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ROAD TRAFFIC ACCIDENT EXPERIENCES AMONG DIPONEGORO UNIVERSITY STUDENTS IN INDONESIA: PREVENTION RECOMMENDATIONS BASED ON THE HIERARCHY OF CONTROLS

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ABSTRACT

Road traffic accidents are an important public safety concern because they can cause injuries, damage to infrastructure and vehicles, and loss of life. This study aimed to describe road traffic accident experiences among Diponegoro University students and identify potential preventive measures using the hierarchy of controls. A quantitative descriptive approach was used, with questionnaire data collected from 30 university students. The survey covered accident history, vehicle use, personal protective equipment (PPE), pre-accident circumstances, road and environmental conditions, vehicle condition, injuries, and damage. Motorcycles were the most commonly reported mode of transport (96.7%). Most participants reported having experienced a road traffic accident (86.7%), and 83.3% reported using PPE when riding; however, 53.3% reported using PPE only occasionally. Reported accident circumstances included falls, slipping, and collisions. Commonly reported contributing conditions included careless riding, fatigue, slippery or sandy roads, and the absence of traffic signs. Most reported injuries were minor, with the legs and hands among the most frequently affected body parts. Based on the hierarchy of controls, suggested measures included removing road hazards, replacing rigid roadside barriers with more forgiving materials where appropriate, repairing road defects, maintaining vehicles, improving traffic signage, and consistently using helmets and other suitable protective equipment. Because the study used a small convenience sample and descriptive questionnaire data, the findings should be interpreted as exploratory and cannot be generalized to all students. Larger studies with validated instruments and clearer definitions of exposure and accidents are needed.

Keywords: Road traffic accidents; Hierarchy of controls; University students; Motorcycle safety; Personal protective equipment; Occupational health and safety

1 INTRODUCTION

Road traffic accidents remain a public safety concern in Indonesia and internationally. Increasing motor vehicle use can increase exposure to traffic hazards, while crashes may cause injuries of varying severity, damage to vehicles and public infrastructure, and fatalities. The Indonesian national traffic police reported that 94,600 road traffic accidents were recorded across Indonesia between January and 13 September 2022, compared with approximately 70,200 during the same period in 2021. The same source also reported 19,054 fatalities during the 2022 period. The World Health

Organization (WHO) estimated approximately 1.19 million road traffic deaths globally in 2021, with road traffic injuries remaining the leading cause of death among people aged 5–29 years [1]. WHO's Indonesia country profile also identifies the substantial role of powered two- and three-wheelers in the national vehicle fleet [2].

University students may be exposed to traffic risks through routine travel to and from campus and other destinations. The source survey focused on Diponegoro University students and documented their accident experiences, travel patterns, use of protective equipment, and perceptions of the circumstances surrounding accidents. Motorcycles were the predominant vehicles used by participants, and a substantial proportion of participants had experienced at least one road traffic accident.

The hierarchy of controls is a structured approach to risk reduction that prioritizes controls closer to the source of a hazard. The five levels discussed in the source manuscript are elimination, substitution, engineering controls, administrative controls, and personal protective equipment (PPE). Although this framework is commonly used in occupational health and safety, it can also inform the development of road-safety interventions. Measures that remove road hazards or improve road and vehicle design should generally be considered alongside administrative measures and individual protective equipment. In road-safety research, related systems-based approaches emphasize that safer outcomes depend not only on individual road-user behaviour but also on road design, vehicle safety, speed management, enforcement, and post-crash care [3–5].

This study aimed to describe road traffic accident experiences among a sample of Diponegoro University students and propose prevention measures organized according to the hierarchy of controls.

2 MATERIALS AND METHODS

2.1 Study Design and Participants

The study used a quantitative descriptive design. Questionnaire data were collected from 30 Diponegoro University students. Convenience sampling was used to recruit Diponegoro University students encountered in campus parking areas around March 2026. The inclusion criteria were at least one year of driving experience and previous experience of a near miss or accident while driving.

2.2 Data Collection and Variables

The questionnaire covered participants' age, history and frequency of road traffic accidents, commonly used vehicles, PPE use and its frequency, trip distance, accident circumstances and body position, perceived stress, pre-accident conditions, accident location, road and weather conditions, vehicle condition, injury severity and location, and damage severity.

3 RESULTS

3.1 Participant Profile and Travel Patterns

The survey included 30 participants who met the inclusion criteria. Among participants who had experienced accidents, the most common age range was 17–20 years. Motorcycles were the predominant mode of transport: 96.7% of participants reported usually using a motorcycle. Short-distance trips were reported somewhat more frequently than long-distance trips (53.3% versus 46.7%).

3.2 Accident History and Protective-Equipment Use

A total of 86.7% of participants reported having experienced a road traffic accident, while 13.3% reported no such experience. Regarding PPE use while riding, 83.3% reported using PPE, whereas 16.7% reported not using it. However, when frequency was considered, 36.7% reported using PPE very often, 53.3% reported using it sometimes, and 10.0% reported using it rarely. The questionnaire defined PPE as helmets, shoes, and gloves. Evidence from Indonesian population data has also identified helmet use as an important factor associated with road traffic injury outcomes [6,7].

3.3 Reported Accident Circumstances

The survey data indicate that falls were the most frequently reported accident events, followed by slipping or skidding and stumbling or collision. The prone position was the most commonly reported body position during an accident, followed by sitting and supine positions; fewer participants reported a side-lying position. Participants commonly attributed accidents to careless riding and also reported fatigue. Stress responses were mainly categorized as either mild stress or no stress. These data reflect participants' reports and do not establish causal relationships.

3.4 Road, Weather, and Vehicle Conditions

Most reported accidents occurred on public roads, while a smaller number occurred on footpaths; the chart indicated no accidents on toll roads. Slippery road surfaces were the most frequently reported road condition, followed by sandy surfaces, missing traffic signs, and sharp bends. Participants reported accidents in both clear and rainy weather. Most participants described their vehicles as being in good condition, although some reported brake failure or damage, while others reported depleted brake fluid. These responses suggest that road-surface conditions, rider behaviour, weather, and vehicle maintenance all warrant consideration in prevention planning.

3.5 Injuries and Damage

The collected data show that reported injuries were predominantly minor, with a smaller number of moderate injuries and no severe injuries reported. The legs and hands were the most frequently reported injured body parts, while head injuries were uncommon in this sample and no back injuries were reported. Vehicle or property damage was most often classified as minor, followed by moderate and severe damage.

3.6 Summary of Reported Factors

Table 1 summarizes the factors reported by the university students.

Table 1: Summary of reported accident factors

Factor	Responses reported in the source manuscript
Accident event	Falls; slipping/skidding; stumbling or collision
Position during accident	Prone; sitting; supine; side-lying
Pre-accident condition	Careless riding; fatigue
Location	Public road; footpath
Road condition	Slippery surface; sandy surface; missing traffic signs; sharp bend
Weather	Rainy; clear
Vehicle condition	Good condition; brake-fluid depletion; brake failure or damage
Injury severity	Mostly minor; some moderate injuries
Damage severity	Mostly minor; some moderate and severe damage

4 DISCUSSION

This descriptive survey identified several potentially relevant areas for road-safety prevention among the participating students. First, motorcycle use was nearly universal in the sample, and most participants reported a previous accident. This pattern supports the importance of addressing motorcycle-related risks among students. However, the small sample and absence of a comparison group mean that the study cannot estimate accident prevalence in the wider student population or determine whether student status is associated with accident risk.

Second, the reported circumstances point to a combination of behavioural, environmental, and mechanical factors. Careless riding and fatigue were noted in the source, while slippery or sandy road surfaces and vehicle braking problems were also reported. These factors should not be treated as independently verified causes because the survey relied on self-reports and did not describe a systematic crash-investigation procedure. Future research should distinguish between participants' perceptions of contributing factors and factors confirmed by objective evidence.

Third, participants did not consistently report frequent PPE use. Although 83.3% reported using PPE, more than half reported using it only sometimes. This discrepancy illustrates why a simple yes/no question may not adequately capture protective behaviour. Future questionnaires should include separate questions on helmet use, helmet fastening, compliance with helmet standards, footwear, gloves, visibility aids, and other relevant protective measures. PPE should be viewed as one component of a broader prevention strategy rather than a substitute for safer roads, vehicles, and traffic systems. This is consistent with broader evidence that helmet use varies substantially across settings and is influenced by legislation and enforcement [8]. Systematic reviews report that motorcycle helmets reduce the risk of death and head injury, while full-face helmets may provide additional protection against traumatic brain injury and facial injury [9,10].

The hierarchy of controls provides a framework for organizing interventions according to their relationship to the hazard. Elimination measures proposed in the source include removing loose sand from road edges and filling potholes. The proposed substitution measure involved replacing rigid concrete barriers with rubber barriers. Such a substitution should be adopted only after an engineering assessment confirms that the alternative meets road-design and crash-protection requirements; a softer material is not automatically safer in every road context. Engineering controls include repairing road defects and maintaining vehicles, while administrative controls include installing clear traffic signs on public roads and footpaths where appropriate. PPE measures include the consistent use of a properly fitted helmet, suitable footwear, and gloves. A systems-based approach to road safety supports prioritizing interventions that make the transport environment safer and more forgiving, rather than relying exclusively on education or individual compliance [3–5,11].

The proposed measures also imply that responsibility should not rest solely with individual riders. Road authorities, campus administrators, transport planners, vehicle owners, and students may each have a role in identifying hazards, maintaining infrastructure and vehicles, communicating safety rules, and encouraging protective behaviour. Prioritizing higher-level controls can reduce reliance on individual compliance alone.

Several limitations should be acknowledged. The sample comprised only 30 students, and the sampling strategy is not specified. The survey instrument, data-collection period, response rate, and operational definitions are not described. Some chart labels and narrative summaries are ambiguous, and participant-level data are not included. No statistical tests were conducted, and the design cannot establish causality. In addition, the literature review in the original document lists prior studies without complete bibliographic information, limiting verification and proper citation. These limitations should be addressed before submission and are particularly important when comparing the present exploratory survey with larger Indonesian studies and systematic reviews, which use broader samples or more formal evidence-synthesis methods [6–8,12,13].

RECOMMENDATIONS

Table 2 summarizes the preliminary recommendations derived from the survey results. These recommendations are organized according to the hierarchy of controls.

Control level	**Potential road-safety measures based on the source manuscript**
Elimination	Remove loose sand and other debris from road edges and repair or eliminate potholes and other road-surface hazards.
Substitution	Assess whether suitable, standards-compliant alternatives to rigid roadside barriers are appropriate at specific locations; do not substitute materials without engineering review.
Engineering controls	Repair damaged road surfaces and improve road design; establish routine vehicle inspections and maintenance, including the braking system.
Administrative controls	Install and maintain clear traffic signs at relevant locations, including access roads and footpaths; provide road-safety education and communicate safe-riding procedures.
Personal protective equipment	Encourage consistent use of a compliant, correctly fastened helmet and appropriate protective footwear and gloves.

5 CONCLUSION

In this survey of 30 Diponegoro University students, motorcycles were the predominant mode of transport, and 86.7% of participants reported having experienced a road traffic accident. Participants identified falls, slippery or sandy road surfaces, careless riding, fatigue, and some vehicle braking problems among the reported accident circumstances. Most participants reported using PPE, but not all reported frequent use. The hierarchy of controls can be used to organize prevention measures, including removing road hazards, improving road surfaces and signage, maintaining vehicles, promoting safe riding practices, and ensuring consistent use of appropriate protective equipment. Given the small sample and descriptive nature of the data, the findings are exploratory. Larger studies using clearly defined variables, validated questionnaires, transparent sampling procedures, and complete statistical reporting are needed to draw stronger conclusions about road traffic risks among university students.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The authors declare no conflicts of interest.

Statement of informed consent

Informed consent was obtained before the survey.

Data availability

The dataset is available upon request to the second author.

Author contributions

The first author contributed to writing the manuscript and analysing the survey results, while the second author was responsible for data collection.

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