

DETERMINANTS OF PASSENGERS' SAFETY AWARENESS ON DOMESTIC FERRIES: EVIDENCE FROM PANGKOR ISLAND, MALAYSIA

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ARTICLE INFO	ABSTRACT
Article History: Received: 20 January 2026 Revised: 1 April 2026 Accepted: 28 April 2026 Published: 15 August 2026 Keywords: Domestic ferries, passengers, safety awareness	Recent statistics indicate a rising trend of ferry-related accidents in Malaysian waters, raising concerns about passenger safety in domestic ferry operations. Despite increasing passenger volumes, particularly at high-traffic destinations such as Pangkor Island, empirical research on passengers' safety awareness remains limited, as prior studies have largely focused on crew safety and operational management. This gap constrains understanding of passengers' preparedness and compliance with onboard emergency procedures. This study examined the factors influencing passengers' safety awareness on domestic ferries in Pangkor Island, with particular emphasis on situational awareness, wayfinding, safety information, and safety delivery, grounded in the Theory of Planned Behaviour (TPB) and supported by situational awareness theory, SERVQUAL, and cognitive mapping theory. Data were collected from 420 respondents using a convenience sampling technique. Descriptive analysis using SPSS version 29 was conducted to explore the demographic characteristics of respondents. Pearson correlation analysis was applied to determine the relationships between the independent variables and passengers' safety awareness. In contrast, multiple linear regression analysis was employed to examine the relative influence of each factor. The findings revealed that all four independent variables had a significant positive impact on passengers' safety awareness. Among the variables examined, wayfinding emerged as the most influential predictor ($\beta = 0.375$) followed by safety information, situational awareness and safety delivery. This study provides valuable insight for ferry operators seeking to improve safety information through improved facilities, signs, and safety briefings, thereby enhancing safety management practices and operational effectiveness, and informing policy improvements for ferry operators and maritime authorities. Future research could explore a broader geographical area, adopt longitudinal research and utilise mixed methods to deepen understanding of this issue and further strengthen passenger-centred safety strategies in domestic ferry operations.

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Introduction

Water transport plays a crucial role in connecting activities worldwide. Ferries and passenger island destinations and supporting tourism vessels are widely used in many coastal and

archipelagic regions due to their affordability, accessibility and capacity to transport large numbers of passengers. In Malaysia, water transport serves as an important mode of connectivity to major island destinations, such as Pangkor Island, Langkawi Island and Tioman Island (Raduan *et al.*, 2017). Passenger vessels have become one of the most popular types of sea transport, contributing to population movement and tourism (Liu *et al.*, 2022). In Pangkor Island in particular, ferries represent the primary means of transportation, resulting in high passenger volumes, especially during peak travel seasons. As ferry services play a vital role in supporting island connectivity, tourism development and local economic activities, ensuring passenger safety has become an increasingly critical priority.

Gohari *et al.* (2025) reported a growing pattern of ferry accidents in Malaysian waters, which caused concerns regarding passenger safety. MMD (2026) reported that 257 maritime accidents involving various types of vessels were recorded between 2021 and 2025. While these incidents include different vessel categories such as cargo ships, tankers and service vessels, they remain relevant to passenger ferry safety because these vessels share the same navigational waters and shipping lanes with ferries. Previous studies indicate that maritime accidents frequently involve collisions, contact incidents and navigation-related events between different vessel types operating in congested maritime areas, which can lead to severe consequences for all vessels involved (Fazlee *et al.*, 2023).

For example, collisions between ships are recognised as one of the most common maritime accident categories and may occur when vessels operate in proximity, especially in coastal or high-traffic waters. Passenger ferry operations are particularly vulnerable because ferry routes often intersect with other commercial shipping activities, increasing exposure to risks such as collision, grounding, fire and mechanical incidents (Gohari *et al.*, 2025). Although not all recorded incidents involve

ferries directly, the rising number of maritime accidents reflects broader safety challenges within Malaysian waters, where ferries operate alongside other commercial vessels, thereby influencing overall navigational safety and risk exposure. Passenger arrivals and departures at Pangkor Island increased by approximately 65% between 2021 and 2024 (MMD, 2026), indicating a substantial rise in ferry traffic and placing considerable operational pressure on ferry services, particularly during peak seasons. This rapid growth has raised safety concerns as overloading and congestion of ferries have been cited as key risk factors contributing to maritime accidents (MalayMail, 2024). These accident trends indicate that safety challenges in domestic ferry operations are not solely technical or operational in nature but also involve human and behavioural dimensions.

Passenger density in ferries has been identified as lowering situational awareness, reducing attention towards safety information, and undermining knowledge about emergency response, which makes it difficult to respond to emergencies effectively (Lau *et al.*, 2020). From a counselling psychology perspective, heightened crowding and environmental stressors can negatively impact passengers' cognitive processing, emotional regulation and risk perception, thereby impairing their psychological readiness to heed safety cues and respond appropriately during emergencies. This behavioural response is consistent with the Theory of Planned Behaviour (TPB), where perceived behavioural control and attitudes toward safety procedures influence an individual's intention to comply with emergency instructions. Reduced situational awareness and heightened emotional stress may weaken passengers' safety-related intentions and increase vulnerability during evacuation scenarios. Integrating psychological perspectives with maritime safety theory provides a stronger explanatory basis for examining passengers' safety awareness. Ferry incidents have demonstrated that passenger confusion (Wang *et al.*, 2021), unclear communication (May, 2000), and low safety awareness increase the risk of loss

of life. Despite these behavioural implications, empirical examination of passengers' safety awareness within Malaysian domestic ferry operations remains limited.

Although the number of ferry passengers in Malaysia, specifically at Pangkor Island, is increasing, passenger safety awareness has not been well studied, as most previous research focuses on crew safety rather than passenger behaviour (Barasa *et al.*, 2025). This imbalance limits the development of comprehensive safety management strategies that adequately address passenger preparedness and emergency response. A structured investigation into the determinants of passengers' safety awareness is necessary to strengthen evidence-based safety management in domestic ferry operations.

This study aimed to examine the influence of situational awareness, wayfinding, safety information and safety delivery on passengers' safety awareness on domestic ferries in Pangkor Island. A quantitative research approach employing descriptive analysis, Pearson correlation analysis and multiple linear regression analysis was adopted, with data collected through a structured survey questionnaire. TPB served as the underpinning theory, supported by the theory of Situational Awareness, Service Quality (SERVQUAL) theory, and cognitive mapping theory. The study provides practical insights for ferry operators, policymakers, and maritime authorities to strengthen onboard safety communication, improve environmental design, and promote a stronger safety culture, contributing to safer ferry operations and the protection of human life at sea.

This study contributes to maritime safety research in three important ways. First, it shifts the focus from crew-centred safety studies to a passenger-centred behavioural perspective, addressing a critical but underexplored dimension of domestic ferry safety. Second, Pangkor Island represents a high-traffic and operationally pressured ferry destination with documented accident trends, making it a relevant real-world context for examining passenger

safety awareness. Third, by integrating TPB with situational awareness theory, SERVQUAL, and cognitive mapping theory, this study advances maritime safety research through a multidisciplinary framework linking behavioural, environmental, and service-related factors to passenger safety outcomes.

Literature Review

This study adopted TPB, developed by Ajzen (1985), as the underpinning theory for explaining human behaviour in safety-related situations. TPB assumes that attitude, subjective norms, and perceived behavioural control are determinants of behavioural intention, which acts as the main predictor of actual behaviour. To reinforce the theoretical foundation, this study incorporated the theory of situational awareness formulated by Endsley *et al.* (1988) that describes how one perceives and reacts to changing circumstances. Situational awareness involves 3 levels, including perception of environmental elements, comprehension of their meaning and projection of their future status (Endsley, 1995). Cognitive mapping theory was developed by Tolman (1948) to explain how human beings form mental representations that help them navigate and make spatial decisions. Cognitive maps helped people observe, learn, remember, and recognise spatial attributes like routes, landmarks, exits, and crossroads so that they could efficiently navigate familiar and unfamiliar spaces. The theory of SERVQUAL, which was created by Parasuraman *et al.* (1985), explains service quality as a gap between customer expectations and perceived service delivery, with tangibles as one of the dimensions of service quality (Iloka & Anukwe, 2022). Tangibles refer to physical facilities (Zakaria *et al.*, 2010), such as equipment, signage, and staff appearance. The framework has been implemented in different areas of service viz. transportation and public safety (Hsu & Chen, 2021).

Rather than functioning as parallel explanations, these theories are integrated into a unified behavioural framework. TPB explains how passengers' attitudes toward

safety procedures, perceived social expectations (subjective norms), and perceived behavioural control influence their safety awareness and intention to comply with emergency instructions. Situational awareness and wayfinding operationalise perceived behavioural control by enhancing passengers' ability to interpret environmental cues, locate exits and respond effectively during emergencies. Safety information and safety delivery align with subjective norms and service expectations, as clear communication, safety demonstrations and visible safety facilities shape passengers' perceptions of expected safety behaviour. Through this integration, behavioural intention, environmental cognition and service quality collectively explain passengers' safety awareness in domestic ferry operations.

Guided by TPB and supporting theories, passengers' safety awareness in domestic ferry services is influenced by cognitive, environmental, informational, and service-related factors. Situational awareness allows passengers to sense dangers, learn about evolving conditions, and forecast risks. High passenger density was identified as decreasing situational awareness, hindering attention to safety information and emergency responses (Lau *et al.*, 2020), contributing to passenger confusion during emergencies (Wang *et al.*,

2021). Wayfinding is a way to find and leave the premises, using clear signs, user logs, and easy structures to reduce confusion during emergencies (Shiwakoti *et al.*, 2019). Safety information also improved knowledge of emergency measures and proper behaviour in case of accidents (Chang & Liao, 2009), while the lack of clear or efficient communication leads to misunderstanding and unsafe behaviour (Hystad *et al.*, 2016). Safety delivery refers to the quality of onboard safety services, viz. crew communication, safety demonstrations, and facilities, which enhance passenger trust, compliance, and overall safety awareness (Lau *et al.*, 2020). Research hypotheses were formulated based on the reviewed literature as shown in Figure 1 below, and the following conceptual framework was formulated as below:

H1: There is a significant positive relationship between situational awareness and passengers' safety awareness.

H2: There is a significant positive relationship between wayfinding and passengers' safety awareness.

H3: There is a significant positive relationship between safety information and passengers' safety awareness.

H4: There is a significant positive relationship between safety delivery and passengers' safety awareness.

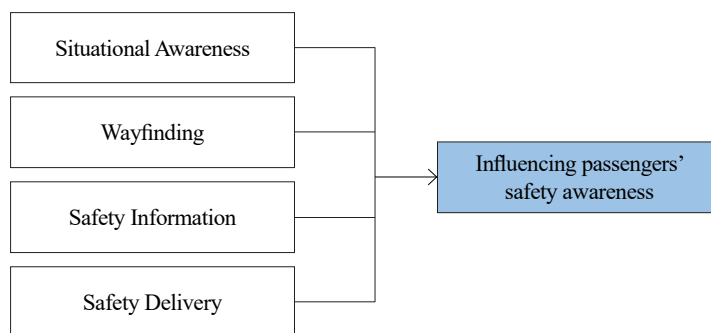


Figure 1: Research framework for the study

Methodology

This study used a cross-sectional quantitative research design to investigate the factors that affect passengers' safety awareness on domestic ferry services operating around Pangkor Island.

A convenience sampling method was used to collect data from 420 ferry passengers in various locations, since it was not possible to access all locations (Kothari, 2004). This study employed a non-probability convenience sampling approach, which was considered appropriate due to the high mobility of ferry passengers and the limited access to a complete passenger sampling frame. This approach may limit the generalizability of the findings beyond the study context. The questionnaire also included a demographic profiling section to capture respondents' background characteristics, including gender, age, education level, occupation and travel purpose. Collecting these socio-demographic variables provides contextual understanding of the passenger profile and supports interpretation of safety awareness findings, as previous studies indicate that demographic characteristics such as education level, gender and socio-economic background can influence individuals' safety awareness, risk perception and responses to safety information in transport environments.

This study employed a non-probability convenience sampling approach, which was considered appropriate due to the high mobility of ferry passengers and the limited access to a complete passenger sampling frame. However, this approach may limit the generalizability of the findings beyond the study context. The questionnaire also included a demographic profiling section to capture respondents' background characteristics, including gender, age, education level, occupation and travel purpose. These socio-demographic variables were collected to provide contextual understanding of the respondents and to allow the interpretation of safety awareness patterns across different passenger groups.

A structured questionnaire with 22 items was designed based on the previous studies that involve situational awareness (Wang *et al.*, 2021), wayfinding (Shiwakoti *et al.*, 2019), safety information (Chang & Liao, 2009), safety delivery (Lau *et al.*, 2020) and safety awareness (Lau *et al.*, 2020). The instrument consisted of 5 items measuring situational awareness, 5

items measuring wayfinding, 4 items measuring safety information, 4 items measuring safety delivery and 4 items measuring passengers' safety awareness. Example items include "I know where the emergency exits are located", "I know where the emergency red button is located" and "The ferry provides safety and emergency evacuation videos". Respondents' agreement levels were measured using a 5-point Likert scale with options of 1 (strongly disagree) to 5 (strongly agree) (Goi, 2016). Content validity was established through adaptation of items from established literature and review by subject-matter experts in maritime studies and safety management to ensure clarity, relevance and contextual appropriateness.

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 29, where descriptive statistics were first applied to summarise respondents' demographic profiles, followed by reliability testing, normality testing, Pearson correlation analysis to determine relationships between variables, and multiple linear regression analysis to examine predictive relationships among constructs. A pilot test with 30 respondents (Browne, 1995) was conducted to determine the instrument's reliability using Cronbach's alpha, with values exceeding 0.70 considered acceptable and indicating satisfactory internal consistency.

Results and Discussion

The study involved 420 respondents. The majority of respondents were female (56.9%). Most respondents were aged between 26 and 30 years (32.9%) and held undergraduate qualifications (60.7%). For occupation, respondents working in the service industry formed the largest group (26.4%). Leisure and recreation (45.0%) was the main travel purpose, and almost half of the respondents used ferry services three to four times a year (48.6%). As presented in Table 1, mean values for all variables ranged between 3.899 and 4.039, while corresponding standard deviations fell between 0.783 and 0.848. The instrument was found

to be reliable, with Cronbach's alpha values ranging from 0.729 to 0.795, which suggests an acceptable level of internal consistency. Data were considered normally distributed, as the skewness and kurtosis values fell within the acceptable range of ± 2 (George & Mallery, 2016). Pearson correlation analysis revealed that wayfinding ($r = 0.794$), situational awareness ($r = 0.782$), safety information ($r = 0.758$) and safety delivery ($r = 0.747$) had strong positive correlations in influencing passengers' safety awareness ($p < 0.001$) (Cohen, 1988). Although correlations above 0.75 may suggest conceptual proximity among constructs, multicollinearity diagnostics confirmed that variance inflation

factor values were below the recommended threshold of 5, indicating that the constructs remain statistically distinct and suitable for regression analysis (Sang & Bekhet, 2015).

Multiple linear regression analysis in Table 2 indicated that a combination of 4 independent variables accounted for 73.9% of the variance in influencing passengers' safety awareness ($R^2 = 0.739$). The results showed that wayfinding had the strongest positive predictive effect ($\beta = 0.375$, $p < 0.001$), followed by safety information ($\beta = 0.248$, $p < 0.001$), situational awareness ($\beta = 0.231$, $p < 0.001$), and safety delivery ($\beta = 0.097$, $p = 0.041$). These findings supported H1, H2, H3 and H4.

Table 1: Descriptive statistics of variables and correlation matrix

Var.	I	M	SD	α	Skewness	Kurtosis	Var.	Correlation Matrix				
								IPSA	SIA	WAF	SAI	SAD
IPSA	4	3.943	0.825	0.729	-0.926	-0.247	IPSA	1				
SIA	5	3.941	0.783	0.781	-0.895	-0.312	SIA	0.782**	1			
WAF	5	3.899	0.810	0.795	-0.844	-0.182	WAF	0.794**	0.766**	1		
SAI	4	4.039	0.848	0.784	-0.987	-0.351	SAI	0.758**	0.755**	0.691**	1	
SAD	4	3.933	0.788	0.733	-0.918	-0.340	SAD	0.747**	0.789**	0.727**	0.786**	1

Note: Var.- Variables; I- Items; M- Mean; SD- Standard deviation; α - Cronbach's Alpha; IPSA- Influencing passengers' safety awareness; SIA- Situational awareness; WAF- Wayfinding; SAI- Safety information; SAD- Safety delivery; ** Correlation is significant at the 0.01 level (2-tailed)

Table 2: Multiple linear regression results

F	Unstd. Coeff. β	SE	Std. Coeff. β	t	P	VIF	Results
(Constant)	0.120	0.114	-	1.048	0.295	-	
SIA	0.244	0.050	0.231	4.874	<0.001	3.593	Supported (H1)
WAF	0.382	0.042	0.375	9.062	<0.001	2.730	Supported (H2)
SAI	0.241	0.043	0.248	5.654	<0.001	3.058	Supported (H3)
SAD	0.102	0.050	0.097	2.051	0.041	0.280	Supported (H4)

Note: F- Factors; Unstd. Coeff. β - Unstandardized coefficients β ; SE- Standard error; Std. Coeff. β - Standardized coefficients β ; t- t-value; P- p-value; VIF- Variance inflation factor; Dependent variable = IPSA; $R = 0.739$, $R^2 = 73.9\%$, adjusted $R^2 = 73.7\%$, $F = 294.437$, significant = 0.05

This study examined the relationships between situational awareness, wayfinding, safety information and safety delivery with passengers' safety awareness in domestic ferry operations. Each construct in this study was treated as a latent variable and measured using multiple questionnaire items on a 5-point Likert scale. In total, the measurement model consisted of 22 questionnaire items distributed across five constructs, as reported in Table 1.

Situational awareness and wayfinding were each measured using five items, while safety information, safety delivery and passengers' safety awareness were measured using four items each. These measurement items represent the observable indicators (parameters) used to operationalise the latent constructs and capture different dimensions of passengers' perceptions and behavioural responses. Consistent with prior studies of Wang *et al.* (2021) and Chang

and Liao (2009) attitude, and behavior (KAB, situational awareness and safety information were positively associated with improved emergency preparedness. Wayfinding emerged as the strongest predictor, suggesting that environmental cues and spatial clarity play a critical role in shaping passengers' safety awareness during ferry travel.

Demographic findings showed that young, well-educated, leisure-oriented passengers defined the main profile of domestic ferry users on Pangkor Island. Pearson correlation analysis showed that passengers' safety awareness was positively correlated with all independent variables. These results indicated that all 4 independent variables influenced passengers' safety awareness during domestic ferry operations. Wayfinding demonstrated the strongest relationship with safety awareness, indicating that clearer navigation and evacuation cues were linked to higher levels of passenger safety awareness, highlighting the importance of effective wayfinding in emergency preparedness (Wang *et al.*, 2021). The strong correlations suggest that passengers with higher educational backgrounds were more likely to develop greater safety awareness when supported by effective wayfinding and situational cues. Situational awareness showed a strong correlation, suggesting that passengers with greater awareness of their surroundings were better able to identify potential hazards, make informed decisions and respond effectively to safety situations, enhancing safety awareness (Schmalacker, 2025). Safety information and safety delivery were positively associated with passengers' safety awareness, although their influence was comparatively weaker than wayfinding and situational awareness.

Multiple linear regression analysis indicated that all hypotheses were supported, where situational awareness, wayfinding, safety information, and safety delivery were found to have significant impacts on passengers' safety awareness. Situational awareness emerged as a significant determinant of passengers' safety awareness (H1), consistent with previous

findings that greater awareness enhanced emergency preparedness (Wang *et al.*, 2021) and facilitated timely responses (Shiwakoti *et al.*, 2019). Chang and Liao (2009) attitude, and behavior (KAB reported that safety education improved attentiveness and reduced panic during emergencies, while Abd Rahman *et al.* (2022) found that limited awareness of emergency information reduced passengers' readiness during evacuations. Wayfinding was confirmed as a significant predictor (H2), consistent with previous studies, which highlight that familiarity with wayfinding tools (Shiwakoti *et al.*, 2019), evacuation maps (Shiwakoti *et al.*, 2016), and assembly areas (Wang *et al.*, 2021) enhanced passengers' safety awareness.

From a theoretical perspective, the findings extend the application of TPB within maritime passenger settings. Specifically, situational awareness and wayfinding strengthen perceived behavioural control by enhancing passengers' confidence in navigating emergency environments. At the same time, safety delivery aligns with subjective norms by reinforcing expectations of appropriate safety conduct through visible crew practices and communication. This integration demonstrates that environmental and service-related factors operate through behavioural control mechanisms to shape safety awareness in maritime contexts.

The dominance of wayfinding aligns with respondents' younger age and higher educational levels, which likely enhance their interpretation of visual and spatial information. Safety information had a positive significant impact in influencing passengers' safety awareness (H3), confirming that clear safety information (Chang & Liao, 2009), familiarity with emergency measures (Hystad *et al.*, 2016) and innovative approaches to delivering safety information (Della *et al.*, 2020) improved passengers' readiness during emergencies. Safety delivery demonstrated a significant positive impact in influencing passengers' safety awareness (H4), indicating that effective safety demonstrations and sufficient lifesaving and fire-fighting equipment enhanced passengers'

safety awareness, aligned with Lau *et al.* (2020). Overall, the findings highlight the importance of integrating behavioural theory with environmental design and service quality considerations to enhance passenger safety awareness in domestic ferry operations.

Conclusions and Future Research

This study investigated factors influencing passengers' safety awareness on domestic ferries in Pangkor Island with particular focus on situational awareness, wayfinding, safety information and safety delivery. The findings revealed that transportation was mainly used by young passengers aged between 26 and 30 years (32.9%), with most of them having undergraduate education (60.7%) and travelling mainly for leisure and recreational purposes (45.0%). Wayfinding showed the strongest correlation with influencing passengers' safety awareness, followed by situational awareness, safety information and safety delivery, which also demonstrated a positive but comparatively weaker association. These findings indicate that enhancing passengers' safety awareness on domestic ferries requires an integrated approach that includes effective wayfinding systems, clear safety communication and passenger-focused safety practices, supported by appropriate operational and policy measures. The practical implications of this study are significant for multiple stakeholders.

For ferry operators, efforts should focus on strengthening onboard signage clarity, improving evacuation maps, enhancing the visibility of emergency exits and delivering more engaging safety demonstrations to increase passengers' situational awareness. For maritime regulators, clearer guidelines and monitoring standards on safety communication, passenger briefings and signage compliance should be established to ensure consistent safety practices across domestic ferry routes. In terms of training and signage design, investment in crew communication training and evidence-based signage systems that prioritise visual clarity, spatial orientation and user-friendly

safety information is essential to improve passengers' emergency responsiveness. This study was limited by the scope of a single ferry route and the use of a cross-sectional survey design, which may limit the generalizability of findings and prevent assessment of changes in safety awareness over time. Future research may extend this investigation to other ferry routes beyond Pangkor Island and adopt longitudinal or mixed-method approaches to provide deeper insight into how passengers' safety awareness evolves across different operational contexts.

This study contributes to maritime safety literature by extending the application of behavioural theory, particularly TPB, within a domestic ferry passenger setting. It advances passenger behaviour research by integrating cognitive, environmental and service-related determinants into a unified safety awareness framework. Additionally, the findings provide empirical evidence relevant to Malaysian transport policy by highlighting the importance of passenger-centred safety strategies in strengthening domestic ferry operations.

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Conflict of Interest Statement

The authors declare no conflict of interest.

Author Contributions Statement

YHW, MTP, and ART contributed to the original draft preparation, data collection, and data analysis. NAI, KMC, MHS, KBL, NHMM, and LC were responsible for the review and editing of the manuscript.

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