by car and school bus demonstrated greater attitudes and self-regulatory behaviour supportive of rules and cautious behaviour, while those on auto rickshaws or private buses showed less alignment with such beliefs. Regression analyses confirmed that risk perception and safety awareness were the dominant predictors of risk-endorsing behaviours ($\beta = 0.380$ for auto-rickshaw; $\beta = 0.380$ for car), indicating that children's evaluation of traffic hazards strongly influences their engagement in risky practices. These differences may reflect both socio-economic variation and the degree of exposure to formal safety

Table 8. Summary of mode-specific regression models using efa-derived predictors

Travel mode	Dependent variable	Predictors	R^2	Adjusted R^2	F (df_1, df_2)	p-value	Std. Error of Estimate	Durbin–Watson	Max VIF
Two-wheeler	F3_Helmet use non-compliance	F1_Protective safety attitude and behaviour, F2_Observed adult risk behaviour,F4_Traffic risk perception awareness	0.408	0.397	38.824 (3,169)	<.001	0.708	1.680	1.175
Auto-rickshaw	F1_Risk-endorsing behaviour and attitude	F2_Risk perception and safety awareness, F3_Observed adult risk behaviour	0.438	0.431	59.621 (2,153)	<.001	0.464	1.759	1.002
Car	F1_Risk-endorsing behaviour and attitude	F2_Risk perception and safety behaviour, F3_Observed adult risk behaviour	0.652	0.646	101.172 (2,108)	<.001	0.401	2.073	1.140
School bus	F3_Safety attitudes and self-regulatory behaviour	F1_Risk perception and behavioural awareness, F2_Observed adult risk behaviour	0.456	0.452	121.544 (2,290)	<.001	0.493	1.859	1.010
Private/ state bus	F2_Self-risky behaviour	F1_Observed adult risk behaviour, F3_Risk perception awareness, F4_Permissive risk attitude	0.500	0.492	62.333 (3,187)	<.001	0.517	1.634	1.112

education, reinforcing the need for mode-specific, context-sensitive interventions.

Interestingly, the factor structure and regression findings suggest that children do not perceive traffic safety as a monolithic concept but rather as a multifaceted experience shaped by observed adult behaviour, personal risk-taking tendencies, cognitive risk awareness, and permissive attitudes. This reinforces the need for multimodal and context-specific traffic safety interventions, rather than a one-size-fits-all approach. Policies should simultaneously address attitudinal change, risk awareness, and adult modelling effects to foster safer commuting behaviours (Elvik et al., 2009).

Overall, the study's findings are consistent with international research on social learning and adolescent safety behaviour, particularly the notion that children's exposure to adult rule-breaking undermines formal safety messaging. However, the inclusion of regression analyses strengthens the evidence by quantifying the relative influence of perceptual, attitudinal, and observational factors, showing that interventions targeting both children and adult role models are likely to be most effective. The study uniquely contextualises these insights within the Indian school transport setting, offering guidance for targeted interventions.

The findings also suggest that promoting road safety awareness among children must extend beyond school-based instruction. Traffic safety campaigns should target parents, drivers, and transport operators, particularly in informal transport contexts, to reduce contradictory signals. Community- and family-based reinforcement of traffic norms could further enhance the effectiveness of school-focused initiatives.

This research is not without limitations. While it provides rich mode-specific insights, it relies on self-reported perceptions and behaviours, which may be influenced by social desirability or recall bias. Future research may incorporate observational, longitudinal, or experimental methods to triangulate findings. Additionally, differences based on gender, age, or urban-rural context warrant further exploration.

In summary, the study demonstrates that children's traffic safety behaviours are influenced by a combination of risk perception, observed adult behaviour,

protective attitudes, and permissive risk tendencies. The integration of EFA and multiple regression analyses offers robust evidence that both cognitive and social factors contribute significantly to children's engagement in risky behaviours, highlighting the importance of context-specific, multi-stakeholder strategies to foster safer school commutes in India.

8. Conclusions

This study offers a scientifically grounded contribution to the understanding of traffic safety perceptions and behaviours among school-going children in India. By examining multiple modes of school transport—two-wheelers, auto-rickshaws, cars, school buses, and private/state buses—this research adds empirical depth to a relatively underexplored area within child road safety literature. It provides a comparative, mode-specific analysis of how school children perceive risks, observe adult behaviours, and engage in their own safety practices during daily commutes.

The data were collected through a mixed-mode (online and offline) questionnaire survey administered across two Indian states. Exploratory Factor Analysis (EFA) and Multiple Regression Analysis were employed to uncover latent dimensions of traffic safety perceptions, attitudinal tendencies, observational learning, and self-reported risky behaviours, and to examine their predictive influence on children's traffic safety outcomes across different travel modes. This integrated approach allowed for the identification of context-specific factors—such as Protective Safety Attitude and Behaviour, Observed Adult Risk Behaviour, Risk Perception Awareness, Self-Risky Behaviour, and Permissive Risk Attitude—and quantified their contribution to children's engagement in unsafe practices.

The findings reveal a consistent gap between traffic safety awareness and actual behaviours, particularly among children commuting by two-wheelers, auto-rickshaws, and private/state buses. Despite reporting knowledge of traffic rules—such as wearing helmets or using seat belts—many students admitted to participating in or witnessing unsafe practices. Multiple regression results indicate that observed adult risk behaviour is a significant predictor of children's unsafe practices across all modes, with standardised coefficients ranging from $\beta = 0.099$ (school bus) to $\beta = 0.307$ (two-wheeler), highlighting the strong modelling effect of adult behaviour. Protective safety attitudes and risk perception awareness further explain 40–50 % of the variance in self-reported risky behaviours, particularly in informal transport contexts.

Importantly, the study demonstrates that travel mode-specific risks require targeted solutions. Children commuting via school buses exhibited higher Risk Perception and Behavioural Awareness, which strongly predicted safer attitudes and self-regulatory behaviour ($\beta = 0.439$), emphasising the protective role of structured and supervised travel environments. Conversely, children using auto-rickshaws and private/state buses displayed greater permissive risk-taking, influenced both by lower risk perception and exposure to adult violations, while two-wheeler passengers reported high helmet non-compliance linked to attitudinal and observational factors. These insights can inform policymakers and educators in designing age-appropriate, mode-specific, and context-sensitive safety interventions.

Nevertheless, certain limitations may have influenced the study outcomes. First, the reliance on self-reported data—particularly from younger children—raises concerns about recall accuracy and social desirability bias. Children in lower age groups may not fully notice or interpret traffic behaviours during travel. Second, the use of both online and offline data collection across two states with differing socio-infrastructural contexts may have introduced variability that could not be fully controlled.

Future research should employ observational or video-based approaches to objectively assess children's traffic behaviours, while the use of gamified tools could enhance engagement and behavioural realism,

especially among younger students. The mode-specific findings from this study provide a robust foundation for targeted interventions, such as gamified safety modules or school-based campaigns, tailored to the distinct risk behaviours associated with each travel mode.

In conclusion, this study advances the field of traffic safety by offering a nuanced, empirically supported understanding of how children experience and respond to road environments during school commutes in India. The integration of EFA and regression analyses highlights that both cognitive (risk perception, safety awareness) and social factors (observed adult behaviour, permissive attitudes) significantly influence children's engagement in risky behaviours. A multi-stakeholder strategy—combining behavioural education, parental and driver involvement, infrastructure improvements, and enforcement—is essential to bridge the gap between awareness and action. The evidence generated can inform more effective, data-driven policies and interventions to safeguard school-going children in increasingly complex and urbanised traffic systems.

CRediT contribution

Manjunath Ishwar Borakanavar: Conceptualization, Data curation, Formal analysis, Methodology, Writing—original draft. **Akhilmith V**: Conceptualization, Data curation, Formal analysis, Writing—original draft, Writing—review & editing. **Hoai Nguyen Pham**: Conceptualization, Data curation, Investigation. **Yogeshwar V Navandar**: Methodology, Supervision, Validation, Writing—review & editing. **K Krishnamurthy**: Supervision, Validation, Writing—review & editing.

Data availability

The data are available on request to the authors.

Declaration of competing interests

The authors report no competing interests.

Ethics statement

The authors confirm that the data collection for this study was conducted with proper ethical considerations. Permission was obtained from the respective school authorities, including the principals, as well as from the parents of the participating students. Additionally, approval was secured from the department head to ensure adherence to institutional guidelines.

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Declaration of generative AI use in writing

During the preparation of this work, the authors used ChatGPT 4.0 in order to improve the readability and language of the manuscript. After using this tool/services, the authors reviewed and edited the content as needed and takes full responsibility for the content of the published article.

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Appendix

Traffic safety attitude of children across different travel modes

Mode of travel	Statement	Response category (%)				
		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Two-wheeler	You should always wear your helmet when travelling in on a two-wheeler	65.9	17.9	13.3	2.9	0
	It is important to make sure that helmet is properly buckled before the journey	48.5	34.7	12.7	3.5	0.6
	Travelling with more than two people on two-wheeler is not dangerous when the driver is highly skilled	8.7	19.6	27.2	25.4	19.1
	The passenger should avoid unnecessary movement in order to avoid losing balance while traveling	46.8	23.7	15.6	11.0	2.9
Auto-rickshaw	Over speeding of auto rickshaws can cause accidents	32.0	52.6	9.0	5.1	1.3
	It is fun to put out body parts out of a moving auto rickshaw	0.6	9.0	17.9	40.4	32.1
	No harm in carrying a greater number of passengers as long as the driver is able to drive	3.2	9.0	18.6	44.2	25.0
	I will not get down from the auto rickshaw before it is completely stopped	56.4	30.8	7.7	4.5	0.6
Car	You should always wear your seatbelt when travelling in a car	58.6	23.4	13.5	4.5	0
	There is no harm in playing the music in high volume inside the car	0	6.3	28.8	48.7	16.2
	It is safer to get down from the vehicle after making sure that no vehicle is coming near that side	46.9	36.9	10.8	5.4	0
	It is fun to put out hands/head out of the window of a moving car	0.9	9.0	9.0	32.4	48.7
School bus	It is annoying to stand in queue before getting into the bus	23.2	35.5	26.3	9.9	5.1
	Didn't feel it safe to get out from a moving bus before it is completely stopped	43.0	26.3	18.1	8.9	3.7
	Fun to put the hands/head out of the window of a moving bus	9.9	8.5	13.0	25.9	42.7
	It is dangerous to cross the road behind the bus after getting down	27.3	28.0	19.1	18.4	7.2
	It is "OK" to travel by hanging out from the door of an over-crowded bus when you are in a hurry to reach home	4.2	11.0	13.1	29.8	41.9
Private/ state bus	It is not dangerous to put hands/head out of the window of a moving bus when there is not much vehicle on road	6.3	8.4	9.9	27.2	48.2
	It is unsafe to get out from a moving bus before it is completely stopped	36.1	31.9	11.0	8.4	12.6
	Getting into the bus in a queue should always be followed	36.7	34.0	18.3	8.9	2.1

Risk perception of children commuting by different modes of travel

Mode of travel	Statement	Response category (%)				
		Very high risk	High risk	Moderate risk	Less risk	No risk
Two-wheeler	Carrying more than two passengers	47.9	34.3	10.8	6.8	0.2
	Opening umbrella on a moving two-wheeler	45.4	39.7	9.7	5.1	0.1
	Hanging out dress near the wheel	44.3	35.0	16.7	4.0	0
Auto-rickshaw	Overloading auto rickshaw with children	48.7	38.5	9.0	3.8	0
	Sitting in dangerous position	48.7	34.6	12.8	3.9	0
	Putting body parts out of a moving auto rickshaw	43.6	33.3	18.6	4.5	0
Car	Putting body parts out of moving car	51.4	29.7	11.7	7.2	0
	Opening doors without looking for any vehicles coming from sides	52.3	29.7	14.4	3.6	0
	Distracting the drivers while driving	34.2	37.8	26.2	1.8	0
School bus	Putting body parts out of moving vehicle	33.4	36.9	20.2	8.9	0.6
	Overloading of vehicle	44.1	35.1	14.3	6.5	0
	Running to catch moving bus	46.8	30.7	16.0	5.5	1.0
Private/ state bus	Hanging out of the door in a moving bus	64.3	20.4	7.9	5.8	1.6
	Running to catch the bus	58.6	23.1	14.7	2.6	1.0
	Trying to get down from a moving bus	46.1	31.9	13.1	7.3	1.6

Traffic risky behaviour of children by mode of travel

Mode of travel	Statement	Response category (%)				
		Never	Rarely	Sometimes	Often	Too often
Two-wheeler	Not wearing helmet while travelling	43.4	23.1	25.4	2.3	5.8
	Not buckling the helmet strap properly	46.8	27.8	18.5	2.3	4.6
	Try to get down from the vehicle before it completely stopped	66.5	9.8	14.5	6.3	2.9
	Doing activities that can cause distractions to driver	66.5	15.0	11.0	3.5	4.0
Auto-rickshaw	Put your head or hands out of moving auto rickshaw	45.5	34.6	18.6	0	1.3
	Getting yourself seated in dangerous position	52.5	30.8	15.4	0	1.3
	Travel in auto rickshaw when it is overloaded	33.3	30.1	28.9	5.2	2.5
	Getting down from the auto rickshaw before it completely stopped	62.2	23.7	9.0	2.6	2.5
Car	Not wearing seatbelt	15.3	34.2	33.3	14.5	2.7
	Doing activities that can cause distractions to driver	55.9	25.2	13.5	4.5	0.9
	Put your head or hands out of moving vehicle	66.7	11.7	16.2	5.4	0
	Try to get down from the vehicle before it completely stopped	82.9	8.1	5.4	2.7	0.9
School bus & private/ state bus	put their hands/head move out of a moving bus	72.7	11.6	11.6	2.7	1.4
	climbed down from a moving bus before it is completely stopped	66.9	16.7	12	1.7	2.7
	crossed the road from behind the bus after getting down	45.4	24.6	21.8	3.8	4.4
	push or shove others when they are boarding the bus	68.3	9.2	11.3	6.1	5.1

Observed misbehaviours of other road users by mode of travel

Mode of travel	Statement	Response category (%)				
		Never	Rarely	Sometimes	Often	Too often
Two-wheeler	Not wearing helmet	31.2	22.6	22.5	13.9	9.8
	Driving vehicle after consuming alcohol	69.9	13.3	10.4	3.5	2.9
	Not wearing seat belt	41.6	22.0	26.6	6.9	2.9
	Using mobile phone while driving	42.8	17.9	24.3	7.5	7.5
Auto-rickshaw	Not wearing helmet	15.4	25.6	41.1	12.8	5.1
	Driving vehicle after consuming alcohol	43.6	38.5	11.5	5.1	1.3
	Not wearing seat belt	14.7	29.5	37.2	16.0	2.6
	Using mobile phone while driving	19.2	25.0	28.9	19.2	7.7
Car	Not wearing helmet	18.1	27.9	38.7	8.1	7.2
	Driving vehicle after consuming alcohol	64.0	24.3	9.9	0.9	0.9
	Not wearing seat belt	24.3	30.6	31.5	8.1	5.5
	Using mobile phone while driving	24.3	34.2	28.9	11.7	0.9
School bus & private/ state bus	Not wearing helmet	33.0	15.2	26.2	13.6	12.0
	Driving vehicle after consuming alcohol	61.3	21.5	10.0	3.1	4.1
	Not wearing seat belt	36.7	20.4	24.1	9.9	8.9
	Using mobile phone while driving	34.6	17.3	25.1	11.5	11.5