

## Determinants of Safe Riding Behavior among Adolescent Motorcyclists in Urban Indonesia: A Cross-Sectional Study

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### ABSTRACT

**Background:** Traffic accidents are a leading cause of death among adolescents globally and nationally, with high school students in urban areas being particularly vulnerable due to high motorcycle usage and inadequate safety practices.

**Objective:** This study aimed to analyze the factors associated with safe riding behavior specifically knowledge level, attitude, and riding equipment completeness among students of Senior High School X Padang in 2025.

**Methods:** A quantitative cross-sectional study was conducted involving 95 students selected through purposive sampling. Data were collected via a validated and reliable online questionnaire administered through Google Forms on April 10–11, 2025. Univariate and bivariate analyses were performed using the chi-square test.

**Results:** Among participants, 49.5% exhibited risky riding behavior, 31.6% had a low knowledge level, 41.1% held negative attitudes toward road safety, and 84.2% had incomplete riding equipment. Bivariate analysis revealed significant associations between knowledge level ( $p = 0.000$ ) and attitude ( $p = 0.000$ ) with safe riding behavior. No significant association was found between riding equipment completeness and safe riding behavior ( $p = 0.280$ ).

**Conclusion:** Knowledge and attitude are significant predictors of safe riding behavior among high school students. School-based interventions, including traffic safety education and attitude-change programs, combined with family and community involvement, are recommended to improve adolescent safe riding behavior.



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## Introduction

Traffic accidents remain a critical public health concern, particularly among adolescents. According to the World Health Organization (WHO, 2023), road traffic injuries are the leading cause of death among individuals aged 5–29 years, accounting for approximately 1.19 million fatalities annually, or 15 deaths per 100,000 population. In low- and middle-income countries (LMICs), including Indonesia, the burden is disproportionately higher due to rapid motorization, inadequate infrastructure, and inconsistent enforcement of traffic regulations (Staton et al., 2016).

In Indonesia, motorcycles constitute the dominant mode of personal transportation, particularly among adolescents and young adults. Data from the Indonesian Automotive Industry Association (Gaikindo, 2020) indicate that more than 93,000 school-age children are involved in traffic accidents annually. In Padang City, West Sumatra, data from the Padang Metropolitan Police Traffic Unit (Satlantas Polresta Padang, 2024) recorded 654 traffic accidents in 2024, with 1,487 total victims, 379 of whom were adolescents aged 15–25 years. Motorcycles were involved in 71.4% of these incidents. East Padang District recorded the highest accident frequency with 68 cases, an area where Senior High School (SMA) X Padang with over 1,000 students, the majority of whom commute by motorcycle is located (Badan Pusat Statistik, 2023).

Safe riding behavior refers to a complex set of practices that include wearing appropriate protective gear, obeying traffic regulations, maintaining appropriate speed, and exercising good judgment on the road (Undang-Undang No. 22 Tahun 2009). The determinants of this behavior are multifactorial. According to Green and Kreuter's PRECEDE-PROCEED model (2005), behavioral determinants can be categorized as predisposing factors (e.g., knowledge, attitudes, beliefs), enabling factors (e.g., availability of safety equipment, access to resources), and reinforcing factors (e.g., peer support, family influence, enforcement). This theoretical framework has been applied extensively in road safety research, particularly in adolescent populations (Dwidianti et al., 2019; Salmawati & Puspita, 2020).

Knowledge plays a crucial role in shaping behavioral intentions and actions. Individuals with higher knowledge of traffic laws and safety risks are more likely to adopt precautionary riding behaviors (Fitri, 2021; Notoatmodjo, 2012). Attitude, as conceptualized by Ajzen (1991) in the Theory of Planned Behavior, mediates the relationship between knowledge and actual behavior. A positive attitude toward road safety increases the likelihood of compliance with safe riding practices, while a negative or dismissive attitude heightens risk (Arianto & Setiaji, 2023). Riding equipment completeness including helmet use, reflective gear, and proper footwear represents an enabling factor that directly mitigates injury severity in the event of an accident (Mengga et al., 2022).

An initial survey of 10 students at SMA X Padang revealed that 80% could not correctly identify common traffic signs, 90% did not possess a valid driver's license, and most did not consistently wear a certified helmet. These preliminary findings indicate deficits in both knowledge and safe riding practice, supporting the rationale for a more systematic investigation.

Previous studies in Indonesia have reported varying prevalence rates of risky riding behavior among high school students, ranging from 37.8% to 53.3% (Mirfan et al., 2021; Mokoginta et al., 2022; Setiaji & Arianto, 2023), with knowledge and attitude consistently identified as significant correlates. However, evidence on riding equipment completeness as a behavioral determinant remains inconclusive (Salmawati & Puspita, 2020; Jenni Lilis S., 2023). This study aims to provide contextually relevant evidence from a high-risk urban school setting in Padang, contributing to the development of targeted, school-based road safety interventions.

## Method

**Study Design and Setting:** This study employed a quantitative research approach with a cross-sectional design, which is appropriate for examining the concurrent associations between multiple independent variables and a single dependent variable at one point in time. The study was conducted at SMA X Padang, located in East Padang District, Padang City, West Sumatra an area with the highest recorded traffic accident frequency in Padang in 2024. Data collection was carried out on April 10–11, 2025.

**Population and Sample:** The study population comprised all active students at SMA X Padang who rode motorcycles to school. The sample size of 95 students was determined based on purposive sampling with the following inclusion criteria: (a) enrolled as active students at SMA X Padang, (b) owned or regularly operated a motorized two-wheeled vehicle, (c) willing to participate by providing informed consent, and (d) owned a

smartphone with internet access to complete the online questionnaire. Students who were absent during data collection or who did not meet the inclusion criteria were excluded. A purposive sampling approach was selected because the target behavior safe riding is only applicable to students who actively ride motorcycles, making random sampling from the full school population impractical and potentially introducing bias through including non-riders.

**Variables and Measurement:** The **dependent variable** was *safe riding behavior*, assessed using a structured questionnaire adapted from prior validated instruments (Arianto & Setiaji, 2023; Mokoginta et al., 2022). Respondents were classified as exhibiting "risky" or "safe" riding behavior based on a median cut-off score. The **independent variables** were: **a) Knowledge level:** Assessed using 10 items covering traffic regulations, helmet standards, speed limits, and road safety principles. Respondents were categorized as "low" (score < median) or "high" (score ≥ median). **b) Attitude toward safe riding:** Measured using a 10-item Likert-scale instrument evaluating beliefs and evaluations about safe riding practices. Respondents were categorized as "negative" or "positive" based on median split. **c) Riding equipment completeness:** Evaluated based on ownership and regular use of SNI-certified helmet, gloves, closed shoes, and reflective vest. Respondents were classified as "incomplete" (lacking ≥1 required item) or "complete."

**Instrument Validity and Reliability:** The questionnaire was pilot-tested on 20 students from a comparable school outside the study sample. Validity was assessed using Pearson's product-moment correlation test, with all items achieving a correlation coefficient ≥ 0.30 ( $p < 0.05$ ), indicating adequate item-scale correlation. Reliability was assessed using Cronbach's alpha, with coefficients of 0.82 (knowledge), 0.79 (attitude), and 0.76 (safe riding behavior), all exceeding the acceptable threshold of 0.70, confirming internal consistency.

**Data Collection:** Data were collected through a self-administered online questionnaire distributed via Google Forms. A research assistant supervised the completion sessions during school hours to minimize missing responses and ensure standardized conditions. The questionnaire included an information sheet and consent declaration as the first screen, requiring explicit agreement before proceeding.

**Data Analysis:** Data were analyzed using SPSS version 25.0. Univariate analysis described the distribution of each variable using frequency and percentage. Bivariate analysis examined the association between each independent variable and safe riding behavior using the chi-square test ( $\chi^2$ ), with a significance threshold of  $p < 0.05$ . Where expected cell frequencies fell below 5, Fisher's exact test was applied.

**Ethical Considerations:** This study received ethical approval from the Research Ethics Committee of Universitas Alifah Padang under Decree No. 001325/KEP Universitas Alifah Padang/2025. Participation was voluntary, and respondent anonymity and data confidentiality were strictly maintained.

## Results and Discussions

### Characteristics of Respondents

Table 1 presents the frequency distribution of respondent characteristics and study variables.

**Table 1. Frequency Distribution of Respondent Characteristics and Study Variables (n = 95)**

Variable	n	%
<b>Age</b>		
15 years	6	6.3
16 years	40	42.1
17 years	38	40.0
18 years	11	11.6
<b>Gender</b>		
Male	46	48.4
Female	49	51.6

Variable	n	%
<b>Accident History</b>		
No	57	60.0
Yes	38	40.0
<b>Safe Riding Behavior</b>		
Risky	47	49.5
Safe (No Risk)	48	50.5
<b>Knowledge Level</b>		
Low	30	31.6
High	65	68.4
<b>Attitude</b>		
Negative	39	41.1
Positive	56	58.9
<b>Riding Equipment</b>		
Incomplete	80	84.2
Complete	15	15.8

The majority of respondents were 16 years old (42.1%), followed by 17-year-olds (40.0%). Slightly more than half were female (51.6%). Regarding accident history, 60.0% had never been involved in a traffic accident, while 40.0% reported at least one prior accident. In terms of the primary outcome, 49.5% of students exhibited risky safe riding behavior. Most students (68.4%) demonstrated high knowledge levels, while 41.1% held negative attitudes toward safe riding. Notably, the vast majority (84.2%) had incomplete riding equipment.

#### Association between Study Variables and Safe Riding Behavior

Table 2 presents the bivariate analysis results examining the relationship between knowledge level, attitude, riding equipment completeness, and safe riding behavior.

**Table 2. Association between Knowledge Level, Attitude, and Riding Equipment with Safe Riding Behavior (n = 95)**

Variable	Risky Behavior n (%)	Safe Behavior n (%)	Total n (%)	PR (95% CI)	p-value
<b>Knowledge Level</b>					
Low	27 (90.0)	3 (10.0)	30 (100)	2.92 (1.99–4.29)	0.000
High	20 (30.8)	45 (69.2)	65 (100)	Ref	
<b>Attitude</b>					
Negative	35 (89.7)	4 (10.3)	39 (100)	4.19 (2.51–6.99)	0.000
Positive	12 (21.4)	44 (78.6)	56 (100)	Ref	
<b>Riding Equipment</b>					

Variable	Risky Behavior n (%)	Safe Behavior n (%)	Total n (%)	PR (95% CI)	P-value
Incomplete	42 (52.5)	38 (47.5)	80 (100)	1.58 (0.75–3.32)	0.280
Complete	5 (33.3)	10 (66.7)	15 (100)	Ref	

Students with low knowledge levels were 2.92 times more likely to exhibit risky riding behavior compared to those with high knowledge levels (PR = 2.92; 95% CI: 1.99–4.29;  $p < 0.001$ ). Similarly, students with negative attitudes had a 4.19 times higher prevalence of risky behavior than those with positive attitudes (PR = 4.19; 95% CI: 2.51–6.99;  $p < 0.001$ ). The confidence interval for riding equipment completeness crossed the null value (PR = 1.58; 95% CI: 0.75–3.32), confirming the absence of a statistically significant association, though the direction of effect remained consistent with the hypothesized relationship.

### Prevalence of Risky Safe Riding Behavior

This study found that 49.5% of students at SMA X Padang exhibited risky safe riding behavior, which is consistent with and slightly lower than findings from comparable studies in Indonesian high school settings. Setiaji and Arianto (2023) reported a risky safe riding behavior prevalence of 49.4% among 12th-grade students at a vocational high school in Riau, while Mirfan et al. (2021) documented a higher prevalence of 53.3% at SMA Negeri 1 Lubuk Alung in Padang Pariaman Regency. A lower prevalence of 37.8% was reported by Mokoginta et al. (2022) at SMAN 1 Kotamobagu. These variations across studies may reflect differences in school environment, sociodemographic characteristics, enforcement culture, and geographic traffic contexts. Nonetheless, the consistently high prevalence across Indonesian studies ranging from approximately 37% to 53% underscores a systemic public health challenge that requires coordinated intervention strategies.

From a developmental perspective, adolescents are particularly prone to risky behavior due to psychosocial changes during this life stage. The "storm and stress" phenomenon, characterized by heightened emotional reactivity, risk-taking propensity, and susceptibility to peer influence, renders adolescents more likely to violate traffic norms (Syakur et al., 2023). This is compounded by the fact that most Indonesian high school students do not legally meet the minimum age requirement (17 years) for a motorcycle license, yet many ride daily without formal training (Enjely, 2023).

### Association between Knowledge and Safe Riding Behavior

The strong and statistically significant association between knowledge level and safe riding behavior ( $p = 0.000$ ) found in this study is consistent with the existing body of evidence. Arianto and Setiaji (2023) similarly reported a significant knowledge-behavior association ( $p = 0.001$ ) among senior high school students in Riau. Jenni Lilis S. (2023) found comparable results among vocational students in Sorong, as did Fitri (2021) among college students in Padang. These convergent findings across diverse Indonesian populations reinforce the centrality of knowledge as a behavioral determinant in the context of road safety (Kementerian Perhubungan RI, 2015).

Theoretically, this association is well-grounded in Notoatmodjo's (2012) behavioral model, which posits that knowledge constitutes the cognitive foundation of behavior. Individuals who understand traffic regulations, recognize the consequences of speeding, and appreciate the protective function of safety equipment are better equipped to make informed decisions while riding. Importantly, the association between knowledge and behavior is not simply linear; rather, knowledge functions as a necessary but not sufficient condition for behavioral change, as demonstrated by the 30.8% of students with high knowledge who still exhibited risky behavior. This suggests the presence of moderating factors such as attitude, peer norms, and contextual pressures, which may attenuate the knowledge-behavior link.

### Association between Attitude and Safe Riding Behavior

The significant association between attitude and safe riding behavior ( $p = 0.000$ ) is one of the most robust findings of this study, with 89.7% of students holding negative attitudes engaging in risky behavior. This is consistent with the Theory of Planned Behavior (Ajzen, 1991), which posits that attitude toward a behavior—shaped by beliefs about its outcomes and their valuation is a proximal determinant of behavioral intention and subsequent action. A negative attitude toward traffic safety, such as perceiving helmet use as uncomfortable or regarding traffic violations as inconsequential, directly undermines safe riding practices (Maryani, 2024).

These findings align closely with Arianto and Setiaji (2023), who reported a significant attitude-behavior association ( $p = 0.004$ ), and with Dwidianti et al. (2019), who found attitude to be a significant predictor of safe riding among high school students in Padang. Internationally, Staton et al. (2016) highlighted that attitudinal factors particularly perceived invulnerability and low risk perception are among the strongest predictors of non-compliance with road safety practices in LMICs. Given this evidence, attitude-change interventions grounded in behavior change communication should be prioritized in school-based programs.

### **Non-Significant Association between Riding Equipment and Safe Riding Behavior**

The absence of a statistically significant association between riding equipment completeness and safe riding behavior ( $p = 0.280$ ) in this study warrants careful interpretation. While statistically non-significant, there was a directionally consistent pattern: 52.5% of students with incomplete equipment engaged in risky behavior compared to 33.3% of those with complete equipment, suggesting a clinically meaningful difference that may not have achieved statistical significance due to the small proportion of students with complete equipment ( $n = 15$ , 15.8%), which limits statistical power.

This finding is partially consistent with Salmawati and Puspita (2020), who also found no significant relationship between equipment ownership and safe riding behavior among students in Palu, suggesting that equipment availability alone does not guarantee safe behavior. In contrast, Mengga et al. (2022) demonstrated that helmet use significantly reduces craniofacial injury risk, emphasizing equipment's role in injury mitigation rather than behavioral compliance. The paradox may be explained by the fact that equipment ownership and actual use are distinct constructs: a student may possess a certified helmet but choose not to wear it consistently.

Furthermore, the extremely high proportion of students with incomplete equipment (84.2%) in this sample may reflect systemic socioeconomic barriers and weak enforcement rather than attitudinal non-compliance alone. Under Indonesia's Road Traffic and Transportation Law (Undang-Undang No. 22 Tahun 2009), all motorcyclists are legally required to wear SNI-certified helmets; however, school-level monitoring of equipment use remains inconsistent. The Ministry of Transportation Regulation No. PM 111/2015 further stipulates speed limits that are frequently disregarded in residential and school zones. Policy enforcement mechanisms, including school gate inspections and community policing, may be needed to translate equipment availability into consistent use.

### **Implications for Intervention**

The combined findings of this study highlight the need for multi-component, school-based road safety interventions that simultaneously target knowledge, attitude, and equipment access. At the school level, structured traffic safety education embedded into the curriculum including hazard perception training, simulation exercises, and guest lectures from traffic authorities could effectively address both knowledge deficits and attitudinal barriers. Family-based approaches, including parent education sessions on supervising adolescent riding behavior and modeling safe practices, represent a complementary strategy given the role of reinforcing factors in Green and Kreuter's model (2005). At the community and policy level, strengthening enforcement of helmet and equipment regulations in school zones, combined with subsidized access to certified safety equipment, could address the enabling factor deficits identified in this study.

## **Conclusions**

This study demonstrated that knowledge level and attitude are significantly associated with safe riding behavior among high school students at SMA X Padang ( $p = 0.000$  for both), while riding equipment completeness did not reach statistical significance ( $p = 0.280$ ). Nearly half of the students (49.5%) exhibited risky riding behavior, and the overwhelming majority (84.2%) had incomplete riding equipment.

These findings highlight the urgent need for integrated, evidence-based road safety programs targeting adolescent motorcyclists in high-risk urban school settings. Priority recommendations include: (1) integrating road safety literacy into school curricula with emphasis on attitude formation; (2) implementing family-centered education programs to reinforce safe riding norms at home; (3) establishing school-level monitoring of equipment compliance; and (4) advocating for community and local government policy initiatives that improve enforcement and access to safety equipment. Future research should employ longitudinal designs to establish causal pathways and evaluate the effectiveness of specific intervention models.

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