future transportation

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Self-Reported Speed Compliance and Drivers Speeding Behaviour in Cameroon

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Abstract: Speeding is a significant global issue, with disparities in speed and safety outcomes between low- and middle-income countries (LMICs) and high-income countries (HICs). This study aims to address speed research gaps in LMICs by examining the prevalence of self-reported speeding and factors influencing drivers' speeding behavior using the Theory of Planned Behavior (TPB). An online survey involving 387 anonymous drivers was conducted in Yaoundé. Results showed that all drivers reported exceeding speed limits, with 81% exceeding them by 5 km/h, 12% by 10 km/h, and 7% by more than 10 km/h in urban areas. On highways, 54% reported exceeding the limit by more than 10 km/h. Age, driver's license, and gender showed significant associations with speed limit non-compliance. This study's results suggest that the TPB can be useful in assessing speeding behavior, as the inclusion of TPB variables led to a more than 50% proportionate increase in speeding behavior variance. Structural equation modeling revealed attitude towards speeding as the strongest predictor of speeding intention, along with certain demographics indirectly influencing speeding behavior through speeding intention. Perceived behavioral control and speeding intention directly influenced speeding behavior. These findings emphasize the potential of interventions targeting attitude, intentions, and perceived behavioral control to modify speeding behavior and improve road safety.

Keywords: road safety; speeding behavior; speed compliance; speeding intention; theory of planned behavior; low- and middle-income countries

Citation: Fondzenyuy, S.K.; Fowo Fotso, C.S.; Feudjio, S.L.T.; Usami, D.S.; Persia, L. Self-Reported Speed Compliance and Drivers Speeding Behaviour in Cameroon. *Future Transp.* **2024**, *4*, 659–680. https://doi.org/10.3390/futuretransp4020031

Academic Editor: Laura Eboli

Received: 26 February 2024
Revised: 23 May 2024
Accepted: 11 June 2024
Published: 12 June 2024

1. Introduction

Speeding (excessive or inappropriate speed) is an important road safety risk factor responsible for a majority of fatal and serious injury crashes worldwide. Meanwhile, the effects of speeding on crash outcomes are disproportionate between low- and middle-income countries (LMICs) and high-income countries (HICs). A recent analysis shows that speeding accounts for about 54% of fatalities worldwide, with a probability of 95% that these occur on LMIC roads [1]. These disparities may be attributable to factors such as differences in road safety culture, high traffic heterogeneity (leading to significant speed variation), poor land use planning, and inadequate post-crash care. Moreover, speed is one of the primary road safety factors that influence the exposure, likelihood, and severity of crashes, making speed management critical for improving road safety [2–5]. Recent estimates indicate that a 1 km/h reduction in speed could decrease fatalities and injury crashes by 7.7% and 5.8%, respectively [6]. Conversely, an increase in speed is likely to have the opposite effect. For vulnerable road users such as pedestrians, cyclists, and motorcyclists, the impact of speed is even more pronounced, as they are not protected by a

"metal cage" [7,8]. These detrimental effects of speeding underscore the urgent need for effective speed management and including speed-related research to inform policymakers.

Understanding the factors that affect speeding behavior is critical for developing effective preventive measures to mitigate speeding. Research shows that there is a significant cultural difference in speeding behavior between HICs and LMICs [9–12] but also among LMICs [13,14]. These findings suggest the need to investigate the local situation, which will contribute to the development of local-specific solutions. This is especially important within LMICs where there are significant research gaps.

1.1. The Theory of Planned Behaviour (TPB) and Speeding

The theory of planned behavior (TPB) postulated by Ajzen (1985, 1991) has often been used by several researchers to study the speeding behavior of drivers [13,15–19]. The TPB studies factors that affect a behavior (e.g., speeding). These factors include attitude (ATT), subjective norm (SN), perceived behavioral control (PBC), and intentions. According to the theory, ATT, SN, and PBC have an influence on the behavioral intention (e.g., speeding intention), while both the behavioral intention and PBC have an influence on the behavior (e.g., speeding) [20].

In terms of definition, attitude refers to the overall positive or negative assessment of specific behavior, subjective norms represent the perceived social pressure from others or social groups to behave in a particular way, and perceived behavioral control refers to the perception of the ease or difficulty of performing a particular behavior [20,21].

However, despite the wide applicability of the TPB in safety behavior, some researchers believe that the attitude–behavior relation, in theory, may not have strong applicability in a low-income country context [22–24]. For instance, a cross-cultural study contrasting Ghana with Norway revealed that while attitudes towards speeding significantly predicted speeding behavior in Norway, this was not the case for Ghanaians [24]. The authors attributed this to the fact that the questionnaire design or the social cognitive model's (i.e., the TPB) assumption that attitudes are significant predictors of behavior may not align with the local context and culture in Ghana. Similarly, an earlier study in Iran indicated a weak correlation between attitudes toward speeding and actual speeding behavior [23]. Nonetheless, both sets of researchers advocated for additional research to explore these factors in other LMIC contexts. Furthermore, given that these studies are over a decade old and considering advancements in traffic safety and potential shifts in safety culture in countries/cities due to advanced technology, there may be variations in these findings nowadays. For example, a more recent study in Iran (employing robust statistical analysis), in contrast to the earlier Iran study, affirmed the TPB's applicability in the Iran context. Moreover, studies in other LMIC contexts, such as Indonesia [15], China [21], and Nigeria [19], have supported the applicability of the TPB. These recent developments and considering the past inconsistencies that overrule the TPB underscore the necessity for ongoing research in this area, especially given the varying differences in local contexts.

In high-income countries (HICs), where most of the research on the TPB has taken place, the TPB has informed the creation of interventions, such as attitude campaigns aimed at altering behavior. It is reasonable to assume that if the TPB is also validated in LMICs, it is plausible that similar behavioral campaigns could yield comparable outcomes. However, this does not negate the importance of context-specific countermeasures. Therefore, the design of such behavioral studies must take into account local nuances.

Beyond the factors listed in the TPB, several other factors are usually attributable to determining speeding behavior. An earlier research work based on an exploratory review summarised these factors into four categories [25]:

- Person-related factors: Speed choice is affected by individual characteristics such as crash history, gender, age, attitudes, values, and predisposition to sensation seeking.

- Social factors: Speed choice is affected by the influence of others, such as peer/passenger pressure, media, exposure to role models, behaviors, and the traveling speeds of others. Factors such as perceived risk and vehicle operating costs can be supplemented to this list.
- Situational factors: These include factors such as emergencies, running late, the purpose of the trip, keeping up with the traffic flow, and the opportunity to speed.
- Legal factors: Speed choice is affected by the presence of enforcement initiatives (such as speed cameras and police enforcement) and punishment.

These factors are quite dependent on the culture of drivers and the society in which they live; hence, the extent of each factor and the subsequent speeding choice can tend to differ between countries, regions, or cities with wide cultural differences.

Based on the importance of these factors, some researchers have extended the TBP for speeding to include factors such as past behavior, driving habits, legal sanctions, and personal traits. These factors have proven significant mediating effects on speeding behavior, though the size of the effect differs between studies [15,17,21,26]. Hence, the investigation of these factors on speed behavior is important.

1.2. An Overview of the Prevalence of Speeding and Factors Affecting Speeding across Countries

Ref. [25] examined legal, social, and personal factors influencing speeding among 320 Queensland drivers to determine the misalignment between driver attitudes and speeding behavior. This study found that most drivers underestimated the risk of exceeding posted speed limits (PSLs), with a third preferring to exceed PSLs by 10–20 km/h. Key reported factors for speeding included exposure to role models who speed, favorable attitudes towards speeding, experiences of punishment avoidance, and perceived certainty of punishment.

A subsequent study of 628 Queensland drivers reported that over half of the drivers admitted to speeding for more than 10% of their driving time [27]. This study also identified a significant influence of media on speeding, with speeders more likely to be exposed to materials that encourage speeding.

Another Australian study [28] surveyed 5179 drivers, noting that speed limit compliance varied across speed zones. While most drivers adhered to speed limits in lower speed limit zones (40 km/h and 50 km/h), 47% of drivers reported exceeding the speed limits on 100 km/h roads, although only a small number of these drivers (<0.5%) sped by 11 km/h or more. The acceptability of speeding also varied across drivers, with 8% deeming it acceptable to exceed 40 km/h and 50 km/h speed limit by 10 km/h, while twice as many (16%) considered that driving 10 km/h over in a 100 km/h zone was acceptable. The age and sex of drivers were found to be related to speed limit non-compliance. Studies carried out in other contexts, such as Greece and France, also showed that these demographics significantly influenced drivers' non-compliance [29,30].

Ref. [31] analyzed attitudes towards speeding among 17,000 European road users from 17 countries. While 25% of drivers accepted driving over the limit by 20 km/h on motorways, fewer condoned such behavior on other road types. However, 40% observed that other drivers commonly exceeded limits by up to 10 km/h. This study also observed that acceptability levels differed significantly between age and gender and varied between individual countries.

In Kenya, a longitudinal study assessed the prevalence of speeding and attitudes towards it through four Knowledge, Attitude, and Practice (KAP) surveys conducted over a two-year period. The findings indicated that 40% of drivers speed, with light truck drivers being the most frequent offenders at a rate of 61.2%. Traffic levels and time pressures were cited as the main reasons for speeding [32]. Despite an awareness of the dangers and risks of speeding, knowledge of speed limits among drivers was low, with only 30% admitting being well-informed of the speed limits. In contrast, similar studies in Sweden [33]

have shown knowledge of speed limits to be as high as 97%, indicating some disparity in speed limit awareness between some HICs and LMICs.

Ref. [34] investigated the influence of traffic enforcement on speeding in China, focusing on low-speed limit roads. A field study measured actual speeds, and a survey explored the effects of hypothetical enforcement scenarios. Results showed low compliance with speed limits, with only 24% of drivers adhering to the speed limits and with the operating speed exceeding the limit by up to 50%. This study indicated that stricter enforcement, including higher fines and license revocation, could deter speeding. It concluded that drivers often base their speed on the flow of traffic rather than on enforcement presence.

An Ethiopian study identified factors such as self-efficacy, weak enforcement, and social pressure as significant influences on speeding among minibus drivers [35]. Similarly, a study in Indonesia found that non-government employees were more prone to speeding, with attitudes and non-legal sanctions being significant predictors of speed intentions [15].

Contrary to most findings, a study in Lahore, Pakistan, using the TPB, found that certain attitudes had a negative association with speeding intentions, while subjective norms and traffic enforcement awareness were positively correlated [36].

A naturalistic driving study in Malaysia highlighted the impact of social and cultural factors on driving styles, with significant differences in speeding based on gender, age, and cultural background [37]. A similar Malaysian study found socioeconomic characteristics and driver attitudes to be significant predictors of speeding behavior [38].

Cross-cultural research has further elucidated the role of cultural factors in speeding behavior. A study comparing Swedish and Turkish drivers using TPB found differences in speed limit compliance, with Swedish drivers exhibiting more positive attitudes and higher compliance [10]. Another study involving participants from eight countries demonstrated that cultural factors (oral sound, written, visual extraverted, and introverted cultures) were strong predictors of driver behaviors [12]

Comparative research between 720 Dutch and Iranian drivers revealed differing attitudes towards safety and risk-taking, with Iranian drivers more likely to speed and engage in risky behavior. While speeding was unacceptable from the perspective of Dutch drivers, Iranian drivers believed that exceeding the speed limit by 5 or 10 mph was okay because everyone did it [9].

Ref. [39] examined road user tolerance for traffic violations across seven countries in Asia, the Middle East, Europe, and Africa. This study found widespread tolerance for exceeding speed limits by 20 km/h on highways and by 10 km/h in urban areas, with over 50% of participants in all countries showing leniency. However, tolerance for speeding in school zones was lower. Italy displayed the highest tolerance for speeding, followed by Egypt, whereas China had the lowest tolerance.

Last, a cross-cultural study among drivers in Thailand, Laos, and Cambodia found distinct factors influencing speeding intentions in each country, suggesting diverse road safety cultures among developing nations. Attitude was the most significant factor influencing speeding for drivers in Thailand; subjective norm and perceived behavioral control were significant for Laos drivers, while perceived behavioral control was significant for Cambodian drivers [13].

The synthesis of various studies on speeding reveals that the prevalence of speeding is a common issue across different contexts and countries. Key findings indicate that a significant proportion of drivers regularly exceed posted speed limits, with factors influencing this behavior ranging from TPB variables, such as experiences of punishment avoidance, to social influences. Cultural and demographic variables, such as age and gender, also play a role in speeding behavior. Additionally, the perception of enforcement measures and the credibility of speed limits are important determinants. While some drivers underestimate the risks associated with speeding, others rationalize their behavior based on the behavior of their peers or cultural norms. The studies collectively underscore

the complexity of factors contributing to speeding, highlighting the need for localized studies, especially given the differences between the countries.

1.3. Speeding Issues in Cameroon

In Cameroon, speeding is widely recognized as a significant issue impacting road safety, primarily due to the high legal speed limits of 60 km/h in urban areas and 110 km/h in rural areas [40]. Considering the well-established and positive correlation between speed and road accidents [6] it is believed that these elevated speeds are responsible for a majority of the crashes and fatalities occurring in Cameroon. However, there is a lack of comprehensive research on this specific topic within the context of Cameroon, which hampers efforts to identify interventions for mitigating speeding. An exploratory review of the available literature reveals a notable absence of studies examining the factors influencing speeding behavior in Cameroon. This is a common challenge faced by many other low- and middle-income countries (LMICs), especially in sub-Saharan Africa, where research in this domain is scarce.

Existing research conducted through the ESRA study (E-Survey of Road users' Attitudes), which involved a sample of 200 respondents in Cameroon between 2019 and 2020, focused on self-reported driving behavior [41]. The findings indicate that approximately 40% of drivers reported speeding in built-up areas, while 44% and 47% reported speeding on motorways and outside built-up areas, respectively. These self-reported statistics provide an estimation of the prevalence of speeding in Cameroon. However, it is important to acknowledge certain limitations of the ESRA study, such as the relatively small sample size, exclusive focus on cars, and the absence of an in-depth evaluation of the factors influencing speeding and the extent of speeding violations. Moreover, the literature highlights that some drivers in LMICs may be unaware of the speed limits [22], which implies that asking drivers about their speed above the limit could yield biased results in cases where drivers lack awareness of the specific speed limits. This was the case for the ESRA study.

1.4. Study Aim and Research Hypotheses

This research aims to close the observed gaps in the literature through the following objectives:

1. Investigate the prevalence of self-reported speeding in a sample of drivers (including different vehicle types).
2. Assess the usefulness of the TPB in determining speeding behavior.
3. Investigate the factors affecting the speeding behavior of drivers based on the TPB and demographic characteristics.

Based on the literature, several hypotheses have been developed. Studies have shown inconsistent results regarding the effects of the Theory of Planned Behavior (TPB) on explaining speeding behavior, especially in the context of LMICs. While some studies suggest that variables such as speeding attitude may yield negative results [36] or have a weak association with speeding behavior/intention [22–24], or display inconsistencies in the strength of the relationship between countries [10,13] others demonstrate a strong association with the speeding intention [15,19,21]. This highlights the need for further investigation into the TPB. In addition, although significant associations between demographic characteristics and speeding behavior have been observed [28–30], studies have seldom investigated the effects of these variables on speeding behavior simultaneously in conjunction with the TPB through the mediating effect of speeding intention. Based on these observations, the following hypotheses will be investigated in this research through structural equation modeling:

Hypothesis 1. *Drivers' attitudes, perceived risk, perceived behavioral control, and subjective norms significantly correlate with the speeding intention.*

Hypothesis 2. *The speeding intention and perceived behavioral control correlate with actual speeding behavior.*

Hypothesis 3. *Drivers' attitudes, perceived risk, perceived behavioral control, subjective norms, and demographic characteristics significantly correlate with speeding intention.*

2. Materials and Methods

2.1. Procedure

This study employed an online questionnaire to investigate the stated objectives. The questionnaires were developed and subsequently distributed through various social network channels, with responses collected randomly from anonymous drivers. Prior to the online distribution of the questionnaire, a pilot study was conducted to ensure clarity and to ensure that any necessary corrections were implemented. The questionnaire was formulated in both national languages, English and French. The online survey period spanned two months, specifically October and November of 2023.

2.2. Study Participants and Descriptive Statistics

The target population for this study comprised drivers in Yaoundé, the capital city of Cameroon. The selection of this target population to investigate drivers' speeding behaviors was based on several reasons. These include the city's connection to multiple regions within the country, the presence of diverse vehicle types, the high variability of driver behaviors (from local knowledge, a mix of compliant drivers and non-compliant drivers), and the density of traffic, which offers a wide range of driving situations representative of the challenges encountered in numerous urban areas and highways throughout the country.

Table 1 presents demographic information and descriptive statistics for driver-related variables. A total of 387 responses were received from drivers of cars (210), motorcycles (66), tricycles (9), trucks (39), and buses/minibusses (63). In terms of gender, 68% of the sample (263 individuals) are male, while females represent 32% (124 individuals). The age distribution is as follows: 11.1% (43 individuals) are between 18 and 25 years old, 27.9% (108 individuals) fall within the 26–35 age range, 30.7% (119 individuals) are in the 36–45 age group, 23.8% (92 individuals) are in the 46–55 age group, and 6.5% (25 individuals) are 56 years old or older. Regarding driving experience, 8.3% (32 individuals) have less than one year of experience, 41.1% (159 individuals) have 1 to 5 years of experience, 40.6% (157 individuals) have 6 to 10 years of experience, and 10.1% (39 individuals) have over 10 years of experience.

Table 1. Descriptive statistics of demographic information and driver-related characteristics.

Criterion		Number	Percentage (%)
Sex	Male	263	68
	Female	124	32
Age	[18;25]	43	11.1
	[26;35]	108	27.9
	[36;45]	119	30.7
	[46;55]	92	23.8
	≥56	25	6.5
Education Level	Primary	3	0.8
	Secondary	260	67.2
	Higher	124	32

Vehicle type	Car	210	54.3
	Motorcycle	66	17.1
	Tricycle	9	2.3
	Truck	39	10.1
	Bus or minibus	63	16.3
Driver Experience	<1	32	8.3
	[1;5]	159	41.1
	[6;10]	157	40.6
	>10	39	10.1
License type[NB]	A	9	2.3
	B	263	68
	C	111	28.7
	Other	4	1

NB: License type A refers to powered two-wheelers (motorcycles); type B pertains to motor vehicles (with fewer than 10 seats and a maximum gross vehicle weight rating of 3.5 tonnes, including passenger cars and sport utility vehicles); type C is for motor vehicles for goods (with a gross vehicle weight rating greater than 3.5 tonnes, such as trucks and lorries); type D is for motor vehicles for the transportation of people (with more than 9 seats, including buses and minibusses); Others include heavy machinery vehicles and tractors for public works.

2.3. Questionnaire Design

The questionnaire was designed to measure variables based on the Theory of Planned Behavior (TPB) and to consider other factors that influence speeding behavior and other areas of interest. The formulation of specific questions was guided by prior research on the topic. The questionnaire consisted of two primary categories of questions: socio-demographic information and questions pertaining to speed behavior within the context of the theory of planned behavior. The arrangement of these questions was as follows:

2.3.1. Socio-Demographic Information

Socio-demographic data focused on questions such as gender, age group, education level, marital status, driving license type, vehicle type, and number of years of experience.

2.3.2. Speeding Intention (SI)

Speeding intention was assessed through four items classified into two categories. Category one (items i to ii) aimed to measure the intention to adopt speed management technologies, while Category two (items ii to iii) directly focused on speeding intention for the TPB application. The items included (i) SI1: I am willing to use speed management technologies (e.g., speed limiters and speed warnings) to help me comply with speed limits. (Agree/Disagree) (ii) SI2: Are you ready to adopt the following speed management technologies? Participants could select multiple responses from: "Automatic speed limiters installed in vehicles", "Speed alerts that alert you when you're over the speed limit", "Intelligent speed enforcement systems on the roads", and "Speed Surveillance Cameras for Sanctions Enforcement". (iii) SI3: On a scale of 1 to 5, how tempted are you to speed? (Always/Never) (iv) SI4: How often are you tempted to exceed the speed limit in urban areas? (Never, Occasionally, Sometimes, Often, Always). Only Category two questions were used to assess speeding behavior to test the TPB (Cronbach's alpha for Category two questions was 0.625).

2.3.3. Perceived Behavioral Control (PBC)

Perceived behavior was measured on two items: (i) PBC: In the case of breaking the speed limit, to what extent do you perceive the risk of being stopped by the police? (Extremely High, High, Medium, Low, Very Low) (ii) How do you rate your driving skill compared to other drivers? (Much Better, Better, Same, Worse, Much Worse). These two

items were considered separately due to a negative Cronbach's alpha. Item one was used to investigate the TPB.

2.3.4. Self-Reported Speeding (SB)

Self-reported speeding, considered as speeding behavior, was measured through 6 items divided into two categories. Category 1 had five items that were categorized for the TPB to represent the speeding behavior. Category 2 had 1 question to measure knowledge of speed limits. Category 1 questions included: (i) SB1: By how much do you often exceed the speed limits in urban areas? (Never, 5 km/h, 10 km/h, 15–20 km/h, More) (ii) SB2: By how much do you often exceed the speed limits on highways? (Never, 5 km/h, 10 km/h, 15–20 km/h, More) (iii) SB3: In general, what is your preferred speed when driving on highways? (60 km/h, 70 km/h, 80 km/h, 100 km/h, over 100 km/h) (iv) SB4: In general, what is your preferred speed when driving in urban areas? (Under 50 km/h, 50 km/h, 60 km/h, over 60 km/h) (v) SB5: How often have you exceeded the speed limit on highways like Douala-Yaoundé? (Never, Occasionally, Sometimes, Often, Always) Category 2 question was: (vi) SB6: Are you aware of the speed limits in urban areas and highways in Cameroon? (Yes/No). The Cronbach's alpha for Category 1 questions was 0.86.

2.3.5. Subjective Norm (SN)

The subjective norm was assessed through 5 items: (i) SN1: I think speeding is socially unacceptable. (Yes/No) (ii) SN2: Speeding is dangerous for me and other road users. (Totally Agree, Agree, Disagree, Totally Disagree). (iii) SN3: To what extent do you think people who are important to you would approve/disapprove if you break the speed limit? (Approve, Disapprove, Indifferent). (iv) SN4: In your opinion, what do pedestrians and users of soft mobility (bicycles, scooters, unicycles, etc.) think about speeding drivers? (Approve, Disapprove, Indifferent). (v) SN5: What is your opinion about speeding in areas such as residential streets, around schools, or hospitals? (Approve, Disapprove, Indifferent). The Cronbach's alpha was negative for all the questions combined. After observing the signs and magnitude of dimension reduction factors through factor analysis, items (i), (ii), and (v) were retained as they belong to the same factor with higher factor loadings (>0.5).

2.3.6. Attitude towards Speeding Behavior (AT)

Attitude towards speeding behavior was assessed through four items: (i) AT1: In your opinion, how often do you engage in speeding during your driving sessions? (Never, Occasionally, Sometimes, Often, Always). (ii) AT2: I feel responsible for respecting the speed limits. (Yes/No) (iii) AT3: What are the reasons that could lead you to speeding while driving? Participants could select multiple responses from options such as time pressure (e.g., being late), feeling powerful or excited, traffic rules, and driving experience. (iv) AT 4: What are the reasons that could lead you to speeding while driving? Participants could select multiple responses from options such as "Experienced drivers can safely drive at speeds above the legal limit", "The police don't often punish speeding", "The speed limits are set too low", "Speeding is acceptable on certain roads or in certain situations". The value of Cronbach's alpha was very low for the attitude questions. However, after conducting dimension reduction (factor analysis), one factor explained all of these variables with factor loadings greater than 0.4.

2.3.7. Perceived Risk

The perceived risk was assessed through one question: Do you think that complying with a speed limit would decrease the risk of accidents? (Totally Agree, Agree, No Idea, Disagree, Totally Disagree).

2.4. Data Analysis

The analysis included descriptive statistics, Chi-square test, Pearson correlation analysis, factor analysis, hierarchical regression analysis, structural equation modeling, and other post-hoc analyses. Separate analyses were conducted using Excel version 2308, R software version 4.3.1, and the Statistical Package for the Social Sciences (SPSS) version 27.

Descriptive statistics were carried out for demographics and driver-related data. Chi-square tests for independence were conducted to examine the relationships between the demographics and the speeding behavior (level of compliance).

Confirmatory factor analysis (CFA) and principal component analysis (PCA) were carried out to investigate the relationship between the observed variables (e.g., AT1 to AT4), which described the latent variables (e.g., AT). The resulting factors and factor loadings were used to identify and screen observed variables that had a significant relationship with the latent variable. This process was also guided by reliability testing using Cronbach's alpha to assess the consistency of the observed variables for each latent variable (also called construct). The factors (in all cases, one factor) derived from carrying out the dimension reduction (PCA) were used to develop composite indicators from the observed variables to form the latent variables. These composite indicators were created for AT, SN, SI, and SB, which were later used in regression analysis and structural equation modeling.

Hierarchical linear regression analysis was conducted to predict both speeding intention and speed behavior. Demographic characteristics were entered as the first set of predictors, followed by the composite variables of the TPB as the second set of predictors. This analysis aimed to understand the change in variability of SI and SB after the addition of the TPB variables.

Structural equation modeling (SEM) was used to study the relationships between observed and latent variables, as well as the mediating effect with the independent variable (speeding behavior). SEM allows for the analysis of causal relationships among variables using simultaneous equations. It integrates both direct and indirect measures of variables, considers measurement errors, and enables estimation of model parameters, evaluation of data fit, and testing of specific hypotheses. Two SEM models were developed to investigate the best model fit for the TPB:

- SEM 1: The structural model is built using the composite variables of the TPB and the perceived risk variable. SI is modeled as a function of AT, PR, PB, and SN, while SB is modeled as a function of PB and SI.
- SEM 2: The structural model is similar to SEM 1 but includes demographic characteristics as predictors of SI.

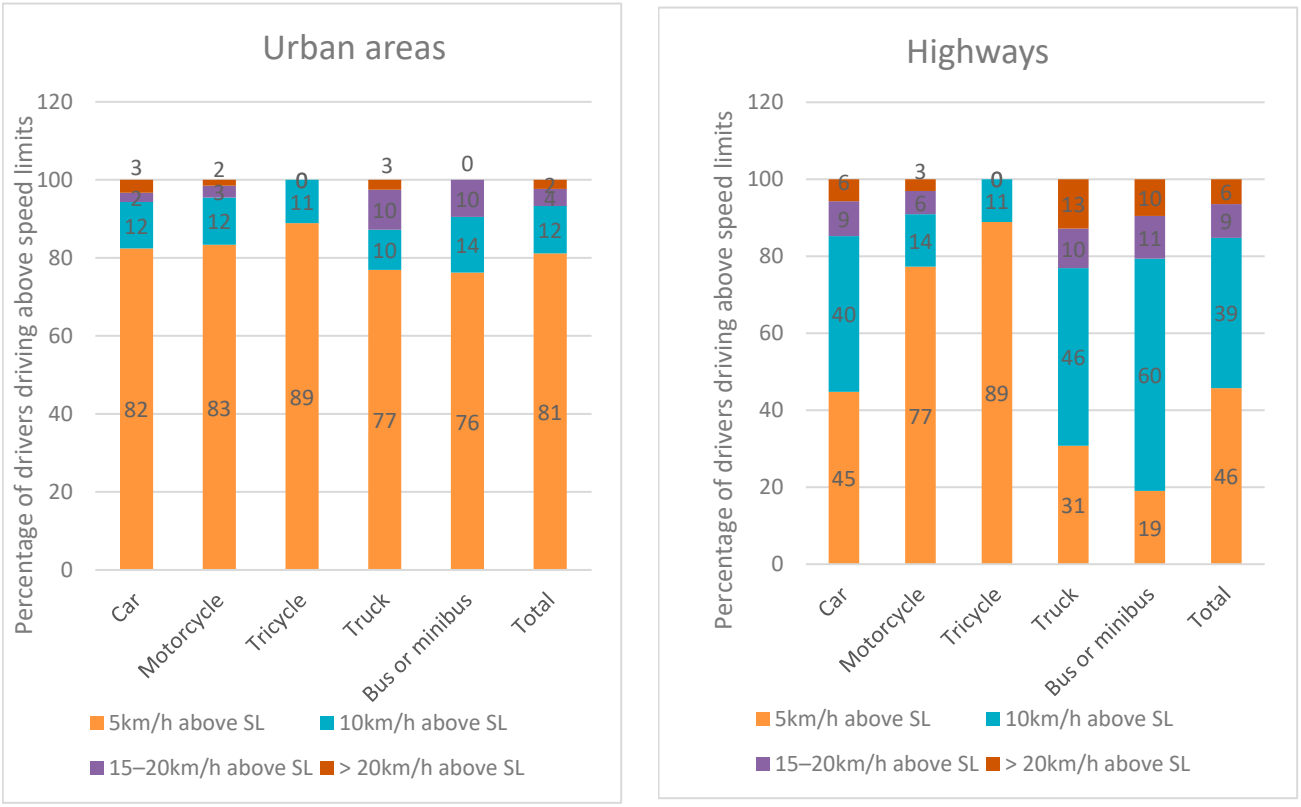
2.5. Ethics

The Ethical Committee of the National Advanced School of Public Works, Yaoundé, approved this study. Participants were informed of this study's objectives, and the confidentiality of their data was ensured.

3. Results

3.1. Self-Reported Speed Limit Non-Compliance and Knowledge of Speed Limit

Figure 1 presents results on drivers' self-reported speed limit non-compliance in urban areas and highways categorized by vehicle type. The results indicate that in urban areas, 81% of drivers exceeded speed limits by 5 km/h, 12% exceeded by 10 km/h, 4% exceeded by 15 to 20 km/h, and 2% exceeded by more than 20 km/h. In highways, as expected, the percentage of drivers exceeding the speed limit by more than 10 km/h (54%) increased significantly, particularly among bus or minibus drivers. It is worth noting that none of the drivers reported driving within the speed limits in either urban areas or highways.



(**a**) (**b**)

Figure 1. Self-reported speed limit non-compliance according to vehicle types in (**a**) urban areas and (**b**) highways.

Regarding participants' knowledge of speed limits, 89% of the total sample claimed to know the speed limits. This knowledge was highest among bus/mini-bus and car drivers, with 98% and 91% respectively. However, 56% of tricycle drivers and 26% of motorcycle drivers reported not knowing the speed limits. It is important to note that the sample size for tricycle drivers was relatively small. After excluding drivers with no knowledge of speed limits from the analysis, the overall trend of non-compliance remained largely unchanged, consistent with Figure 1.

These findings have significant implications for targeted road safety interventions, highlighting the need to address non-compliance with speed limits. However, given the limited sample size of tricycle drivers, caution should be exercised when generalizing the results to this specific group.

3.2. Association between Age, Gender, Driver's License, and Speed Limit Non-Compliance

The chi-square test of independence was employed to examine the relationship between demographics and self-reported speeding. The results of this analysis are presented in Table 2. The *p*-value indicates the significance of the association, while Cramer's V reflects the strength of the association. Cramer's V values up to 0.10, 0.30, and 0.50 indicate small, medium, and large effects, respectively (Cohen, 1992 cited in [29]).

The findings reveal a statistically significant association between age and speed limit non-compliance in both urban areas (χ^2 = 28.8, $p < 0.05$, V = 0.16) and highways (χ^2 = 41.4, $p < 0.001$, V = 0.19). The highest cumulative percentage of drivers exceeding speed limits (>10 km/h) in urban areas was observed among the [18;25] age group, whereas on highways, the highest percentage was observed among those aged 56 or older.

Table 2. Association between age, driver's license, sex, and speed limit non-compliance in urban.

		5 km/h above SL	10 km/h above SL	15–20 km/h above SL	>20 km/h above SL	Pearson Chi-Square	Asymptotic Significance (2-Sided)	Cramer's V
% Self-reported speed limit non-compliance in urban areas								
Age	[18;25]	69.8	23.3	7.0	0.0			
	[26;35]	80.6	12.0	1.9	5.6			
	[36;45]	90.8	6.7	2.5	0.0	28.8	0.004 *	0.16
	[46;55]	75.0	16.3	6.5	2.2			
	>=56	80.0	4.0	12.0	4.0			
Driver_license	A	77.8	22.2	0.0	0.0			
	B	82.5	12.2	2.3	3.0			
	C	78.4	11.7	9.0	0.9	15.6	0.075	0.12
	Other	75.0	0.0	25.0	0.0			
Sex	Male/Homme	77.6	14.8	4.6	3.0			
	Female/Femme	88.7	6.5	4.0	0.8	8.0	0.046 *	0.14
% Self-reported speed limit non-compliance on highways								
Age	[18;25]	62.8	23.3	7.0	7.0			
	[26;35]	57.4	30.6	6.5	5.6			
	[36;45]	47.9	42.9	5.9	3.4	41.4	0.000 **	0.19
	[46;55]	28.3	45.7	17.4	8.7			
	>=56	20.0	60.0	4.0	16.0			
Driver_license	A	66.7	11.1	11.1	11.1			
	B	53.6	33.5	8.4	4.6			
	C	25.2	55.9	8.1	10.8	41.3	0.000 **	0.19
	Other	50.0	0.0	50.0	0.0			
Sex	Male/Homme	42.2	40.3	9.1	8.4			
	Female/Femme	53.2	36.3	8.1	2.4	7.3	0.063	0.14

* Significant at $p < 0.05$. ** Significant at $p < 0.01$.

Regarding license type, there is no significant association with speed limit non-compliance in urban areas (at $p < 0.05$). However, a significant relationship is observed in highways ($\chi^2 = 41.3$, $p < 0.001$, V = 0.19), with drivers holding a type C license exhibiting higher non-compliance (for speeds > 10 km/h above speed limits).

In terms of gender, a statistically significant association is found in urban areas ($\chi^2 = 8$, $p < 0.005$, V = 0.14), with males reporting higher speeds than females (for speeds > 10 km/h above speed limits). However, no significant association is observed in highways.

Despite the high incidence of speed non-compliance, 95.9% of drivers expressed willingness to use speed management technologies to assist them in complying with speed limits. The majority of drivers favored the adoption of automatic speed limiters installed in vehicles and speed surveillance cameras as a means to ensure compliance with speed limits.

3.3. Factor Analysis and Reliability Statistics

Table 3 displays the results of the factor analysis and reliability test. Initially, a factor analysis was conducted on all observed variables (all the questions). Variables with lower factor loadings and those that decreased the reliability within the group were identified and removed. The results presented in Table 3 represent the second step, where factor analysis was performed again on the observed variables selected in the first step. In all cases, a single component was obtained, and the factor loadings of the observed variables were greater than 0.4, which is deemed acceptable [42]. These factors, also referred to as

components, were used to construct composite latent variables for speeding intention (SI), speeding behavior (SB), subjective norm (SN), and attitude (AT).

Table 3. Factor loadings and reliability test.

Variables		Factor Loadings	Percentage of Variance	Cronbach Alpha
Attitude	AT 1	0.64	29.4	0.095
	AT 2	0.49		
	AT 3	0.35		
	AT 4	0.60		
Speeding Intention	SI 3	0.83	73.2	0.625
	SI 4	0.85		
Speeding Behavior	SB 1	0.90	68.2	0.864
	SB 2	0.81		
	SB 4	0.75		
	SB 5	0.73		
	SB 6	0.90		
Subjective Norm	SN 1	0.78	44.97	0.316
	SN 2	0.62		
	SN 5	0.53		

3.4. Correlation Analysis

Before conducting the hierarchical regression analysis and structural equation model, a Pearson correlation analysis was performed to examine the relationships between sociodemographic variables (gender, age, education level, marital status, driver's license, driver's experience, vehicle type) and the composite variables (AT, SI, SB, and SN), including the non-composite variables PR and PBC. The results of the correlation analysis are presented in Table 4.

Table 4. Correlation analysis.

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Sex	1												
2	Age	−0.067	1											
3	Edu_Lv	0.176 **	0.254 **	1										
4	Mari_Statut	0.072	0.574 **	0.307 **	1									
5	Driv_lic	0.269 **	0.398 **	0.170 **	0.272 **	1								
6	Veh_ty	0.325 **	0.357 **	0.245 **	0.162 **	0.712 **	1							
7	Driv_Ex	0.191 **	0.691 **	0.195 **	0.428 **	0.299 **	0.266 **	1						
8	AT	−0.043	0.087	0.023	−0.052	0.021	0.015	0.143 **	1					
9	SN	0.067	-0.106 *	0.129 *	0.135 **	−0.033	−0.06	−0.015	0.166 **	1				
10	SI	0.215 **	0.297 **	0.243 **	0.152 **	0.133 **	0.157 **	0.355 **	0.400 **	0.056	1			
11	PR	0.094	−0.011	0.04	−0.054	−0.007	0.005	−0.068	0.044	0.365 **	0.076	1		
12	PBC	0.112 *	−0.056	0.163 **	0.06	0.221 **	0.177 **	−0.015	0.01	−0.05	0.076	−0.035	1	
13	SB	0.141 **	0.1	0.238 **	0.144 **	0.135 **	0.133 **	0.119 *	0.265 **	0.102 *	0.244 **	0.143 **	0.337 **	1

* Significant at $p < 0.05$. ** Significant at $p < 0.01$.

The correlation analysis provides insights into the associations between the variables of interest. Significant correlations (especially at $p < 0.01$) were found between most of the variables and speeding intention (SI) and speed behavior (SB). The significant correlation coefficients ranged from low (0.1 to 0.3) to moderate correlations (0.3 to 0.4). These suggest that there are several important determinants of SI and SB. The highest correlation for SB

was observed with perceived behavioral control (PBC), indicating that individuals' belief in their ability to control their speeding behavior is strongly related to their actual behavior. For speeding intention, the highest correlation was found with attitude (AT), suggesting that individuals' attitudes towards speeding influence their intention to engage in speeding behavior. Additionally, education level exhibited a positive and significant relationship with most of the variables, indicating that higher levels of education are associated with certain attitudes, intentions, and behaviors related to speeding.

3.5. Results of Hierarchical Multiple Regression Analysis

The objective of the hierarchical multiple regression analysis was to elucidate the factors influencing the intention of speeding and speeding behavior by incorporating several independent variables at different steps. The analysis was conducted in two steps. In the first step (STEP1), the effects of various demographic and driver-related independent variables were examined, including sex, age, education level, marital status, driver's license, vehicle type, and driver experience. In the second step (STEP2), other independent variables were added, which included the factors of the TPB (AT, SN, PBC, and PR). The results for speeding intention and speeding behavior are presented in Tables 5 and 6, respectively. No multicollinearity issues were observed for the speeding intention and speed behavior models, as the VIF (Variance Inflation Factor) of all predictors fell between 1 and 3. VIFs below 10 are often recommended [43,44].

Table 5. Hierarchical regression analysis for speeding intention.

	Model	**R2**	**R2_Change**	**F_Change**	**β**	**Sig.**
STEP1	Sex	0.18	0.18	11.876 ***	−0.138	0.008 **
	Age				0.122	0.101
	Education_Level				−0.163	0.001 **
	Marital_statut				−0.053	0.374
	Driver_license				−0.04	0.566
	Vehicle_type				0	0.996
	Driver_Experience				0.247	<0.001 ***
STEP2	Sex	0.321	0.141	19.437 ***	−0.151	0.002 **
	Age				0.096	0.165
	Education_Level				−0.158	0.001 **
	Marital_statut				0.006	0.917
	Driver_license				−0.031	0.629
	Vehicle_type				0.013	0.84
	Driver_Experience				0.189	0.002 **
	AT				0.356	<0.001 ***
	SN				0.011	0.821
	PBC				0.071	0.119
	PR				0.093	0.044 *

* Significant at $p < 0.05$. ** Significant at $p < 0.01$. *** Significant at $p < 0.001$.

According to the results of Table 4, in Step 1, the overall model accounted for 18% of the variance in the intention of speeding with sex, education level, and driver experience, demonstrating a significant relationship with speeding intention (at $p < 0.05$). In Step 2, after the addition of the variables of TBP, the model variance increases to 32.1%, representing an increase of about 57%. In addition to sex, education level, and driver experience, attitude and perceived risk show a significant relationship with speeding intention. All significant variables except for sex showed a positive relationship with speeding

intention. This indicates that either gender (in this case, males) is more inclined to have the intention of speeding. These findings provide valuable insights into individuals' propensity to engage in speeding behavior. However, it should be noted that the generalizability of these results to other populations or contexts may vary.

Table 6. Hierarchical regression analysis for speeding behavior.

Model		R2	R2_Change	F_Change	β	Sig.
STEP1	Sex	0.159	0.159	10.240 ***	−0.106	0.043 *
	Age				0.18	0.018 *
	Education_Level				0.279	<0.001 ***
	Marital_statut				−0.219	<0.001 ***
	Driver_license				0.07	0.317
	Vehicle_type				0.066	0.347
	Driver_Experience				0.084	0.207
STEP2	Sex	0.314	0.155	16.884 ***	−0.064	0.191
	Age				0.103	0.137
	Education_Level				0.254	<0.001 ***
	Marital_statut				−0.156	0.005 **
	Driver_license				0.024	0.707
	Vehicle_type				0.05	0.438
	Driver_Experience				0.037	0.56
	AT				0.149	0.002 **
	SN				−0.023	0.633
	PBC				−0.274	<0.001 ***
	PR				0.11	0.019
	SI				0.216	<0.001 ***

* Significant at $p < 0.05$. ** Significant at $p < 0.01$, *** Significant at $p < 0.001$.

Regarding speeding behavior, the initial step (Step 1) of the analysis accounted for 15.9% of the variance, revealing significant relationships between speeding behavior and sex, age, education level, and marital status. In the subsequent step (Step 2), after incorporating additional variables related to the Theory of Planned Behavior (TPB), the variance increased to 31.4%. This represents a proportionate increase of more than 50%. Notably, education level, marital status, attitude, perceived behavioral control, perceived risk, and speeding intention emerged as significant factors at this stage. It is important to mention that certain variables, such as sex and age, which were significant in Step 1, lost significance in Step 2. This could be due to issues of the masking effect of other variables.

Comparing the models for speeding behavior and speeding intention, the signs of the variables that were significant in both models remained consistent, indicating a mediating relationship between speeding intention and speeding behavior.

3.6. Structural Equation Models

3.6.1. SEM1

SEM 1 results (shown in Figure 2) validated the TPB framework. The structural equation depicted the direct and indirect effects of various factors on speeding behavior (SB), including the mediating effect of speeding intention (SI). The goodness-of-fit analysis indicated that the model generally fell within acceptable levels based on inference from past studies [16,18,45]. The Tucker-Lewis index (TLI) and comparative fit index (CFI) were estimated at 0.892 and 0.675, respectively, which were close to the acceptable threshold of 0.9. The Root Mean Square Error of Approximation (RMSEA) was 0.006, indicating a good

fit, while the Standardized Root Mean Square Residual (SRMR) was 0.045, below the threshold of 0.08. However, the *p*-value of the chi-square test showed some significance, suggesting a poor fit. Nevertheless, it is important to note that the chi-square test is sensitive to large sample sizes and can yield significant *p*-values regardless of the model fit.

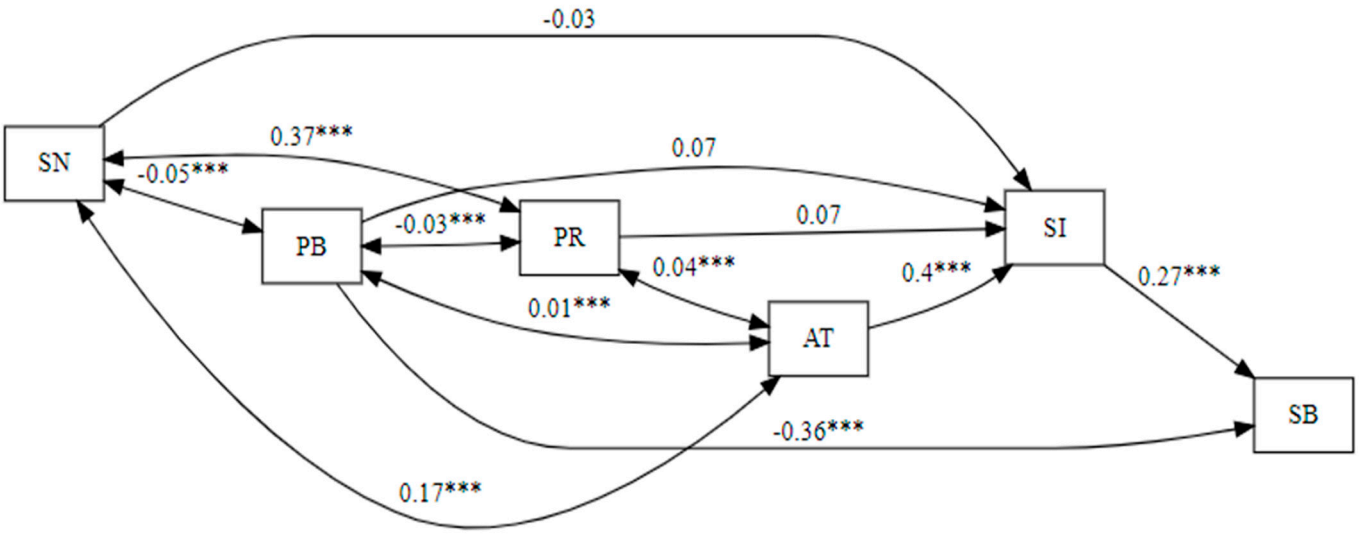


Figure 2. SEM1: Speeding behavior model with variables of the TPB. *** $p < 0.001$.

According to the SEM 1 results, attitude (AT) towards speeding behavior was the only variable with a significant relationship with speeding intention (SI) (beta = 0.4, $p < 0.001$). This positive relationship indicates that drivers who feel confident in their driving experience, perceive a sense of power, or experience time pressure are more likely to have positive intentions regarding speeding. The coefficient of determination for the speeding intention variable was 0.17. The standard path coefficients revealed that subjective norm (SN) (beta = 0.17, $p < 0.001$), perceived behavioral control (PB) (beta = 0.01, $p < 0.001$), and perceived risk (PR) (beta = 0.01, $p < 0.001$) demonstrated significant relationships with attitude, which in turn acted as a mediator for speeding intention.

Regarding speeding behavior, the coefficient of determination was 0.187. Consistent with the TPB, speeding intention (beta = 0.27, $p < 0.001$) and perceived behavioral control (beta = −0.37, $p < 0.001$) exhibited significant relationships. The negative relationship observed for perceived behavioral control (PB) is not uncommon and indicates that drivers who perceive lower control (such as feeling less likely to be apprehended by the police or facing difficulties adhering to speed limits) are more inclined to exceed speed limits. The positive relationship for speeding intention (SI) suggests that drivers with a high intention to speed are more likely to engage in speeding behavior.

3.6.2. SEM2

The SEM 2 results (Figure 3) depict the relationship between demographic and driver characteristics in explaining the variance in speeding intention (SI). The evaluation of model parameters, including TLI, CFI, RMSEA, and SRMR, indicated a fair fit, with some variables meeting acceptable limits while others did not. The interaction between variables was allowed but not reflected in the diagram to improve readability. The results revealed that education level (beta = −0.16, $p < 0.001$), sex (beta = −0.15, $p < 0.001$), driver experience (beta = 0.19, $p < 0.001$), perceived risk (beta = 0.09, $p < 0.05$), and attitude (beta = 0.36, $p < 0.001$) demonstrated significant relationships with speeding intention, reflecting strong indirect effects on speeding behavior. These variables explained 32% of the variance in speeding intention.

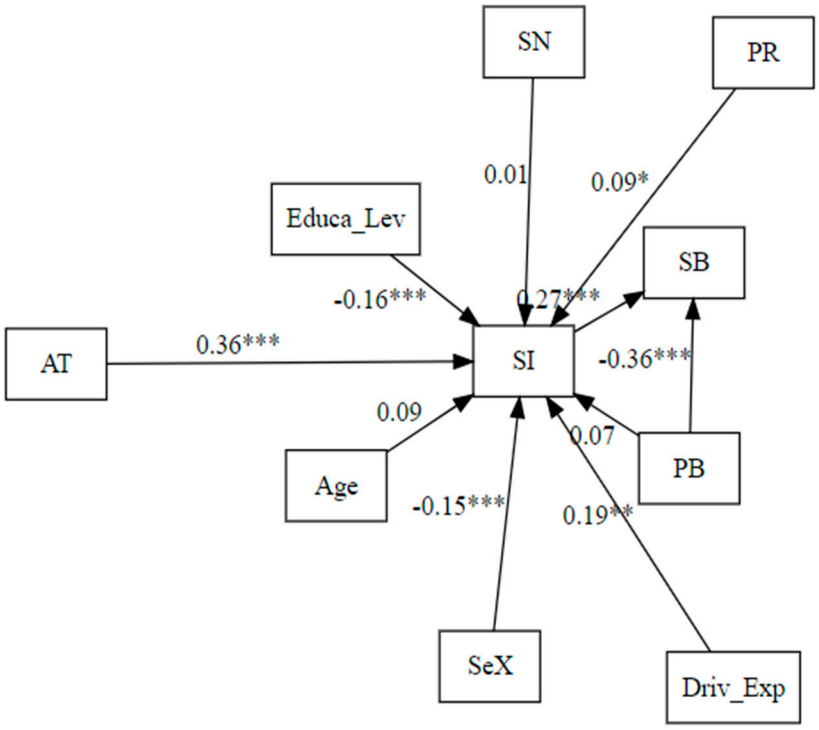


Figure 3. SEM3: Speeding behavior model with variables of the TPB and demographic characteristics. *** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$.

The observed negative structural relationship between the level of education and intention to engage in speeding means that as the level of education increases, the intention to engage in speeding decreases. This can be translated into effects such as increased risk awareness. Individuals with higher levels of education are often associated with higher levels of cognitive skills and critical thinking, and they may be more informed about the dangers and negative consequences associated with speeding. The negative relationship between gender and speeding intention means that there is a tendency for women who are in the minority in this study to have a reduced intention to engage in speeding. The observed positive structural relationship between driving experience and speeding intention indicates that there is a tendency for greater driving experience to be associated with an increased intention to engage in speeding. This means that the more driving experience a person has, the more likely they are to express an intention to drive at high speeds as they become overconfident in their skills. Additionally, greater familiarity with roads and driving conditions can also influence the intention to drive at high speeds.

Similar to the SEM 1 results, in SEM 2, speeding intention (beta = 0.27, $p < 0.001$) and perceived behavioral control (beta = −0.36, $p < 0.001$) exhibited significant relationships with speeding behavior. Speeding intention and perceived behavioral control accounted for 19% of the variance associated with speeding behavior (SB).

Additional analysis was undertaken to assess the direct impact of demographic factors, such as driver experience, on speeding behavior. The rationale behind this investigation is the premise that drivers with many years of experience, or those familiar with the road and its surroundings, may exhibit certain speeding behaviors unintentionally. However, the outcomes of this analysis did not reveal a statistically significant correlation (at $p < 0.05$) between driver experience and speeding behavior. Therefore, until further investigation is conducted in different contexts, the influence of driver experience on speeding behavior is considered to be mediated solely through its effect on speeding intention.

4. Discussion

The results of this study reveal several significant findings regarding speeding behavior in lower-middle-income countries such as Cameroon. The first part of this study examined self-reported speeding non-compliance and its association with demographic and driver characteristics. The second part focused on analyzing the factors influencing speeding behavior based on the theory of planned behavior.

The findings regarding speeding non-compliance shed light on the extent of speeding in urban areas and highways in Cameroon. It was found that 100% of drivers reported exceeding the speed limits by at least 5 km/h, and this rate increased further in high-speed environments such as highways. These reported non-compliance rates are higher than those observed in the 2019/2020 survey for Cameroon [41]. These results are highly concerning, considering the strong correlation between speed and crashes. Studies have shown that a 1 km/h increase in speed is expected to raise fatalities and serious injuries by 8% and 6% respectively [6]. The impact is likely to be even greater due to the high presence of vulnerable road users, especially in the capital city, Yaoundé, where data were collected from study participants. This high level of speeding non-compliance may be contributing to the high number of vulnerable road user fatalities in the country. Therefore, there is an urgent need for speed management measures in both urban areas and highways to reduce speed levels. Encouragingly, a significant majority of drivers expressed their willingness to adopt speed management technologies, such as speed limiters and speed surveillance systems, to help them comply with speed limits.

However, the high reporting of speeding non-compliance may indicate that the speed limits are not perceived as credible or consistent with drivers' expectations. This perception could be influenced by roadway geometric features and other external factors, which may suggest that higher speeds on the roads are feasible than those indicated by the speed limit signs, thus prompting drivers to travel at higher speeds [46]. Nevertheless, in the local context of Yaoundé, most urban and highway roads typically feature only one lane in the direction of travel, and the overall quality of the infrastructure generally does not support very high speeds. This observation implies that the prevalent speeding non-compliance is more likely a behavioral issue (as shown in the results) rather than a problem with the speed limits themselves.

Additionally, evidence emerged that up to 11% of drivers were not aware of the speed limits, which is not uncommon in lower-middle-income countries, particularly in sub-Saharan Africa, where traffic regulations and speed limits are often poorly defined [22]. This value is considerably lower than the 30% reported in a previous study conducted in a similar LMIC, Kenya [32], which ascertains differences in the country's awareness and compliance with speed limits. Furthermore, this study revealed a statistically significant association between age, gender, driver's license status, and speed limit non-compliance, with the effects varying according to the road type. These findings align with previous research conducted in other lower-middle-income countries [37,38], as well as in higher-income countries [28,29], suggesting that demographic factors are influential in speeding behavior across different economic contexts. The results indicated higher levels of speeding among young drivers in urban areas, whereas, on highways, older drivers were found to have higher levels of speeding. This suggests that a larger proportion of drivers on highways are older, more experienced drivers who tend to exceed speed limits due to their familiarity with such roads. This was further supported by the fact that the percentage of speeders was significantly higher for buses/minibusses on highways, which older drivers typically drive. These findings also align with previous research indicating that older drivers are more likely to speed outside built-up areas [28,47]. This highlights the importance of considering the context of road type when examining speeding behavior. Furthermore, the results showed that males were more likely to report high non-compliance than females, which is a common finding [28,47]. However, this significant association was observed only in urban areas and not on highways. These context-dependent

results on gender suggest the need for future research on other contexts to validate or invalidate the findings.

Regarding the factors influencing speeding behavior under the Theory of Planned Behaviour (TPB), several important findings emerged from the regression analysis and structural equation models. The results of the regression analysis demonstrated that, after controlling for demographic and driver-related characteristics in the first step, the addition of TPB variables accounted for over 50% of the variance in both speeding intention and speed behavior. This indicates a strong relationship between TPB variables and supports the theory (Hypothesis 1 and 2), consistent with findings reported in another study [48].

A significant and robust relationship was observed between speeding behavior and both speeding intention and perceived behavioral control, which aligns with previous studies [17–19,48]. These results suggest that modifying drivers' speeding intentions and their perception of control over speeding can have a substantial impact on their actual speeding behavior. However, it is important to acknowledge the negative relationship between speeding behavior and perceived behavioral control, as noted by other authors [18]. This suggests that increasing perceived control may not always lead to reduced speeding behavior.

Speeding intention, in turn, played a mediating role in influencing speeding behavior and validated the various hypotheses. The determinants of speeding intention were primarily attitude but also perceived risk and other demographic and driver-related characteristics such as education level, gender, and driver experience. Attitude emerged as the most significant variable influencing speeding intention, with a positive association as observed by other authors [17,48,49]. The findings regarding the effects of demographic and driver characteristics on speeding intention are also consistent with previous research [17,48], showing a consistent pattern in how these factors shape drivers' intentions to speed.

Subjective norm, however, did not show a statistically significant relationship with speeding intention. This aligns with the research of [19,21] but in contrast with those of other authors [10]. However, the reasons for this observation could be attributable to the cultural emphasis on individual autonomy, where personal beliefs and attitudes often override societal expectations. Strong personal justifications for speeding, such as viewing it as efficient or necessary, may further undermine the role of subjective norms. Additionally, if drivers are cognizant of the risks associated with speeding (as proven in the significant relationship between perceived risk and speeding intention), they might choose not to engage in the behavior, regardless of what is considered normative. The inconsistency in traffic law enforcement in Cameroon could also erode the social expectation to comply with speed limits, diminishing the influence of subjective norms on intentions to speed. Moreover, if speeding is normalized within certain Cameroonian contexts, it might not be perceived negatively, thus weakening the impact of subjective norms. Although subjective norms do not directly influence the intention to speed, they are significantly associated with attitudes towards speeding, indicating that they may indirectly affect intentions by shaping attitudes, which are more directly predictive of behavior.

Notably, new evidence that emerged from this research highlighted the determinants of speeding attitude, revealing a significant relationship between attitude and subjective norm, perceived risk, and perceived behavioral control. The positive relationship between attitudes and subjective social norms indicates that individuals are more likely to have a favorable attitude towards speeding if they perceive that their peers and the broader society accept or even endorse such behavior. Perceived risk also plays a pivotal role; when individuals recognize the potential dangers and legal consequences of speeding, their attitude towards the behavior becomes more negative, which can deter them from speeding. Last, perceived behavioral control, which reflects an individual's confidence in their ability to control their driving speed, can lead to a more cautious attitude towards speeding.

When drivers feel capable of managing their speed, they are less likely to view speeding favorably. However, these observations need to be confirmed in future research.

Overall, this study corroborates many findings from the existing literature while also providing new insights into the complexities of speeding behavior. The similarities with previous studies reinforce the validity of the TPB and the influence of demographic factors on speeding. These findings have important implications for speed management strategies, highlighting the urgent need for effective measures in urban areas and highways of Cameroon. Efforts to change attitudes towards speeding could result in corresponding changes in speeding intention and subsequent alterations in speed behavior. Additionally, perceived behavioral control plays a critical role in influencing drivers' speeding behavior and should also be targeted. To address the high prevalence of speeding and reduce associated risks and fatalities, it is crucial to raise awareness of speed limits among drivers (especially motorcycle riders, who often do not have formal training), improve traffic regulations and enforcement, introduce speed management technologies such as speed limiters and implement targeted interventions. It is worth noting that these interventions should also include infrastructure change to optimize the expected benefits.

5. Conclusions

Excessive and inappropriate speeding continues to pose a road safety challenge in low- and middle-income countries (LMICs) such as Cameroon. However, the effective management of speeding in these countries is impeded by a lack of research. In Cameroon and its neighboring sub-Saharan countries, there is often a dearth of studies on speeding behavior. This study aims to address these gaps by examining the prevalence of self-reported speeding and the factors influencing drivers' speeding behavior, as guided by the Theory of Planned Behavior (TPB). A survey was conducted online, involving 387 anonymous drivers from the capital city, Yaoundé. The survey questionnaire covered demographic characteristics, driver-related factors, and TPB variables, including speed behavior, speeding intention, attitude, subjective norm, perceived behavioral control, and perceived risk. Chi-square tests of association were employed to explore the relationship between self-reported non-compliance and demographic and driver-related factors. Hierarchical linear regression and structural equation modeling were employed to examine the factors influencing speeding behavior.

The results revealed that in urban areas, 81% of drivers exceeded speed limits by 5 km/h, 12% exceeded by 10 km/h, 4% exceeded by 15 to 20 km/h, and 2% exceeded by more than 20 km/h. The percentage of drivers exceeding the speed limit by more than 10 km/h was higher on highways. Additionally, this study found that only 89% of drivers were aware of the speed limits, with tricycle and motorcycle drivers displaying significantly lower awareness. The statistical analysis confirmed a significant association between age, driver's license, and gender with speeding non-compliance, although the associations varied between urban areas and highways. Furthermore, the results of hierarchical linear regression analysis indicated that the inclusion of TPB variables accounted for a more than 50% proportionate increase in the variance of both speeding intention and speeding behavior, underscoring a strong relationship between TPB variables and speeding-related factors. Therefore, the TPB proves suitable for determining speeding intention and behavior in Cameroon. The structural equation modeling validated the various hypotheses 1, 2, and 3, further demonstrating the usefulness of the TPB and the influence of demographic characteristics on speeding behavior through the mediating effect of speeding intention. The results revealed that while attitude was the only significant factor influencing speeding intention among the TPB variables, education level, gender, driver experience, and perceived risk were significant predictors of speeding intention. These factors indirectly influence speeding behavior through the mediating factor of speeding intention. In addition to the speeding intention, the perceived behavioral control also exhibited a substantial and significant impact on speeding behavior. These findings suggest that

interventions targeting attitude, intentions, and perceived behavioral control can effectively modify speeding behavior.

6. Limitations and Further Research

Despite the relevance of this study, there are certain limitations that should be considered in future research. The reliability of some constructs in the survey questions was low, potentially influencing the results. One possible issue could be the use of different evaluation scales within each construct, which should be resolved in future studies. In addition, the sample size was relatively small for tricycles and only moderately high for trucks, emphasizing the need for future studies with larger sample sizes. However, this study also encompassed the entire national territory rather than focusing solely on the capital city. Future research should also involve the measurement of actual driving speeds on urban roads and highways and compare them with self-reported data. A further limitation of this study is the collective examination of speeding behaviors across various ranges (i.e., exceeding the posted speed limit by 5 km/h, 10 km/h, 15–20 km/h, and >20 km/h) with independent contributing factors, without isolating and analyzing the influence of common factors, or individual effects, and their interactions within each speed range.

Author Contributions: Conceptualization, analysis, writing, and original draft preparation by S.K.F.; data collection, cleaning, and treatment by C.S.F.F.; review and editing by S.L.T.F.; Methodology, review, and editing by D.S.U.; Supervision and review by L.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by Ethical Committee of the National Advanced School of Public Works, Yaounde (protocol code: MPT 502 and approved on 21 August 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data is available upon request.

Acknowledgments: We acknowledge the administrative staff and students at the National Advanced School of Publics.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Fondzenyuy, S.K.; Turner, B.M.; Burlacu, A.F.; Jurewicz, C. The Contribution of Excessive or Inappropriate Speeds to Road Traffic Crashes and Fatalities: A Review of Literature. *SSRN* **2024**. https://doi.org/10.2139/ssrn.4706224.
2. Elvik, R.; Christensen, P.; Amundsen, A. *Speed and Road Accidents: An Evaluation of the Power Model*; The Institute of Transport Economics: Oslo, Norway, 2004; Volume 740. Available online: http://www.trg.dk/elvik/740-2004.pdf (accessed on 30 December 2023).
3. Goran, N. Traffic Safety Dimensions and the Power Model to Describe the Effect of Speed on Safety. Ph.D. Thesis, Lund Institute of Technology and Society, Traffic Engineering, Lund, Sweden, 2004.
4. Fondzenyuy, S.K.; Turner, B.M.; Burlacu, A.F.; Jurewicz, C. Speed Management Research: A Summary Comparison of Literature Between High-Income and Low and Middle-Income Countries. 2024.Available online: https://www.roadsafetyfacility.org/publications/speed-management-research-summary-comparison-literature-between-high-income-and-low (accessed on 7 March 2024).
5. Turner, B.M.; Eichinger-Vill, E.M.; El-Samra, S.; Adriazola-Steil, C.; Burlacu, A.F. *Guide for Safe Speeds: Managing Traffic Speeds to Save Lives and Improve Livability*; World Bank: Washington, DC, USA, 2024.
6. Elvik, R.; Vadeby, A.; Hels, T.; van Schagen, I. Updated estimates of the relationship between speed and road safety at the aggregate and individual levels. *Accid. Anal. Prev.* **2019**, *123*, 114–122. https://doi.org/10.1016/j.aap.2018.11.014.
7. Jurewicz, C.; Sobhani, A.; Woolley, J.; Dutschke, J.; Corben, B. Exploration of Vehicle Impact Speed—Injury Severity Relationships for Application in Safer Road Design. *Transp. Res. Procedia* **2016**, *14*, 4247–4256. https://doi.org/10.1016/j.trpro.2016.05.396.
8. Doecke, S.D.; Baldock, M.R.J.; Kloeden, C.N.; Dutschke, J.K. Impact speed and the risk of serious injury in vehicle crashes. *Accid. Anal. Prev.* **2020**, *144*, 105629. https://doi.org/10.1016/j.aap.2020.105629.

9. Sheykhfard; Haghighi, F.; Fountas, G.; Das, S.; Khanpour, A. How do driving behavior and attitudes toward road safety vary between developed and developing countries? Evidence from Iran and the Netherlands. *J. Saf. Res.* **2023**, *85*, 210–221. https://doi.org/10.1016/j.jsr.2023.02.005.
10. Warner, H.W.; Özkan, T.; Lajunen, T. Cross-cultural differences in drivers' speed choice. *Accid. Anal. Prev.* **2009**, *41*, 816–819. https://doi.org/10.1016/j.aap.2009.04.004.
11. Huang, Y.; Sun, D.; Tang, J. Taxi driver speeding: Who, when, where and how? A comparative study between Shanghai and New York City. *Traffic Inj. Prev.* **2018**, *19*, 311–316. https://doi.org/10.1080/15389588.2017.1391382.
12. Nordfjærn, T.; Şimşekoğlu, Ö.; Rundmo, T. Culture related to road traffic safety: A comparison of eight countries using two conceptualizations of culture. *Accid. Anal. Prev.* **2014**, *62*, 319–328. https://doi.org/10.1016/j.aap.2013.10.018.
13. Tankasem, P.; Satiennam, T.; Satiennam, W. Cross-Cultural differences in speeding intentions of drivers on urban road environments in asian developing countries. *Int. J. Technol.* **2016**, *7*, 1187–1195. https://doi.org/10.14716/ijtech.v7i7.4701.
14. Torfs, K.; Delannoy, S.; Schinckus, L.; Willocq, B.; Van den Berghe, W.; Meesmann, U. *Road Safety Culture in Africa Results from the ESRA2 Survey in 12 African Countries*; ESRA Project (E-Survey of Road Users' Attitudes); Vias Institute: Brussels, Belgium, 2021.
15. Qaid, H.; Widyanti, A.; Salma, S.A.; Trapsilawati, F.; Wijayanto, T.; Syafitri, U.D.; Chamidah, N. Speed choice and speeding behavior on Indonesian highways: Extending the theory of planned behavior. *IATSS Res.* **2022**, *46*, 193–199. https://doi.org/10.1016/j.iatssr.2021.11.013.
16. Alizadeh, M.; Davoodi, S.R.; Shaaban, K. Drivers' Speeding Behavior in Residential Streets: A Structural Equation Modeling Approach. *Infrastructures* **2023**, *8*, 11. https://doi.org/10.3390/infrastructures8010011.
17. Javid, M.A.; Ali, N.; Shah, S.A.H.; Abdullah, M. Structural Equation Modeling of Drivers' Speeding Behavior in Lahore: Importance of Attitudes, Personality Traits, Behavioral Control, and Traffic Awareness. *Iran. J. Sci. Technol.-Trans. Civ. Eng.* **2022**, *46*, 1607–1619. https://doi.org/10.1007/s40996-021-00672-1.
18. Javid, M.A.; Al-Hashimi, A.R. Significance of attitudes, passion and cultural factors in driver's speeding behavior in Oman: Application of theory of planned behavior. *Int. J. Inj. Contr. Saf. Promot.* **2020**, *27*, 172–180. https://doi.org/10.1080/17457300.2019.1695632.
19. Etika, A.A.; Merat, N.; Carsten, O. Do drivers differ in their attitudes on speed limit compliance between work and private settings? Results from a group of Nigerian drivers. *Transp. Res. Part F Traffic Psychol. Behav.* **2020**, *73*, 281–291. https://doi.org/10.1016/j.trf.2020.06.024.
20. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.
21. Ding, Y.; Zhao, X.; Wu, Y.; Zhang, X.; He, C.; Liu, S. How psychological factors affect speeding behavior: Analysis based on an extended theory of planned behavior in a Chinese sample. *Transp. Res. Part F Traffic Psychol. Behav.* **2023**, *93*, 143–158. https://doi.org/10.1016/j.trf.2023.01.003.
22. Nordfjærn, T.; Jrgensen, S.; Rundmo, T. A cross-cultural comparison of road traffic risk perceptions, attitudes towards traffic safety and driver behaviour. *J. Risk Res.* **2011**, *14*, 657–684. https://doi.org/10.1080/13669877.2010.547259.
23. Yunesian, M.; Alireza, M.; Ali, M.; Javad, H.V. Drivers' knowledge, attitudes, and behavior: A cross-sectional study. *Psychol. Rep.* **2008**, *102*, 411–417.
24. Lund, I.O.; Rundmo, T. Cross-cultural comparisons of traffic safety, risk perception, attitudes and behaviour. *Saf. Sci.* **2009**, *47*, 547–553. https://doi.org/10.1016/j.ssci.2008.07.008.
25. Judy, F.; Barry, W. The speed paradox: The misalignment between driver attitudes and speeding behaviour. In *2005 Australasian Road Safety Research, Policing & Education Conference*; Australasian Road Safety Research, Policing & Education: Wellington, New Zealand, 2005.
26. De Pelsmacker, P.; Janssens, W. The effect of norms, attitudes and habits on speeding behavior: Scale development and model building and estimation. *Accid. Anal. Prev.* **2007**, *39*, 6–15. https://doi.org/10.1016/j.aap.2006.05.011.
27. Stefanidis; Truelove, V.; Nicolls, M.; Freeman, J. Perceptions matter: Speeding behavior varies as a function of increasing perceived exposure to content encouraging the behavior. *Traffic Inj. Prev.* **2022**, *23*, 226–231. https://doi.org/10.1080/15389588.2022.2049259.
28. Stephens, N.; Nieuwesteeg, M.; Page-Smith, J.; Fitzharris, M. Self-reported speed compliance and attitudes towards speeding in a representative sample of drivers in Australia. *Accid. Anal. Prev.* **2017**, *103*, 56–64. https://doi.org/10.1016/j.aap.2017.03.020.
29. Vardaki, S.; Yannis, G. Investigating the self-reported behavior of drivers and their attitudes to traffic violations. *J. Saf. Res.* **2013**, 46, 1–11. https://doi.org/10.1016/j.jsr.2013.03.001.
30. Varet, F.; Apostolidis, T.; Granié, M.A. Social value, normative features and gender differences associated with speeding and compliance with speed limits. *J. Saf. Res.* **2022**, *84*, 182–191. https://doi.org/10.1016/j.jsr.2022.10.018.
31. Yannis, G.; Dragomanovits, A.; Laiou, A.; Richter, T.; Ruhl, S.; La Torre, F.; Domenichini, L.; Graham, D.; Karathodorou, N.; Li, H. Use of accident prediction models in road safety management—An international inquiry. *Transp. Res. Procedia* **2016**, *14*, 4257–4266. https://doi.org/10.1016/j.trpro.2016.05.397.
32. Bachani, A.M.; Hung, Y.W.; Mogere, S.; Akungah, D.; Nyamari, J.; Stevens, K.A.; Hyder, A.A. Prevalence, knowledge, attitude and practice of speeding in two districts in Kenya: Thika and Naivasha. *Injury* **2013**, *44* (Suppl. S4), S24–S30. https://doi.org/10.1016/S0020-1383(13)70209-2.

33. Haglund, M.; Åberg, L. Speed choice in relation to speed limit and influences from other drivers. *Transp. Res. Part F Traffic Psychol. Behav.* **2000**, *3*, 39–51. https://doi.org/10.1016/S1369-8478(00)00014-0.
34. Zhao, D.; Han, F.; Meng, M.; Ma, J.; Yang, Q. Exploring the influence of traffic enforcement on speeding behavior on low-speed limit roads. *Adv. Mech. Eng.* **2019**, *11*, 1–9. https://doi.org/10.1177/1687814019891572.
35. Mamo, W.G.; Ross, V.; Alhajyaseen, W.K.M.; Reinolsmann, N.; Brijs, K. A study on the determinants of Ethiopian minibus taxi drivers' speeding behaviour: An application of the 'major theorists' model. *Procedia Comput. Sci.* **2022**, *201*, 189–196. https://doi.org/10.1016/j.procs.2022.03.027.
36. Javid, M.A.; Ali, N.; Abdullah, M.; Campisi, T.; Shah, S.A.H.; Suparp, S. Analysis of Driver's Socioeconomic Characteristics Relating to Speeding Behavior and Crash Involvement: A Case Study in Lahore. *Infrastructures* **2022**, *7*, 18. https://doi.org/10.3390/infrastructures7020018.
37. Al-Hussein, W.A.; Kiah, M.L.M.; Por, L.Y.; Zaidan, B.B. Investigating the effect of social and cultural factors on drivers in Malaysia: A naturalistic driving study. *Int. J. Environ. Res. Public Health* **2021**, *18*, 22. https://doi.org/10.3390/ijerph182211740.
38. Mohamad, F.F.; Abdullah, A.S.; Mohamad, J. Are sociodemographic characteristics and attitude good predictors of speeding behavior among drivers on Malaysia federal roads? *Traffic Inj. Prev.* **2019**, *20*, 478–483. https://doi.org/10.1080/15389588.2019.1612057.
39. Suzuki; Tang, K.; Alhajyaseen, W.; Suzuki, K.; Nakamura, H. An international comparative study on driving attitudes and behaviors based on questionnaire surveys. *IATSS Res.* **2022**, *46*, 26–35. https://doi.org/10.1016/j.iatssr.2021.10.002.
40. WHO. Global Status Report on Road Safety 2023. 2023. Available online: https://www.who.int/publications/i/item/9789240086517 (accessed on 13 December 2023).
41. Vias Institute. *Cameroon—ESRA2 Country Fact Sheet*; ESRA2 Survey (E-Survey of Road Users' Attitudes); Vias Institute: Brussels, Belgium, 2020. Available online: https://www.esranet.eu/storage/minisites/esra2019countryfactsheetcameroon.pdf (accessed on 20 January 2024).
42. Guadagnoli, E.; Velicer, W.F. Relation of sample size to the stability of component patterns. *Psychol. Bull.* **1988**, *103*, 265–275. https://doi.org/10.1037/0033-2909.103.2.265.
43. Ambros, J.; Turek, R.; Šragová, E.; Petr, K.; Šucha, M.; Frič, J. How fast would you (or should you) drive here? Investigation of relationships between official speed limit, perceived speed limit, and preferred speed. *Transp. Res. Part F Traffic Psychol. Behav.* **2021**, *83*, 164–178. https://doi.org/10.1016/j.trf.2021.09.003.
44. Chevalier, A.; Coxon, K.; Chevalier, A.J.; Wall, J.; Brown, J.; Clarke, E.; Ivers, R.; Keay, L. Exploration of older drivers' speeding behaviour. *Transp. Res. Part F Traffic Psychol. Behav.* **2016**, *42*, 532–543. https://doi.org/10.1016/j.trf.2016.01.012.
45. Hooper, D.; Coughlan, J.; Mullen, M.R. Structural equation modelling: Guidelines for determining model fit. *Electron. J. Bus. Res. Methods* **2008**, *6*, 53–60.
46. Montella, A.; Calvi, A.; D'Amico, F.; Ferrante, C.; Galante, F.; Mauriello, F.; Riccardi, M.R.; Scarano, A. A methodology for setting credible speed limits based on numerical analyses and driving simulator experiments. *Transp. Res. Part F Psychol. Behav.* **2024**, *100*, 289–307. https://doi.org/10.1016/j.trf.2023.12.008.
47. O'Hern, S.; Vuorio, V.; Stephens, A.N. Kaahaajat: Finnish Attitudes towards Speeding. *Int. J. Environ. Res. Public Health* **2023**, *20*, 1995. https://doi.org/10.3390/ijerph20031995.
48. Dinh, D.D.; Kubota, H. Speeding behavior on urban residential streets with a 30km/h speed limit under the framework of the theory of planned behavior. *Transp. Policy* **2013**, *29*, 199–208. https://doi.org/10.1016/j.tranpol.2013.06.003.
49. Forward, S.E. The theory of planned behaviour: The role of descriptive norms and past behaviour in the prediction of drivers' intentions to violate. *Transp. Res. Part F Traffic Psychol. Behav.* **2009**, *12*, 198–207. https://doi.org/10.1016/J.TRF.2008.12.002.