

PROMOTING ROAD SAFETY FOR SUSTAINABLE COMMUNITIES: ANALYSING DRIVING ANGER, AGGRESSIVE DRIVING, AND ROAD ACCIDENT PRONENESS WITH PARTIAL LEAST SQUARES STRUCTURAL EQUATION MODELLING (PLS-SEM) APPROACH

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ABSTRACT

Objective: Numerous studies have emphasized the web of factors contributing to a driver's vulnerability to road accidents. These factors often stem from the interaction between drivers' conduct, environmental conditions, and vehicle-related aspects. Among these elements, road rage and aggressive driving behavior are particularly noteworthy for their roles in road accidents. In this article, we delve into the connection between road rage, aggressive driving, and their combined impact on the likelihood of road accidents among Malaysian drivers.

Theoretical framework: Theoretical materials were based on international scientific publications, reports, and scientific papers. Empirical findings from previous studies were critically reviewed for a more complete and objective presentation of the road accident problem.

Methodology: This study used a cross-sectional design to administer self-administered questionnaires to drivers. The survey method made it possible to study the factors influencing susceptibility to traffic accidents quantitatively. The analysis reveals compelling insights using a rigorous structural equation modeling approach.

Results and Conclusion: Driving anger and aggressive driving significantly influence the likelihood of road accidents among Malaysian drivers. This study holds significant implications for theoretical understanding and practical intervention strategies to reduce road accident proneness within the Malaysian road user community. The findings provide valuable insights

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and recommendations to enhance road safety, ultimately contributing to the sustainability of communities through reduced road accidents.

Originality/value: The originality and value of the study lie in its in-depth examination of the relationship between driving anger, aggressive driving, and the likelihood of road accidents among Malaysian drivers. It goes beyond existing research by employing a rigorous structural equation modelling approach, drawing from international scientific publications and empirical findings. This comprehensive approach offers fresh insights into the specific context of Malaysia and provides a foundation for practical interventions to reduce road accident proneness, contributing to community sustainability and road safety.

Keywords: aggressive driving, driving anger, road accidents, structural equation modelling, sustainable communities.

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PROMOVER A SEGURANÇA RODOVIÁRIA PARA COMUNIDADES SUSTENTÁVEIS: ANALISANDO A RAIVA POR DIRIGIR, A CONDUÇÃO AGRESSIVA E A PROPENSÃO A ACIDENTES RODOVIÁRIOS COM A ABORDAGEM DE EQUAÇÃO ESTRUTURAL PARCIAL DOS MÍNIMOS QUADRADOS (PLS-SEM)

RESUMO

Objetivo: Numerosos estudos destacaram a teia de fatores que contribuem para a vulnerabilidade do condutor aos acidentes rodoviários. Estes fatores resultam frequentemente da interação entre o comportamento dos condutores, as condições ambientais e os aspectos relacionados com os veículos. Entre estes elementos, a raiva rodoviária e o comportamento agressivo da condução são particularmente notáveis pelos seus papéis em acidentes rodoviários. Neste artigo, analisamos a conexão entre a raiva na estrada, a condução agressiva e seu impacto combinado na probabilidade de acidentes rodoviários entre os motoristas malaios.

Estrutura teórica: Os materiais teóricos foram baseados em publicações científicas internacionais, relatórios e artigos científicos. Os resultados empíricos de estudos anteriores foram revistos de forma crítica para uma apresentação mais completa e objetiva do problema do acidente rodoviário.

Metodologia: Este estudo usou um design transversal para administrar questionários autoadministrados aos motoristas. O método de levantamento permitiu o estudo quantitativo dos fatores que influenciam a susceptibilidade a acidentes de trânsito. A análise revela percepções convincentes usando uma abordagem rigorosa de modelagem de equações estruturais.

Resultados e Conclusão: A raiva e a condução agressiva influenciam significativamente a probabilidade de acidentes rodoviários entre os motoristas malaios. Este estudo tem implicações significativas para a compreensão teórica e estratégias práticas de intervenção para reduzir a prontidão de acidentes rodoviários dentro da comunidade de usuários de estrada da Malásia. As conclusões proporcionam informações e recomendações valiosas para melhorar a segurança rodoviária, contribuindo, em última análise, para a sustentabilidade das comunidades através da redução dos acidentes rodoviários.

Originalidade/valor: A originalidade e o valor do estudo estão em seu exame aprofundado da relação entre a raiva de condução, condução agressiva e a probabilidade de acidentes rodoviários entre motoristas malaios. Ele vai além da pesquisa existente, empregando uma



abordagem rigorosa de modelagem de equações estruturais, com base em publicações científicas internacionais e descobertas empíricas. Esta abordagem abrangente oferece novas ideias sobre o contexto específico da Malásia e fornece uma base para intervenções práticas para reduzir a propensão para acidentes rodoviários, contribuindo para a sustentabilidade da comunidade e a segurança rodoviária.

Palavras-chave: condução agressiva, raiva, acidentes rodoviários, modelagem de equações estruturais, comunidades sustentáveis.

1 INTRODUCTION

Present-day traffic accidents have reached an alarming level, resulting in fatalities and loss of life. The road accident rate in Malaysia is escalating at approximately 3% each year, resulting in a shocking number of accidents (Road Safety Department Malaysia, 2019). Cars are one of Malaysia's most common vehicles in road accidents, while automobile drivers and passengers are the most frequently killed (Royal Malaysian Police, 2019). Road accidents have cost billions of medical bills or the loss of a family breadwinner and impose a severe financial strain on the victims and their families, preventing them from adequately managing their household expenses (Adu et al., 2023; Bucsuházy et al., 2020). Horrific images of this predicament haunt every motorist, as approximately 85 percent of global traffic accidents are caused by driver behaviour (Chu et al., 2019; Ismail et al., 2016). Driving anger and aggressive behaviours, encompassing reckless driving, impatience, self-centred driving tendencies, and non-compliance with road and traffic regulations are key factors influencing driver behaviour (Sullman et al., 2015).

2 THEORETICAL FRAMEWORK

Anger represents an emotional and physiological reaction triggered by perceived insults, injustices, frustrations, or annoyances (Elsaieh et al., 2023; Herrero-fernández & Fonseca-Baeza, 2017). When applied to driving, "driving anger" pertains to an individual's mental and physiological response to becoming furious when faced with provocation and dissatisfaction on the road (Montoro et al., 2018). Those with elevated anger levels tend to exhibit anger more frequently and intensely while driving, which is associated with increased traffic violations and road accidents (Zhang et al., 2019). Furthermore, individuals with high anger are more inclined to react angrily to provoking incidents, resulting in a more aggressive driving style that can lead to traffic accidents.



Zhang et al., (2019) find it intriguing to examine how drivers express anger in similar situations, such as encountering a slow-moving vehicle ahead. The expression of anger varies significantly between drivers. For instance, one driver may become enraged, honk the horn, glare at the slow driver, attempt to overtake, and potentially cause an accident. Conversely, another driver may remain calm, continue driving cautiously, and avoid collisions (Montoro et al., 2018); how drivers express anger while driving impacts whether they are more likely to be involved in a road accident or to prioritise safe driving practices. This study contributes to a deeper understanding of the relationship between driving anger and susceptibility to road accidents, emphasising the importance of studying how drivers outwardly express their anger.

Individuals' consistent or regular driving habits primarily influence their driving behaviour and the frequency of traffic accidents. Among these habits, aggressive driving stands out as the foremost contributor to traffic collisions (Islam & Mannering, 2020). In the context of this study, aggressive driving is defined as any unsafe behaviour aimed at harming other road users, including actions like high-speed passing and attempts to provoke irritation among fellow drivers.

As Huang (2014) highlighted, aggressive driving can be categorised into three levels: low, moderate, and high. A low level of aggressive driving tends to result in a deteriorating driving style as it stirs anger in the driver without significantly affecting their driving performance. Meanwhile, moderate aggressive driving leads to mildly aggressive behaviours, such as speeding, abrupt lane changes, disregard for traffic signs, and occasional overtaking of other vehicles, among other actions. High-level aggressive driving escalates to extreme behaviours, including physical altercations or even violence.

Huang (2014) underscores that moderate manifestations of aggressive driving, including tailgating, disregarding traffic signals, abruptly cutting off other vehicles, excessive speeding, and hazardous overtaking, inherently represent unsafe and deliberate actions that carry substantial risks to fellow road users and property.

Several pieces of research have examined the association between anger while driving, aggressive driving, and road accident proneness. The investigation of drivers' driving anger towards road accident proneness is equally significant, as it will ultimately affect a person's safety on the road. For instance, Herrero-Fernández and Fonseca-Baeza (2017) did a study among automobile drivers to demonstrate that anger while driving contributes to high accident risk. The data revealed a substantial correlation between



driving anger and the likelihood of small and large traffic accidents. They also discovered that anger while driving increased the driver's intent to cause harm. In addition, Montoro et al., (2018) provided more evidence supporting the impact of rage emotions on predicting accidents among public transport drivers. The results indicated that drivers who regularly display anger while driving might have a more significant and ongoing propensity to be involved in road accidents.

Furthermore, Ismail et al., (2016) investigated the correlation between aggressive driving behaviours and the likelihood of road accidents. Their focus centred on the presence of hostility in traffic, revealing a significant link between aggressive driving and an elevated risk of road accidents. This study notably identified that behaviours like excessive speeding, tailgating, failure to yield to fellow road users, and running red lights were among the most prevalent forms of aggressive driving (Ismail et al., 2016). Moreover, individuals who exhibited these behaviours were also more inclined to engage in additional forms of aggressive driving, further heightening the potential for accidents.

Concurrently, Khan et al., (2014) embarked on a study to elucidate the connection between aggressive driving and the risk of road accidents. Additionally, their study aimed to enhance drivers' comprehension of the consequences of their actions on the road and bolster awareness regarding these behaviours. Their research uncovered that many drivers had been involved in at least one collision related to aggressive driving during their lifetime. The survey findings pinpointed specific aggressive driving actions, including deliberately forcing a vehicle off the road, obstructing passing vehicles with intent, pursuing other vehicles aggressively, driving at excessively high speeds, and tailgating, as crucial contributors to aggressive driving (Khan et al., 2014).

While prior research, exemplified by studies like Herrero-Fernández and Fonseca-Baeza (2017), Ismail et al., (2016), Khan et al., (2014), and Montoro et al., (2018), has made significant strides in elucidating the link between driving anger, aggressive driving, and susceptibility to road accidents, notable research gaps have come to light. One such gap pertains to the instruments employed for variable measurement. For instance, in the study by Herrero-Fernández and Fonseca-Baeza (2017), the assessment items used to gauge road accident proneness exhibited poor internal consistency coefficients due to a less-than-adequate adaptation of the original measurement. Thus, to bridge the gap, this present study addresses these gaps by employing measurement tools recognised for their



high reliability and validity, as recommended by Iversen and Rundmo (2002), to assess the likelihood of road accidents.

Additionally, another discernible gap in previous studies involves the utilisation of only a single predictor. For instance, both the Ismail et al., (2016) and Khan et al., (2014) studies exclusively explored one predictor, such as aggressive driving, concerning drivers' proneness to road accidents. Furthermore, prior research sometimes focused on specific subsets of drivers, such as public transport drivers, representing a minority group involved in road accidents (Montoro et al., 2018).

To address these gaps and build upon prior research, Herrero-Fernández and Fonseca-Baeza (2017), Kassim et al., (2019), and Zhang et al., (2019) have called for studies that evaluate the influence of a broader array of predictors on road accident proneness. This approach offers a more comprehensive understanding of the myriad factors influencing drivers' tendencies to be involved in road accidents. Kassim et al., (2019) have emphasised the importance of concentrating on high-risk commuting drivers, representing the majority group involved in road accidents. Consequently, this study incorporates additional variables, including aggressive driving, into a unified framework, thereby enriching our comprehension of the relationship between these factors and road accident proneness, particularly among high-risk drivers within the Malaysian context.

3 METHODOLOGY

This study employed a cross-sectional research design involving the distribution of a self-administered questionnaire to drivers selected from 18 auto-service workshops in four northern states of Malaysia. The participants were chosen using a random sampling method. Before the data collection process, a pilot study was conducted involving 50 car drivers from Kedah. This pilot study was crucial in ensuring the validity and accuracy of the survey instruments. The feedback and insights from the pilot study prompted several modifications to the questionnaire.

The data collection phase resulted in the receipt of 631 responses out of the 1200 questionnaires distributed, yielding a response rate of 52.6%. Subsequently, data entries with missing values and dishonest responses were excluded from the analysis. This meticulous screening process culminated in a final sample of 597 drivers, of which 73% were male. The participants had an average age of 39.47 years ($SD = 8.2$, range 23 – 71 years), with a standard deviation of 8.2. Furthermore, the participants' mean number of



severe road accidents was 1.31 (SD = 1.14; range: 5–35 years), while the mean number of minor road accidents stood at 3.87 (SD = 1.14).

This study employed an adapted version of the Driving Anger Scale developed by Deffenbacher et al., (1994). The Driving Anger Scale (DAS) consists of 14 categories, including behaviours like aggressive gestures, unlawful driving, the presence of police, slow driving, inconsiderate behaviour, and traffic impediments. Participants were asked to express their agreement levels regarding their experience of anger while driving, rating each item on a 5-point Likert scale (ranging from Very low = 1 to Very high = 5).

Besides, this study utilised an updated version of the Aggressive Driving Test (AVIS) introduced by Chraif et al., (2018) to assess driver's driving aggression. The revised AVIS comprises fifteen statements that capture various aspects of aggressive driving behaviour. Participants were asked to indicate their level of agreement with each statement using a 5-point Likert scale (ranging from Very low = 1 to Very high = 5).

In measuring road accident proneness, the study considered the total number of major and minor accidents that participants had been involved in since obtaining their driving license. Additionally, participants were required to provide demographic information such as gender, age, and driving history.

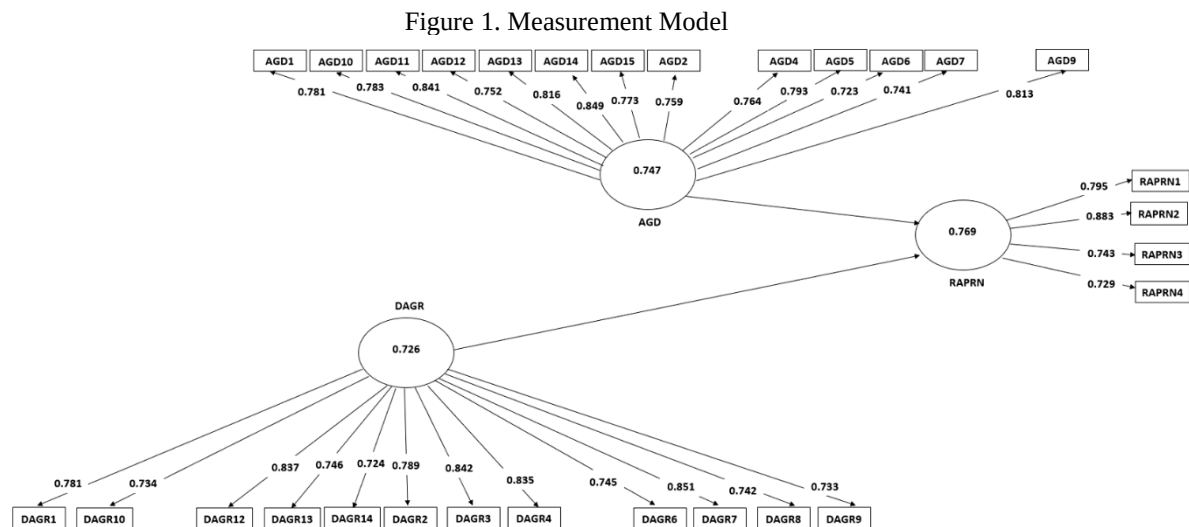
4 RESULTS AND DISCUSSION

Valid data collected in this study underwent analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM). Initially, the analysis focused on the measurement model, verifying the suitability of driving anger, aggressive driving, and road accident proneness as constructs in this research. Internal consistency was assessed through indicator loadings analysis and composite reliability calculations. Subsequently, convergent validity was ascertained by computing the Average Variance Extracted (AVE), ensuring the reliability of the measurement items. Finally, the path modelling technique was applied, with road accident proneness as the dependent variable and driving anger and aggressive driving as the independent variables in the analysis.

The initial step in assessing a measurement model involves examining indicator loadings. It is recommended that loadings exceeding 0.70 be sought, as they indicate strong reliability (Hair et al., 2019). This study excluded AD8, AD3, DA5, and DA11 from the analysis due to loadings below the 0.70 threshold (refer to Figure 1 and Table 1 for details).



Figure 1 provides a visual representation of the three latent constructs: the independent variables, driving anger (DA) and aggressive driving (AD), as well as the dependent variable, road accident proneness (RAP). The item loadings are within the box, while the extracted mean-variance (AVE) is denoted by the value within the circle. For a comprehensive breakdown of the outer loadings, composite reliabilities, and AVE for each construct examined in this study, please refer to Table 1.



Note: AGD = Aggressive Driving; DAGR = Driving Anger; RAPRN = Road Accident Proneness
Source: Compile by authors

The final step in assessing a measurement model involves the examination of its discriminant validity. This study evaluated discriminant validity using the Heterotrait-Monotrait correlation ratio (HTMT). Table 2 presents the HTMT values, all below the conventional threshold of 0.85, as Henseler et al., (2015) recommended, thus implying that discriminant validity is established among all pairs of constructs. In conclusion, the results obtained for both convergent and discriminant validity affirm that the measurement model employed in this study is robust and suitable for evaluating the outcomes of the PLS-SEM analysis.

Before delving into the examination of direct links, the study conducted a collinearity test to ensure that structural linkages did not unduly impact the regression results. As presented in Table 3, the results reveal that the Variance Inflation Factor (VIF) values are below 3, signifying the absence of collinearity issues.



Table 1 . Result of the Measurement Model

Constructs	Items	Outer Loadings	CR	AVE
AGD	AGD1	0.781	0.807	0.747
	AGD10	0.783		
	AGD11	0.841		
	AGD12	0.752		
	AGD13	0.816		
	AGD14	0.849		
	AGD15	0.773		
	AGD2	0.759		
	AGD4	0.764		
	AGD5	0.793		
	AGD6	0.723		
	AGD7	0.741		
	AGD9	0.813		
	DAGR1	0.781		
DAGR	DAGR10	0.734	0.818	0.726
	DAGR12	0.837		
	DAGR13	0.746		
	DAGR14	0.724		
	DAGR2	0.789		
	DAGR3	0.842		
	DAGR4	0.835		
	DAGR6	0.745		
	DAGR7	0.851		
	DAGR8	0.742		
	DAGR9	0.733		
	RAPN1	0.795		
	RAPN2	0.833		
	RAPN3	0.743		
RAPN	RAPN4	0.729	0.826	0.769

Note: AGD = Aggressive Driving; DAGR = Driving Anger; RAPRN = Road Accident Proneness
Source: Compile by authors

Table 2. Discriminant Validity

	AGD	DAGR	RAPRN
AGD	-		
DAGR	0.518	-	
RAPRN	0.483	0.557	-

Note: AGD = Aggressive Driving; DAGR = Driving Anger; RAPRN = Road Accident Proneness
Source: Compile by authors

Table 3. Collinearity Assessment

	AGD	DAGR	RAPRN
AGD			1.554
DAGR			1.432
RAPRN			-

Note: AGD = Aggressive Driving; DAGR = Driving Anger; RAPRN = Road Accident Proneness
Source: Compile by authors

As illustrated in Figure 2 and hypothesised, the subsequent step involved scrutinising the direct relationships between driving anger and aggressive driving on road accident proneness. The comprehensive findings on evaluating the structural model's direct relationships are outlined in Table 4.



The results showcase positive and statistically significant path coefficients for both aggressive driving (AGD) and driving anger (DAGR) in relation to road accident proneness (RAPRN). The model effectively explains 57.2% of the variance in the endogenous variable, RAPRN. Additionally, it is noteworthy that both AGD and DAGR exhibit substantial effect sizes. Furthermore, the Q^2 value, with a magnitude of 0.331, indicates a moderate level of predictive significance for the direct path on RAPRN.

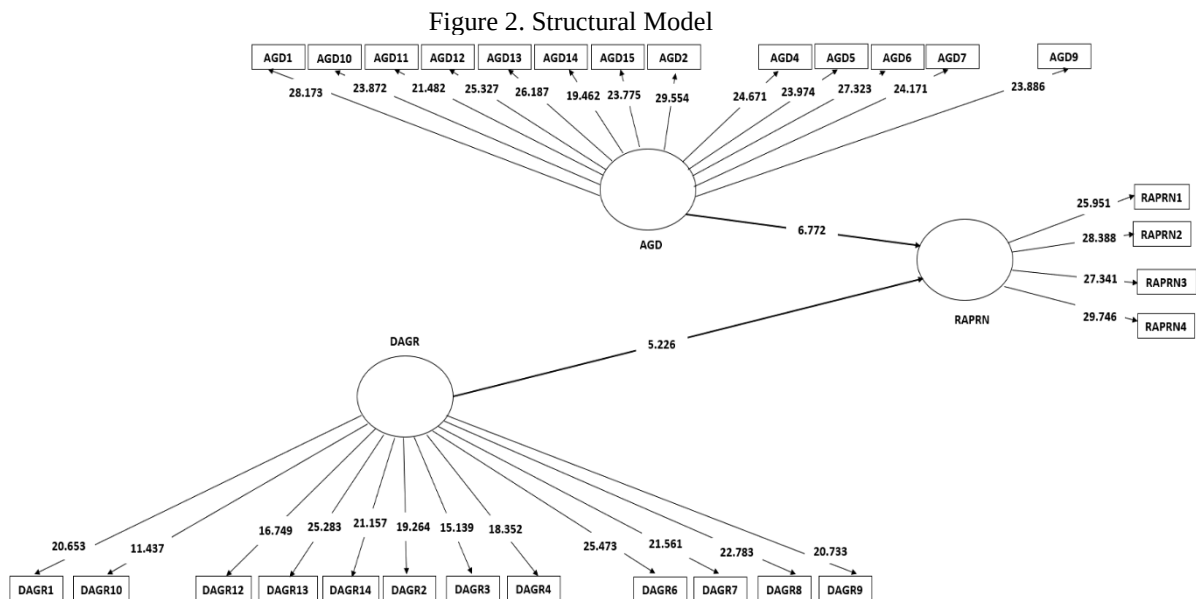


Table 4. Path Coefficients

Direct Path	Path coefficient	T statistics	p values	R ²	Q ²	Result
AGD → RAPRN	0.429	6.772	0.001	0.572	0.331	Significant
DAGR → RAPRN	0.307	5.226	0.001			Significant

Note: AGD = Aggressive Driving; DAGR = Driving Anger; RAPRN = Road Accident Proneness
Source: Compile by authors

This study investigated the correlation between driving anger, aggressive driving, and road accident proneness within a substantial sample of licensed Malaysian drivers. The primary objective was realised as the analysis uncovered a noteworthy path coefficient, signifying that anger while driving exerts a positive and statistically significant impact on the propensity to be involved in automobile accidents. This finding is consistent with prior research (Åbele et al., 2020; Montoro et al., 2018; Zhang et al., 2019).



The findings of this study illuminate the concept that when a driver experiences frustration while operating a vehicle, it can result in lapses in concentration and a diminished ability to maintain control over the vehicle, consequently increasing the likelihood of road accidents. This conclusion aligns with the results of previous investigations conducted by Ball et al., (2018), Islam and Mannering (2020), and Mehdizadeh et al., (2018).

The second path coefficient, as indicated in prior research by Ball et al., (2018), Islam and Mannering (2020), and Mehdizadeh et al., (2018), revealed that aggressive driving exerts a positive and statistically significant influence on the probability of road accidents. Notably, a substantial number of drivers who exhibit aggressive driving behaviours such as tailgating, abrupt lane changes, and weaving in and out of traffic have been involved in at least one road collision, with various outcomes ranging from major and minor injuries to near misses or traffic citations (Islam & Mannering, 2020; Kassim et al., 2019). Consequently, the second objective of this study has been accomplished.

5 CONCLUSION

This study advances the existing body of knowledge within the academic realm concerning road accident proneness. It substantially contributes by enhancing our comprehension of road accident proneness and associated characteristics, drawing insights from a sizable cohort of drivers categorised as high-risk road users due to their daily commuting patterns and reliance on personal vehicles for daily activities.

The outcomes of this research have broader implications, pointing towards potential avenues for future interventions. These could include public education initiatives targeting all road users and innovative mass media campaigns that underscore the adverse consequences of road accidents, including major and minor injuries, enduring disabilities, and post-traumatic disorders. Such interventions hold promise for mitigating or preventing traffic accidents in Malaysia, with a particular focus on the high-risk driver population.

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Department of Malaysia. However, the views expressed by the authors do not necessarily reflect the views of any organization.



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