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Original Article

Effectiveness of Speed Cameras on the Prevention of Road Traffic Collisions and Casualties in Cameroon

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ABSTRACT

Issues related to transport collision and casualties cannot be undermined as it has a direct effect on human health and death, hence relevant policies are required to reduce road traffic accidents. Our study discussed the factors influencing the use of speed cameras by drivers in Cameroon, the study investigated the effects of speed cameras on the prevention of road traffic collisions and casualties in Cameroon and determined the actual problems faced by drivers in the use of speed cameras in Cameroon. Methodologically, the study applied the probit technique to estimate the result via primary data. The sample size consisted of 200 drivers collected through a well-structured questionnaire distributed among the drivers plying the Yaoundé-Douala, Douala-Bafoussam, and Bafoussam-Yaoundé major highways. The key findings revealed a significant link between the factors influencing drivers' use of speed cameras and their impact on road safety. These factors included main occupation, level of education, marital status, age, and prior involvement in traffic incidents. Notably, the study found that an increased presence of speed cameras led to a substantial reduction in road traffic collisions by 41.4% and road traffic casualties by 6.9%. This emphasized the crucial role of speed cameras in effectively mitigating road accidents and their resulting injuries in Cameroon. Alongside this, it highlighted the practical challenges associated with speed camera implementation, such as inadequate awareness, abrupt speed changes, signage issues, limited visibility, technical constraints, and privacy concerns. These findings collectively underscored the need for comprehensive strategies to address both the behavioural and infrastructural aspects of road safety to ensure the effective use of speed cameras for accident prevention in Cameroon. The study suggests that decision-makers in the transport sector should multiply the provision of speed cameras. This is a wise step in the prevention of road traffic collisions and casualties in Cameroon and a better labour market.

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INTRODUCTION

Road traffic collisions and casualties remain an important issue among the leading causes of casualties accounting for more than 1.2 million fatalities and 50 million injuries globally per year. Of these casualties, speeding is a substantial contributing factor. Nowadays, speed reduction is mainly achieved through speed law enforcement measures meanwhile, the government of Cameroon through the Ministry of Transport introduced speed cameras as a means for the control of traffic collisions and casualties on the roads on March 8, 2021.

The use of speed cameras, also known as speed enforcement cameras or radar cameras is a common road safety measure employed by many countries worldwide, including Cameroon. These cameras are designed to monitor vehicle speeds and capture images or videos of vehicles exceeding the speed limit. The primary objective of using speed cameras is to reduce the incidence of traffic collisions and casualties by enforcing speed limits and discouraging excessive speeding. The determination of the effectiveness of speed cameras in preventing road traffic collisions and casualties in Cameroon will involve considering a study of road traffic collisions and casualties on the major roads of Cameroon from the period January 1, 2016, until March 8, 2021 (1,897 days). This is when the use of speed Cameras as a road traffic control measure, was introduced in Cameroon along the major highways and to compare the findings with the results of the study from then until August 31, 2023 (875 days).

The likelihood of being involved in a crash increase with higher speeds. As noted by WHO (2004), an increase in speed of just 1 km/h (0.6 mph) is associated with a 3% increase in the occurrence of crashes [1]. Higher speeds reduce the time available for drivers to react to unexpected situations and increase the distance required to stop a vehicle. The "Three E's" – energy, exposure, and errors, describe the relationship between speed and crash severity. Higher speeds increase the energy released in a collision, leading to more severe impacts and an increased likelihood of fatalities.

Global Road Safety Partnership (GRSP) estimates that a 5% reduction in average speed can result in a 30% reduction in fatal crashes [2]. In Cameroon, most road accidents occur along the Yaoundé-Douala-Bafoussam-Yaoundé Road identified as a "Death Triangle" because it records over 46% of the entire road accidents on Cameroon highways and most of these accidents are due to excessive speed [3]. According to the elaboration of a national strategy for road accident prevention and safety in 2009 done by the Ministry of Transport of Cameroon, it was revealed that 70% of road accidents were due to human error with excessive speed as the leading factor. Findings from 2004 to 2007 show that excessive speed accounts for 20% of road accidents on the Yaoundé-Douala highway meanwhile reports from 2018 to 2019 along with the Douala-Dschang highway account for 34.3%. Controlling vehicles' speed can prevent crash occurrence and reduce the impact when they occur, lessening the severity of injuries sustained by the victims [4].

It is crucial to highlight that the successful implementation of speed cameras in Cameroon would require careful planning, adherence to local regulations and legal frameworks, and the allocation of appropriate resources. Public

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awareness campaigns and educational programs would also be necessary to inform drivers about the purpose and benefits of speed cameras. Furthermore, it is important to recognize that speed cameras should be complemented by other road safety measures, such as driver education, road infrastructure improvements, and comprehensive traffic enforcement strategies. These combined efforts can lead to significant improvements in road safety and a reduction in speeding-related incidents in Cameroon. Collective international evidence showcases the positive impact of speed cameras in terms of reducing speeding, collisions, and casualties [5]. They serve as valuable tools in promoting road safety, but their implementation needs to be considered in conjunction with other road safety measures and tailored to the specific context to maximize their effectiveness.

The problem addressed in this research is the effectiveness of speed cameras in preventing road traffic collisions and casualties in Cameroon. Speeding is a significant risk factor for road traffic accidents, contributing to a higher likelihood of collisions and increasing the severity of resulting injuries. While speed cameras have been implemented in various countries as a means of enforcing speed limits and promoting compliance, there is a lack of specific research on their effectiveness in the Cameroonian context.

Addressing these issues is important for reducing the human and economic costs associated with road accidents. Despite the widespread implementation of speed cameras in many countries, research specifically focused on their effectiveness in preventing road traffic collisions and casualties is limited especially in developing countries. This lack of research as is the case of Cameroon, poses challenges in formulating evidence-based road safety policies and interventions. Understanding the potential effectiveness of speed cameras in reducing speeding and improving compliance with speed limits is essential for promoting road safety in Cameroon [4]. Literature related to this domain of study in Cameroon is still scarce and developing. This makes it problematic and a call for concern. To resolve these issues, the study targets as objectives: (1) to discuss the drivers of use of speed cameras by drivers in Cameroon, (2) to investigate the effects of speed cameras on the prevention of road traffic collisions and casualties in Cameroon, and (3) to determine the actual problems faced by drivers in the use of speed cameras in Cameroon.

LITERATURE REVIEW

Road traffic collision, also known as a traffic accident or crash, refers to any event that involves a vehicle or vehicles on a road and results in damage or injury to people or property [6]. The term "collision" emphasizes the impact between vehicles, objects, or pedestrians rather than attributing it solely to chance or randomness [7]. This broader term recognizes that many collisions are preventable and that they are the product of various contributing factors. The understanding of road traffic collisions has evolved, shifting from viewing them as unavoidable accidents to acknowledging that the majority are preventable incidents that can be mitigated through proactive measures [8].

Severity levels range from minor collisions without significant injuries to more severe incidents involving fatalities or severe injuries [9]. Classifications based on the types of vehicles involved, such as car-to-car collisions, pedestrian-vehicle collisions, or motorcycle accidents, allow for further analysis of the specific dynamics and risk factors associated with each type [10]. Important measures include injury severity indices, such as the number of fatalities, serious injuries, and minor injuries, as well as the economic costs associated with collisions, including medical expenses, property damage, lost productivity, and emergency response [8,11].

Road traffic accidents cause significant economic losses to individuals, their communities, and the country as a whole [12]. These losses arise from the cost of treatment, the loss of outputs for those killed or injured, and the burden on family members who need to take time off duties to care

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for the injured [12]. Road traffic accidents are a major but ignored global public health threat, requiring joined efforts for effective, prompt, and sustainable prevention [13].

In Cameroon, road traffic injuries caused 6,560 deaths, accounting for 2.97% of all deaths [13]. The age-adjusted death rate for road injuries in Cameroon is 35.06 per 100,000 populations, ranking it 28th in the world for road traffic accident fatalities [13]. Government statistics indicate that Cameroon experiences an estimated 16,583 road accidents annually, resulting in over 1,000 fatalities, with approximately 6,000 deaths according to WHO estimates [13]. On average, 18 people die each day due to road traffic accidents in Cameroon, equating to one death every 80 minutes [13]. This is particularly concerning considering the generally poor condition of road infrastructure in the country, with approximately 90% of roads being poorly constructed and untarred. Vehicle occupants and pedestrians account for 43% and 38% of road traffic accident fatalities, respectively, particularly in large cities [13].

The above review of empirical literature reveals that a handful of studies have been conducted in this domain and very little has been done in less developed countries such as Cameroon [14]. However emphasis has been laid on accident and casualties, but little or nothing is done in the area of speed camera. This study therefore seeks to examine the link between speed camera and accident/casualties. This study will definitely bring about marginal value to the existing body of knowledge in Cameroon at large.

Therefore our study enormously contributes to knowledge in the sense that as earlier explained, there is a general view in the literature that traffic control (reduction in accident) within an economy may have positive effects on the economic growth and development of that economy. Implicitly, therefore, reduction in the level of casualty may have a positive impact on poverty reduction and improve labour market. However, most conclusions regarding this role of reduction in accidents are drawn from studies conducted in developed economies; as [14] laments, research into the role of speed camera in economic development is primarily confined to developed economies whilst the core limited research emanating from developing economies is largely based on urban studies.

METHODOLOGY

Area and Scope of the Study

Cameroon is a country located in the western part of the Central African region. The official name of Cameroon is the Republic of Cameroon and its total land area is 475, 442 sq. km [14] it is the fifty-fourth largest in terms of area. Cameroon is bordered by the Republic of Congo, Gabon, and Equatorial Guinea to the south, Central African Republic to its east, Chad to its north, and Nigeria to the west. It has a 402 km long coastline in the west of the Bight of Biafra, part of the Gulf of Guinea and the Atlantic Ocean. Cameroon lies between latitudes 1^{o} and 13^{o}N, and longitudes 8^{o} and 17^{o}E. Cameroon is a country with several major towns, amongst which are Yaoundé, the political capital of the country with about one million inhabitants, Douala, which is the major economic city, has more than two million inhabitants. The other main towns are Garoua, Bafoussam, Maroua, Bamenda, Buea etc.

The population of Cameroon in 2020 was estimated at 27, 482,681 people as of Saturday, December 4, 2021, based on world meter elaboration of the latest United Nations data [14]. Cameroon has slightly more women (50.5%) than men (49.5%). Over 60% of the population is under age 25. People over 65 years of age account for only 3.11% of the total population. Cameroon's population is almost evenly divided between urban and rural dwellers. Population density is highest in the large urban centres, the western\ highlands, and the northeastern plain. A large number of Cameroonians live as subsistence farmers. The country is often referred to as "Africa in miniature" for its geological, linguistic, and cultural diversity. Its natural features include beaches, deserts, mountains, rainforests, and savannas. People from the overpopulated western highlands and the underdeveloped north are

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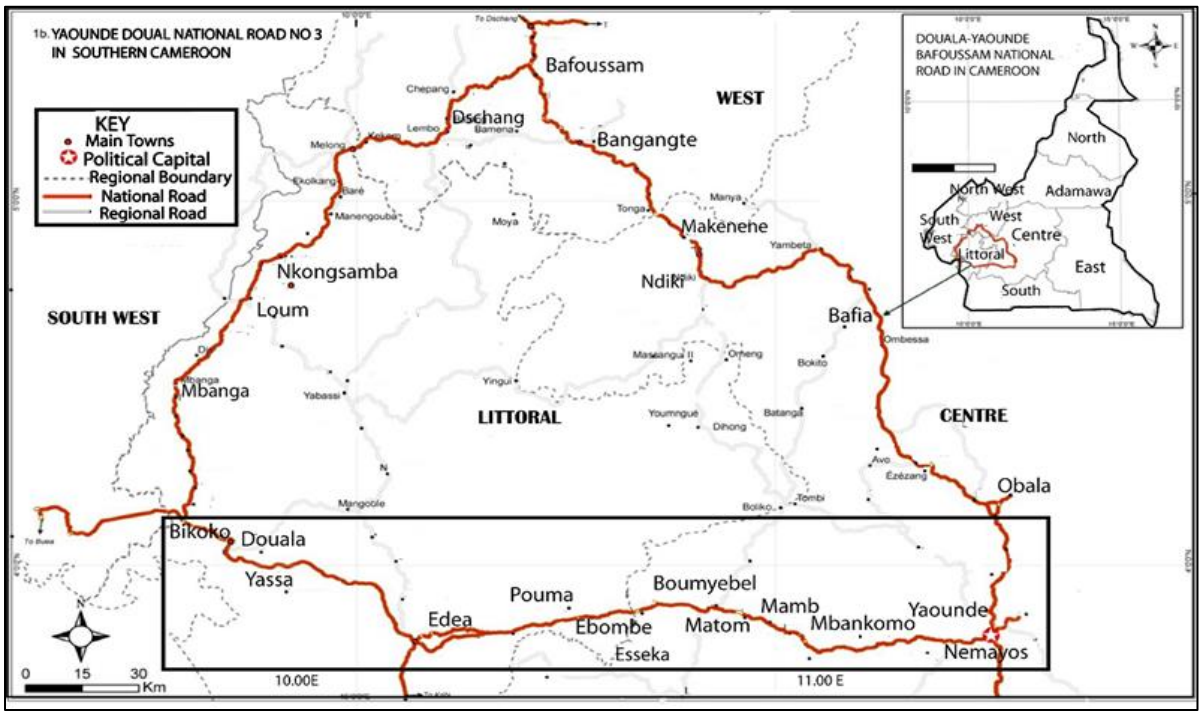
moving to the coastal plantation zone and urban centres for employment. Smaller movements are occurring as workers seek employment in lumber mills and plantations in the south and east. Although the national sex ratio is relatively even, these out-migrants are primarily males, which leads to unbalanced ratios in some regions [14].

Roads in Cameroon are classified based on their importance and function. National roads are the most significant, connecting major cities and economic centres. Regional roads connect national roads to local areas within a region, while departmental roads link regional roads to smaller administrative units. Urban roads are found within cities and towns, serving residential and commercial areas. Rural roads connect rural communities and provide access to markets, health facilities, and essential services. This classification helps prioritize resources and plan maintenance activities to improve connectivity and meet the diverse transportation needs across the country. Road safety on the country's road network is a pressing concern as speeding, reckless driving, inadequate driver training, and low awareness of traffic rules increase the risk of collisions and casualties. These incidents not only result in loss of life but also hinder social and economic progress. Addressing these challenges requires implementing road safety measures, including speed cameras, to promote compliance with traffic regulations and reduce road traffic collisions and casualties. The road networks that were surveyed can be seen as illustrated in Figure 1.

Figure 1: The road networks of Yaoundé-Douala-Bafoussam-Yaoundé.



Source: MINTP (2015).

The study population was made up of road users and travel agency employees plying the segment of road Yaoundé-Doula-Bafoussam-Yaoundé (the triangle of death). This corridor was selected as the ideal study area, as it is one of the most heavily trafficked and closely monitored segments of the road, with a significant presence of speed cameras for safety enforcement [15]. The sampled populations irrespective of age or sex were then issued questionnaires or interviewed directly to have their perceptions concerning the effectiveness of speed cameras in preventing road traffic collisions and casualties. The study adopted a quantitative design to obtain data useful for evaluating the work. The quantitative research design has been used for this work. This particular design was adopted because it allowed the researchers to systematically measure and analyse

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the participants' perceptions and experiences related to the use of speed cameras and their impact on road safety outcomes [16].

To get the sample size of this study, we applied the Yamene formular developed in 1967 which has been widely and scientifically use as well as conventionally accepted to determine the sample size of a given population. The formular is thus; $n = N/1+(e)^2$, here n is the sample size, N is the population size and e is the margic of error. From this study, the population size (*N*) is given as 5767 which is the daily traffic as estimated by the government of Cameroon in 2022 [14]; the margin of error (e) = 0.05. Computing for the sample size (n) of this study, we have: $5767/1+5767(0.05)^2 = 374$. This is our original sample size targeted in this study. However, this sample size proes abortive in the field and in the process of cleaning the data set. Based on this, we ended up using a smple size of 200 as most questionnaire were poorly filled and so were rejected. In addition, statistically, its confirmed that when $n \geq 30$ then the statistics or data is good for inference.

Quantitative data was collected from primary and secondary sources. It should be noted that the study involved numerical data. This quantitative data was gathered from diverse participants including drivers, travel agency employees, and road users within these selected road segments. Voluntarily, they were approached and their opinions and experiences regarding the effectiveness of speed cameras in reducing traffic collisions and casualties within the Triangle of Death were solicited [15]. This data collection approach involved gathering first-hand insights from individuals directly impacted by the presence of Speed Cameras and their effects on road collisions and casualties. These participants provided valuable perspectives on how speed cameras influence road safety and potentially contribute to reducing collisions and casualties on the selected road segment. Thus, a cross-sectional survey was used for the collection of data which included both primary and secondary data. The data collection was done in October 2023. To meet the general objectives of the study, two methods of primary data collection were used. The data collection was based on the impact of speed cameras on reducing vehicle speeds, the significant differences in the incidence of road traffic collisions in areas with speed cameras and those without, and the perceptions and attitudes of drivers towards the presence and effectiveness of speed cameras in Cameroon [15], [16].

A structured Likert scale questionnaire with closed-ended questions was used to collect information from the participants who voluntarily gave their opinions concerning the Effectiveness of Speed Cameras in reducing Road Traffic Collisions and Casualties in Cameroon. The questionnaire was prepared in English and French, and distributed to the participants. The questions were designed for analysis using the SPSS for Windows computer software [17]. Questionnaires had the advantage of covering a large area easily and quickly. It was anonymous and self-administered to increase the return rate and solve problems related to supplementary information. Quantitative data obtained were entered and analysed using the Statistical Package for the Social Sciences (SPSS) software (version 23). SPSS for Windows is a powerful statistical analysis and data management system in a graphical environment using descriptive menus and simple dialogue boxes to perform operations [17].

To ensure the reliability and stability of the research instrument, the researcher ensured that the questions were asked in conformity with the research objectives of the study and a pilot test of the research instrument was conducted and calculated using Office Microsoft Excel which was computed of question reliability and validity. The questionnaire was given to the supervisor for revision and approval. Necessary corrections were made and a pre-test was conducted. The reliability of the instrument was achieved by pilot testing of instruments where 10 questionnaires were drafted and administered to some drivers within Yaoundé town. To further validate the questionnaire, it was reviewed by a panel of 3 experts in the fields of

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transportation, road safety, and survey design. The panel provided input on the content validity, face validity, and overall questionnaire structure. Their recommendations were incorporated into the final version of the questionnaire [16], [18]. Considering ethical issues, the study received approval from the National Advanced School of Public Works, Yaoundé, Université Libre de Bruxelles, University of Padua, and Sapienza University of Rome to be conducted. Permission to collect data was obtained from the authorities of the Paramilitary Police Force (National Gendarmerie) and the Ministry of Transport. The objectives and protocol of the study were clearly explained to the participants, emphasizing their voluntary participation and the option to withdraw from the study at any time without providing a reason. Participants were assured that their information would be treated confidentially and solely used for the study. Proper citation and referencing following the American Psychological Association (APA) 7th edition style was employed to ensure the avoidance of plagiarism.

Empirical Specification

Theoretically, we make use of the economic model of the family developed by [19] and as applied by [20]. This forms the conceptual basis for our analysis of the effectiveness of speed cameras in the prevention of Road Traffic Collisions and Casualties in Cameroon. Based on these authors, the relationship between speed cameras and Road Traffic Collisions/Casualties can be described within the framework of a simple household production model (see also [21]). Thus, the generic model of Collisions/Casualties for driver i is assumed to be:

$$CC_i = \lambda_1 \chi_i + \delta_1 SC_i + \varepsilon_{1i} \quad (1)$$

Where CC_i represents a binary variable representing driver collision/casualty in the road network of Yaoundé-Douala-Bafoussam-Yaoundé; χ_i is a vector of household characteristics such as: sex of drivers, level of education, place of residence, age, experience, etc. These are factors believed to be influencing speed cameras. SC_i is a road traffic speed camera. Further, ε is a random error term while the coefficient δ is the parameter of primary interest and represents the impact that speed camera has on road traffic collisions/casualties and shows the effect of the other factors apart from speed camera.

The equation (1) above reports the probit estimate that measures the marginal effects of speed cameras on collisions/casualties. The probit estimate is an appropriate estimate in this type of study because it attempts to capture the impact of speed cameras in addition to a driver's collisions/casualties. However, this single-equation estimate may be upward or downward-biased depending upon the effect that speed camera has on traffic circulation and on the correlation between omitted variables and speed cameras. For example, if speed camera has a positive impact on collisions/casualties, then we would expect the probit estimate of to be biased upward. To avoid this problem of endogeneity, we have seriously scrutinized our selection of variables in the collisions/casualties equation. This means that our model is void of any biases.

In addition, as reviewed by [20], we can calculate the marginal effects of speed cameras on collisions/casualties based on the following equation;

$$ME(\chi^K) = \frac{1}{N}\sum_i \frac{\delta p(CC_i = / \chi_i, SC_i, \hat{\beta}, \hat{\lambda}, \hat{\delta})}{\delta \chi_i^k} \quad (2)$$

Where: χ^k is the average of the marginal effect of everyone in the sample and χ_i is a vector of characteristics with χ_i^k the k'th element in that vector, thus, the marginal effect of the speed camera on collisions/casualties will be:

$$ME((\chi) = \frac{1}{N}\sum_i \langle P(CC_i = 1 SC_i = 1) - P(CC_i = 1 SC_i = 0) \rangle \quad (3)$$

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The marginal effect of speed cameras on collisions/casualties will be estimated in STATA 14 as demonstrated in the next section. In this equation 3, *P* represent probability while *N* stands for real numbers in the marginal effect formular.

EMPIRICAL RESULTS

Characteristics of Respondents, Camera, Road Traffic Collisions and Casualties

Table 1 deals with the demographic characteristics of sampled drivers, following the tabulated information, all the sampled drivers are of the male gender this may be because this domain of economic activity is still predominated by the male sex especially commercial transportation being within an urban community or in inter-urban transportation. Evidence from both developed and developing countries shows that men and women have different patterns in travelling, driving and accessing public spaces, this is consistent with [6]. Women typically walk longer distances than men and make frequent, shorter trips with more stops to combine multiple tasks (see [11]). Men, by contrast, tend to follow more direct and linear patterns. Females engage in more non-work-related travel than males and are more likely to be accompanied by children or elderly relatives. They are also more reliant on public transport. Thus, transport has a gender bias problem and the observation is consistent with that of [13].

Among the men sampled 79.50% were married with 20.5% single, about 19.5% had no education, primary education (44.50%), secondary education (25%), and 11% of them had higher education. This implies that only very few drivers in Cameroon attained a higher education level considering that the driving profession is not a highly skilled to acquire. The sample equally revealed that the majority of drivers fall between the age group of 36 years to 45 years with about 34%. This is quite a mature age group of hard-working age and the result corresponds to the views of [22]. The other age bracket of drivers includes less than 25 years (9%), between 25 years to 35 years (31.5%), between 46 years to 55 years (14.50%) and greater than 56 years of age is 11%.

This suggests the sample represented a mix of family-oriented and more independently-minded drivers, which could shape their attitudes towards road safety measures. The relatively low levels of formal education among many of the drivers implies they may have a more limited technical understanding of speed camera technology and its intended safety benefits. Conversely, the more educated drivers may have a more nuanced appreciation for how speed cameras can prevent collisions.

Generally, across the world, the minimum age requirement for a commercial driver's license varies depending on the type of commercial vehicle and the type of commerce. A person must be at least 18 years old to apply for a driver's license and drive a commercial vehicle within the same municipality, this observation is in line with [16]. A person must be at least 21 years old to drive a commercial vehicle across urban centre lines or transport hazardous materials that require placards. Additionally, a person must have no prior disqualifying criminal offences and complete an entry-level commercial driver training program, [5] had a similar observation.

Among the drivers sampled, about 40% of them had between five years to ten years of experience in driving implies the drivers are not novice but know what exactly they are into, moreover considering that most of the drivers sampled are inter-urban drivers 10 years of experience is an appropriate age for exploitation. Other age groups include; less than five years of experience (25%), ten to fifteen years of experience (18%) and greater than 15 years of experience 17%. Considering the household size of the sampled drivers, we observed that despite the mature age group of the drivers most of them had a Small Household size (< 5 persons) with about 58%. Other include average household size (7- 10 persons) with about 26.5% and large household size with about 15.5%.

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Table 1: Demographic characteristics of sampled drivers

Variable	Modality	Frequency	Percent
Gender	Female	0	0
	Male	200	100
	Total	200	100
Age	Less 25 yrs	18	9.00
	Between 25-35 yrs	63	31.50
	Between 36-45 yrs	68	34.00
	Between 46-55 yrs	29	14.50
	56 yrs and above	22	11.00
	Total	200	100
Education	no education	39	19.50
	primary education	89	44.50
	secondary education	50	25.00
	higher education	22	11.00
	Total	200	100.00
Marital Status	Single	41	20.50
	Married	159	79.50
	Total	200	100.00
Household Size	Small household Size (< 5 persons)	116	58.00
	Average household size (7- 10 persons)	53	26.50
	Large household size	31	15.50
	Total	200	100
Years of experience in driving	Less than 5 years experience	50	25.00
	5 – 10 years experience	80	40.00
	10 – 15 years experience	36	18.00
	Greater than 15 years	34	17.00
	Total	200	100

Characteristics of Sampled Drivers' Perception of Speed Cameras

In *Table 2* we attempt to discuss four main issues from the perspective of drivers with respect to the use of speed cameras: firstly, the drivers that are conscious of speed cameras and regulate their speed on the highway, secondly, the availability of speed cameras on high way, thirdly, the drivers who know that speed cameras are used to prevent road traffic accidents and finally the drivers indicated absence of speed cameras on the road they plied.

Concerning drivers who are conscious of speed cameras and regulate their speed on highways, 71% of the respondents confirmed that they make use of speed cameras to regulate speed while 29% indicated that they do not. Once a driver is aware that a speed camera is installed in a certain area, they tend to behave themselves and drive the speed limit in said area and they transmit the message to their colleagues. If a driver encounters enough speed cameras, they will be more likely to wonder (or assume) if there are such cameras anywhere they drive, especially in urban areas and school zones. However, while drivers may begin to adjust their driving behaviour in areas that they become aware are being surveyed with cameras, this behaviour does not always transfer to other areas and intersections, especially where they can confirm there are no cameras. Familiar areas that are known by drivers to be camera-free may still generate speeding, reckless driving and the running of red lights.

Focusing on the availability of speed cameras on highways, a majority of road users confirmed the availability of speed cameras on Cameroon highway roads. The Ministry of Transport informs that in early March 2021, it acquired speed camera enforcement systems to reduce traffic accidents in Cameroon, this was equally confirmed by [21]. The Ministry of Transport has decided to install

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surveillance cameras in 100 interurban transport buses belonging to various travel agencies, serving the Yaoundé-Douala, Douala-Bafoussam, and Bafoussam-Yaoundé axes. An initiative that is part of the project for the intelligent and centralized management and monitoring of interurban transport, the pilot phase of which was launched on Monday, September 27, 2021. This intelligent jumbo bus surveillance system will make it possible to monitor the behaviour of drivers, control the biometric parameters of the drivers, the tracking of interurban vehicles by geo-location, and the monitoring of the exterior and interior environment of the vehicle using on-board smart cameras, dangerous practices if they persist, will no longer escape the gaze (see [21]).

Table 2: Characteristics of sampled drivers' perception of speed cameras

Variable	Modality	Frequency	Percent
Drivers conscious of speed cameras and regulated speed	Make Use of a speed camera	142	71
	Do not bother about speed cameras	58	29
	Total	200	100
Availability of speed cameras on highway	Strongly Disagree	34	17.00
	Disagree	27	13.50
	Agree	93	46.50
	Strongly Agree	46	23.00
	Total	200	100
Drivers who know that speed cameras are used to prevent road traffic accidents	Strongly Disagree	56	28.00
	Disagree	29	14.50
	Agree	62	31.00
	Strongly Agree	53	26.50
	Total	200	100.00
Drivers indicated the absence of speed cameras on the roads they ply	Strongly Disagree	73	36.50
	Disagree	25	12.50
	Agree	41	20.50
	Strongly Agree	61	30.50
	Total	200	100

In relation to drivers who know that speed cameras are used to prevent road traffic accidents, more than 50% of the driver respondents confirm this. Considering that the Ministry of Transport informed that in late February 2021, it acquired speed camera enforcement systems to reduce traffic accidents in Cameroon. It can be concluded that most drivers in Cameroon are aware of the use and relevance of speed cameras, though about 42% are yet to be aware. Finally, about drivers who indicated the absence of speed cameras on the road they plied. The findings indicated that Cameroon does not have speed cameras distributed on all the roads in Cameroon, especially within the cities. The Ministry of Transport equipped 100 intercity buses with surveillance cameras to reduce traffic accidents and not taxis that ply the municipalities.

Characteristics of Drivers' Perception of Traffic Collisions and Casualties

Statistically, *Table 3* presents the characteristics of drivers' perceptions of road traffic collisions and casualties. Here, 87% drivers indicated of being victims of road traffic collisions while 79.5% noted that they have had major casualties in road accidents. According to government statistics, Cameroon records an estimated 16,583 road accidents each year, killing over 1,000 people, and approximately 6000 according to WHO estimates per year. More so, road traffic injuries are a major cause of death and disability in sub-Saharan Africa, including Cameroon.

In the same way, most of the accidents and serious injuries obtained by drivers in Cameroon are caused by several factors: about 38% revealed that excess speed is a problem, 37.5% mentioned the poor state of the vehicle, 3.5% indicated they

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had accidents due to distractions in driving, 13% mentioned accident in Cameroon is caused by drug consumption. About 18% said the accident is caused by poor weather conditions. About 31% confirmed that accidents are caused by the poor state of roads while 12% said it is due to non-compliance with road traffic laws.

Table 3: Characteristics of drivers' perception of road traffic collisions and casualties

Variable	Modality	Frequency	Percent
Drivers are victims of road traffic collision	Yes	174	87.00
	No	26	13.00
	Total	200	100
Drivers are victims of road traffic collision casualties	Yes	159	79.50
	No	41	20.50
	Total	200	100
The driver had an accident due to excess speed	Yes	76	38.00
	No	124	62.00
	Total	200	100.00
Had an accident due to the poor state of the vehicle	Yes	75	37.50
	No	125	62.50
	Total	200	100.00
Had an accident due to a distraction	Yes	69	34.50
	No	131	65.50
	Total	200	100
Had an accident due to drug consumption	Yes	26	13.00
	No	174	87.00
	Total	200	100
Had an accident due to poor weather condition	Yes	36	18.00
	No	164	82.00
	Total	200	100
Had an accident due to poor road condition	Yes	62	31.00
	No	138	69.00
	Total	200	100
Had an accident due to non-compliance with road traffic laws	Yes	24	12.00
	No	176	88.00
	Total	200	100
Had an accident due to fatigue	Yes	21	10.50
	No	179	89.50
	Total	200	100
Had an accident due to reckless driving	Yes	47	23.50
	No	153	76.50
	Total	200	100
Had an accident due to inadequate training	Yes	33	16.50
	No	167	83.50
	Total	200	100

Others indicated that it is driver fatigue and it is about 10%, about 23.5% revealed that accidents in Cameroon are caused by reckless driving and finally 16.5% underscored that accident is caused by inadequate knowledge in driving. All these factors are consistent with the statistics of the Governments of Cameroon, which stipulated that the causes of road accidents in Cameroon include: human causes, which account for 70% of road traffic accidents in Cameroon. Driver's inattention, excess speed, and poor driving skills (especially amongst drivers with no legal driving licenses and over 7000 drivers with fake licenses) respectively account for the most common causes, which are: overcrowded buses, bad roads, corruption and poor state of vehicles (see [22]).

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Determinants of the Use of Speed Cameras

Table 4 presents the determinants of the use of speed cameras by drivers. The result shows that education (99.6%) is positive and significantly influences the driver's use of speed cameras and the result is significant at a one percent level. As revealed in the literature, traffic injuries are among the leading causes of death and disability in many countries. The knowledge, attitudes, and practice of drivers towards traffic regulations are key factors in decreasing traffic injuries and deaths. Peer-led education is a credible approach to influencing students to modify their behaviour positively. Eighty-two drivers (48.5%) with educational levels of diploma and higher had greater knowledge of traffic regulations than the other drivers.

Being a driver as an occupation is equally enhancing the use of speed cameras in driving to about 51.6% and the result is significant at the 10% level. As noted earlier, sites with cameras saw a decrease in mean speeds, a decrease in the likelihood that a driver was driving at more than ten miles per hour above the speed limit, and a reduction in the likelihood of a crash resulting in an incapacitating or fatal injury, [16] had a similar observation. In a phone survey of drivers in the community, 95% were aware of the speed cameras, and 76% of those aware had reduced their speeds because of the cameras. It is already mentioned in the literature that the real impact of all these new types of traffic cameras lies in their mere presence. When drivers know that Intersection X has speed cameras, they tend to be more careful around it, much more than Intersection Y where there is no speed camera (see [10]).

Married drivers are also observed to be making use of speed cameras when driving. Married here signifies being responsible and so for the sake of their families will turn to be more conscious than otherwise. The aged drivers are always more careful in driving than the young folks, this is because of their more respect for life than otherwise. Most drivers who once had a road traffic accident are more careful in doing so than any other. They respect the speed cameras, and road signs as a result of their initial experience and so promote the use of speed cameras.

Implications of Speed Cameras on Road Traffic Collisions and Casualties

Speed Cameras and Road Traffic Collisions

Table 5 presents the estimate of speed cameras in traffic collisions. The result shows that speed Cameras are negatively affecting traffic collisions. This means that a unit increase in the number of speed cameras will reduce road traffic collisions by 41.4% and the result is significant at a one percent level. Thus, being a red-light camera, speed camera, bus lane camera, road rule camera, or road safety camera our study as estimated by the Probit technique shows that mobile cameras and fixed cameras have the probability of reducing road traffic collisions. These cameras detect traffic violations.

In relation to our study, traffic violations include speeding, red traffic light violations, or vehicles going through the toll booth without paying the toll. Worldwide speed cameras increase road safety. These cameras reduce 22-44% of road fatalities. Hence; fewer injuries on-road and more safety overall. Wider deployment of cameras will surely increase law enforcement and discipline among drivers. These cameras function such that when a driver is travelling fast and overspeeding, the system takes a photograph of the vehicle and mobile cameras can change their location and can be on any road as they are mounted on vehicles, this variable is consistent with [8]. However, the intersection cameras work differently. This camera depends on sensors in the road. These in-road sensors are located at a specified distance. These sensors determine the speed of the car by measuring the time taken to travel by a vehicle from one sensor to another. If a vehicle approaches at high speed, then the camera clicks. In addition, on highways and expressways cameras are mounted above the flow of traffic. They somewhat work like mobile cams. These cameras transmit a radar beam on the flow of traffic. This beam bounces back from the moving vehicle & enters into the camera again (see [8]). It

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gives highly accurate speed data of the moving vehicle. If the speed is higher than the speed limit, then the camera takes a photograph, this is inline with [18].

Table 4: Determinants of the use of speed cameras

Variable	Estimation method: Probit Estimate			
	Coef.	Std. Err.	Z	P>|z|
	Speed Camera in driving			
Experience in driving (1= between 10-15 years)	.3453501	.3048816	1.13	0.257
Household size (1= large size)	-.2102076	.3324673	-0.63	0.527
Occupation (1= driver)	.516613999*	.3093497	1.67	0.059
Education (1= higher)	.99601596***	.3688948	2.70	0.004
Marital Status (1= married)	1.099859***	.327277	3.36	0.001
Age	.3320468**	.1308008	2.54	0.011
Once a Victim of a traffic collision	1.132955**	.5372512	2.11	0.035
Had obtained Casualty in a traffic accident	.74238528*	.407904	1.82	0.087
Excess speed (1= Yes)	.1868905	.2568218	-0.73	0.467
Poor weather (1 = Yes)	-1.11801***	.2970319	3.76	0.000
Constant term	-1.473534*	.7638549	-1.93	0.054
Pseudo R2	0.1982			
LR chi2/ Prob > chi2	47.04[10; 0.0000]			
Log-likelihood	-95.169499			
Number of observation	200			

Table 5: Estimate of speed cameras on traffic collisions and casualties

Variables	Estimation method: Probit Estimate	
	Coefficient	Coefficient
	Traffic Collision	Traffic Casualties
Speed Camera	-.414*** (2.61)	-.069*(1.92)
Experience in driving (1= between 10-15 years)	-.865 (-0.60)	-.347(-1.09)
Household size (1= large size, 0 otherwise)	.171*** (3.14)	.376*(1.87)
Occupation (1= driver)	-.334* (1.88)	-.936**(1.97)
Education (1= higher)	.217 (0.52)	.503(0.71)
Marital Status (1= married)	-.869 (-0.68)	.242*(1.81)
Age	.154 (0.85)	0.012**(2.29)
Once a Victim of a traffic collision	n/a	0.616***(2.58)
Had obtained Casualty in a traffic accident	-.034*** (-7.11)	n/a
Excess speed (1= Yes)	-.010 (-0.11)	3.887(1.04)
Poor weather (1= Yes)	.018*** (7.30)	.079***(3.32)
Constant term	-.127*** (4.75)	-.437(1.09)
Pseudo R2	0.2702	0.1202
LR chi2/ Prob > chi2	11.44[0.0020]	8.01 [0.0120]
Number of observation	200	200

As what is obtained in the literature, studies consistent with ours such as that of [23] have shown that speed cameras can be an effective means of reducing vehicle crashes deaths and injuries without compromising mobility. Reductions in outcomes across studies ranged from 5% to 69% for collisions, 12% to 65% for injuries, and 17% to 71% for deaths near cameras. The reductions over wider geographical areas were of a similar order of magnitude. Speed safety cameras are an important tool and numerous studies have shown that cameras reduce speeds and crashes on all types of roads. The control variables as from *Table 5* complementing speed cameras in reducing collision are: being a driver as occupation, having obtained casualty in a traffic accident, while variables such as poor weather and large household size instead increase

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road traffic collision. The impact of weather conditions and various weather conditions can significantly increase the risk of driving on the road. Heavy rain, strong winds, high temperatures, and visual impairment may cause a driver to lose control of a vehicle and result in a car accident. Severe weather conditions have a strong correlation to causing auto accidents, and drivers need to be mindful of this risk. These studies even suggest that drivers should also be cautious before driving on roads during severe weather conditions as a driver may be better off waiting until a storm has passed to leave home. They may also want to pull over to the side of the road before completing a journey during a thunderstorm, hurricane, or tornado.

Speed Cameras and Road Traffic Casualties

Table 5 equally presents the estimate of speed cameras on road traffic casualties. The result revealed that a unit increase in the number of existing speed cameras has a proportional probability effect of reducing the number of road traffic casualties by 6.9% and the result is significant at a 10% level. It is argued that by reducing the velocity of motor vehicles, speed cameras reduce kinetic energy and therefore severity of the casualty, hence automated speed camera enforcement is effective in reducing speed and speed-related crashes. Our study is consistent with that of [24] who revealed that road traffic collisions are an important cause of death and disability worldwide. Every year around the world 1.2 million people are killed and up to 50 million are injured or disabled as a result of road traffic collisions. Morbidity from road traffic collisions is expected to increase in future years, and it is estimated that road traffic collisions will move from ninth to third place in the global burden of disease ranking, as measured in disability-adjusted life years.

Another associated study consistent with ours is that of [25], who postulated that measures to reduce traffic speed are considered essential to reducing casualties on the road. Speed cameras are increasingly used to help reduce traffic speeds in the belief that this will reduce road traffic collisions and casualties, and an expansion in the use of speed cameras is underway in many countries, most notably the United Kingdom. The use of speed cameras is controversial, however. Vociferous opponents, including some motoring-associated organizations, oppose their use, and cameras are often criticized in the media. The lack of readily available evidence of the effectiveness of cameras has made it difficult for road safety and health professionals to engage in an informed debate about the effectiveness of speed cameras. As mentioned earlier, all traffic violations recorded by the camera undergo secondary speed verification. So, the system carries out two independent measurements of every traffic violation. Thus, these measurements are compared for consistency before issuing the fine. These systems have a small tolerance of 2 Kmph for fixed and 3 Kmph for mobile cameras.

Poor weather condition is observed to increase road traffic casualties by 7.9% as per the result in *Table 5.* This result is consistent with that of the US Department of Transportation reports that about 6,250 people die yearly from weather-related auto accidents. Over 480,000 people are injured in weather-related crashes every year. Certain weather conditions also account for crashes, and the statistics for over ten years are as follows: (1) Wet Pavement: 74 percent of weather-related crashes, Rain: 46 percent, Snow: 17 percent, Ice: 12 percent and Fog: 3 percent. These car accident statistics indicate how dangerous it can be for drivers to travel on wet roads. Drivers may want to reconsider or postpone a trip until weather conditions have cleared and roads have dried. Severe weather conditions may result in snow, slush, flooding, and debris accumulation inroads. Freeway traffic speeds may also be reduced due to strong winds, snow, and sleet conditions.

Challenges Faced by Drivers with the Use of Speed Cameras

Table 6 shows the practical challenges faced by drivers with the use of speed cameras. Among these challenges are: lack of awareness, sudden Speed change, inadequate signage (poor road

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signs), limited visibility, technical limitations and privacy concerns.

Lack of awareness is a major cause while drivers do not make good use of cameras. About 72.5 respondents indicated that unawareness plays a big on drivers' avoidance of using speed cameras. Relative to comparable sites without cameras and driver awareness, sites with cameras saw a decrease in mean speeds, a decrease in the likelihood that a driver was driving at more than ten miles per hour above the speed limit, and a reduction in the likelihood of a crash resulting in an incapacitating or fatal injury. A phone survey of drivers in the community, [8] indicated that 95% were aware of the speed cameras, and 76% of those aware had reduced their speeds because of the cameras. Sudden speed change is another challenge with the use of speed cameras. The safety risk is involved in driving slower than optimal speed for conditions, which an awareness of a speed camera could create. Additionally, the sudden realization of such a camera can cause an abrupt speed change by drivers, increasing the risk of rear-end accidents. Limited visibility is another challenge in the use of speed cameras. This explains why, the guidelines from the Department for Transport say: (i) speed cameras must sit in a yellow housing. (ii) the housing itself should be visible and not obscured by trees or bushes. (iii) one should be able to see the speed camera from 60 meters away in a 40 mph zone, or 100 meters for all other zones and (vi) signs should be placed in areas where there are visible camera housings - but this isn't mandatory [11]. Even if drivers were previously unaware of their speed, speed cameras might cause them to slow down.

Table 6: Practical challenges faced by drivers with the use of speed cameras

Factor	SD		D		A		SA	
	F	%	F	%	F	%	F	%
Lack of awareness	15	7.50	40	20.00	96	48.00	49	24.50
Sudden Speed change	49	24.50	7	3.50	85	42.50	59	29.50
Inadequate/poor signage	37	18.50	18	9.00	75	37.50	70	35.00
Limited visibility	51	25.50	12	6.00	87	43.50	50	25.00
Technical limitations	51	25.50	13	6.50	51	25.50	85	42.50
Privacy concerns	49	24.50	7	3.50	85	42.50	59	29.50

Visible speed cameras can deter drivers from exceeding the speed limit. Some argue that visible speed cameras are necessary to promote safe driving practices. Even if drivers were previously unaware of their speed, speed cameras might cause them to slow down. Visible speed cameras can deter drivers from exceeding the speed limit and causing accidents. Visible speed camera tickets may also encourage drivers to pay greater attention to their speed in the future, thereby reducing the likelihood that they will violate the law again. Opponents of speed cameras argue that they are nothing more than a scheme to make money. They assert that speed cameras are typically installed in areas where the speed limit is too low or where motorists are unaware of it. They also assert that visible speed cameras can result in collisions. When a driver sees a speed camera, they may slam on the brakes, resulting in a rear-end collision with another vehicle. This could result in a series of occurrences. Other relevant challenges to speed cameras include inadequate Signage (poor road signs), technical limitations, and privacy concerns [11]. In all these, some disadvantages of speed cameras are: (i) They can cause drivers to drive below the posted speed limit, creating a road safety hazard, (ii) they can generate tickets for false readings due to radar errors, (iii) they can increase rear-end collisions because of sudden braking at yellow lights, stop signs, and school zones and (iv) they have no evidence of improving road safety or reducing deaths.

CONCLUSION

The study covers various aspects related to the characteristics of sampled respondents, road traffic collisions and casualties, the determinants of speed camera use, the implications of speed cameras on road traffic collisions and casualties,

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and the challenges faced by drivers with the use of speed cameras. In terms of the characteristics of the sampled drivers, the study reveals a gender disparity in the driving profession, with all sampled drivers being male. This is because women are not typically involved in driving as a profession in Cameroon. The education levels of the drivers were generally low, with only a small percentage having higher education. The majority of drivers belonged to the age group associated with experience and maturity.

The study also provides insights into the minimum age requirements for obtaining a commercial driver's license and the driving experience of the sampled drivers. A significant proportion of drivers had between five to ten years of driving experience, indicating a sufficient level of knowledge and experience in their profession. Different types of speed cameras contributed to reducing collisions by detecting traffic violations, promoting law enforcement, and discipline among drivers.

The study also examined the impact of control variables and weather conditions on road traffic collisions and casualties. It was found that being a driver as an occupation enhanced the effectiveness of speed cameras in reducing collisions. Drivers who had previously experienced a casualty in a traffic accident were more conscious and likely to adhere to speed cameras and road rules. Poor weather conditions increased the risk of road traffic collisions and casualties. Lastly, the study discussed the challenges faced by drivers with the use of speed cameras. Lack of awareness, sudden speed changes, limited visibility, inadequate signage, technical limitations, and privacy concerns were identified as significant challenges. Visible speed cameras were found to deter drivers from exceeding the speed limit and causing accidents, but opponents argued that they could lead to collisions if drivers abruptly brake upon seeing them. Overall, the study's findings highlight the positive impact of speed cameras on preventing road traffic collisions and casualties, the importance of control variables and weather conditions, and the challenges faced by drivers. The results contribute to the existing literature on speed cameras and provide valuable insights for informed debates and decision-making in the field of road safety.

In conclusion, this study addressed the research problem of evaluating the impact of speed cameras on road traffic collisions and casualties. The key results obtained provide valuable insights into the effectiveness of speed cameras. An increase in the number of speed cameras led to a significant reduction in road traffic collisions by 41.4% and road traffic casualties by 6.9%.

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