Study of Knowledge, Attitudes and Practices Related to Road Safety and Motorcycle Accidents Among Food Delivery Drivers

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ABSTRACT

Motorcycle accidents are among the main occupational hazards for food delivery drivers (FDDs) in Malaysia. This cross-sectional study aimed to assess the accident rate and its relationship with socio-demographic factors, knowledge, attitudes, and practices (KAP) among FDDs nationwide. A total of 103 eligible drivers participated via an online questionnaire from 14 April to 1 May 2025. Data were analysed using IBM SPSS v28. The results showed that 15.53% had been involved in a motorcycle accident, equivalent to a rate of 155.34 per 1,000 riders. Significant associations at $p < 0.05$ were found between accident involvement and education level (p=0.014), job type (p=0.013) and delivery speed (p=0.034). Poor knowledge (p=0.003) and unfavourable attitudes (p=0.039) were significantly linked to higher accident risk, while safety practices showed no significant association (p=0.802). Lower education levels reduced the odds of avoiding accidents (Exp(B)=0.218, p=0.020), while more delivery rounds were associated with fewer accidents (Exp(B)=0.078, p=0.028). Significant relationships were also found between knowledge and safety practices (p=0.002) and between attitudes and practices (p=0.03). These findings highlight the need for targeted interventions focusing on safety knowledge and attitude development to reduce accident risks among FDDs.

Keywords: food delivery drivers, knowledge, attitudes, practices and safety behaviour

1 INTRODUCTION

The rapid growth of the gig economy has significantly reshaped the food delivery landscape in Malaysia, particularly in urban and semi-urban areas. Platforms such as GrabFood, Foodpanda, ShopeeFood, and AirAsia Food have created flexible income-generating opportunities, attracting a large segment of the workforce especially during the COVID-19 pandemic, which disrupted traditional employment structures and accelerated the digitalization of services [1]. While this sector provides economic benefits, it also presents significant occupational safety and health (OSH) risks, especially for food delivery drivers (FDDs) who predominantly use motorcycles as their mode of transportation. These riders are exposed daily to various road hazards and traffic-related dangers, often without formal employment protections [2].

According to national statistics, motorcyclists make up the largest proportion of traffic accident victims, and the vulnerability is even greater for gig workers who face time pressure and productivity demands [3]. According to Malaysia's Transport Minister Anthony Loke, more than 1,200 road accidents involving food delivery riders were reported between 2018 and May 2022, resulting in 112 fatalities, 82 serious injuries and 1,048 minor injuries [4]. These risks are further exacerbated by external factors including unpredictable weather, fatigue, poor road infrastructure, inconsistent law enforcement, and insufficient safety training provided by delivery platforms [5]. The same report identified speeding, mobile phone use while riding, and the pressure to meet fast delivery targets as key contributors to these incidents. Similarly, Zulkifly (2023) emphasized that the algorithm-driven nature of platform work, combined with insufficient regulation and oversight, has intensified occupational risks for gig economy workers in Malaysia [1].

Studies have shown that rider behaviour and accident risk are strongly influenced by individual-level cognitive and psychological factors, particularly knowledge, attitudes, and practices (KAP) related to road safety. In a recent study by Prakobkarn *et al.* (2024) [6] involving FDDs in Bangkok, individuals with poor knowledge of road safety and negative attitudes toward traffic laws were significantly more likely to be involved in accidents. Similarly, findings from Fan *et al.* (2022) and Qian *et al.* (2024) [7,8] emphasized that low risk perception and overconfidence among riders contributed to unsafe behaviours such as ignoring red lights, speeding, or tailgating. These studies highlight the value of the KAP framework in identifying behavioural factors that influence road safety outcomes.

Article Information

Received 4 September 2025
Accepted for publication 4 November 2025
Published: 30 November 2025

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However, while international evidence continues to grow, there remains a lack of Malaysia-specific data examining the role of KAP in motorcycle accident involvement among FDDs. Most local studies have focused on general motorcyclists, school children, or students [6, 9], with limited attention to gig-based FDDs who are increasingly dominating Malaysia's two-wheeled traffic. The unique Malaysian context characterized by inconsistent enforcement of road safety laws, varied helmet compliance, congested urban infrastructure, and cultural driving norms further underscores the need for targeted, localized research [3,5].

In response to the identified research gap, this study was undertaken to examine the relationship between FDDs' KAP related to road safety and their involvement in motorcycle accidents in Malaysia. The study specifically aimed to: (1) Determine the rate of motorcycle accidents among FDDs; (2) Identify the relationship between demographic factors with the rate of motorcycle accidents among FDDs; (3) Examine the relationship between food delivery drivers' KAP levels and the rate of motorcycle accidents; (4) Assess the relationship between food delivery drivers' knowledge, attitudes, and practices regarding road safety. To achieve these objectives, a quantitative, cross-sectional design was employed using a structured, self-administered online questionnaire distributed nationwide via google form. Descriptive statistics were used to report accident prevalence and summarize KAP scores. Inferential analyses, including Chi-square tests and binary logistic regression, were applied to identify significant associations and predictive relationships between demographic characteristics, KAP dimensions, and accident involvement. The findings are expected to provide valuable insight into behavioural risk factors and inform the development of targeted road safety interventions for Malaysia's growing food delivery workforce.

2 MATERIAL AND METHODS

2.1 Study Design

This study adopted a quantitative, cross-sectional design to evaluate the relationship between FDDs' KAP related to road safety and their involvement in motorcycle accidents. A cross-sectional approach was selected as it allows the simultaneous assessment of multiple variables and their associations at a single point in time, making it particularly suitable for exploring behavioural and demographic factors within an occupational population [10]. This design is commonly used in public health research due to its efficiency in identifying potential correlations and risk patterns, especially in mobile and informally employed groups like FDDs [11].

2.2 Data collection and Sampling Method

The survey was made accessible in both English and Malay to ensure comprehension among a diverse group of participants. This method was deemed appropriate due to both logistical constraints and the specific aim of targeting active motorcycle-based FDDs operating within Malaysia's gig economy. Data collection was carried out over an 18-day period, from 14 April to 1 May 2025 and collected nationwide across Malaysia using a structured, self-administered online questionnaire distributed via Google Forms through online platforms, leveraging targeted Facebook groups, WhatsApp messaging chains, and other rider community networks that are commonly used for communication among FDDs.

Participants were required to meet three inclusion criteria to be eligible for the study: (1) Hold a valid motorcycle driving license, (2) Be currently engaged in food delivery work and (3) Using a motorcycle as their primary mode of transportation. These criteria were designed to ensure that the sample accurately represented individuals most exposed to road hazards in the delivery sector. Exclusion criteria included being under 18 years of age or using non-motorcycle modes of transport for delivery, such as cars or bicycles, which present different risk profiles and were outside the study's scope.

All participants were provided with a brief introduction page outlining the study objectives, confidentiality assurances, and ethical considerations. Before proceeding to the questionnaire, respondents were required to give informed consent electronically by checking a designated consent box. This process ensured voluntary participation and adherence to ethical research standards. The combination of purposive sampling and digital recruitment allowed for the inclusion of a geographically diverse sample of FDDs from both urban and semi-urban areas, making the findings more reflective of the broader rider population in Malaysia.

2.3 Sampling Size

Based on prevalence estimates and a 95% confidence level, the final number of completed responses collected was 103. While this figure falls short of the original target, it is still considered acceptable for the types of statistical analyses employed in the study, including Chi-square tests and binary logistic regression. These methods are robust enough to detect moderate to large effect sizes even in smaller samples, if assumptions such as minimum expected cell frequencies are met. Furthermore, the sample was purposively selected to reflect the study population of interest which is active motorcycle-based FDDs across Malaysia and included a diverse range of participants from different demographic backgrounds and delivery

platforms. Given the exploratory nature of this research and the limited availability of Malaysia-specific data on this topic, the obtained sample size remains sufficient to generate meaningful insights and support valid inferences about key associations between knowledge, attitudes, practices, and accident involvement.

2.4 Research Tools

The primary research instrument was a structured, self-administered questionnaire, adapted with permission from a validated tool developed previously by Prakobkarn *et al.* [6] for a similar study on KAP and motorcycle accidents among FDDs in Bangkok, Thailand. Minor modifications were made to align the questionnaire with Malaysian traffic laws, cultural context, and enforcement practices. The final instrument was bilingual (English and Malay) and comprised five sections: (1) Demographic information, (2) Knowledge of road safety, (3) Attitudes toward safety practices, (4) Self-reported behavioural practices on the road, and (5) Accident history.

2.5 Data Analysis

To address the study objectives, various statistical analyses were conducted using IBM SPSS statistics version 28, which offered a comprehensive platform for performing both descriptive and inferential tests. For Objective 1, which aimed to determine the rate of motorcycle accidents among FDDs, descriptive statistics were employed. Frequencies and percentages were calculated to summarize the number and proportion of participants who reported experiencing motorcycle accidents. This provided a clear overview of the accident prevalence within the sample population.

For Objective 2, which explored the relationship between demographic factors and accident occurrence, a two-step analysis was performed. Initially, Chi-square tests were conducted to identify bivariate associations between accident involvement and individual demographic variables such as age, gender, monthly income, education level, job type (full-time or part-time), and delivery experience. Following this, binary logistic regression was applied to determine which demographic factors significantly predicted accident involvement while adjusting for potential confounders. This multivariate approach allowed for the simultaneous evaluation of multiple variables and provided adjusted odds ratios (Exp(B)) to quantify the strength and direction of association between each factor and accident risk.

To address Objective 3, which focused on the relationship between KAP levels and motorcycle accident involvement, the raw scores from the questionnaire were first calculated and then categorized. In the Knowledge section, nine items (K1–K9) assessed respondents' awareness of road safety principles. Each item was scored as "Yes" = 1 point, "Not Sure" = 0.5 points, and "No" = 0 points. The total possible score was 9. A score of 8 or above was categorized as Good Knowledge, while scores below 8 were labelled as Poor Knowledge.

In the Attitude domain, twelve items (A1–A12) were measured using a three-point Likert scale: "Agree" = 3, "Not Sure" = 2, and "Disagree" = 1. For negatively worded items (A2, A3, A5, A7, A10, A11, and A12), reverse coding was applied. The total possible score was 36. Respondents who scored more than 60 % or 27 were considered to have a Favourable Attitude, while those scoring below 27 were categorized as having an Unfavourable Attitude.

The Practice section contained fourteen items (P1–P14) assessed on a similar 3-point scale: "Practiced" = 3, "Not Sure" = 2, and "Not Practiced" = 1. Reverse coding was also used for negatively worded items (P4, P5, P6, P8, P9, P10, P11, and P14). The total score ranged from 14 to 42. Respondents scoring 32 or more were categorized as having Proper Safety Practices, while scores below 32 indicated Non-proper Practices. After classification, each KAP domain (Knowledge, Attitude, and Practice) was cross tabulated with accident involvement (Yes/No), and Chi-square tests were performed to determine whether statistically significant associations existed.

For Objective 4, the study investigated the relationship between knowledge, attitude level and safety practices among FDDs. The same categorization of knowledge ("Good" vs. "Poor") and practice ("Proper" vs. "Non-proper") scores was applied as described above. A Chi-square test of independence was used to assess whether a statistically significant association existed between drivers' knowledge and their actual safety practices. The relationship between attitude and safety practices was examined. Attitude scores were categorized as "Favourable" or "Unfavourable," while safety practices were again divided into "Proper" and "Non-proper" categories. The Chi-square test was similarly applied to determine whether attitudes toward safety significantly influenced the likelihood of engaging in safe driving behaviours.

All scoring and categorization of KAP domains were initially performed in Microsoft Excel. The processed data were then imported into SPSS for statistical testing. A significance level of $p < 0.05$ was set for all inferential analyses to ensure that only statistically relationships were reported.

2.6 Ethical Approval

Ethical approval was granted by the *Jawatankuasa Etika Penyelidikan Manusia, Universiti Sains Malaysia* (JEPeM-USM) under the reference number USM/JEPeM/KK/24121164. An electronic

consent form was included at the beginning of the survey, and all participant information was anonymized to ensure confidentiality and voluntary participation.

3 RESULTS

3.1 Rate of Motorcycle Accidents among FDDs

Based on Table 1, out of the 103 FDDs who participated in the study, 16 individuals (15.53%) reported being involved in at least one motorcycle accident within the past year. This corresponds to an estimated accident rate of 155.34 per 1,000 riders, which highlights a significant occupational hazard within the food delivery sector. This finding aligns closely with data reported by Prakobkarn *et al*. (2024) [6], who documented a similarly high incidence of motorcycle accidents among FDDs in Bangkok, largely attributed to time pressure, poor road infrastructure, and fatigue.

In this study, the most reported causes of motorcycle accidents among FDDs included poor road conditions, time pressure, and sudden lane changes triggered by traffic congestion (Table 2). These factors reflect the demanding conditions of the gig-based delivery industry, where riders must adhere to tight delivery schedules while navigating unpredictable and congested urban environments [2,3]. Poor road surface conditions, such as potholes, uneven pavements, and waterlogging, have been widely recognized as contributors to motorcycle instability and crash risk, particularly in urban areas lacking dedicated motorcycle lanes [1,3]. Inadequate signage and poor lighting further limit riders' ability to anticipate hazards, especially during night shifts or in unfamiliar locations [5].

3.2 Relationship between Demographic Factors with the Rate of Motorcycle Accidents among FDDs

The Chi-square analysis revealed significant relationships between motorcycle accident involvement and three key demographic variables among FDDs: education level (p=0.014), job type (p=0.013), and average delivery speed (p=0.034) (Table 3). Specifically, riders with only high school education were more likely to report involvement in motorcycle accidents compared to those with tertiary qualifications. This result aligns with findings by Adebayo et al (2023) [14] and Champahom (2022) [15], who noted that individuals with lower academic attainment often have limited comprehension of road signs, traffic rules, and safe riding strategies, which may compromise their ability to navigate traffic safely and avoid risky situations.

Further analysis using binary logistic regression (Table 4) confirmed the significant associations identified in the bivariate analysis.

Table 1: Accident history among FDDs (n = 103)

Accident History	FDDs, n (%)	Estimated accident rate per 1,000 population
Yes	16 (15.53)	155.34
No	87 (84.47)	-

Data was presented as frequency (percentage).

Table 2: Reported causes of accidents

Cause	Frequency
Poor road conditions	28
Weather conditions	24
Speeding	14
Using mobile phone	10
Careless car drivers	4
Other drivers' behaviour	2
Reversing vehicles without checking blind spots	2
Lack of focus	2
Impulsive behaviour	2
Hit by others	2

Specifically, participants with lower educational levels were significantly more likely to be involved in motorcycle accidents, with an odds ratio of Exp(B) = 0.218 and a p-value of 0.020. This suggests that riders with limited formal education were over four times more likely to experience accident involvement compared to those with higher education levels. This reinforces findings from previous studies, which highlight that education is linked to better comprehension of traffic laws, road signage, and hazard perception [2, 5,15].

3.3 Relationship between FDDs' KAP Level and the Rate of Motorcycle Accidents

Table 5 shows statistically significant associations between FDDs' knowledge level (p=0.003) and attitude level (p=0.039) with motorcycle accident involvement. Participants who demonstrated poor knowledge of road safety principles and held negative attitudes toward traffic regulations were more likely to have experienced accidents. These findings align with the Theory of Planned Behaviour [17] and the Knowledge, Attitude, and Practice (KAP) model, both of which posit that knowledge and attitudes directly influence risk perception and behaviour. In other words, when riders lack essential road safety knowledge or hold dismissive views about safety rules, they are more likely to underestimate risks and engage in hazardous riding behaviour.

3.4 Association between FDDs' Safety Knowledge and Their Actual Practices

Table 6 presents the distribution of safety practices across different levels of safety knowledge among

Table 3: Demographic factors related to motorcycle accidents

Factor	Category	Accident, n (%)		P value
		Yes	No	
Age	≤ 29	10 (62.5)	52 (59.8)	0.728
	30 - 39	6 (37.5)	33 (37.9)	
	≥ 40	0 (0)	2 (2.3)	
Gender	Male	16 (100.0)	85 (97.7)	0.540
	Female	0 (0)	2 (2.3)	
Education level	High school	10 (62.5)	76 (87.4)	0.014*
	Bachelor's degree & above	6 (37.5)	11 (12.6)	
Years of Experience	≤ 3	12 (75.0)	60 (69.0)	0.629
	≥ 4	4 (25.0)	27 (31.0)	
Income per month (RM)	≤ RM1500	11 (68.8)	64 (73.6)	0.691
	> RM1500	5 (31.3)	23 (26.4)	
Type of job	Main job	8 (50.0)	69 (79.3)	0.013*
	Part-time	8 (50.0)	18 (20.7)	
Average delivery rounds per day	1-15	11 (68.8)	38 (43.7)	0.065
	> 15	5 (31.3)	49 (56.3)	
Average speed while delivering (km/hr)	≤ 80	5 (31.3)	13 (14.9)	0.034*
	81-90	11 (68.8)	51 (58.6)	
	> 90	0 (0)	23 (26.4)	

Chi-Square test; df: degree of freedom; *A P value less than 0.05 indicates a statistically significant difference.

Table 4: Factors related to motorcycle accidents

Parameters	B	S.E.	Wald	df	P-value	Exp(B)
Education:	-1.525	.654	5.434	1	.020	0.218
Income	1.941	1.177	2.718	1	.099*	6.964
Average rounds	-2.545	1.159	4.820	1	.028	0.078

Binary Logistic Regression; df: degree of freedom; *A P value less than 0.05 indicates a statistically significant difference.

Table 5: Knowledge, attitude and practices level information

KAP Level	Accident, n (%)		Total (n = 103)	χ^2	df	P value
	Yes (n = 16)	No (n = 87)				
Knowledge						
Poor	10 (62.5%)	22 (25.3%)	32 (31.1%)	8.739	1	0.003*
Good	6 (37.5%)	65 (74.7%)	71 (68.9%)			
Attitude						
Unfavourable	3 (18.8%)	4 (4.6%)	7 (6.8%)	4.273	1	0.039*
Favourable	13 (81.3%)	83 (95.4%)	96 (93.2%)			
Practice						
Improper	5 (31.3%)	30 (34.5%)	35 (34.0%)	0.063	1	0.802
Proper	11 (68.8%)	57 (65.5%)	68 (66.0%)			

Chi-Square test; df: degree of freedom; *A P value less than 0.05 indicates a statistically significant difference.

Table 6: Knowledge level vs practice level

Knowledge Level	Proper Practice		χ^2	df	P value
	Yes	No			
Good	40 (58.8)	31 (88.6)	9.55	1	0.002*
Poor	28 (41.2)	4 (11.4)			

Chi-Square test; df: degree of freedom; *A P value less than 0.05 indicates a statistically significant difference.

Table 7: Attitudes level vs practice level

Attitude Level	Proper Practice		χ^2	df	P value
	Yes	No			
Favourable	66 (97.1)	30 (85.7)	4.70	1	0.03*
Unfavourable	2 (2.9)	5 (14.3)			

Chi-Square test; df: degree of freedom; *A P value less than 0.05 indicates a statistically significant difference.

FDDs. Among those with good safety knowledge, 58.8% (n = 40) demonstrated proper safety practices, while 41.2% (n = 28) did not. In contrast, only 11.4% (n = 4) of drivers with poor knowledge engaged in proper safety practices, whereas a majority which is 88.6% (n = 28) exhibited non-proper practices. Overall, the chi-square test revealed a statistically significant association between knowledge and safety practices ($\chi^2(1, N = 103) = 9.55$, $p = 0.002$), indicating that higher safety knowledge is strongly linked to safer on-road behaviour.

This result reinforces the core principle of the KAP model, which suggests that knowledge is a critical foundation for developing positive attitudes and translating them into safe practices. Riders who are better informed about traffic laws, the correct use of personal protective equipment (PPE), and hazard recognition are more likely to adopt responsible behaviours such as consistent helmet use, adherence to speed limits, and proper signalling while riding. These findings are consistent with previous research by Mahdavi *et al.* (2023) and Akuh *et al.* (2023) [9,18], which reported that individuals with higher levels of road safety knowledge demonstrated more defensive, law-abiding, and risk-aware riding behaviours. The evidence clearly suggests that improving road safety knowledge among FDDs can play a key role in reducing unsafe practices and, by extension, accident risk.

3.5 Association between FDDs' Attitudes and Their Safety Practices

The chi-square analysis shows a clear and statistically significant link between FDDs' attitudes toward road safety and their self-reported safety practices ($\chi^2(1, N = 103) = 4.70$, $p = 0.03$; Fisher's Exact = 0.043). As summarised in Table 7, 97.1 % of riders with favourable attitudes adhered to proper safety behaviours, whereas only 2.9 % engaged in unsafe practices; by contrast, riders with unfavourable attitudes accounted for 14.3 % of the non-compliant group. This stark disparity underscores the pivotal role that attitudinal orientation plays in translating safety norms into day-to-day riding behaviour. Drivers who value traffic laws, recognise the risks of reckless riding and internalise personal responsibility are far more likely to wear helmets consistently, obey speed limits and avoid mobile-phone use while riding.

4 DISCUSSIONS

Comparable trends have been observed in other Southeast Asian countries, where the rapid growth of gig-based delivery services has outpaced the implementation of safety regulations. For instance, Quy Nguyen-Phuoc *et al.* (2022) [12] found that approximately 21.7% of delivery riders in Ho Chi Minh City experienced road crashes annually, with younger and part-time workers being the most vulnerable. Similarly, a study by Chen (2023) [13] in China indicated that over 25% of e-hailing and delivery riders reported road traffic accidents within the previous 12 months, with many incidents linked to long working hours and smartphone use while riding.

In the Malaysian context, these results echo the findings of Rusli *et al.* (2022) [2], noted that motorcyclists constitute the majority of road traffic fatalities in the country, with gig economy workers representing a growing proportion of these statistics [2]. Moreover, the exposure of riders to hazardous road conditions, delivery-related stress, and productivity demands likely compounds their vulnerability, as also noted in local analyses by Zulkifly, 2023 and MIROS, 2022. [1,3].

Many riders reported feeling pressured to meet fast delivery deadlines or fulfil platform-imposed performance quotas, which often leads to speeding, abrupt lane changes, or riding while fatigued [1,5]. The structure of incentive-based gig platforms, such as performance bonuses and customer ratings, creates a work culture that prioritizes productivity over safety [3,7]. These findings are further supported by Chen (2023) [13], who noted that occupational stress and constant pressure to deliver quickly often reduce riders' ability to make safe decisions in traffic.

Additionally, sudden lane changes and aggressive filtering through traffic were commonly cited by riders as necessary but hazardous behaviours, particularly during peak hours or in high-density areas. These practices have been associated with accident risk in studies on urban motorcyclists, including those in the food delivery sector [2,6]. Compounding these risks is the lack of formal safety training, inconsistent enforcement of road regulations, and minimal oversight from platforms [1,3], which leaves many riders ill-equipped to manage the complex challenges of road navigation while under pressure.

These findings are supported by previous research findings in Malaysia, where riders with limited education, younger age groups and less delivery experience are more likely to engage in hazardous behaviours [2], who noted that inconsistent work schedules and limited safety guidance can increase vulnerability among less experienced riders [5], who observed that delivery platforms often prioritize efficiency over standardizing safety training, especially for casual or part-time workers. Additionally, delivery speed emerged as another significant factor, with riders reporting average speeds of 81–90 km/h having a higher rate of accident involvement compared to those riding at slower speeds. This supports the findings of Dong *et al.* (2021) [16], who identified speeding, often driven by tight delivery deadlines and algorithm-based performance incentives, as a major contributor to risky behaviour and traffic accidents in the gig economy. Similar patterns have been documented by Fan *et al.* (2022) and Chen (2023) [7, 13], who reported that pressure to maintain short delivery times leads to high-risk practices such as lane filtering, red-light running, and speeding. Malaysian Institute of Road Safety Research (MIROS) also highlighted that speeding is one of the top contributing factors to road crashes involving motorcyclists in Malaysia [3]. These combined findings point to the need for policy interventions and platform-based reforms that reduce speed incentives and promote safer riding behaviour through education, monitoring, and targeted enforcement.

In addition, riders who reported completing a higher number of delivery rounds per day were found to have a lower likelihood of being involved in accidents (Exp(B) = 0.078, p = 0.028). One possible explanation for this trend is that riders who perform frequent deliveries may develop enhanced route familiarity, riding skill, and adaptation to traffic conditions, allowing them to better anticipate hazards and respond safely. This aligns with findings by Fan *et al.* (2022) and Chen (2023) [7,13], who observed that more experienced riders tend to exhibit safer on-road behaviour compared to less active or novice riders. These results suggest that both formal education and practical riding exposure play important roles in influencing safety outcomes. Therefore, food delivery platforms and safety authorities should consider developing training modules and onboarding programs that address the specific needs of riders with limited education or riding experience [1,3].

Interestingly, the practice component of KAP showed no statistically significant relationship with accident involvement (p = 0.802). Although many participants reported engaging in safe practices such as wearing helmets and using indicators, these actions may not have been applied consistently or may have been practiced in ways that were ineffective under high-risk conditions. This disconnect suggests that behaviour alone may not be sufficient to prevent accidents if not reinforced by accurate knowledge and positive attitudes. These findings are consistent with studies by Quy Nguyen-Phuoc *et al*. (2022) and Fan *et al.* (2022) [12,13], which highlighted the limitations of behaviour-focused interventions that overlook the internal cognitive and emotional drivers of safety-related decisions. Therefore, improving accident outcomes among FDDs requires not just promoting compliance but also strengthening their understanding of risk and reshaping their perceptions and attitudes toward safe riding.

These findings are consistent with international evidence. Fan *et al*. (2022) and Dong *et al.* (2021) [7,16] reported that riders who internalise safety values maintain compliance even when external enforcement is limited, while Prakobkarn *et al.* (2024) and Mahdavi *et al.* (2023) [6,9] showed that positive attitudes significantly predict safe riding in other Southeast-Asian contexts. Similarly, studies in Nigeria and China have demonstrated that riders with strong safety attitudes are more likely to comply with helmet and speed regulations despite platform time-pressure or variable enforcement by Qian *et al*. (2024); Adebayo *et al*. (2023) and Peng *et al*. (2022) [8, 14, 19] further highlight that favourable attitudes enhance risk perception and self-regulation under occupational stress. Collectively, these results confirm that cultivating positive safety attitudes through incentives, peer influence, organisational safety culture and regular training is essential for reducing unsafe practices and mitigating accident risk among Malaysian FDDs.

4.1 Comparative Analysis with Regional and Global Studies

The findings from this study align with a growing body of international research on occupational road safety within the gig economy. For example, Qian et al. (2024) [8] reported that in Vietnam, high job demands combined with limited personal resources such as inadequate safety training, financial insecurity, and poor work-life balance were significantly associated with increased accident risk

among motorcycle-based delivery workers. Similarly, Chen (2023) [13] found in a Chinese context that occupational stress, largely driven by tight delivery schedules and algorithmic management systems, contributed to distracted, fatigued, and occasionally aggressive riding behaviour. These international studies support the present study's findings, which suggest that both external job-related pressures (e.g., delivery speed targets) and internal psychological factors (e.g., knowledge and safety attitudes) interact to shape rider safety outcomes.

However, Malaysia presents a unique regulatory context that differentiates it from countries with more structured enforcement systems. In countries such as China, gig rider behaviour is increasingly managed through technological enforcement, mandatory licensing, and centralized regulatory frameworks [16, 20]. In contrast, Malaysia's food delivery sector operates with minimal formal regulation, inconsistent enforcement of traffic laws, and limited institutional safety oversight [1, 3]. As a result, many FDDs are more vulnerable to occupational hazards, and platform-level interventions remain largely voluntary and difficult to enforce. This new regulatory Gig Workers Bill 2025 gap reduces the overall effectiveness of safety campaigns and training efforts. The absence of comprehensive oversight highlights the urgent need for integrated policy reforms that combine enforcement, standardised rider training, and platform accountability to better protect the growing gig workforce in Malaysia's road-based delivery sector.

5 CONCLUSIONS

In summary, the results of this study provide substantial support for several of the proposed hypotheses. First, the analysis confirmed that demographic factors specifically education level, job type, and riding speed are significantly associated with motorcycle accident involvement, thereby supporting Hypothesis 1. Riders with lower education levels, those engaged in part-time delivery work, and those who reported higher average riding speeds were found to be at greater risk of being involved in accidents. These findings align with prior research by Champahom *et al*. (2022) and Dong *et al*. (2021) [15, 16], which emphasized the influence of demographic and occupational characteristics on accident risk among motorcycle delivery workers. Second, the study found that both knowledge and attitude levels were significantly related to accident history, supporting Hypothesis 2. This suggests that FDDs who possess higher road safety knowledge and hold more favourable attitudes toward safe riding practices are less likely to experience motorcycle accidents, an outcome consistent with the KAP model and the Theory of Planned Behaviour [17,18].

In addition, the data revealed a statistically significant relationship between knowledge and safety practices as well as between attitudes and practices rate of motorcycle accidents, thereby confirming Hypotheses 3 and 4, respectively. These findings highlight that both knowledge and attitudes serve as important precursors to the adoption of safe riding behaviours. Similar conclusions were drawn in studies by Fan *et al*. (2022) and Mahdavi *et al*. (2023) [7,9], which found that improvements in road safety awareness and perception translated into more consistent safety compliance among riders. However, the study also demonstrated that safety practices alone were not significantly associated with accident involvement. This result suggests that while safe behaviours may be present, they are not always sufficient to reduce accident risk unless they are reinforced by a strong foundation of knowledge and a positive safety mindset. This is supported by findings from Quy Nguyen-Phuoc *et al*. (2022) and Chen (2023) [12,13], who stressed the importance of internal cognitive and motivational factors in shaping effective safety behaviour.

This study highlights the critical occupational risks faced by FDDs in Malaysia due to motorcycle-related accidents. With a reported accident rate of 15.53%, the findings underscore the vulnerability of this rapidly expanding workforce within the gig economy. Statistically significant associations were identified between accident involvement and several demographic factors, particularly education level, job status, and average delivery speed. Most notably, drivers with poor knowledge and unfavourable attitudes toward road safety were more likely to be involved in accidents, confirming that cognitive and attitudinal dimensions play a vital role in shaping safe riding behaviour [2, 12, 16].

Although many respondents reported engaging in safety practices, these behaviours were not statistically associated with lower accident rates unless they were supported by strong knowledge and positive attitudes. This reinforces the notion that behavioural change cannot be sustained through enforcement alone; it must be anchored in internalized awareness and personal responsibility [13, 17]. As such, interventions focused only on external regulations or blanket safety campaigns may be insufficient. Instead, the findings support the need for a comprehensive and targeted strategy that includes rider education, attitude development, and contextual support from both platform providers and policymakers. For Malaysia's growing gig-based workforce, particularly in the food delivery sector, such multifaceted efforts are essential to reduce accident risk, promote long-term safety culture, and ensure occupational well-being [1,2,5].

5.1 Study Limitation

There are several limitations to this study that should be acknowledged. First, the reliance on self-reported data collected through an online questionnaire introduces the potential for recall bias and response bias. Respondents may have overreported socially acceptable behaviours such as consistent helmet use or adherence to speed limits or underreported accident involvement, which could affect the accuracy of the findings [21]. Second, the cross-sectional design of the study restricts the ability to infer causal relationships between KAP and accident involvement. While significant associations were identified, it is not possible to determine the directionality of these relationships or how they might change over time. A longitudinal study would be more appropriate for capturing changes in safety behaviour and accident risk across different stages of a rider's employment. Third, although the sample size of 103 participants met the minimum requirement for statistical analysis, it may not fully represent the broader population of FDDs in Malaysia. This is especially true for those operating in rural regions or working with smaller, informal platforms, who may face different road safety challenges and lack access to formal training or institutional support [3,12].

5.2 Recommendation for Future Research

To improve future studies on motorcycle safety among FDDs, several methodological enhancements are recommended. First, researchers should consider using probability sampling techniques, such as stratified or cluster sampling, to ensure the sample better represents the broader FDD population. This would increase the generalizability of findings across different regions, age groups, and working conditions [22,23]. Second, future research should adopt longitudinal study design rather than cross-sectional methods. By following riders over time, researchers can better understand how safety training, regulations, or platform policies affect behaviour and accident risk [24, 25].

In addition, the use of a mixed-methods approach is recommended. While quantitative surveys offer statistical insights, qualitative methods like interviews or focus groups can help explore deeper motivations and barriers to safe behaviour [22, 26]. To improve response rates, future researchers should consider broader outreach strategies. Collaborations with delivery platforms, rider associations, and unions can increase access to participants, especially if surveys are distributed via apps, email, or rider portals. Incentives such as small payments or lucky draws may also encourage participation [27,28,29].

Finally, future research should focus on specific subgroups, such as inexperienced riders, those working in high-traffic areas, or those who ride long hours. Segmenting the population would allow researchers to develop more targeted interventions. For example, younger riders may benefit from training in impulse control and risk awareness, while veteran riders may need refreshers on fatigue management or hazard detection [30].

5.3 Suggestions

Several practical suggestions can be made to key stakeholders involved in road safety and food delivery. First, food delivery platforms should offer structured safety training during onboarding and at regular intervals. These programs should cover not only traffic laws but also topics such as defensive riding, fatigue prevention, and the proper use of safety equipment like helmets and reflective clothing. Methods like peer mentoring, scenario-based learning, or interactive modules may increase rider engagement and knowledge retention [30].

Second, government authorities should increase enforcement, especially in high-risk urban areas. This can include roadside checks, mobile patrols, and automated enforcement such as speed and red-light cameras. Data from accident hotspots should be used to guide targeted inspections and interventions [19, 31]. Third, public health agencies and NGOs should run safety awareness campaigns that are tailored specifically to delivery riders. These campaigns should use visual, relatable content and be shared through popular platforms such as social media, in-app messages, or rider forums [27].

Fourth, employers and policymakers must address job pressures that encourage unsafe behaviour. Instead of rewarding fast delivery, companies should offer safety-based incentives like accident-free bonuses, subsidized insurance, or leaderboard rankings for safe riders [13]. This aligns with the Job Demands-Resources (JD-R) model, which emphasizes reducing job stress and reinforcing positive behaviour through rewards [32].

Lastly, a multisectoral effort involving companies, regulators, researchers, and riders is needed to improve safety outcomes. This can be done by applying the four E's of road safety: Education, Enforcement, Engagement, and Engineering. For instance, safer routes with designated motorcycle lanes, rest stops, and in-app alerts for traffic hazards or rider fatigue could significantly enhance rider protection [31]. In summary, promoting a strong safety culture across all levels from platforms to policymakers is key to reducing road injuries and improving the wellbeing of FDDs in Malaysia's growing gig economy.

ACKNOWLEDGMENTS

The author would like to thank all the volunteer participants and those involved in this study.

CONFLICT OF INTEREST

All authors declared no conflict of interest.

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