

Analysis of Traffic Violations Among Novice Drivers and Motorcyclists in Ecuador: A Road Safety Perspective

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Abstract - This study focuses on analyzing traffic violations committed by novice drivers of non-professional licenses in Ecuador. Despite the extensive literature on the relationship between driver age, experience, and road accidents, traffic violations, as indicators of risky behaviors, have received limited attention. The aim of this research is to provide a detailed insight into the trends and characteristics of violations committed by novice drivers and motorcyclists. The sample was collected between 2016 and 2020 from a driving school in Loja, Ecuador. Demographic variables such as age, education level, and gender were analyzed in relation to the violations committed. The results revealed significant gender differences, with a higher proportion of violations committed by males. Additionally, an increase in violations during the first years after obtaining the license, followed by a gradual decrease, was observed. The most common violations included not wearing a seatbelt and parking in prohibited areas. Furthermore, differences in violation trends between drivers and motorcyclists were identified, suggesting the need for differentiated training strategies for both groups. Regarding the relationship between students' age and violations, it was found that younger drivers and motorcyclists were more likely to commit violations, which could be attributed to a penchant for sensation-seeking among young individuals. This study provides a solid foundation for revising and improving training programs in driving schools in Ecuador. A differentiated approach by gender and age group is suggested, as well as the implementation of active learning methods and self-reflection in road safety education. All of these actions will contribute to improving road safety in Ecuador.

Keywords: Traffic violations, Novice drivers. Road safety, Ecuador, Driving school

1. Introduction

Every year, globally, 1.35 million people die, and 50 million are injured due to traffic accidents on roads [1]. The human element is a significant factor within the vehicle-driver/motorcyclist-road system, with a higher proportion of road accidents involving young, inexperienced drivers compared to their older, more seasoned counterparts [2]. To drive a motor vehicle, it is necessary to obtain a driver's license. Generally, a driver's license is obtained by completing a process that includes road education, passing theoretical and practical exams, and meeting specific requirements established by the traffic authority or government agency responsible for issuing driver's licenses in a particular region or country.

Driver education has strong face validity among program providers and parents, who believe it produces safer drivers [3]. However, some studies suggest the opposite. International literature indicates that formal driver instruction may not be an effective safety measure, as it often fails to adequately address age and experience-related factors contributing to the higher collision risk among young drivers [4]. Nevertheless, it is clear that driver training programs are intended to mitigate novice driver/rider risk factors [5] and consequently reduce crashes and traffic violations. Furthermore, training/education cannot replace the need for novices to gain significant on-road, in-car experience at the learner level. For instance, drivers/riders should have the ability to anticipate potentially dangerous road and traffic situations (hazard perception) [6]. In any case, driver education programs are necessary before individuals operate motor vehicles.

Driver education programs generally consist of two primary elements: Driver Education (DE) and Driving Training (DT) [5]. DE educates individuals about traffic laws, road safety, driver responsibilities, and accident prevention. DT provides students with the opportunity to practice driving in real-world situations. The duration and the instructional format of these elements vary from country to country or region, taking local factors into consideration. Driver's training often

includes taking driver's education/training courses and passing both theoretical and practical exams before obtaining a driver's license. In Ecuador, the entity responsible for granting driver's licenses is the Agencia Nacional de Tránsito or ANT.

ANT, also responsible for managing sanctions for traffic law violations, issues a driver's license as long as the student successfully completes the driver training course provided by Professional and Non-Professional Driving Schools or accredited institutions of higher education [7]. Non-professional driving schools enable the acquisition of Type A licenses (for motorcycles, mopeds, etc.) and Type B licenses (for automobiles and trailers weighing up to 1.75 tons). Professional driving schools, on the other hand, allow access to Type C to G licenses, which are for driving taxis, trucks, vans up to 3500 kg, and passenger transport vehicles, including school or tourism transportation, general passenger services, railways, machinery, trucks, or similar vehicles [8].

In Ecuador, non-professional driver's licenses are more common than professional ones. For non-professional driving schools, regulation establishes at least 40% of the course curriculum should be practical classes [9]. Typically, for Type A and B licenses, the course has a duration of 34 hours, distributed as follows: 10 hours of Road Safety Education, 15 hours of Driving Practice, 2 hours of Psychology, 5 hours of Basic Mechanics, and 2 hours of First Aid [10]. The neighboring countries have similar course durations; for instance, in Colombia, students are required to complete theoretical lessons (28 hours for motorcycles and 30 hours for cars) and workshops [11], while in Peru, the duration ranges from 20 to 22 hours and increases when upgrading to a higher category of their license [12].

At present, there is a significant body of prior literature that has focused on the relationship between driver experience, age, and their correlation with accident rates (e.g., see [13]). However, very few studies have concentrated on traffic violations, which, in a certain sense, represent risky behaviors that can lead to accidents. In this context, the objective is to provide a comprehensive understanding of the patterns and characteristics of violations committed by novice drivers and motorcyclists in Ecuador. To achieve this, a sample of drivers and motorcyclists from the years 2016 to 2020 was collected from a local driving school in Loja (Ecuador). Demographic variables were analyzed in relation to the committed violations. This kind of study can facilitate the reorientation or reinforcement of the educational content provided in driving schools. Additionally, it can serve as a baseline for government decision-making.

2. Materials and Methods

2.1. Data collection

Loja, a city located in the south of Ecuador, has a population of around 215,000 individuals [13], with a density of 93.1 people per square kilometre, and the capital has approximately 118,532 residents [14]. A local driving school (Sportmancar) shared the database of students who completed their training from 2016 to 2020 for both non-professional drivers of cars and motorcycles. The available information included the National Identification Number (DNI), age, gender, level of education, nationality, and place of residence. All the participants were Ecuadorian, and the majority resided in the city of Loja. For each year and each type of driver, a random and representative sample was obtained with 95% confidence and a 5% margin of error. Using the DNI of each participant on the website of the ANT [15], it collected the number of infractions, the date of the infraction, the type of infraction, the infraction fee, and other relevant details.

2.2. Data Processing and Analysis

Inconsistent data was removed from both the original database and website. The primary errors included incorrect DNI number, missing information, and sanctions that did not meet with current laws. After the data reduction process, it was confirmed that the remaining number of students met the minimum requirements for the chosen level of confidence and margin of error. With the resulting database, the analysis included the age, level of education, gender, the year when the violation occurred, and the type of violation for each group of drivers. Several tables and figures were used to display the trends among the groups and within the group of drivers used Minitab 14.2 [16].

3. Results

3.1. Data Collection and Processing

After data collection and data reduction, the resulting sample sizes for each year are shown in Table 1. For drivers, we collected between 15-45% of the total sample, while for motorcyclists, it ranged from 30 to 36%. In terms of gender distribution, the proportion of male drivers was higher than that female drivers for all the years analyzed, which is consistent with the national reality—there are fewer female drivers than male drivers. Similarly, there are more male motorcyclists than female motorcyclists on the streets, which is why the sample distribution reflects this trend.

Table 1: Sample size of this study.

Year	Drivers		Motorcyclist	
	Available data	Sample size	Available data	Sample size
2016	480	216 (M:63%, F:37%)	674	245 (M:97%, F:3%)
2017	1199	292 (M:59%, F:41%)	881	268 (M:97%, F:3%)
2018	2147	326 (M:63%, F:37%)	914	271 (M:94%, F:6%)
2019	2211	328 (M:61%, F:39%)	799	260 (M:93%, F:7%)
2020	1257	295 (M:53%, F:47%)	762	256 (M:91%, F:9%)
Total	7294	1457	4030	1300

M: Male, F: Female

Furthermore, the sample of students from the driving school had various levels of education, as shown in Table 2. The majority of individuals seeking to obtain their driver's licenses have completed high school. The proportions are higher among drivers compared to motorcyclists. Additionally, motorcyclists have higher values among individuals with only primary education compared to drivers. These two trends may be attributed to the local socio-cultural background. Most students who wish to obtain a motorcycle driver's license are individuals who may not be able to afford a vehicle or see motorcycling as a means of employment, such as entering the delivery industry.

Table 2: Percentage of level of education of the sample size of this study.

Level of education	Drivers (%)					Motorcyclist (%)				
	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
Elementary	15.42	10.42	13.19	4.91	2.03	27.46	31.72	29.89	14.62	13.67
High school	69.63	75.35	73.31	81.60	89.83	58.61	56.72	56.83	75.00	75.39
College/university	14.95	13.89	13.50	13.50	8.14	13.93	10.82	12.55	10.38	10.94
None	0.00	0.35	0.00	0.00	0.00	0.00	0.75	0.74	0.00	0.00

3.2. Sex Difference

Regarding traffic violations by student sex, a stacked column chart in Figure 1 was made for drivers and motorcyclist.

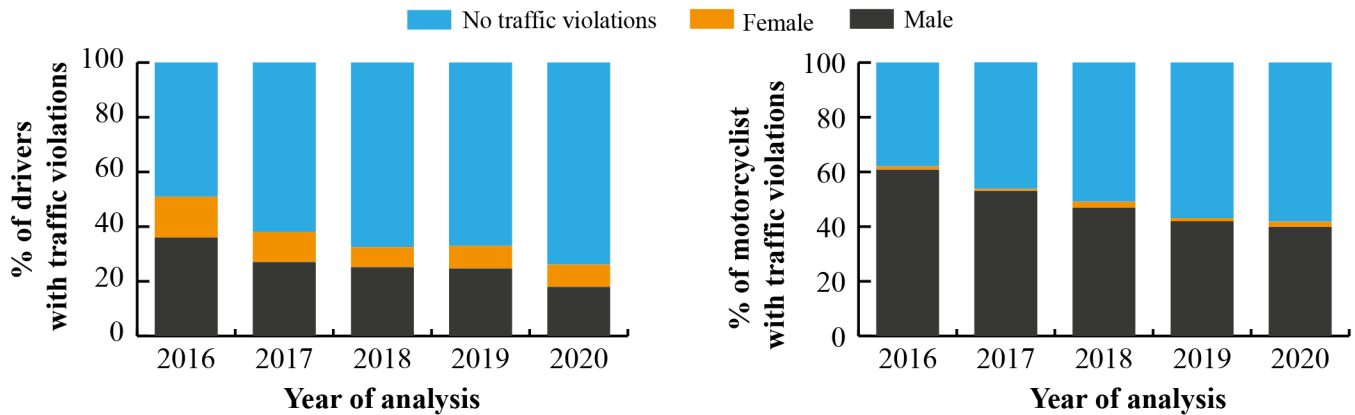


Fig. 1: Percentage of students with traffic violations by study year and participant's sex.

Figure 1 presents the incidence of violations is lower for women compared to men, which is supported by previous literature [17]. On average, students from the school who commit traffic violations account for 18% (26% on average for men and 10% for women). On the other hand, the decreasing trends over the five years analyzed concerning the motorcyclist's sex are similar to those of the drivers. However, motorcyclists commit more violations than drivers. Women also have fewer violations than men, like the drivers, but in this case, the number of female students was much lower than male students. The average violation rate for men over the five years is 49%, while for women, it's 1%. On average, 25% of students, regardless of gender, have traffic violations.

3.3. Level of Education

Regarding the level of education for drivers, the majority of violators (an average of 77% over the 5 years) are high school graduates. This fact is due to the high proportion of individuals in the sample with this level of education. For motorcyclists, the majority of violators (an average of 66% over the 5 years) are also high school graduates. Additionally, there are those who have only completed elementary education, with an average of 19%. These values are also related to the sample proportions. However, driving schools can offer differentiated learning for both groups to ensure that they acquire the knowledge required to navigate the streets and roads safely.

3.4. Number of Traffic Violations After Obtaining the License

Figure 2 displays the percentages of traffic violations for each year of study. The year zero corresponds to the year when the license was obtained, year one is one year after obtaining the license, and so on. This figure includes the infractions recorded up to the year 2023. Figure 2 shows that the number of violations increases up to two years after obtaining the license and then begins to decrease. This trend might be because students, after completing their driver training course, continue learning during those two years, and therefore, they may still make errors during real-world driving, leading to an increase in violations in the initial years. Once drivers have gained experience, errors decrease, as do violations. Schools could consider sending periodic information to their graduates regarding compliance with traffic regulations and road safety to reduce statistics during these two years.

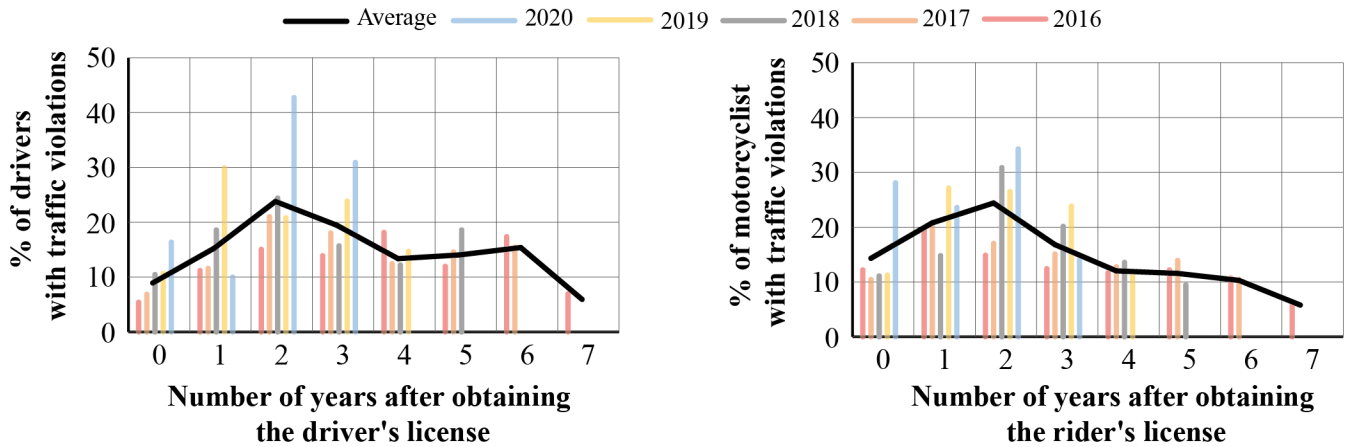
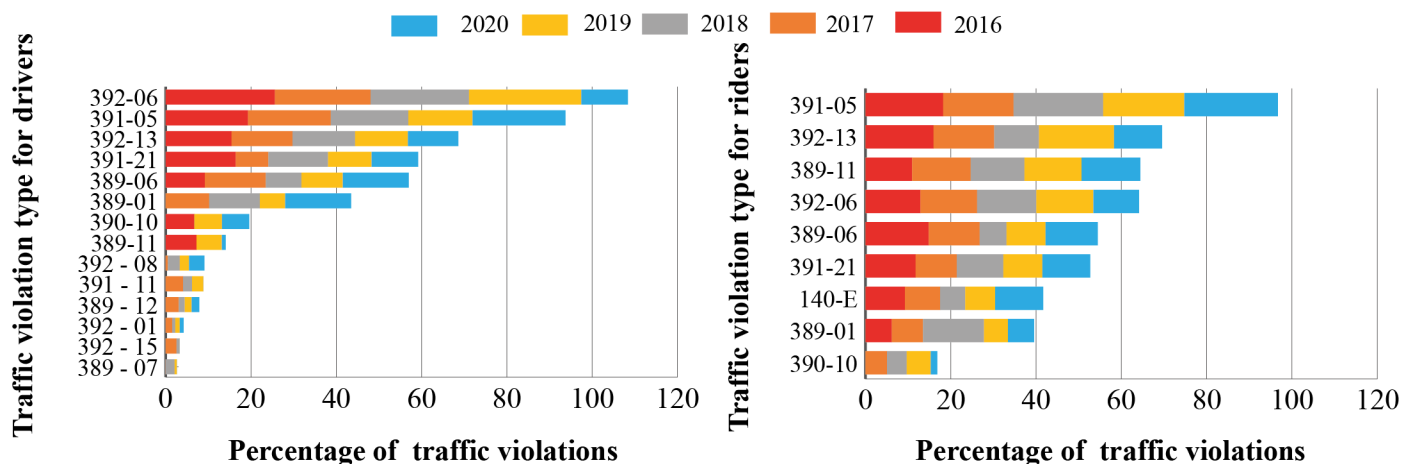


Fig. 2: Percentage of participants with traffic violations by years since obtaining driver's license.

For motorcyclists, a similar trend is observed, with the turning point in the data averages occurring after 2 years of obtaining their license. The percentage distribution between the years is very similar to what was found in the results for drivers. A number of studies indicate that violations become more common in the early stages of driving [18]–[20]. Drivers are at high crash risk when they begin independent driving, with liability decreasing steeply over the first three months [21], but in this study with this data is around two years.

3.5. Traffic Violation Types

An analysis was also conducted to determine the most frequent violations committed by students, as shown in Figure 3. The most frequent violation, which exhibits a similar trend across the analyzed years, is the failure to use a seatbelt while driving. The second most common violation is parking in unauthorized areas. The next two violations are related to vehicle registration documents and the absence or expiration of the driver's license. Similarly, speeding, disregarding traffic signs, and failing to ensure that passengers use seatbelts are among the other common violations. In light of these trends, driving schools could strengthen these topics through the use of simulators, practical driving instruction, among other new learning methods.



Agencia Nacional de Tránsito (ANT) codes

- 140-E: Parking improperly may result in towing.
- 389-01: Ignoring traffic signals, such as stop signs and traffic lights.
- 389-06: Slightly exceeding speed limits.
- 389-07: Driving a vehicle that doesn't meet technical standards, with the possibility of impounding until the issue is resolved.
- 389-11: Not using approved helmets on motorcycles and not wearing reflective clothing at night.
- 389-12: Operating a vehicle without proper identification plates or with altered plates.
- 390-10: Not ensuring seatbelt use by vehicle occupants as required.
- 391-05: Illegally parking, obstructing access for disabled individuals, or blocking pedestrian pathways.
- 391-11: Using heavily tinted vehicle windows, except when authorized.
- 391-21: Driving without a valid driver's license.
- 392-01: Inappropriately using the horn or sound devices, violating noise regulations.
- 392-06: Not wearing a seatbelt when driving.
- 392-08: Walking on the road instead of using sidewalks.
- 392-13: Failing to register the ownership transfer of a motor vehicle within 30 days of the sale.
- 392-15: Installing lights in unauthorized locations on a vehicle.

Fig. 3: Percentage of traffic violation types among students over the study years.

In Figure 3 also shows the most common traffic violations for motorcyclists. This information is valuable for driving schools to reinforce both theoretical and practical content. Similar to drivers, the distribution of traffic violations by year was very similar among motorcyclists. The most common violation is improper parking, followed by issues related to the motorcycle's legal registration. The failure to use an approved helmet or reflective clothing comes next. Surprisingly, there's also a violation related to not using a seatbelt while driving, which may not directly apply to motorcyclists. However, some individuals may have permission to drive cars as well, which could explain the appearance of this violation. Finally, exceeding speed limits and driving without a valid or expired license are also among the common violations for motorcyclists.

3.6. Age versus Traffic Violations

An analysis was conducted to explore the correlation between students' age and their traffic violations, as depicted in Figure 4. Students' ages ranged from 18 to 70 years, and the data from all five years studied revealed a consistent trend. To provide a clear picture, an average was computed for each age group of drivers. The trend suggests that younger students tend to commit more violations compared to their older counterparts, with violations decreasing as age and experience increase. This trend aligns with the commonly observed sensation-seeking behavior in younger individuals, which typically decreases with age, a phenomenon well-documented in previous literature. Based on the insights from Figure 4, driving schools might consider offering tailored supplementary training based on students' age. Potential age ranges to consider align with the variations observed in the average trend from Figure 4: ≤20, 20-30, 30-40, 40-50, and >50. These age categories correspond to the trends shown in the figure's averages.

When looking at the percentage of violations and the age of motorcycle driving school students (see Figure 4), there is a similar trend to that observed among car drivers. This trend shows a higher percentage of violations among younger students, which decreases as age increases. Interestingly, drivers under 20 years old have a higher percentage of violations compared to motorcyclists of the same age. However, on average, motorcyclists have higher percentages up to around the age of 30, after which the values become similar. Based on these trends, it could consider segmenting the data into age categories: ≤ 30 , 30-40, 40-50, and >50 . These categories align with the variations observed in the data and could be used for further analysis or tailoring training programs to different age groups.

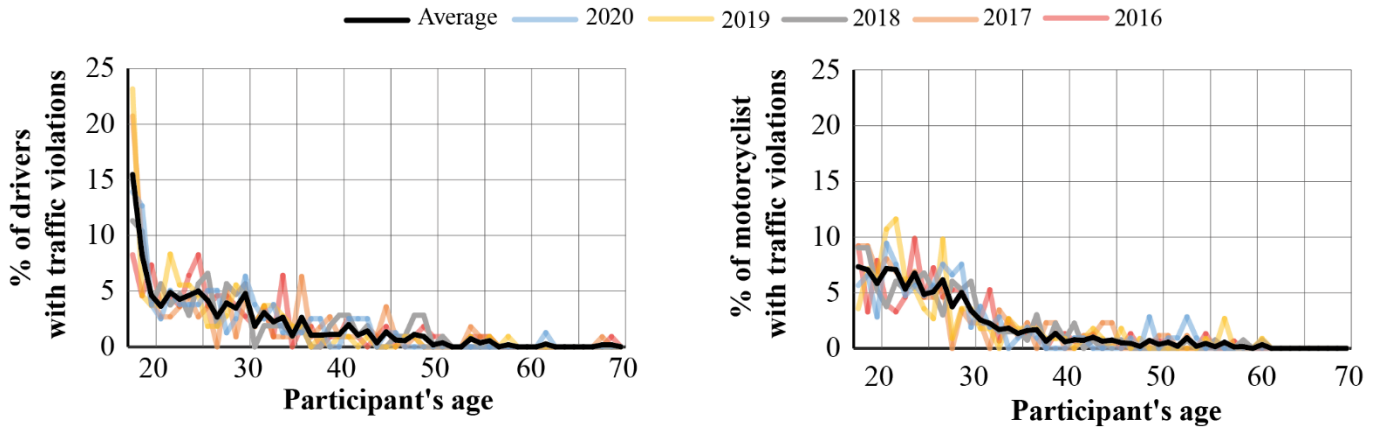


Fig. 4: Percentage of traffic violation type by student age.

Based on the data in Figure 4, a linear regression line was fitted. The equation (1) represents the result of this calibration, with an R^2 adjusted value of 0.61. Both the constant and the inverse of age had p-values equal to 0.000, indicating statistical significance. It's worth noting that Equation (1) provides consistent results up to the age of 57, after which it generates negative values, which is not appropriate. Nonetheless, this equation demonstrates a high correlation with the data and can be used for analyzing traffic safety and its relationship with the age of offenders. Similar to the drivers, the equation (2) was obtained for the motorcyclists, which has an R^2 adjusted value of 0.74. The variables in this equation were the constant and the inverse of the student's age, both with p-values equal to 0.000. Equation (2) provides consistent results up to the age of 58, after which it yields negative values. It's important to note that both equations are similar to each other, as the constants and the factors of the inverse of age are alike. Consequently, it's possible to adjust a single equation. However, for equations with higher R^2 values, it might be preferable to adjust equations for specific age ranges, as mentioned earlier for each age group of students. The trend shown in Figure 4, along with Equations 1 and 2, demonstrates that crash rates consistently and significantly decline with each successive year of age. This trend has been previously documented [22].

$$\text{Percentage of traffic violation of the driver} = -3.66 + 211 \frac{1}{\text{Student' age of the driver}} \quad (1)$$

$$\text{Percentage of traffic violation of the motorcyclist} = -3.56 + 207 \frac{1}{\text{Student' age of the rider}} \quad (2)$$

As a final comment, the current topic is relevant, especially in Ecuador, which had an 89% increase in road accidents involving drivers and motorcyclists in 2022 [23]. To reduce crashes and traffic violations, it's necessary to reevaluate pedagogical methods. For instance, road safety education should promote active learning methods and encourage self-reflection [24], [25]. It's important to consider that young people typically study driving theory and skills solely to obtain a license, and they may not be highly motivated to learn safe driving techniques since they have limited driving experience at that stage [26]. Furthermore, licensing systems that require substantial prior experience before obtaining a license have the

potential to positively influence the development of novice drivers. Ecuador might consider implementing a Graduated Driver Licensing (GDL) program, which involves additional training time, allowing more time to develop driving skills. Also, the annual data from driving schools, gathering information related to variables like age and education level, is for refining the driver training system. Specifically, the year-by-year actions taken during this study, particularly in pedagogical and educational aspects, likely contributed to reducing violations.

4. Conclusion

The aim of this research was to provide a detailed insight into the trends and characteristics of violations committed by novice drivers and motorcyclists. To achieve this, a sample of drivers and motorcyclists from a local driving school between 2016 and 2020 was collected. The study reveals that, in general, men tend to commit more traffic violations than women, both among drivers and motorcyclists. Therefore, differentiated training strategies for both sexes and the importance of promoting road safety among male drivers are emphasized. The research demonstrates that violations tend to increase in the first few years after obtaining a license and then decrease. This suggests the need for increased supervision and training for novice drivers during their initial years of road experience. The article identifies the most common violations, such as not using seat belts, parking in prohibited areas, and issues related to documentation and licenses. These findings indicate areas where driving schools could focus their training and awareness efforts. The study also shows that younger drivers and motorcyclists tend to commit more violations than their older counterparts. Based on these findings, it is suggested that driving schools could reinforce training in specific areas, considering the trends in violations. Furthermore, the use of active learning methods and self-reflection in road safety education is recommended.

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