REVIEW ARTICLE

Understanding risk factors in road traffic accidents among young motorcyclists aged 18-24: a scoping review

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ABSTRACT

Road traffic accidents (RTAs) are global public health issues affecting young motorcyclists aged 18-24 years due to their risky behaviors, such as emotional, rushed, and careless driving. Therefore, this review aimed to identify and analyze risk factors contributing to RTAs among young motorcyclists. The procedures began with a comprehensive search on Scopus, ScienceDirect, and PubMed databases for studies published between 2019 and 2022 using Arksey and O'Malley's framework as well as the PRISMA-ScR checklist. Based on the search results, a total of 13 peer-reviewed studies met stringent inclusion criteria, focusing on individuals aged 18-24 driving 2-wheeled motorcycles. Critical appraisal results using Joanna Briggs Institute (JBI) tools showed several key factors influencing RTA rates, including age and gender differences, sensation-seeking behavior, as well as social and environmental impacts, particularly peer passenger influence. This indicates the urgent need for targeted interventions, such as age-specific educational programs and stricter regulations, and calls for longitudinal studies to assess the long-term effectiveness of the interventions. Integrating these results into policy frameworks is crucial for reducing accidents among young motorcyclists, advocating for a comprehensive approach that combines education, regulation, and ongoing evaluation to enhance road safety.

Key words:
traffic accidents; motorcycles; risk-taking behavioral; adolescent; scoping review

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INTRODUCTION

Road traffic accidents (RTAs) are critical global public health issues, claiming approximately 1.2 million lives annually and generating an economic impact exceeding $500 billion.[1] These figures emphasize the severity of RTAs, which are a major concern for policymakers and health professionals worldwide. The World Health Organization (WHO) estimates that RTAs reduce national GDPs by 3%, indicating the substantial socio-economic burden they impose.[2,3] Among these fatalities, vulnerable road users, particularly motorcyclists are disproportionately affected due to the limited protection their vehicles provide, accounting for 54% of deaths.[4]

According to previous studies, young motorcyclists, especially those aged 18-24 years, are at high risk and experience the highest rates of traffic accidents and related fatalities.[3,5,6] In addition, their vulnerability is exacerbated by a combination of behavioral tendencies, environmental conditions, and the inherent dangers of motorcycles.[7] In low- and middle-income countries, where 90% of RTAs occur, young adults are disproportionately represented.[8,9] The growing popularity of motorcycles among young adults due to their affordability and ease of maneuverability further increases these risks, particularly among inexperienced drivers, with 55.8% experiencing RTAs after obtaining their licenses.[10,11]

Despite these risks, current interventions aimed at mitigating the dangers faced by young motorcyclists are inadequately developed and inconsistently implemented. Previous studies have shown that cognitive failures, such as attention deficits and poor hazard perception, significantly contributed to RTAs, but these issues are insufficiently addressed in current safety programs.[12] In addition, the psychological and social determinants of risky driving behaviors, such as aggression and risk-taking, are acknowledged but not thoroughly understood or targeted.[13] The influence of demographic variables, including age, gender, and socio-economic status on accident risk remains unclear, particularly across different socio-economic and cultural contexts.[2] This knowledge gap hinders the development of comprehensive and effective interventions. Therefore, this review aimed to fill these gaps by providing a comprehensive review of factors contributing to RTAs among young motorcyclists. By analyzing existing literature, the review also aims to identify the behavioral, demographic, and infrastructural influences that contribute to the high incidence of RTAs. The results are expected to provide directions for future studies and policy development to create more effective and sustainable safety interventions for young motorcyclists.

METHODS

This scoping review was conducted following Arksey and O'Malley's 5-stage framework and adhered to the PRISMA-ScR checklist to ensure systematic and transparent reporting.[14–16] The checklist was used to enhance both the transparency and comprehensiveness of the review, following best practices in systematic review methodologies.[17,18]

Research question and eligibility criteria

The research question explored why traffic accidents comprising 2-wheeled motorcycles were prevalent among young adult drivers. Inclusion criteria included (1) studies published between 2019 and 2024 in English, (2) articles, (3) studies focused on individuals aged 18-24, and (4) reports concerning 2-wheeled motorcycles. Exclusion criteria included review articles, studies involving individuals outside the 18-24 age range, and those associated with other vehicle types, such as mopeds or bicycles.

Search strategy

A comprehensive search strategy was employed across Scopus, ScienceDirect, and PubMed databases using Boolean combinations of keywords, such as "traffic AND accidents" OR “Road AND Traffic AND accident” AND “young AND riders”. The articles used in this review were drawn from various journals and publishers, reflecting the broad scope of study in the field of traffic safety and human behavior. These articles included publications in The Open Public Health Journal, managed by Bentham Open, and Injury, a journal published by Elsevier that focused on studies related to trauma and injury prevention. Additionally, a study published in Transportation Report Interdisciplinary Perspectives and Transportation Procedia, both published by Elsevier, highlighted studies related to transportation and road safety.

A study published in the Malaysian Journal of Medicine and Health Sciences, managed by Universiti Putra Malaysia Press, as well as in BMC Public Health published by Springer Nature, provided important insights into public health and driving safety. Additionally, articles from Clinical Epidemiology and Global Health and Transportation Study Part F, both published by Elsevier, contributed to a deeper understanding of the factors influencing road safety.

A study from Jama Network Open and the International Journal of Environmental Report and Public Health, published by MDPI, added further dimensions by focusing on environmental health and its impact on traffic safety. The use of diverse sources from reputable publishers demonstrated a comprehensive approach to understanding and analyzing road safety issues and related human behavior. A total of 515 articles were identified, and managed through Mendeley Reference Manager, with duplicates systematically removed.

Study selection

The initial screening involved evaluating the titles and abstracts of 515 articles by the first author, with relevant studies coded and discussed with the team (ZS, BW, YS). A total of 4 independent reviewers applied inclusion and exclusion criteria consistently. After removing duplicates (4 articles), 511 articles underwent a 2-stage screening process, including a full-text review, resulting in 13 studies selected for synthesis. The study selection process and reasons for exclusion were detailed in the PRISMA flow diagram (Figure 1).

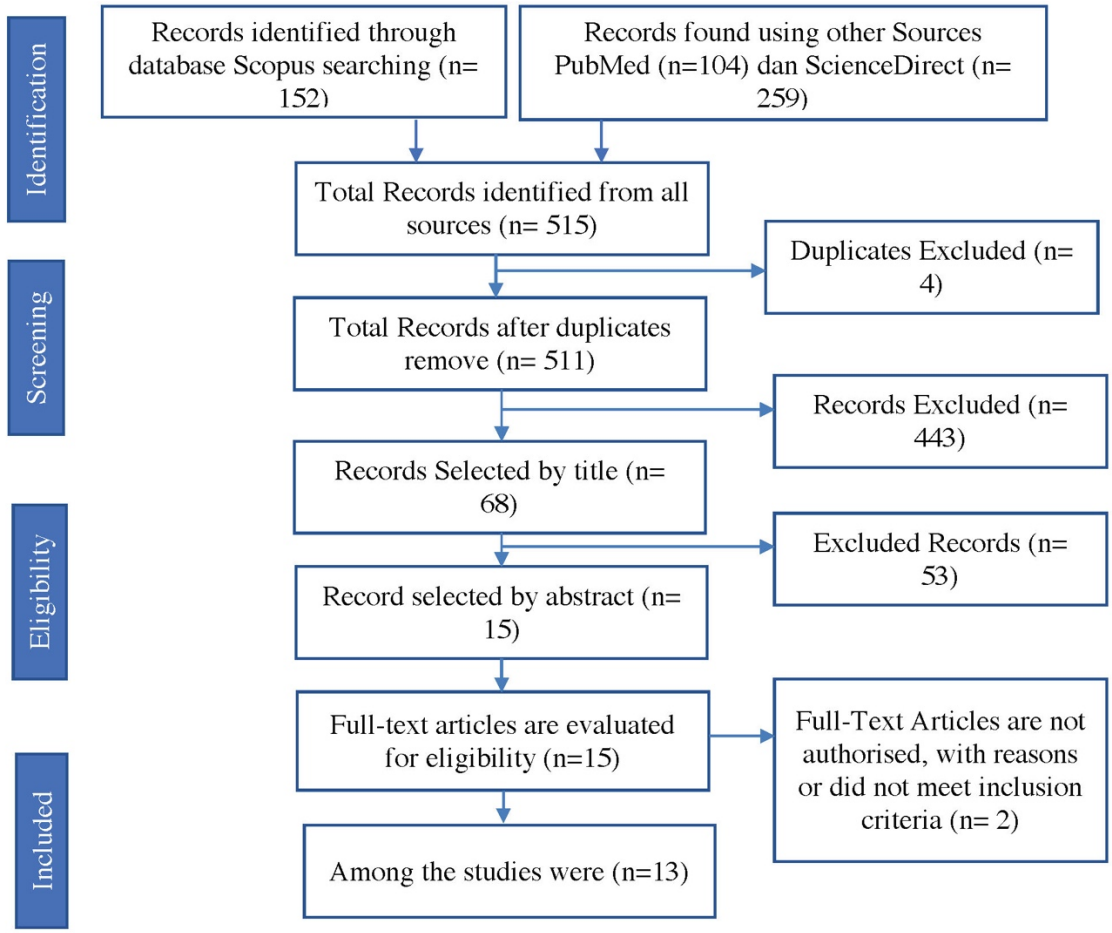

Figure 1. PRISMA flow diagram of study search and selection

Data Extraction and Synthesis

Data extraction was conducted using Microsoft Excel®, capturing essential details such as study title, author's name, publication year, study site, population, aim, report design, and key findings. Additionally, extracted data were organized in a matrix format in Microsoft Word (Table 3). Quality appraisal was performed using the Joanna Briggs Institute (JBI), Critical Appraisal Checklist for Cross-Sectional and Cohort Studies, with each study evaluated against 8 criteria and categorized as "Yes" (Y), "Unclear" (U), or "Not Applicable" (NA). Data synthesis employed a narrative approach, focusing on the causal factors of RTAs among young motorcyclists, integrating findings across various contexts and study designs.

RESULTS

Characteristics of Included Studies

The initial search yielded 515 articles from Scopus (n = 152), PubMed (n = 104), and ScienceDirect (n = 259). After abstract analysis and full-text review, 13 articles met the inclusion criteria. These studies were conducted across diverse locations including Italy (1), India (2), Thailand (3), Malaysia (1), Pakistan (1), Croatia (1), Qatar (1), the U.S. (1), Greece (1), and Indonesia (1), which utilized cross-sectional and prospective cohort designs. The characteristics of a selected manuscript generally refer to the specific attributes, criteria, or factors that were considered when selecting a study or manuscript to include in a literature review.

These characteristics ensured that the selected manuscript was relevant, high-quality, and appropriate for answering the study questions. Each study was rated as "Include" (I), indicating that the report met the criteria for inclusion and was methodologically sound, providing reliable data for further analysis. Detailed critical appraisals are presented in **Tables 1** and **2**. Meanwhile, data extraction from this study can be seen in **Table 3**.

The reviewed studies showed various factors contributing to RTAs from studies conducted in different countries. These factors included behavioral aspects such as sensation-seeking, peer passenger influence, and traffic violations, all closely linked to risky driving behavior. Demographic differences, such as gender and age, also affected driving behavior, with findings indicating that males and younger drivers were more prone to engaging in risky behavior. Technology such as Virtual Reality (VR) and visibility conditions were found to influence speed perception, impacting accident risk. The use of technology and driving training played an important role in reducing accident rates, particularly among young drivers (**Table 4**).

Theme 1: Age and Gender Differences in Driving Behavior

The studies consistently identified significant differences in driving behavior influenced by both age and gender. Uttra et al. (2020) found that health motivation and perceived behavioral control had a stronger influence on women's driving behavior compared to men, leading to safer practices among female drivers.[19] However, studies by Ahmad et al. (2022) and Khan et al. (2022) showed that men were more frequently involved in accidents and engaged in higher-risk driving behaviors than women.[20,21] Babic et al. (2022) further highlighted female drivers exhibited more accurate speed perception under virtual reality conditions, suggesting cognitive differences in risk perception between genders.[22]

Male drivers were more often implicated in traffic accidents, which were attributed to their aggressive driving styles and a higher propensity for risky behavior.[11,23] However, Nori et al. (2020b) found no significant gender differences in driving behavior when spatial strategy was considered, indicating that spatial ability could be more critical in predicting safe driving practices.[10] Age also emerged as a significant factor, with younger drivers, particularly males, becoming more prone to risky behaviors, which correlated with higher accident rates.[11] Notably, young drivers with a driver's license were found to be less likely to suffer accidents compared to those without a license, underscoring the importance of formal driving education.[24] These findings suggested that gender and age were crucial factors in driving behavior, and interventions tailored to these variables could improve traffic accident prevention strategies.

Theme 2: Sensation-Seeking Behavior

Sensation-seeking behavior, particularly thrill and adventure-seeking, was identified as a key factor influencing risky driving behavior among young and novice drivers. Swarna Stefy Grace et al. (2020) found that sensation-seeking behaviour was strongly associated with the tendency of novice drivers to engage in risky driving behaviors.[25] This finding was supported by Sumit et al. (2021), who showed that young motorcyclists with high levels of sensation-seeking were more likely to engage in dangerous stunts, which could increase the risk of accidents.[26]

Additional studies, such as Nori et al. (2020b), identified other risky behaviors, including ordinary violations and aggressive driving, as significant among sensation-seeking individuals, contributing to a higher incidence of accidents.[10] The strong correlation between sensation-seeking and risky driving underscored the need for targeted interventions, including educational and regulatory strategies, to reduce accident rates among young drivers.

Theme 3: Impact of Social and Environmental Factors

Social and environmental factors significantly influenced risky driving behavior among young drivers. A total of 6 studies provided insights into how these factors contributed to traffic accidents.[10,11,24,27–29] Nori et al. (2020) emphasized the role of spatial orientation skills and gender strategies in predicting risky driving, suggesting that cognitive factors were crucial for safe driving practices.[10] Similarly, Tarlochan et al. (2022) and Walshe et al. (2022) highlighted the importance of attitudes toward traffic rules and the quality of driver training as key determinants of accident rates, underscoring the need for comprehensive driver education.[11,24]

Environmental conditions also played a significant role, with Satiennam et al. (2023) and Yannis et al. (2023) finding that low traffic density and infrastructure elements, like long U-turn distances, increased the likelihood of risky behaviors such as wrong-way driving.[27,28] Furthermore, Setyowati et al. (2024) linked risky driving behavior to demographic characteristics and accident history.[29] Enhancing spatial orientation skills through targeted training could reduce risky behaviors and improve road safety for young drivers.[10] Furthermore, these findings underscored the critical impact of social and environmental factors on driving behavior and highlighted potential areas for intervention, including improved driver education and infrastructure design.

Theme 4: Peer Passenger Influence

Peer passengers significantly influenced the driving behavior of novice drivers, as highlighted by Swarna Stefy Grace et al. (2020). The study revealed that novice drivers were more likely to engage in risky driving practices when accompanied by peers, who often encouraged sensation-seeking and higher-risk behaviors.[25] This peer influence played a crucial role in shaping the social dynamics that impacted young drivers' decision-making processes. Consistently, studies found that novice drivers took more risks, such as speeding and dangerous maneuvers, under social peer pressure. These findings emphasized the need to consider social dynamics in interventions aimed at reducing risky driving among young drivers. Educational programs addressing peer pressure and promoting safe driving practices could effectively mitigate these risks and enhance road safety in this vulnerable group.

Table 1. Critical appraisal for included studies using the JBI Critical Appraisal Checklist for Cross-Sectional Studies

Criteria	Raffaella Nori (2020)[10]	P. Swarna Stefy Grace (2020)[25]	Savalee Uttra (2020)[19]	Kumar Sumit (2021)[26]	Sajjakaj Jomnonkwao (2021)[30]	Noor Sakinah binti Ahmad (2022)[20]	Uzmah Rahim Khan (2022)[21]	Darko Babić (2022)[22]	Faris Tarlochan (2022)[31]	Thaned Satiennam (2023)[27]	George Yannis (2023)[28]	Setyowati, et al, (2024)[29]
Were the criteria for inclusion in the sample clearly defined?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were confounding factors identified?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were strategies to deal with confounding factors stated?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Overall appraisal:	I	I	I	I	I	I	I	I	I	I	I	I

Table 2. Critical Appraisal for Included Studies Using the JBI Critical Appraisal Checklist for Cohort Studies

Criteria	Walshe et, al. (2022).[24]
Were the two groups similar and recruited from the same population?	Y
Were the exposures measured similarly to assign people to both exposed and unexposed groups?	Y
Was the exposure measured in a valid and reliable way?	Y
Were confounding factors identified?	Y
Were strategies to deal with confounding factors stated?	Y
Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	Y
Were the outcomes measured in a valid and reliable way?	Y
Was the follow up time reported and sufficient to be long enough for outcomes to occur?	Y
Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	Y
Were strategies to address incomplete follow up utilized?	Y
Was appropriate statistical analysis used?	Y
Overall appraisal:	I

Table 3. Data extraction matrix

No	Title, Author, Year	Country	Study Population	Aim of the Study	Methods	Key Finding
1.	The specific role of spatial orientation skills in predicting driving behavior Nori, et al., (2020)[10]	Bologna, Italy	166 Students	To analyze whether visuospatial contribution in predicting Driving behavior	The spatial and gender strategies on each risky driving behavior and risk perception.	Ordinary violations, aggressive violations, deviations, and errors are statistically significant.
2.	Sensation seeking and peer passenger influence on risky driving among novice drivers in Udupi Taluk, India. P. Swarna Stefy Grace, Kumar Sumit, Neelima Chakraborty, (2020)[25]	India	150 participants	To study sensation-seeking behavior among novice drivers in Udupi Taluk	Cross-sectional study	Sensation-seeking behavior, especially thrill and adventure seeking, is linked to risky driving behavior among novice drivers
3.	Explaining Sex Differences in Motorcyclist Riding Behavior: An Application of Multi-Group Structural Equation Modeling. Savalee Uttra, Napat Laddawan, Vatanavongs Ratanavaraha, Sajjakaj Jomnonkwao, (2020)[19]	Thailand	1516 motorcyclist (903 men, 613 women)	To investigate sex differences in motorcycle riding behavior using structural equation modeling (SEM) and applying the theory of planned behavior (TPB) and locus of control (LC) theory	Multi-group structural equation modeling (SEM)	Significant differences were found in riding behaviors between men and women, with health motivation and perceived behavior control having stronger effects on men, while internal factors had a stronger influence on women
4.	Risky motorcycle riding behaviour among young riders in Manipal, India. Kumar Sumit, Veerle Ross, Kris Brijs,	India	300 young motorcycle riders aged 18–25 years (93% males, 92.3% students)	To determine the structure of a modified version of the Motorcycle Rider Behaviour Questionnaire (MRBQ) and assess its association with self-	Cross-sectional study using exploratory factor analysis and logistic regression	Stunts and violations were positively associated with self-reported near-crash experiences. Riders performing stunts or using motorcycles of 125-

No	Title, Author, Year	Country	Study Population	Aim of the Study	Methods	Key Finding
	Geert Wets, Robert A. C. Ruiter, (2021)[26]			reported crash involvement and violations among young riders in Manipal		200 cc were more likely to receive fines
5.	Analysis of a driving behavior measurement model using a modified driver behavior questionnaire encompassing texting, social media use, and drug and al7.cohol consumption. Sajjakaj Jomnonkwao, Savalee Uttra, Vatanavongs Ratanavaraha, (2021)[30]	Thailand	1,532 drivers aged 20 years or older from 30 provinces in Thailand	To develop a measurement model of risky driving behaviors in Thailand, integrating the Driver Behavior Questionnaire (DBQ) with new factors related to texting, social media, and substance use	Cross-sectional study using Confirmatory Factor Analysis (CFA)	The 6-factor model (violations, errors, lapses, aggressiveness, texting/social media, and drug/alcohol consumption) showed a good fit and effectively measured risky behaviors
6.	Risk Riding Behaviours of Young Motorcyclists Among Students in Univeristi Putra Malaysia, Serdang, Selangor. Noor Sakinah binti Ahmad, Karmegam Karuppiah, et al., (2022)[20]	Malaysia	184 students	To determine riding behaviors of young motorcyclists among university students	Cross-sectional study	Male students showed higher involvement in accidents, with significant behavioral differences between genders
7.	Association of age and severe injury in young motorcycle riders: A cross-sectional study from Karachi, Pakistan. Uzma Rahim Khan, (2022)[21]	Pakistan	45,366 injured motorcycle riders aged 13-24 years	To assess the association between age and severe injury in young motorcycle riders in Karachi	Cross-sectional study using logistic regression analysis.	Motorcycle riders aged 13-17 and 18-19 years had significantly higher odds of severe injury compared to those aged 20-24 years

No	Title, Author, Year	Country	Study Population	Aim of the Study	Methods	Key Finding
8.	Young drivers' perception of speed: VR and video footage comparison study. Darko Babić, Magdalena Čavka, Dario Babić, Pero Hrabač, (2022)[22]	Croatia	80 young drivers (18-24 years old) divided into 2 groups	To analyze how young drivers perceive driving speed depending on the type of road, visibility conditions, and technology used (VR vs. projector)	Cross-sectional study using video footage and VR	Speed perception was more accurate in VR conditions, at nighttime, and on rural roads. Women performed better in speed assessment than men
9.	Understanding Traffic Accidents among Young Drivers in Qatar Tarlochan, et al., (2022)[11]	Qatar	253 young drivers in Qatar from 18 to 25 years	To develop a relationship between the behavior of the Driver, the obligation to traffic legislation, and the personality with traffic accidents.	Cross-sectional studies. Comfort and snowball sampling are non-probability sampling methods.	Traffic violations are related to driving style and attitude toward traffic rules.
10.	Licensing Examination and Crash Outcomes Postlicensure in Young Drivers Walshe et, al., (2022)[24]	Ohio, AS	2018 license applicants	To compare the licensing and accident outcomes of drivers under 18	The prospective community cohort. Poisson's regression model	This study showed that drivers licensed at 18 years old had higher crash rates compared to younger drivers who received training. This underscores the importance of driver education and training in reducing accidents among young drivers.
11.	Wrong way driving intention and behavior of young motorcycle riders. Thaned Satiennam, Nuttapon Akapin, Wichuda Satiennam, Jetsada Kumphong, Nopadon Kronprasert,	Thailand	234 young motorcycle riders (average age 22 years)	To investigate the factors influencing wrong way driving (WWD) behavior among young motorcycle riders using the Theory of Planned Behavior (TPB)	Cross-sectional study using Structural Equation Modeling (SEM)	Subjective norms, attitudes, and perceived behavioral control significantly influence WWD intention. Intention and perceived behavioral control influence WWD behavior, with facilitating

No	Title, Author, Year	Country	Study Population	Aim of the Study	Methods	Key Finding
	Vatanavongs Ratanavaraha, (2023)[27]					circumstances such as low traffic and long U-turn distances increasing WWD behavior
12.	Assessing driver safety behaviour in Greece. George Yannis, Katerina Folla, Dimitrios Nikolaou, Antonis Chaziris, Marianthi Kallidon, (2023)[28]	Greece	Roadside observations of a representative sample from all regions of Greece	To assess driver safety behavior in Greece concerning speeding, seat-belt use, helmet use, and driver distraction, and to identify characteristics associated with these behaviors	Cross-sectional study using roadside observations and logistic regression models	27% of Greek drivers exceeded speed limits, 9% used a mobile phone while driving. Helmet use was high (88%), but seat-belt use was low (65%). Female drivers exhibited safer behaviors than male drivers
13.	Assessment of Risky Riding Behaviors Using the Motorcycle Rider Behavior Questionnaire (MRBQ) among University Students. Dina Lusiana Setyowati, Yuliani Setyaningsih, Chriswardani Suryawati, Daru Lestantyo, (2024)[29]	Indonesia	37 university students from 12 faculties in Semarang, Central Java	To identify risky riding behaviors among university students using the MRBQ	Cross-sectional quantitative survey using a self-administered online questionnaire	Traffic violations in the past 12 months were significantly related to risky riding behavior, while gender, license ownership, and accident history were not strongly associated with risky behavior

Table 4. Contributing Factors to Road Traffic Accidents

No	Title, Author, Year	Country	Contributing Factors
1.	The specific role of spatial orientation skills in predicting driving behavior Nori, et al., (2020)[10]	Italy	Spatial orientation skills, gender differences in risky driving behavior, and risk perception.
2.	Sensation seeking and peer passenger influence on risky driving among novice drivers in Udupi Taluk, India. P. Swarna Stefy Grace, Kumar Sumit, Neelima Chakraborty, (2020)[25]	India	Sensation-seeking behavior, especially thrill and adventure seeking.
3.	Explaining Sex Differences in Motorcyclist Riding Behavior: An Application of Multi-Group Structural Equation Modeling. Savalee Uttra, Napat Laddawan, Vatanavongs Ratanavaraha, Sajjakaj Jomnonkwao, (2020)[19]	Thailand	Gender differences in riding behavior, with stronger effects of health motivation and perceived behavior control in men.
4.	Risky motorcycle riding behaviour among young riders in Manipal, India. Kumar Sumit, Veerle Ross, Kris Brijs, Geert Wets, Robert A. C. Ruiter, (2021)[26]	India	Performing stunts, riding motorcycles of 125-200 cc, and violations associated with self-reported near-crash experiences.
5.	Analysis of a driving behavior measurement model using a modified driver behavior questionnaire encompassing texting, social media use, and drug and al7.cohol consumption. Sajjakaj Jomnonkwao, Savalee Uttra, Vatanavongs Ratanavaraha, (2021)[30]	Thailand	Texting, social media use, drug/alcohol consumption, and other violations contributing to risky driving behaviors.
6.	Risk Riding Behaviours of Young Motorcyclists Among Students in Univeristi Putra Malaysia, Serdang, Selangor. Noor Sakinah binti Ahmad, Karmegam Karuppiah, et al., (2022)[20]	Malaysia	Gender differences, with male students showing higher involvement in accidents.
7.	Association of age and severe injury in young motorcycle riders: A cross-sectional study from Karachi, Pakistan. Uzma Rahim Khan, (2022)[21]	Pakistan	Age-related differences, with younger riders (13-19 years) having significantly higher odds of severe injury.
8.	Young drivers' perception of speed: VR and video footage comparison study. Darko Babić, Magdalena Čavka, Dario Babić, Pero Hrabač, (2022)[22]	Croatia	Accuracy of speed perception influenced by road type, visibility conditions, and technology used (VR vs. projector).
9.	Understanding Traffic Accidents among Young Drivers in Qatar Tarlochan, et al., (2022)[11]	Qatar	Traffic violations related to driving style and attitude towards traffic rules.
10.	Licensing Examination and Crash Outcomes Postlicensure in Young Drivers Walshe et, al., (2022)[24]	Ohio, AS	Higher crash rates in drivers licensed at 18 years old compared to younger drivers who received training.

No	Title, Author, Year	Country	Contributing Factors
11.	Wrong way driving intention and behavior of young motorcycle riders. Thaned Satiennam, Nuttapon Akapin, Wichuda Satiennam, Jetsada Kumphong, Nopadon Kronprasert, Vatanavongs Ratanavaraha, (2023)[27]	Thailand	Subjective norms, attitudes, perceived behavioral control, and facilitating circumstances like low traffic and long U-turn distances.
12.	Assessing driver safety behaviour in Greece. George Yannis, Katerina Folla, Dimitrios Nikolaou, Antonis Chaziris, Marianthi Kallidon, (2023)[28]	Greece	Speeding, mobile phone use, low seat-belt use, and differences in behavior between male and female drivers.
13.	Assessment of Risky Riding Behaviors Using the Motorcycle Rider Behavior Questionnaire (MRBQ) among University Students. Dina Lusiana Setyowati, Yuliani Setyaningsih, Chriswardani Suryawati, Daru Lestantyo, (2024)[29]	Indonesia	Traffic violations strongly related to risky riding behavior, with no strong association found with gender, license ownership, or accident history.

DISCUSSION

This review revealed the substantial impact of sex and age on driving behavior, highlighting distinct patterns between male and female drivers. Studies by Uttra et al. (2020), Ahmad et al. (2022), Khan et al. (2022), and Babic et al. (2022) consistently showed that male drivers were more prone to aggressive and high-risk driving behaviors compared to their female counterparts.[19–22] This tendency was often linked to societal norms that encouraged risk-taking among men. Furthermore, women generally exhibited safer driving behaviors, driven by stronger health motivations and greater perceived behavioral control. These findings suggested that gender-specific interventions could be more effective. For example, awareness campaigns targeting male drivers' risk-taking attitudes and promoting safer driving practices could help mitigate gender disparities in road safety. Additionally, reinforcing cautious driving tendencies in women by enhancing their perceived control over driving situations could further improve road safety outcomes.

The review also underscored the disproportionate involvement of young drivers, particularly those aged 18-24, in RTAs. This age group was often influenced by emotional, rushed, and careless driving behaviors.[11,23,29] A notable relationship between age and time perception was observed, with younger drivers exhibiting less caution and holding a more pessimistic view of the past, which influenced their current driving behavior.[32] Young males, in particular, were more likely to engage in aggressive driving and maintain risky attitudes towards road safety, leading to a higher incidence of accidents compared to females.[11,23,33,34] The findings confirmed that young males aged 18-24 were particularly vulnerable to motorbike accidents, necessitating a deeper examination of the socio-cultural and psychological factors contributing to this high-risk profile. Social norms that glorified risk-taking and aggressive driving further exacerbated these dangers.

Sensation-seeking behavior, widely recognized as a significant predictor of risky driving, particularly among young and inexperienced drivers, was a major contributor to unsafe driving practices.[25,26] The pursuit of thrill and adventure often drove young drivers to engage in dangerous activities such as speeding and reckless overtaking. The strong correlation between sensation-seeking and risky driving behaviors suggested that targeted interventions could be highly effective in mitigating these risks. Educational programs that emphasize the severe consequences of risky driving, while providing alternative outlets for excitement, could help reduce these behaviors among young drivers. Addressing the psychological trait of sensation-seeking through targeted interventions was crucial in reducing accident rates within this demographic.

Social and environmental factors also played a crucial role in risky driving behavior. Several studies, including those by Nori et al. (2020), Tarlochan et al. (2022), Walshe et al. (2022), Satiennam et al. (2023), Yannis et al. (2023), and Setyowati et al. (2024), highlighted the complex interplay between individual behaviors and the driving environment.[10,11,23,27–29] Factors such as spatial orientation skills, attitudes toward traffic rules, the quality of driver training, and environmental conditions like low traffic density and extended U-turn distances significantly contributed to risky driving behaviors. These findings suggested that effective road safety interventions required a multifaceted approach that considered both social and environmental contexts. Urban planning, traffic management, and targeted driver education programs must be integrated into a comprehensive strategy to mitigate risky driving behaviors.

The presence of peer passengers was another critical factor influencing risky driving behavior, especially among novice drivers. Driving with peers often led to increased risk-taking due to social pressure and the desire to impress others.[25] Implementing strategies such as graduated driver licensing (GDL) programs, which limited the number of peer passengers for novice drivers, along with educating young drivers about the risks of peer influence, could effectively reduce peer-induced risky driving behaviors.

Future studies must examine how psychological, social, and environmental factors interact to influence risky driving behaviors among young drivers. Developing and testing interventions targeting sensation-seeking, peer influence, and gender-based strategies was essential. Additionally, investigating environmental impacts on driving behavior could help inform policies. This review focused on peer-reviewed English-language articles and cross-sectional studies to limit its scope, which precluded establishing causality.

CONCLUSION

In conclusion, this review underscored the complex interplay of psychological, social, and environmental factors in risky driving among young drivers. Sensation-seeking, peer influence, and gender differences were key predictors, while environmental contexts significantly shaped risky driving behaviors. Additionally, evidence-based interventions were essential for reducing risks and improving road safety.

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CONFLICT OF INTEREST

The authors declared that there were no conflicts of interest to disclose.

AUTHOR CONTRIBUTIONS

DLS led the design, search strategy, and manuscript drafting. ZS, BW, and YS contributed to the review design, criteria, and critical appraisal, and provided methodological feedback. All authors approved the manuscript for publication.

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