Motorists' Response to Speed Humps: The Influence of Vehicle Type, Driving Frequency, and Acceptability on Traversal Behavior

Nimthera SEWWANDI [a], Ganga N SAMARASEKARA [b], Chaminda KONTHESINGHA [c], Sajith UDAYANGA [d]

[a,b,c] *Department of Civil Engineering, Faculty of Engineering, University of Sri Jayewardenepura, Sri Lanka*
[a] *E-mail: shachinisewwandi97@gmail.com*
[b] *E-mail: gangas@sjp.ac.lk*
[c] *E-mail: konthesingha@sjp.ac.lk*
[d] *Department of Construction Technology, Faculty of Technology, Wayamba University of Sri Lanka*
[d] *E-mail: sajith@wyb.ac.lk*

Abstract: Excessive speeding increases the risk of accidents, reduces reaction time, and compromises pedestrian safety, making well-designed speed control measures essential. Speed humps are widely used as an effective traffic calming measure to reduce vehicle speeds and enhance road safety, especially in urban and residential areas. Driver behavior plays a vital role in the effectiveness of speed humps. This study aims to investigate how vehicle category, driving frequency, and driver acceptability influence motorists' behavior at speed humps. The study used a dual survey approach and findings revealed that these factors significantly influence driving behavior and identified clear trends: as the level of driver acceptability decreases, the likelihood of adopting a safe approach diminishes, while inattentive behaviors increase. Additionally, the study identified perceptional zones of influence of speed humps for each vehicle category and their correlations, highlighting a significant impact of vehicle mass on speed variation behavior.

Keywords: Traffic Calming, Speed Humps, Driver Behavior, Perceptual Zone of Influence

1. INTRODUCTION

Speeding remains a critical issue in road safety, contributing significantly to traffic crashes, severe injuries, and fatalities worldwide. The majority of drivers exceeded the posted speed limit, especially on residential streets, believing that breaking the speed limit may decrease travel time (Dinh and Kubota, 2013). In residential streets, affective attitude, habit, and cognitive attitude are the primary predictors of speeding intention and behavior (Alizadeh, Davoodi and Shaaban, 2023). Speed humps are a popular traffic calming measure (TCM) designed to reduce vehicle speeds and improve road safety, especially in urban and residential areas. When appropriately designed and strategically placed, speed humps can effectively control vehicle speeds, minimize crash risks, create safer driver movements, and improve environments for pedestrians and other road users (Huang and Cynecki, 2000; Pau, 2002; Johnson and Nedzesky, 2004; Ziolkowski, 2014; Agerholm *et al.*, 2020) However, their effectiveness depends on a variety of factors, such as hump geometry, driver behavior, vehicle type, and road conditions. While extensive research has been conducted on the impact of speed bumps on speed reduction and crash prevention, limited studies have focused on how different motorists perceive and respond to them in real-world conditions.

This study directly addresses a research gap identified in previous work by examining aspects of driver behavior that have not been explored in existing literature, using a larger sample size (RAHMAN *et al.*, 2017). Understanding driver behavior at speed humps is crucial for optimizing road safety and enhancing traffic calming measures in Sri Lanka. This study aims to explore how vehicle category, driving frequency, and driver acceptability influence traversal behavior at speed humps. Drivers' responses to speed humps are not uniform; additional factors such as vehicle weight, suspension system, maneuverability, and ground clearance may affect how a motorist approaches and traverses a speed hump. Frequent encounters with speed humps may lead to adaptive behaviors, while driver acceptability influences compliance and cautious behaviors. Additionally, the identification of the perceptual zone of influence (PZoI) is particularly important for determining the effective functional area of a speed hump, optimizing its placement, and establishing appropriate spacing between consecutive humps in a series.

To explore these aspects, this study employs a mixed-method approach, combining a nationwide perceptional survey with an on-site intercept survey conducted at selected speed humps. The findings will contribute to a deeper understanding of the three most common motorist behaviors at speed humps, offering insights for transportation planners and policymakers to improve traffic calming strategies. By identifying patterns in driver behavior and PZoI of different vehicle categories, this research will aid in optimizing the design, placement, and spacing of speed humps to maximize their effectiveness while minimizing driver disappointment and traffic inefficiencies.

2. LITERATURE REVIEW

The implementation of speed humps as a traffic calming measure has been widely studied to understand their effects on vehicle speed reduction, road safety, and negative effects but narrowly studied driver behavior. This review integrates findings from multiple studies to provide an overview of the current knowledge on how speed humps influence driver behavior under different conditions.

2.1 Speed Humps and Driver Behavior

Physical speed control measures like speed humps have been found essential to reduce inappropriate speeding behavior which poses a significant risk factor for traffic-related injuries and fatalities (Agerholm *et al.*, 2020; Majer and Sołowczuk, 2025) A study revealed that the profile (shape) of humps is negatively associated with vehicle speeding behavior at humps (RAHMAN *et al.*, 2017). The long-term behavior of drivers on roads with speed humps suggests adaptation over time. Specifically, (Agerholm *et al.*, 2020) indicate that as drivers become familiar with frequently spaced speed humps, they may begin to exhibit anticipatory behavior by adjusting their speeds in advance of approaching humps. Further, this study pointed out that the distance between the speed humps and adjacent roadside development significantly influences driver speed behavior, suggesting that careful planning can improve their effectiveness in promoting safer driving behavior.

Research has shown that drivers tend to decelerate before encountering a hump and reaccelerate immediately after passing it (Pau, 2002). However, this behavior varies depending on the frequency and spacing of speed humps, as well as driver familiarity with the roadway (Kojima *et al.*, 2011; Vaitkus *et al.*, 2017; Agerholm *et al.*, 2020). Moreover, (Pau, 2002; Ziolkowski, 2014) discovered that improperly placed speed bumps lead to undesirable driver behaviors, such as drivers deviating into adjacent lanes to avoid discomfort. (Huang and Cynecki, 2000) highlight the nuanced relationship between traffic calming devices and driver behavior while pointing out that speed humps when strategically placed, significantly reduced vehicle speeds in urban environments.

2.2 Influence of Road Design on Driver Speed Behavior at Speed Humps

Road design plays a crucial role in the effectiveness of speed humps as well adaptation to road design critically influences driver speed behaviors. Research by (Martens, Comte and Kaptein, 1997) highlights that road design elements such as width, curvature, rough road surface, and speed humps permit safe speeding behavior. Moreover, this study suggested that roadways designed with self-explaining elements encourage drivers to adopt appropriate speeds more naturally without relying heavily on physical interventions such as humps. Additionally, the effectiveness of road design in conjunction with speed humps has been highlighted by various studies. Research indicates that street length, intersections, crossings, and parking, sidewalks, contribute to a greater reduction in speed and improve driver compliance with speed limits (RAHMAN *et al.*, 2017; Majer and Sołowczuk, 2025). The presence of visual stimuli such as painted road markings raised pedestrian crossings, and enhanced lighting further influences driver responses and can significantly enhance the impact of speed humps (Vaitkus *et al.*, 2017). Further, a study (Ziolkowski, 2014) implied that when integrating TCM, such as speed humps with others resulted in greater speed reductions and increased compliance with speed limits.

2.3 Psychological Influence on Driver Behavior

A recent study has shown that a driver's psychological profile influences how they respond to TCM, including speed humps. (Domenichini, Branzi and Smorti, 2019) investigated the relationship between drivers' risk profiles and reactions to five raised pedestrian crossings with different configuration characteristics. It classified drivers into three groups: careful, worried, and at-risk, and found that careful drivers responded more predictably to measures, whereas at-risk drivers were less affected by the measures, maintaining higher speeds despite their presence.

This finding suggests that, although vertical TCM are effective in reducing speed for most drivers, their impact may vary due to individual psychological factors. This underscores the need for a combination of perceptual and physical TCM to influence a broader range of drivers.

2.4 Influence of External Factors on Driver Behavior at Speed Humps

Several external factors impact how drivers respond to speed humps. A study by (Martens, Comte and Kaptein, 1997; RAHMAN *et al.*, 2017) identified that road conditions, visibility, and the presence of pedestrian activity influence driver speed adjustments. Further, the study underlined the influence of distances between speed humps and other road infrastructure on driver behavior, suggesting effective distances from a speed hump to T-intersections, parking, and crossings (RAHMAN *et al.*, 2017). Furthermore, environmental factors such as proximity to commercial zones, residential density, and traffic congestion have been shown to play a role in modifying driver responses to speed humps. (Agerholm *et al.*, 2020) highlighted that the proximity of roadside buildings significantly influences driver speed behavior at humps. Areas with higher pedestrian activity tend to have higher compliance with reduced speeds, whereas roads with heavier vehicle flow may require additional measures to sustain speed reductions (Huang and Cynecki, 2000).

The literature indicates that speed humps are an effective TCM when properly designed and implemented. Their effect on driver behavior is influenced by factors such as road design, spacing, external environmental conditions, pedestrian activity, and psychological aspects. Understanding how motorists react to speed humps, particularly regarding vehicle type, driving frequency, and acceptability, is essential for optimizing hump design and placement to enhance both safety and driver compliance.

3. METHODOLOGY

3.1 Data Collection

This study employs a systematic methodology to investigate driver behavior at speed humps in Sri Lanka. Data were collected through two separate questionnaire surveys during the period from July 20 to September 20, 2024 targeting motorists: a nationwide random sample survey and an on-site intercept survey conducted at selected speed humps. This dual survey approach was designed to achieve two key objectives:

- Broad Perceptional Insights: The nationwide survey gathered diverse perceptions from motorists across Sri Lanka, covering a wide range of road users and driving experiences.
- Real-Time Behavioral Validation: The on-site intercept survey provided direct behavioral observations from drivers encountering speed humps in a natural driving environment.

3.1.1 Survey 1: nationwide random sample survey

A nationwide questionnaire survey was conducted to gather a wide range of motorist perceptions regarding speed humps. This survey was designed as a Google Form and circulated online using multiple distribution platforms. Specifically, the survey link was shared via social media channels (e.g., Facebook groups related to driving and transportation in Sri Lanka), email lists, and relevant WhatsApp groups to reach a diverse group of motorists across all provinces of Sri Lanka. The minimum required sample (385 responses) size was determined through probabilistic calculation using Cochran's formula with 95% confidence ($z=1.96$, $p=0.5$, and $e=0.05$).

3.1.2 Survey 2: on-site intercept survey

To complement the nationwide perception data, a second questionnaire survey was conducted at ten preselected speed hump locations using a convenience sampling method. This approach was appropriate as the study required direct interaction with drivers encountering speed humps in real-time. The ten-speed hump locations were selected from a list obtained from the Colombo Municipal Council, ensuring diverse and representative sites. The selection criteria included the presence of well-constructed speed humps on recently rehabilitated asphalt-layered roads, a minimum 100m-long straight road segment with medium traffic flow to balance feasibility and data richness. Additionally, locations were chosen to reflect mixed traffic flow, ensuring diverse observations of driver behavior. Furthermore, the selected sites represented different road classifications in Sri Lanka, including local roads, B-class roads, AB-class roads, and A-class roads. Data collection at the speed hump sites was conducted with the support of enumerators positioned 75–100 meters ahead of the hump. Drivers who had just passed the hump were invited to participate by being briefly asked to pull over voluntarily. The on-site survey included a simplified version of the online questionnaire, focused on location-specific experiences. A total of 300 responses were collected through this method. Both surveys gathered 685 responses, and the final dataset comprised 658 valid responses, excluding ineligible responses from Survey 1 using a filter question allowing only drivers who have experienced speed humps on roads to proceed.

3.2 Data Analysis

The data were analyzed using IBM SPSS Statistics (version 26) to identify trends in driver behavior at speed bumps. The dataset was summarized with descriptive statistics, and chi-square tests were conducted to examine relationships between motorists' behavior and categorical variables such as vehicle type, travel frequency, and driver acceptance of speed humps. Fisher's Exact Test and the Likelihood Ratio Test were also employed to improve the reliability of the results. Perceptual Zones of Influence (PZoIs) were also determined for various vehicle categories to investigate behavioral variations and statistically verify the trends by Pearson correlation tests. The two-phase survey design enabled response cross-validation, enhancing the reliability of the study and ensuring that the statistical findings accurately reflected real-world driving behavior.

4. RESULTS AND DISCUSSIONS

The study used a dual survey approach to collect data on driver perceptions and behavior at speed humps. The survey examined three common traversal behaviors: driving slowly by gently traversing the speed hump (S), skipping the speed hump by taking the kerb or rerouting (R), and driving at the same speed by ignoring the hump (I). In addition, the impact of vehicle category on driver behavior was studied in seven categories: motorbike (MB), three-wheeler

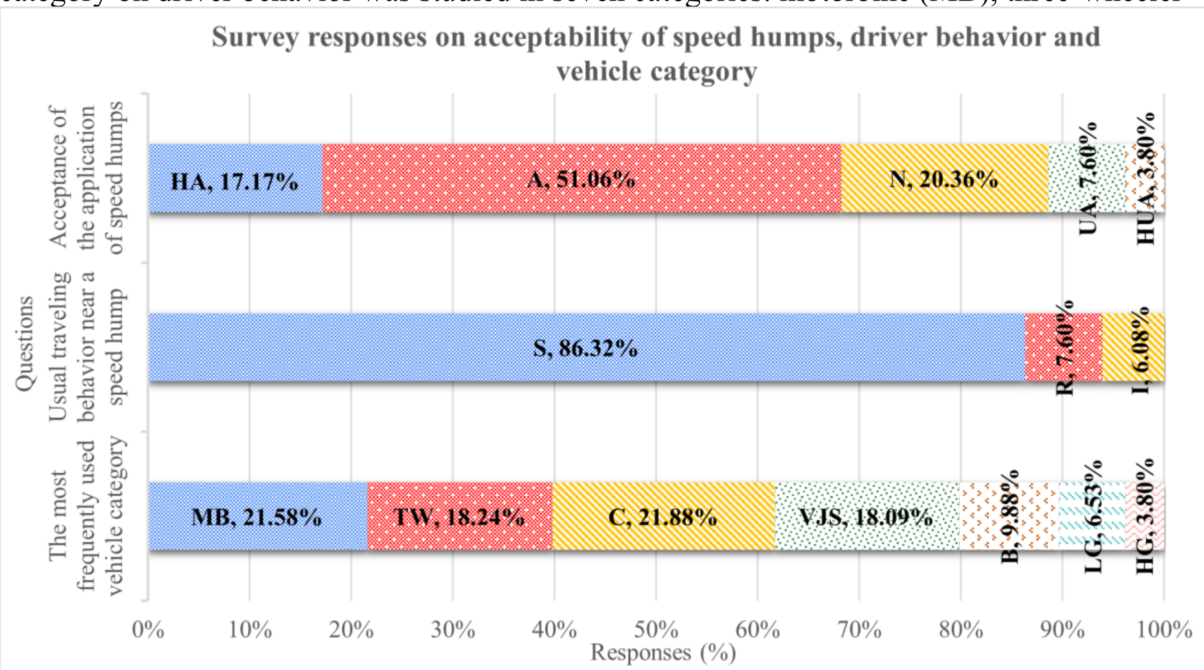

Figure 1: Percentage of survey responses on the acceptability of speed humps, driver behavior, and vehicle category

(TW), passenger car (C), van/jeep/SUV (VJS), bus (B), light goods vehicle (LG), and heavy goods vehicle (HV). The study also assessed how motorists' acceptance of speed humps, categorized as highly acceptable (HA), acceptable (A), neutral (N), unacceptable (UA), and highly unacceptable (HUA), influences traversal behavior. The response rates for these factors are shown in Figure 1, based on the total sample of 658 drivers. The majority of respondents reported slowing down behavior at speed humps, and over half accepted speed humps application, while 20.36% remained neutral.

Furthermore, driving frequency data (N=300) were collected only from Survey 2, as it was site-specific, classifying motorists into regular drivers (who traverse the hump at least once a month) and non-regular drivers (who do not). During data collection, the participants were properly informed about the differences between these groups. This data was used in this study to determine the impact of driving frequency on driver behavior at speed humps.

4.1 Influence of Driving Frequency on Driver Behavior at Speed Humps

Table 1. Chi-square tests results of the influence of driving frequency on driver behavior at speed humps

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	12.805[a]	2	.002	.003		
Likelihood Ratio	11.011	2	.004	.006		
Fisher's Exact Test	11.686			.002		
Linear-by-Linear Association	9.735[b]	1	.002	.003	.003	.002
N of Valid Cases	300					

a. 2 cells (33.3%) have an expected count of less than 5. The minimum expected count is 3.25.

b. The standardized statistic is 3.120.

df = degree of freedom

Fisher's Exact Test ($p = 0.002$) confirms the statistically significant association between the frequency of driving and the behavior of drivers near speed humps found by the Pearson Chi-Square test ($\chi^2 = 12.805$, df = 2, $p = 0.002$) results as in Table 1. Fisher's test was chosen as the most reliable indicator of significance since the Chi-Square result is statistically significant but it partially violated the assumption of expected counts (33.3%<5). The Likelihood Ratio Test also supported the conclusion of a significant relationship ($p=0.004$). When discussing the influence of driving frequency on driver behaviors at speed humps, the results show that regular drivers—who frequently encounter the same speed hump—are significantly more likely to slow down and traverse it gently (91.5%) compared to non-regular drivers (75.4%). It implies that regular drivers who traverse the same speed hump are significantly more likely to adopt this cautious behavior. Conversely, non-regular drivers illustrate more vulnerable behavior, with a higher proportion (15.4%) utilizing the kerb or other lane and 9.2% maintaining their speed despite the hump compared to regular drivers (4.7% and 3.8%, respectively), indicating a greater possibility of aggressive or inattentive driving. The results indicate regular drivers tend to be more cautious and adapt their behavior by slowing down when approaching speed humps. Non-regular drivers exhibit more variability in behavior, with a higher likelihood of skipping or ignoring the hump.

4.2 Influence of Vehicle Category on Driver Behavior at Speed Humps

The chi-Square test result reveals a statistically significant association between vehicle category and driver behavior at speed humps ($\chi^2 = 104.928$, df = 12, $p < 0.001$), with distinct behavioral patterns observed across different vehicle categories. The symmetric measures further validate a moderate strength of association between vehicle category and behavior, with the contingency coefficient (0.371, $p < 0.001$) and Cramér's V (0.282, $p < 0.001$) confirming a significant relationship. The results demonstrate a clear trend where an increase in vehicle size and weight corresponds to a higher likelihood of slowing down when approaching a speed hump. This is evident for HG (100%), LG (97.7%), B (95.4%), and C (94.4%), all of which adopt a cautious approach by gently traversing the hump. In contrast, compared to heavy vehicles, lighter vehicles are more likely to show a greater tendency to bypass the speed hump or maintain the same speed regardless of its presence. Evidence shows that MB and TW report 26.1% and 8.3%, respectively, bypassing the speed humps, while 9.2% and 5.8%, respectively, maintain the same speed, ignoring the humps. This may be due to the maneuverability of light vehicles allowing them to navigate around humps with ease and additionally, light vehicles such as MB and TW experience less suspension-related discomfort than heavy vehicles, which may encourage drivers to avoid them. Table 2 demonstrates these trends.

Table 2. Vehicle category vs. typical travel behavior near a speed hump

			Usual traveling behavior near a speed hump?			
			S Drive slowly	**R** Skip by taking the kerb or rerouting	**I** continue speed by ignoring	Total
Vehicle category (VC)	MB	Count	92	37	13	142
		% within VC	**64.8%**	**26.1%**	**9.2%**	100.0%
	TW	Count	103	10	7	120
		% within VC	**85.8%**	**8.3%**	**5.8%**	100.0%
	C	Count	136	1	7	144
		% within VC	**94.4%**	**0.7%**	**4.9%**	100.0%
	VJS	Count	108	2	9	119
		% within VC	**90.8%**	**1.7%**	**7.6%**	100.0%
	B	Count	62	0	3	65
		% within VC	**95.4%**	**0.0%**	**4.6%**	100.0%
	LG	Count	42	0	1	43
		% within VC	**97.7%**	**0.0%**	**2.3%**	100.0%
	HG	Count	25	0	0	25
		% within VC	**100.0%**	**0.0%**	**0.0%**	100.0%
Total		Count	568	50	40	658
		% within VC	**86.3%**	**7.6%**	**6.1%**	100.0%

Although the results revealed that with an increase in vehicle weight class, the likelihood of inattentive behaviors decreases, a particularly noteworthy pattern emerges in the VJS category, where drivers demonstrate a higher tendency to either bypass the hump (1.7%) or ignore it by maintaining their speed (7.6%). One possible explanation for this behavior is that a significant portion of this category comprises jeeps, which are often equipped with off-road wheels, superior suspension systems, and higher ground clearance. These features enable jeeps to traverse rough terrain with minimal discomfort, rendering speed humps less impactful on their driving experience. Moreover, drivers of jeeps may have a habitual inclination to disregard minor road obstacles, perceiving speed humps as negligible compared to the off-road conditions their vehicles are designed to navigate. This, combined with the overall structural advantages of SUVs and vans, leads to a considerable rate of non-compliance with speed reduction measures in this vehicle category. These findings suggest that vehicle-specific design factors play a critical role in influencing driver compliance with speed humps.

4.3 Influence of Driver Acceptability on Speed Hump Traversal Behavior

The Chi-Square test results ($\chi^2 = 95.829$, $p < 0.001$) reveal a statistically significant association between driver acceptability of speed humps and their traversal behavior. The Phi (0.382) and Cramér's V (0.270) values confirm a moderate yet meaningful association between acceptability and traversal behavior, further supporting the inclusion of driver perception in traffic-calming strategy evaluations. A strong trend is evident: as the level of acceptability diminishes, the likelihood of adopting a safe approach (slowing down while traversing the hump) decreases, whereas inattentive behaviors, such as bypassing the hump or maintaining speed despite its presence, increase. According to the contingency table, the most common safe behavior (slowing down while traversing) occurs among those who regard speed humps as acceptable (92.0%) or highly acceptable (100%). However, as acceptability diminishes, compliance with slowing down declines markedly. Among those with a neutral stance, only 76.9% slow down, and this further decreases to 62.0% for those who view humps as unacceptable and 48.0% for those who are highly opposed. This progressive decline graphically presented in Figure 2 underscores how negative perceptions contribute to non-compliance with speed reduction measures.

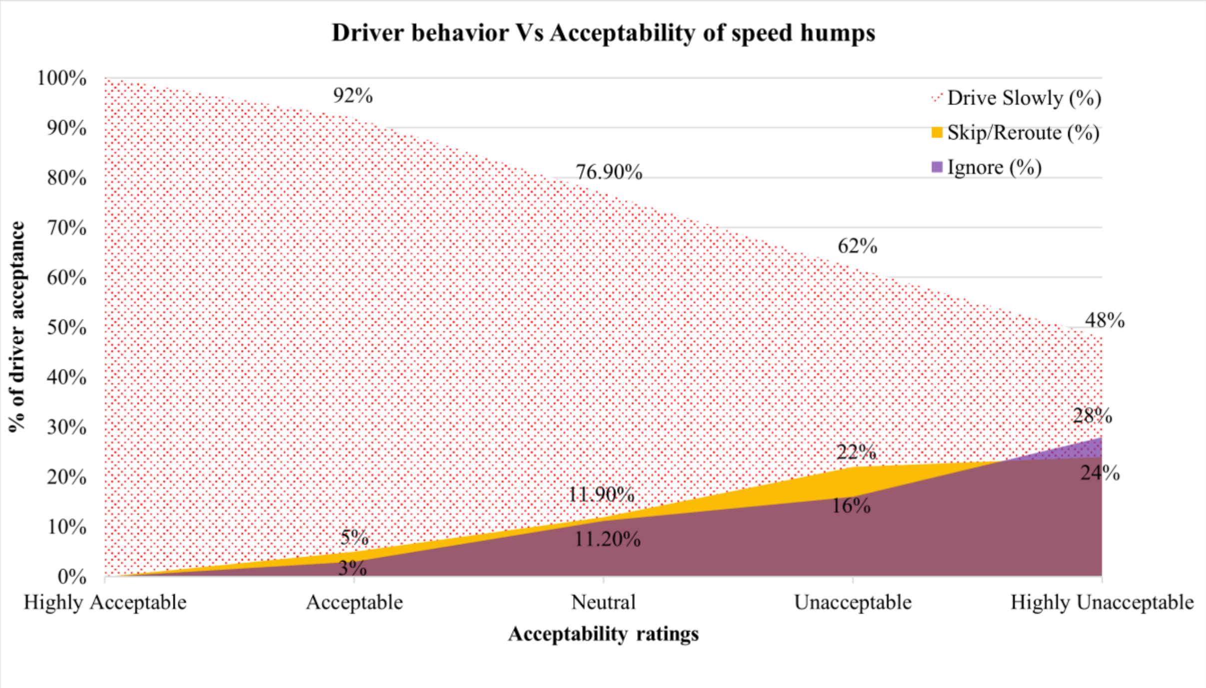

Figure 2. Association between driver acceptability of speed humps and associated traversal behaviors

In contrast, inattentive behaviors (ignoring or bypassing the hump) demonstrate a clear increase as acceptability decreases. Drivers who regard speed humps as highly unacceptable exhibit the highest rate (28%) of maintaining their speed without decelerating, compared to just 0% among those who strongly accept humps. Similarly, the tendency to bypass the hump (e.g., by rerouting) rises from merely 0% among highly accepting drivers to 24% among those who view humps as highly unacceptable. This pattern suggests that negative perceptions contribute to risky behavior, influencing the effectiveness of speed humps in controlling vehicle speeds. However, other factors such as prior experience with speed humps, road familiarity, and the presence of enforcement may also play a role in shaping driver behavior. These findings underscore the importance of public awareness campaigns to enhance driver perceptions of speed humps, ultimately promoting safer driving behaviors and improving road safety.

4.4 Points of Onset for Deceleration and Acceleration of Drivers at A Speed Hump (Perceptual Zone of Influence)

The zone of influence (ZoI) is described as the stretch of road where the speed reduction effect occurs due to the placement of a traffic calming device (Daniel, Nicholson and Koorey, 2011). The sum of these ZoIs on either side is the total ZoI considered specifically for isolated traffic calming measures. This ZoI of speed humps was studied by (Daniel, Nicholson and Koorey, 2011; Yeo *et al.*, 2020; Rahman, Kojima and Kubota, 2021). Research has investigated a related concept through field observations to assess the impact range of speed bumps during both daytime and nighttime for various vehicle categories under mixed traffic conditions. (Raghupathi and P.Vedagiri, 2021). It was revealed that the influence range varied significantly between vehicle types, with larger vehicles generally responding earlier due to their higher momentum and braking distances. The ZoI of speed bumps and speed humps may differ considerably due to their varying effects on speed reduction. Therefore, this study identified the PZoI, which are the distances between points of deceleration and acceleration in response to a speed hump across different vehicle categories, by using data collected from driver perceptions in Survey 2. Identifying the PZoI is critical for comparison with the actual ZoI when determining the optimal spacing between consecutive speed humps in a series and when integrating multiple TCM within a roadway segment.

The results, as illustrated in Figure 3, show significant variations across different vehicle types.

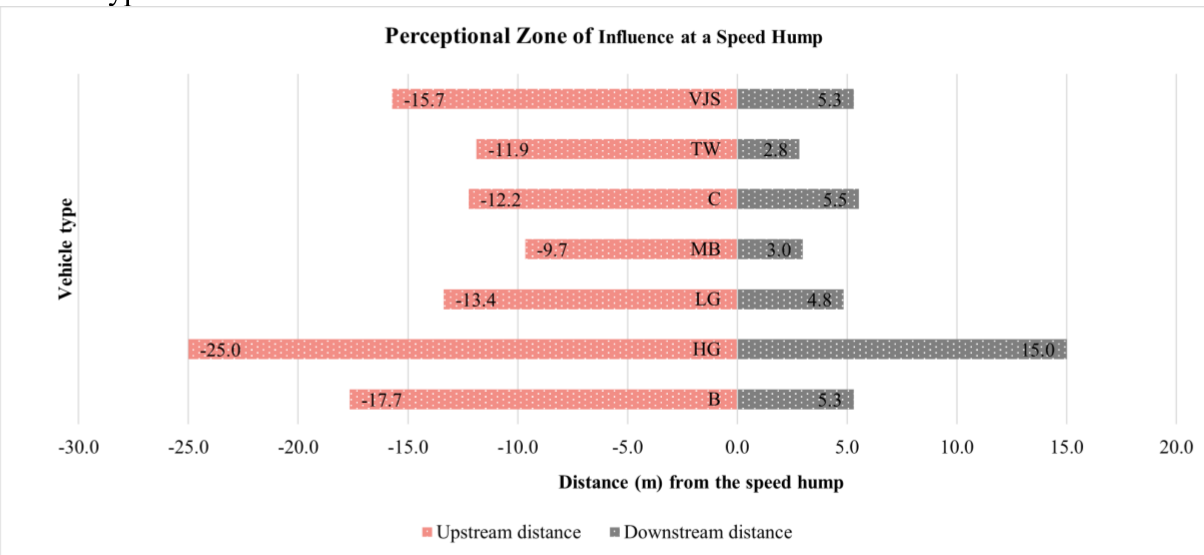

Figure 3. PZoI of different vehicle categories at a speed hump

To statistically verify the trend that heavier vehicles have a larger PZoI, a Pearson correlation test (2-tailed) was conducted to examine the relationship between vehicle category (weight category) and PZoI distances (upstream and downstream) (Figure 4). The results indicate a very strong positive correlation ($r = 0.843$) between vehicle weight class and the PZoI: as vehicle weight increases, the PZoI also expands. The correlation is statistically significant ($p = 0.017 < 0.05$) at the 95% confidence level. There is a strong positive correlation ($r = 0.889$, $p = 0.007$) between vehicle weight and upstream deceleration distance, suggesting that heavier vehicles tend to decelerate much earlier than lighter vehicles when approaching a speed hump (Figure 4). Although vehicle weight class shows a moderate positive correlation ($r = 0.751$, $p = 0.052$) with downstream acceleration distance, this trend is not as statistically robust as in the case of deceleration. These findings imply that as vehicle weight increases, the required upstream deceleration distance increases more significantly than the downstream acceleration distance.

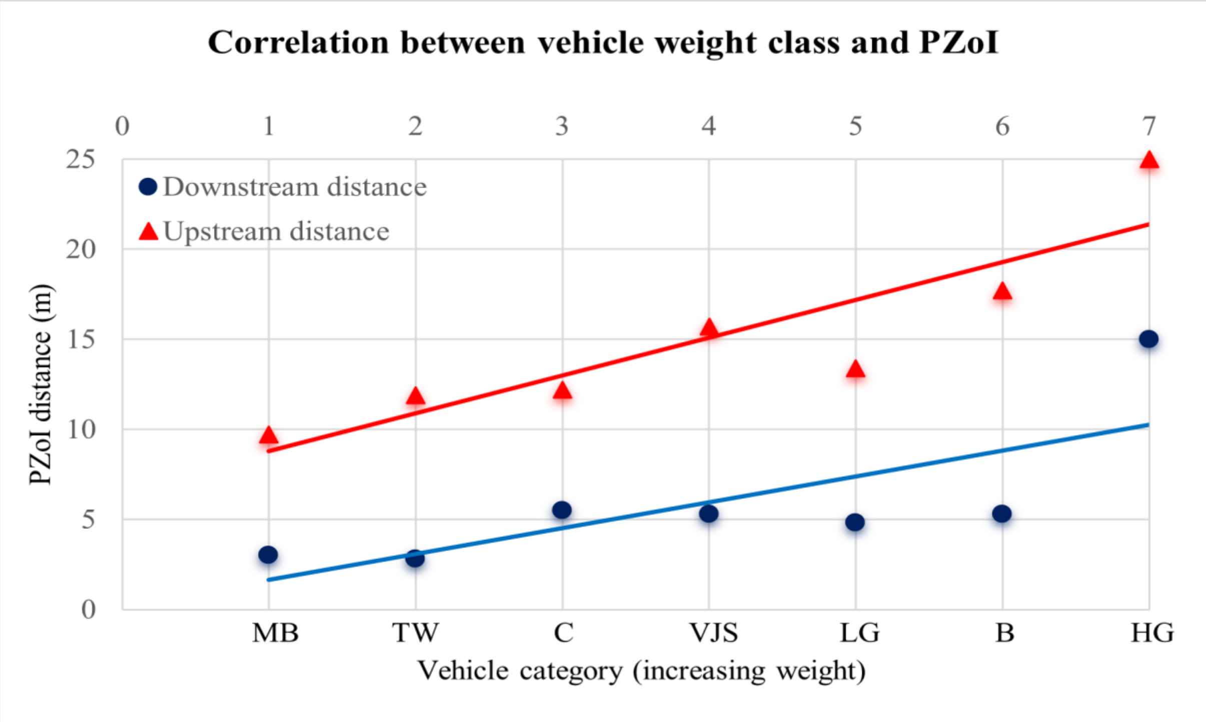

Figure 4. Correlation between vehicle weight and upstream and downstream PZoI distance, (vehicle categories are in ascending weight order)

5. CONCLUSION AND FUTURE DIRECTIONS

This study comprehensively investigated driver behavior at speed humps in Sri Lanka, focusing on three key influencing factors: driving frequency, vehicle category, and driver acceptability using a dual survey approach. The PZoIs of different vehicle categories at speed humps were also examined to gain critical insights into driver behavior. The findings provide valuable insights into how motorists interact with speed humps and the impact of the aforementioned factors on motorist behavior.

The analysis revealed that regular drivers are more likely to be cautious and adapt their behavior by reducing speed when approaching speed bumps, while the behavior of non-regular drivers is more uncertain, leading them to be more likely to ignore or skip the humps. The reason for the contradiction in behavior is familiarity with the road infrastructure; regular drivers are more habituated to the speed humps and have adjusted their driving behaviors accordingly, whereas non-regular drivers may fail to anticipate the hump or attempt to avoid it altogether. These findings highlight significant traffic safety concerns, as bypassing humps or failing to slow down increases the risk of sudden braking, loss of vehicle control, or crashes, particularly in urban areas. Furthermore, the effectiveness of speed humps as a TCM may be undermined if non-regular drivers frequently avoid them. For all vehicles, regardless of familiarity, to achieve the desired speed reduction effects of speed humps, additional road design interventions-such as better signage, visual warnings, and alternative TCM like rumble strips-should be considered. Vehicle category was found to be a critical factor influencing speed hump traversal behavior. Chi-square test results with symmetric measures revealed a statistically significant ($\chi^2 = 104.928$, df = 12, $p < 0.001$) moderate strength of association between vehicle type and motorists' behavior near speed humps. The study identified clear trends: heavier vehicles predominantly adopt a cautious approach by gently traversing the hump, while in contrast, lighter vehicles like MB and TW are more likely to bypass the speed humps or maintain the same speed regardless of their presence. Policy implications should consider the necessity for strategic enforcement measures, such as redesigning speed humps to effectively influence the behavior of non-compliant vehicle categories. The concept of area-wide traffic calming measures, a widely used approach in many countries, may serve as an effective solution to mitigate these trends while enhancing drivers' perception of safety (Udayanga *et al.*, 2024). Driver perception and acceptability of speed humps played a significant role in traversal behavior. A strong trend was observed: as the level of acceptability decreases, the likelihood of adopting a safe approach (slowing down while traversing the hump) diminishes, while inattentive behaviors, such as bypassing the hump or maintaining speed despite its presence, increase. These findings reinforce the need for public awareness campaigns and driver education to enhance compliance with traffic speed humps, ultimately promoting safer driving behaviors and improving road safety. The statistical analysis confirmed a significant positive correlation between vehicle weight class and PZoI of the upstream side ($r=0.889$, $p=0.007$), as well as between vehicle weight class and total PZoIs ($r=0.843$, $p=0.017$), highlighting the significant impact of vehicle mass on speed variation behavior. Identifying the effective zone of a speed hump and its corresponding trends is crucial for optimizing speed hump placement, determining the hump's functional zone, and establishing appropriate spacing between multiple humps or integrating them with other traffic calming measures. Overall, this study demonstrates the importance of considering vehicle types, driver familiarity, and acceptability when designing and implementing speed humps to ensure their effectiveness.

Future research could incorporate real-time speed tracking, long-term behavioral adaptations of drivers, other factors influencing driver behavior, and variations in hump geometry to enhance these insights further. Further, investigations are required to implement and evaluate area-wide traffic calming measures in urbanized roads in Sri Lanka leads to regulating motorists' speeding behaviors. By integrating these considerations into traffic management policies, road safety can be improved while minimizing driver discomfort and inefficiencies in vehicle movement.

6. ACKNOWLEDGMENT

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