THE RISK FACTORS OF SAFETY RIDING BEHAVIOR: A SCOPING REVIEW

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Abstract

Purpose of the study—This study aims to determine the risk factors influencing riding safety behavior in motorcyclists.

Research method—This study used the scoping review method using the PEOS framework and PRISMA flowchart in searching previous articles on six journal databases, namely PubMed, Science Direct, Garuda (Garba Reference Digital), Directory of Open Access Journal (DOAJ), JSTOR, and Taylor and Francis. Of the 3,042 identified articles, 13 were selected because they met the inclusion criteria.

Result—Internal factors influencing safety riding behavior are age, risk perception, Knowledge, consumption of alcohol and drugs, attitude, and work stress. External factors influencing safe riding behavior are road conditions, riding time, type of motorbike, mileage, education provision, workload, and policies

Conclusion—Efforts and strategies are needed from the government as a policy maker, such as combining law enforcement with the provision of education and training, implementing stop lines at local crossroads, and strict policies for protection for delivery couriers.

Keywords: Accident, Motorcyclists, Risk factors, Safety riding

1. INTRODUCTION

People like motorcycles because they are relatively cheap and small so that they can drive even on narrow streets (Herwangi et al., 2015). It gave rise to the phenomenon of a significant increase in the number of motorcycle units worldwide. In 2010, motorcycles accounted for nearly half of all vehicles globally, with 314 million motorcycles in 154 countries (Ivers et al., 2016). However, an increase in motorcycles is followed by an increased risk of traffic accidents (Hidayati & Hendrati, 2016). This is because as many as 84% of accident cases in Indonesia in 2022 involve motorcycle users.

As a preventive measure for traffic accidents, applying safe riding behavior for motorcyclists reduces the risk of traffic accidents (Joddy et al., 2022). Safety riding is an act of riding that prioritizes safety for oneself and other riders, thereby reducing the

risk of traffic accidents. The application of safe riding is the best measure to increase rider awareness regarding the priority of safety and all possibilities that can occur on the road (Wamena, 2021).

In Indonesia, the Regulation of the Minister of Transportation of the Republic of Indonesia Number 12 in 2019 Concerning Safety Protection for Motorcycle Users Used for Public Interests has explained that to ensure safety while riding, the use of motorcycles by both riders and passengers must meet the aspects of safety, security, comfort, affordability, and regularity. Safety riding behavior is included in fulfilling safety aspects where motorbike riders must meet the requirements motorbike riders must have a riding license in the form of SIM C or SIM D if they have special needs, wear clothing that can protect the entire body such as long sleeves or jackets, trousers, shoes, and gloves, bring a raincoat, and wear a helmet according to the Indonesian National Standard (SNI).

Meanwhile, an international agreement, the Vienna Convention in 1968, introduced international directives related to traffic safety regarding the need to draft laws on the use of helmets. This progress was followed by European countries that introduced UNECE 22 in 2002 regarding standards for helmet quality and procedures for using helmets. WHO supports these policies and recommends that WHO member countries develop their respective countries' versions of traffic safety laws (Bhatti et al., 2018).

Safety riding behavior among motorcyclists is influenced by factors which include internal factors and external factors, such as age (Luu et al., 2021), gender (Luu et al., 2021; Uttra et al., 2020), license ownership (Salmawati & Puspita, 2020), and provision of training programs (Ivers et al., 2016; Muni et al., 2020). Then, a literature review research related to safety riding risk factors was conducted by Damani &Vedagiri (2021), who collected evidence regarding factors that influence safety riding behavior in motorbike riders, such as rider factors, vehicle characteristics, and interactions with other riders, road conditions, and infrastructure, and weather. Rider factors include intrinsic factors (attitude and demographics) and extrinsic factors (use of protective equipment, provision of training, alcohol consumption, and cell phone use). Meanwhile, vehicle characteristic factors include the type of motorcycle, engine type, and vehicle technology.

Therefore, this study aims to conduct a review using the scoping review method on the results of previous studies that discuss and find out the latest findings related to safety riding risk factors for motorbike riders.

2. LITERATURE REVIEW AND CONCEPTUAL PROPOSITIONS AND MODEL SYNTHESIS
2.1. Literature Review

In this study, various previous research regarding the risk factors influencing safe riding behavior among motorcyclists have been analyzed. Based on the search results, several relevant studies show the impact of internal and external factors on riding behavior.

1. **Internal Factors**:

1) **Age**: Research by Khan et al. (2022) indicates that riders aged 13-24 have a higher risk of engaging in unsafe riding behaviors. Conversely, Danielle et al. (2020) found that age does not affect safe riding behavior among high school students.
2) **Risk Perception**: Satiennam et al. (2023) noted that riders' risk perception is influenced by existing social norms in the community, which can affect riding decisions.
3) **Knowledge**: Knowledge of safe riding is closely related to riders' compliance with traffic regulations (Andrijanto et al., 2022; Danielle et al., 2020).
4) **Consumption of Alcohol and Drugs**: Kiwango et al. (2021) found that riders who consume alcohol and drugs are at a higher risk of being involved in accidents.
5) **Attitude**: Attitudes towards helmet use significantly influence safe riding behavior, where riders not wearing helmets tend to violate rules more frequently (Jantosut et al., 2021; Akuh et al., 2023).

2. **External Factors**:
o **Road Conditions**: Research by Shafie et al. (2022) revealed that road conditions, especially at intersections, play a crucial role in influencing safe riding behavior.
o **Riding Time**: Jantosut et al. (2021) showed that riders tend to be more aggressive at night when visibility is low and law enforcement is weaker.
o **Type of Motorcycle**: The type of motorcycle also affects riding behavior, where riders on manual motorcycles tend to be more aggressive than those on automatic motorcycles (Jantosut et al., 2021).
o **Education and Policies**: Effective riding education programs can enhance riders' knowledge and awareness, while strict policies can encourage compliance with regulations (Akuh et al., 2023).

2.2. Conceptual Propositions And Model Synthesis

Based on the existing literature review, several conceptual propositions can be developed to understand the factors influencing safe riding behavior:

1. **Model of the Influence of Internal and External Factors**:
   o **Proposition 1**: Age and riding experience influence the level of knowledge and attitudes of riders towards safety, which in turn affects their riding behavior.
   o **Proposition 2**: Risk perception, shaped by social norms and environmental conditions, contributes to riders' decision-making while riding.
2. **Interaction Between Factors**:
   o **Proposition 3**: There is an interaction between internal factors (such as attitudes and knowledge) and external factors (such as policies and road conditions) that can either strengthen or weaken safe riding behavior.
   o **Proposition 4**: The implementation of effective educational programs can change riders' attitudes and knowledge, thereby reducing unsafe riding behavior.
3. **Synthesis Model**:
   o This model can be illustrated as the interaction between internal and external factors that mutually influence the formation of safe riding behavior. For instance, a positive attitude towards safety can be reinforced by supportive policies and good road conditions.

Through the development of this model, it is hoped to provide deeper insights into the factors influencing safe riding behavior and assist in designing more effective interventions to enhance riding safety, especially among motorcyclists.

3. RESEARCH METHODOLOGY
Study Design
This study uses a literature review method of the scoping review type where the stages of implementation refer to a framework based on Arksey & O'Malley (2005), namely (1) identification of research questions using the PEOS framework (Population and their problems, Exposure, Outcome, Study Type); (2) identification of literature sources; (3) selection of literature sources based on inclusion and exclusion criteria using PRISMA diagrams; (4) make data extraction in the form of systematic tables; (5) make a summary in the form of a report; and (6) consultation with competent parties.

Search Strategy
This study aims to find articles that discuss risk factors that influence safety riding behavior in motorcyclists. At the identification stage of research questions, the PEOS framework was used to define research boundaries, form keywords, and develop inclusion criteria.

The keywords used in the search for articles are divided into English and Indonesian. The English keywords used are 'safety riding', 'risk factor', and 'motorcycle rider'. Meanwhile, the Indonesian language keywords used are 'perilaku aman berkendara', 'faktor risiko', 'pengendara motor'.

The inclusion criteria in this study were articles with research objects on motorcycle riders and research topics related to risk factors for safety riding behavior. In addition, articles are published for 2020-2023 in English or Indonesian, as well as original research articles, free full-text articles, open access journals, and indexation of articles. This study excluded articles with a literature review study design to avoid repeated reviews.

Identification and Selection of Articles
This study used six online journal databases for article search: PubMed, Science Direct, Garuda (Garba Reference Digital), Directory of Open Access Journal (DOAJ), JSTOR, and Taylor and Francis. The search for articles in this study uses the PRISMA diagram as a reference for the stages of searching for articles, namely the stages of identification, screening, eligibility, and the total number of selected articles.

Data Extraction and Data Analysis
Data extraction of articles includes the author's name and year of publication, study design, study location, number of study samples, and risk factors found in each article. The extraction of article data is presented in the form of a systematic table. Then, the selected articles were reviewed to the focus of the research discussion by analyzing descriptively the risk factors for safety riding behaviour in motorcyclists based on the findings of the articles reviewed.

In the data analysis stage, the first step is classifying the risk factors that affect safety riding behavior from each article. Then, make a summary of each risk factor. The last

step is to arrange a discussion accompanied by facts, theories, and opinions from the research results of each article.

4. RESULTS AND DISCUSSIONS
4.1. Results

Based on the search results for articles using the PRISMA diagram, 3,042 articles were identified based on keywords in each database. After reviewing the entire article screening process, 13 articles were selected for review. Figure 1 explains the article search flow with the PRISMA diagram.
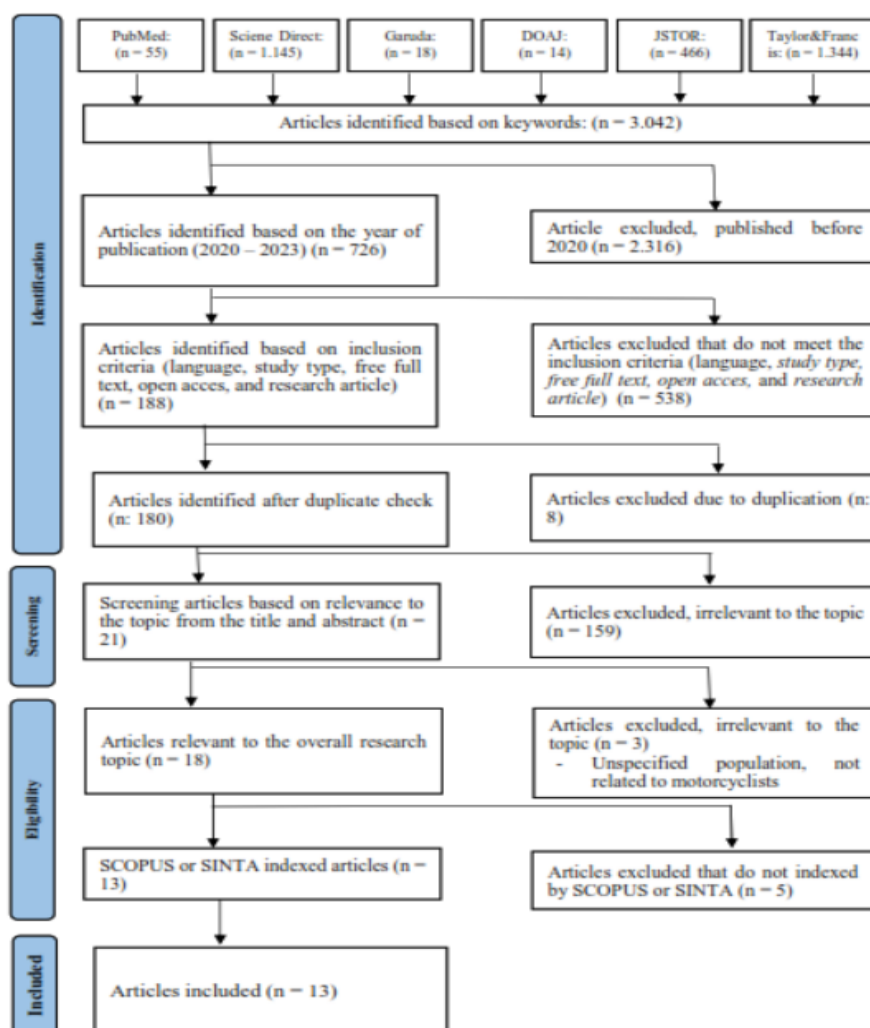
Figure 1 : PRISMA Flow Diagram Article Search

The next step is data extraction. Table 1 presents the identities of the 13 selected articles and complies with all inclusion criteria. Then, the articles reviewed were grouped based on the risk factors for safety riding behavior found to see the analysis results of each risk factor in each article.

Table: 1 Articles Reviewed

No.	Author and Year	Study Design	Settings and Samples	Safety Riding Factors
1.	(Satiennam et al., 2023)	Cross-sectional	Thailand, 234 motorcyclists.	Risk Perception
2.	(Shafie et al., 2022)	Cross-sectional	Malaysia, 3 types of junction roads	Type of T-junction and road conditions.
3.	(Khan et al., 2022)	Cross-sectional	Pakistan, 45,366 traffic accidents among motorcyclists aged 13-24 years.	Age and knowledge of the rider.
4.	(Kiwango et al., 2021)	Case-control	Tanzania had 164 case group respondents and 400 control group respondents.	Consumption of alcohol or marijuana while riding.
5.	(Jantosut et al., 2021)	Cross-sectional	Thailand, 502 motorcyclists break red lights.	Attitude, type of motorbike, riding time, provision of educational programs, and road conditions.
6.	(Akuh et al., 2023)	Cross-sectional	Ghana, 358 motorcyclists.	Attitudes, policies, and provision of educational programs.
7.	(Maulina et al., 2022)	Experimental Research	Indonesia, 78 participants (38 training intervention groups and 40 control groups)	Providing educational programs.
8.	(Andrijanto et al., 2022)	Cross-sectional	Indonesia, 97 motorcyclists.	Providing educational programs.
9.	(Christie & Ward, 2023)	Cross-sectional	UK, 339 delivery couriers.	Workload
10.	(Chou et al., 2022)	Kohort	Vietnam, 600 survey respondents.	Providing educational programs.
11.	(Danielle et al., 2020)	Cross-sectional	Indonesia, 300 high school students.	Age, knowledge, and mileage.
12.	(Chen, 2023)	Cross-sectional	Taiwan, 279 food delivery couriers.	Work stress during the COVID-19 pandemic.
13.	(Papakostopoulos & Nathanael, 2021)	Cross-sectional	Greece, 434 delivery couriers.	Workload and policies.

The next step is classifying the risk factors. According to the 13 articles, some discussed more than one factor. The risk factors found included the attitude factor of helmet use was discussed in 3 articles; the factor of providing training programs was discussed in 3 articles; the work factor was discussed in 3 articles; the knowledge factor was discussed in 3 articles; the perception factor was discussed in 2 articles, the factor road conditions are discussed in 2 articles, age factor is discussed in 2 articles, alcohol and cannabis consumption is discussed in 1 article, the type of motorbike is discussed in 1 article, the riding time factor is discussed in 1 article, and the mileage factor is discussed in 1 article. The risk factors for safety riding behavior are classified based on

internal and external factors. Table 2 shows the extraction of research results for each risk factor from each article.

Tabel 2. Analysis Result

No	Factors of Safety Riding	Author and Year of Publication	Result
		Internal Factors	
1.	Age	(Khan et al., 2022)	The age group 13-17 years and 18-20 years had a low percentage of helmet use (1.6% and 2%). Adolescent age (13-17 years) is a risk factor for safe riding behaviour due to a lack of knowledge and riding experience. In comparison, age 18-20 years is related to falsride self-confidence and lack of safety awareness.
		(Danielle et al., 2020)	Age does not affect safety riding behaviour in high school students (p-value 0.361) because the mindset is similar, so there is no difference in behaviour.
2.	Risk Perception	(Satiennam et al., 2023)	The rider's risk perception is formed from norms that are influenced by the culture of the community, which will shape ridingbehaviour that adapts to the traffic situation.
3.	Knowledge	(Khan et al., 2022)	Lack of knowledge of novice riders (adolescents) will affect safety riding behaviour because riders tend to ride motorcycles while learning and adapting to traffic conditions.
		(Andrijanto et al., 2022)	Lack of knowledge can lead to violation behaviour. It was triggered by the limited outreach and training related to safety riding.
		(Danielle et al., 2020)	There is a relationship between knowledge and safety riding (p-value 0.000018). Riders with a rider's license tend to have safety riding behaviour (p-value 0.011) because it indicates that the rider meets the riding requirements, namely having good riding knowledge and skills.
4.	Consumed Alcohol And Drugs	(Kiwango et al., 2021)	As a result, riders who consumed alcohol and drugs had a risk of 5.98, but after adjusting for confounding factors, the risk was insignificant at only 1.11. It happens because alcohol and drugs can affect the body's physiology, impacting riding behaviour and performance.
5.	Attitude	(Jantosut et al., 2021)	The attitude of a rider who does not use a helmet has and is at risk of committing violating behaviour 2,964 times greater. The attitude of a rider who does not use a helmet has and is at risk of committing violating behaviour 2,964 times greater.
		(Akuh et al., 2023)	Attitudes related to helmet use are influenced by understanding (p-value 0.001).
6.	Work	(Chen, 2023)	Work stress arising from the high workload on

No	Factors of Safety Riding	Author and Year of Publication	Result
	Stress		delivery couriers can cause burnout and fatigue, which triggers the risk of unsafe behaviour while riding (p <0.001).
External Factors			
1.	Road Conditions	(Shafie et al., 2022)	Road conditions at the T-junction traffic affect the emergence of risky behaviour. The percentage of risk behaviour is higher at the T-junction on local roads (32.7%). T-junctions on local roads lead to impatient behaviour and careless turns. T-junctions on significant roads lead to overtaking behaviour from the blind spot.
		(Jantosut et al., 2021)	Motorists who turn left at an intersection tend to be impatient and need to pay attention to vehicles from other directions, with a 2,926 times higher risk. Meanwhile, riders who turn right tend to be more patient and obedient with red lights.
2.	Riding Time	(Jantosut et al., 2021)	Riders who drive at night are 2,504 times more at risk of acting aggressively because of the volume of vehicles and lower levels of law enforcement compared to morning to evening.
3.	Type Of Manual Motorbike	(Jantosut et al., 2021)	This type of manual motorbike has better responsiveness than automatic motorbikes, giving riders the confidence to act aggressively with a risk of 1,567 times higher.
4.	Mileage	(Danielle et al., 2020)	A relationship exists between mileage and risky behaviour (p-value <0.001). Short-distance riders tend to engage in risky behaviour, such as not using a helmet. Meanwhile, riders with long distances tend to behave impatiently, such as riding at speeds above the average and violating traffic.
5.	Providing Educational Programs	(Andrijanto et al., 2022)	The education and training programs provided in the form of outreach and education and the management of traffic lights still need to be improved for riders' safe riding behaviour because many violations are still found.
		(Maulina et al., 2022)	There is a significant difference in understanding regarding traffic signs before and after the training (p-value <0.001). Riders who were given training had a higher traffic sign understanding score than riders who did not.
		(Akuh et al., 2023)	Providing helmet use education to riders changed riderbehaviour and adherence to helmet use (riderp-value <0.001).
6.	Workload	(Christie & Ward, 2023)	Informal freelance delivery couriers have a higher workload and tend to behave more aggressively.

No	Factors of Safety Riding	Author and Year of Publication	Result
			Meanwhile, delivery couriers in formal companies are more closely monitored by company management.
		(Papakostopoulos & Nathanael, 2021)	High workloads such as being on time for deliveries make it risky for delivery couriers to drive at high speed, go in the opposite direction, ride on sidewalks, not wear a helmet, or ride with one hand. As many as 70% of delivery courier respondents engage in risky riding.
		(Chen, 2023)	High workload and time pressure cause work stress for food delivery workers, affecting emotional and mental conditions, which can lead to aggressive behaviour when riding ($p < 0.001$).
7.	Policy	(Akuh et al., 2023)	Traffic laws that are strictly enforced can change the behaviour of more obedient riders (p-value < 0.001).
		(Papakostopoulos & Nathanael, 2021)	Inadequate policies related to informal employment make employers ignore the health and safety of delivery workers. As many as 65% of respondents reported a lack of policies related to their health and safety at work. Meanwhile, 83% reported that employers place more emphasis on time than personal safety.

Internal factors
Age

The rider's age is a risk factor influencing safe riding behavior in motorcyclists. Research Khan et al. (2022) stated that motorbike riders aged 13-17 years and 18-19 years have a higher risk of acting unsafely and sustaining injury while riding. Riders aged 13-17 are generally novice riders who tend to drive while learning, so they are not accompanied by sound Knowledge and experience and are at risk of causing unsafe behavior while riding (Qamara & Widowati, 2022). Whereas. Riders in the 18-19 year age group generally have a riding license and have better riding skills, but are accompanied by self-confidence that leads to a negative direction, causing aggressive actions when riding, generally riding at high speed (Khan et al., 2022).

Meanwhile, research by Danielle et al. (2020) stated the opposite: age did not affect the safety riding behavior of motorcyclists. However, this happened because the research subjects were high school students, so there was no significant age difference. High school students of equal age generally have similar patterns of thought and behavior, including riding behavior, so no significant differences are found between specific age groups in safety riding behavior.

Perception of Risk

Perceived risk is the result of someone's interpretation and evaluation of something. Generally, this risk perception will be influenced by norms and cultural factors that become habits in the group. A person's perception that is formed will eventually form beliefs and influence decision-making (Cheng et al., 2015). Research by

Satiennam et al. (2023) proved that social traffic cultural norms could influence safety riding behavior because motorcyclists will be motivated to adapt to societal behavior.

Subjective norms also have the most significant influence on the formation of one's intentions and beliefs. Riders with good intentions and beliefs have good safety riding behavior because they can control their riding behavior. Certain traffic situations also facilitate the perception of risk and confidence in riding. Traffic situations such as deserted roads, riding at night, and being in a hurry will lead to unsafe riding behavior because riders perceive the risk of an accident to be low. Meanwhile, traffic situations with checkpoints on the highway make motorists turn around carelessly or go against the flow to avoid being inspected by officers (Satiennam et al., 2023).

Knowledge

Knowledge results from one's interpretation after a study by sensing an object. Rider knowledge can affect riding behavior (Andrijanto et al., 2022; Danielle et al., 2020; Khan et al., 2022). A person's riding knowledge can be assessed from the rider's license, which is a requirement and permission to drive, meaning that a person has met administrative requirements, is in good health, and has good riding knowledge and skills. Research by Danielle et al. (2020) proved that motorcyclists with a riding license behave better in safe riding. Therefore, only riders with driving licenses are allowed to ride motorbikes.

Meanwhile, the study of Andrijanto et al. (2022) found that the riding behavior of most motorcyclists is still wrong. Based on the analysis results, it is known that this is caused by a lack of Knowledge and understanding, especially regarding traffic signs, due to limited socialization and education provided by related organizations, so they cannot develop rider knowledge effectively.

Consumption of Alcohol and Drugs

Consumption of alcohol and drugs is a standard behavior carried out by motorists based on the results of previous studies. In the study by Kiwango et al. (2021), research results show that riding under the influence of alcohol or marijuana can affect safe riding behavior.

Riders who consume alcohol and drugs will experience a decrease in riding performance and choose unsafe behavior, such as riding at a speed above the average speed, not wearing a helmet, and not obeying traffic signs. It is due to the effects of alcohol consumption, which can impair psychomotor skills, negatively affect a person's attention and judgment, and increase the likelihood of losing balance. Meanwhile, consuming drugs such as marijuana can affect biological mechanisms and interfere with riding performance. Combining alcohol and drug consumption can diminish a person's ability to carry out coping strategies. Therefore, riding under the influence of alcohol and drugs seriously threatens traffic safety (Kiwango et al., 2021).

Attitude

Using a helmet while riding is a manifestation of good safety riding behavior. The safety awareness from within the rider triggers the rider's attitude regarding helmet use. In the study by Jantosut et al. (2021), it was found that riders who have a

disobedient attitude in using helmets have a 2.964 times higher likelihood of committing violations at red lights because they tend to have the intention to disobey the rules and behave impatiently and risky. Meanwhile, riders who comply and wear helmets tend to be more obedient to traffic regulations because they respect the applicable traffic regulations.

The attitude of riders regarding using helmets while riding is also important. Knowledge and comprehension also impact riders' attitudes about wearing helmets. The study by Akuh et al. (2023) showed that the Knowledge and understanding gained from providing helmet use education influenced attitudes toward helmet use among riders. Riders who understand the benefits of using a helmet as a protective device will react positively to always using a helmet while riding, even though there is no law enforcement in force.

In addition, attitudes about helmet use are triggered by other factors, such as weather and comfort (Akuh et al., 2023). Certain weather conditions, such as scorching heat or heavy rain, will cause riders to use helmets to protect their heads from heat or rain. Meanwhile, the comfort factor is generally triggered by the type and design of the helmet that does not support the characteristics of the community. For example, riders in Jamaica have a low level of adherence to wearing helmets because they feel uncomfortable due to the dreadlocks (Fletcher et al., 2019).

Work Stress

Work stress is a phenomenon that arises due to the high work demands imposed on workers and an unsupportive work environment (Purnawati, 2014). For delivery couriers, the workload in the form of high orders and time pressure can have a burnout effect on workers. Since the COVID-19 pandemic, the demand for goods delivery has significantly increased due to the impact of social restrictions (Chen, 2023).

The main impact of work stress on motorcyclists is the risk of unsafe riding behavior. This risk arises due to the interaction between the stress experienced and the formation of attitudes. Delivery couriers who experience emotional stress tend to choose risky actions due to distraction from intentions and aversion to riding motorbikes (Chen, 2023). The work stress experienced can also cause work fatigue, resulting in decreased riding performance. Work fatigue triggered by high work stress can reduce alertness and motivation, leading to unsafe behavior on the road (Pramesti & Widajati, 2021).

External Factors
Road Conditions

The T-junction is a three-legged intersection that connects three road sections, two of which are straight roads (Shafie et al., 2022). Road junctions often pose a risk to safety riding behavior. In general, risky behavior at the T-junction includes not turning on the turn signal, not entirely stopping, or stopping in front of the boundary line. Research by Jantosut et al. (2021) found a risk factor where riders will turn directly at a T-junction. After all, they feel there is no need to stop because they perceive the risk as low. However, this made them not alert and ignored vehicles passing straight from the other direction. Conversely, motorists who will cross the crossing are generally more

patient in waiting for their turn at a red light because they are aware of a much higher risk of an accident.

Then, the type of road at the T-junction location also influences the rider's safe riding behavior. Research by Shafie et al. (2022) showed that different types of roads at T-junction locations have different risks. At a fork in a local one-lane road, motorists risk making an indiscriminate turn due to the low traffic volume and are often not equipped with traffic signs. In addition, motorists tend to stop at the end of the road to provide a gap for other vehicles that will turn directly because there is no boundary line. Therefore, infrastructure improvements are needed by adding boundary lines or waiting zones and traffic signs at intersections on local roads.

Meanwhile, a fork in a main road with more than one lane has the risk of overtaking carelessly. Motorcyclists feel their vehicles are smaller and faster, so they take another lane and overtake the vehicle in front of them to reduce time and distance. However, this overtaking behavior is often done from the wrong position. For example, overtaking from the side of a larger vehicle's blind spot creates a risk of being hit or hit by a larger vehicle(Shafie et al., 2022).

Riding Time

Riding time is a temporal factor that influences riding behavior. Jantosut et al. (2021) showed that motorcyclists risk violating red lights at night. The risk is two times greater than in any other period. At night, motorcyclists perceive a low safety risk due to the low volume of vehicles. Especially if it is accompanied by adequate lighting to aid the rider's visibility. In addition, some factors lower levels of law enforcement at night also support the confidence and intention of risky behavior in motorcyclists (Jantosut et al., 2021).

Motor Type

Research Jantosut et al. (2021) found evidence that riders with a manual gear motorbike have 1.567 times the risk of violating a red light than riders with an automatic motorbike. Motorcycles with manual gears have the ability and strength to respond more to the rider's needs than automatic motorbikes. In addition, factors such as engine capacity also influence rider behavior. Motorcycles with a larger engine capacity generally have more power, which poses a greater risk (Keall& Newstead, 2013).

The ability of the vehicle affects their perception of riding behavior. Motorcyclists with manual gears and a large motor capacity tend to experience better riding. However, this is accompanied by excessive self-confidence, which causes unsafe behavior while riding (Pai & Saleh, 2007).

Mileage

Mileage is one factor that controls individual perceptions and determines the adoption of certain behaviors. The study by Danielle et al. (2020) proved that destination mileage is related to riding behavior (p-value <0.001). Riders with short distances, around 1-3 km, tend to behave not wearing helmets. Riders think that when

the distance to their destination is close, there is no need to use a helmet because the risk of an accident is low.

Meanwhile, long-distance riders are at risk for aggressive behavior when riding. This is because long distances give riders limited time to reach their destination. This limited time makes them take risky behavior, such as riding a vehicle at a speed above the average or violating traffic (Danielle et al., 2020).

Provision of Educational Programs

Education programs generally target novice or elderly riders who require a license because they are considered to have a greater risk of accidents than experienced riders. The main goal is to assist motorists in improving their riding skills, thereby reducing the risk of traffic accidents (Ivers et al., 2016). Providing educational programs has proven to increase Knowledge and understanding regarding traffic safety for motorbike riders. As a result, motorcyclists experience increased adherence to helmet use because they already have awareness about the benefits of using helmets (Akuh et al., 2023; Maulina et al., 2022).

In contrast, research by Andrijanto et al. (2022) states that the level of compliance still needs to be higher even though an education program has been carried out. After being analyzed, this could occur due to ineffective educational program delivery because it was carried out in a limited manner and was hindered by licensing issues. Providing limited educational programs cannot develop Knowledge and understanding of riders, so they cannot change their riding behavior.

In Indonesia, riding education programs are carried out by the Indonesia Safety Riding Center (ISDC), a service company engaged in this field. This riding education and training program is given to school students, novice riders, professional riders, riding instructors, and rider's license examiners. One of the programs provided is the Short Training Program, which has two sessions, namely, giving theory for 90 minutes with one instructor for 30 people and practical riding for 60 minutes with one instructor for 4/5 people.

Workload

Delivery courier jobs have experienced a significant increase during the coronavirus pandemic since 2020. The increase in demand for delivery services has created jobs for the community. In general, delivery couriers only require a valid SIM and access to the delivery application on their mobile phones. However, the increase in orders during the COVID-19 pandemic also increased the workload for delivery couriers. The high order due to the lockdown has forced couriers to work longer hours amid the threat of exposure to COVID-19 (Chen, 2023).

The workload imposed on delivery couriers is limited to completing the task and the time pressure to complete the task on time. Delivery couriers are required to deliver orders to consumers at the estimated time. If they are late, they are threatened with punishment in the form of bad reviews, temporary suspension of assignments, deductions from wages, and termination of work partners (Christie & Ward, 2023). Other factors exist, such as the desire to meet revenue targets and large orders (Papakostopoulos& Nathanael, 2021).

The impact is the emergence of unsafe riding behaviors, such as riding at abnormal speeds, running through red lights, riding against the direction, riding on sidewalks, and other violating behaviors (Chen, 2023; Christie & Ward, 2023; Papakostopoulos & Nathanael, 2021). In addition, couriers also run the risk of negligent behavior by riding while using cell phones, usually to communicate with consumers or view maps (Christie & Ward, 2023).

Policy

Research by Akuh et al. (2023) proved that enforcement of traffic laws affects motorcyclist compliance. When laws are strictly enforced, motorcyclists are more likely to comply with helmet use. In addition, there is evidence that enforcing traffic policies accompanied by providing safety education about perceptions, weather, conditions, comfort, and the benefits of using helmets positively affects changing behavior in compliance with helmet use for motorists.

Meanwhile, Papakostopoulos and Nathanael (2021) discuss how inadequate policy factors affect the riding behavior of shippers in informal businesses. Weak policies related to health and safety for informal workers make employers disobedient in fulfilling their obligations to workers. Employers are open to paying workers minimum wages and do not provide safety equipment, making them act arbitrarily to meet their needs. For informal delivery workers, unsafe behavior is typical when completing work orders.

In Indonesia, policies related to the protection of the safety and health of motorists who work for the benefit of the community, such as delivery workers, are listed in the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 12 of 2019 concerning Safety Protection for Motorcycle Users Used for the Benefit of the Community. The policy explains the rights and obligations of delivery workers under the auspices of app-based companies and the rights and obligations of app-based companies to workers and consumers. However, there is no explanation regarding sanctions if application-based companies do not fulfill their rights and obligations. The policy is also limited to regulating the protection of the safety and health of workers under application-based companies. There is no policy governing health and safety protection for casual workers employed by informal companies.

4.2. Discussions

The findings of this study highlight the multifaceted nature of risk factors influencing safe riding behavior among motorcyclists. By analyzing both internal and external factors, we gain a comprehensive understanding of how these elements interact to impact rider safety.

Internal Factors

1. Age: The relationship between age and safe riding behavior is complex. Younger riders, particularly those aged 13-24, often exhibit higher levels of risk-taking due to inexperience and overconfidence (Khan et al., 2022). This aligns with the theory of developmental psychology, which posits that adolescents are more prone to risk-taking

behaviors due to ongoing brain development, particularly in areas governing impulse control (Steinberg, 2008).

2. Risk Perception: The findings indicate that riders' perceptions of risk are significantly shaped by social norms and cultural expectations (Satiennam et al., 2023). This is consistent with the Health Belief Model, which suggests that individuals are more likely to engage in protective behaviors if they perceive a high level of threat and believe they can mitigate it (Rosenstock, 1974).

3. Knowledge and Education: Knowledge of safe riding practices plays a critical role in influencing behavior. Riders with formal education on traffic laws and safety measures demonstrate higher compliance (Andrijanto et al., 2022). This supports the notion that educational interventions can effectively reduce risky behaviors and enhance safety awareness (Ivers et al., 2016).

External Factors

1. Road Conditions: The study emphasizes the impact of road conditions on rider behavior. Poorly maintained roads and inadequate signage can increase the likelihood of accidents (Shafie et al., 2022). This finding is supported by environmental psychology, which posits that physical surroundings significantly influence individual behavior and decision-making.

2. Riding Time: The analysis reveals that riders tend to exhibit riskier behaviors during nighttime, attributed to lower visibility and reduced law enforcement (Jantosut et al., 2021). This aligns with the theories of situational awareness and risk perception, suggesting that environmental factors can alter a rider's perception of safety.

3. Policy and Enforcement: Policies regarding helmet use and traffic regulations are crucial in shaping rider behavior. The study found that stricter enforcement correlates with higher compliance rates among riders (Akuh et al., 2023). This is in line with the Theory of Planned Behavior, which posits that perceived behavioral control influences an individual's intention to perform a behavior (Ajzen, 1991).

Synthesis of Findings

The interaction between internal and external factors creates a dynamic environment that influences safe riding behavior. For example, a young rider's lack of experience (internal factor) combined with poor road conditions (external factor) can significantly increase the risk of accidents. Moreover, educational programs that enhance knowledge and awareness can mitigate these risks, demonstrating the importance of targeted interventions.

5. CONCLUSION

Based on the results of the analysis, it is known that the risk factors influence safety riding behavior in motorcyclists. Internal factors include age, perceived risk, Knowledge, consumption of alcohol and cannabis, attitudes, and work stress. Meanwhile, external factors include road conditions, riding time, type of motorcycle, distance traveled, education provision, workload, and policies. Risk factors related to work stress and workload for couriers using motorbikes have not been found and are a new phenomenon due to the COVID-19 pandemic.

The expected recommendation for the Indonesian Police is to combine law enforcement with providing safety riding education for school students or novice riders

and implement waiting zones, boundary lines, and traffic signs at intersections on local roads. The Ministry of Manpower of the Republic of Indonesia is expected to increase the strictness of policies related to risk management for companies to protect the safety and health of delivery service couriers. In addition, for the Health Office, efforts are needed to improve and enforce policies related to protecting the safety and health of informal delivery couriers by involving the Occupational Health Efforts Post (UKK).

Future researchers can conduct further statistical analysis using the meta-analysis method or research the effect of workload and work stress on safety riding behavior using the systematic literature review method.

LIMITATION AND STUDY FORWARD

Limitations

While this study provides valuable insights into the risk factors influencing safe riding behavior among motorcyclists, several limitations must be acknowledged:

1. Scope of Literature Review: The study was limited to articles published between 2020 and 2023, which may not encompass all relevant research. Older studies could provide additional context and insights into long-term trends in riding behavior.
2. Geographical Focus: The majority of the studies reviewed were conducted in specific regions, such as Indonesia, Malaysia, and other Southeast Asian countries. This geographical limitation may affect the generalizability of the findings to other regions with different cultural and infrastructural contexts.
3. Variability in Study Designs: The included studies utilized various research designs, including cross-sectional and case-control studies, which may lead to inconsistencies in the data quality and findings. This variability can complicate the synthesis of results and diminish the robustness of the conclusions drawn.
4. Self-Reported Data: Many studies relied on self-reported data regarding behaviors such as helmet use and alcohol consumption. This reliance can introduce bias, as individuals may underreport risky behaviors due to social desirability or recall issues.
5. Lack of Longitudinal Data: The absence of longitudinal studies limits the ability to assess changes in behavior over time and the long-term effectiveness of interventions aimed at improving riding safety.

Future Scope

Given these limitations, several avenues for future research can be proposed:

1. Broader Literature Review: Future studies should consider including a wider range of literature, extending beyond the past three years, to capture historical trends and changes in riding behavior.

2. Cross-Cultural Studies: Comparative research across different geographical locations can provide insights into how cultural, economic, and infrastructural factors influence riding behavior. This could help develop more tailored interventions.
3. Longitudinal Studies: Conducting longitudinal studies would allow researchers to track changes in riding behavior over time and assess the long-term impacts of educational programs and policy changes.
4. Mixed-Methods Approaches: Incorporating qualitative methods, such as interviews or focus groups, alongside quantitative data could provide deeper insights into the motivations and attitudes of riders, enhancing the understanding of internal factors affecting behavior.
5. Evaluation of Interventions: Future research should focus on evaluating the effectiveness of specific interventions, such as educational programs or policy implementations, in changing rider behavior and improving safety outcomes.
6. Exploration of Emerging Trends: As technology evolves, studies should investigate the impact of new technologies, such as ride-sharing and GPS navigation, on riding behavior and safety.

By addressing these limitations and exploring these future research directions, scholars can contribute to a more comprehensive understanding of motorcycle safety and develop effective strategies to enhance rider safety globally.

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