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Analyzing Drivers' Speed Behavior on Various Roads in Baghdad City

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HIGHLIGHTS

- The multi-lanes and two-lane roads witnessed more frequent speed limits than local residential roads.
- The age factor is the more correlated factor to exceeding speed limits.
- This study recommends the provision of public transportation instead of private means of transport.

ARTICLE INFO

ABSTRACT

This study investigates the driver behavior of a certain number of drivers using a questionnaire method. The questionnaire contains a part of drivers' demographics, including age, gender, and the type of transportation most used by the drivers. It was divided into three parts. Each part deals with a specific type of road in Baghdad City: multi-lane, two-lane, and local. The questions were about the number of times they drove the vehicle on each type of road, the speed at which they drove the vehicle and did not cause accidents, the distance traveled during the last week on each type of road, and the number of times the speed limit was exceeded. The most prominent reasons for increasing the speed of drivers were also indicated, and solutions were suggested to reduce the speed of drivers. The results show that the driver's age was considered an important factor in the driver's behavior. It was found that the older the driver, the more committed he was to the proposed speed limits for each type of road. In addition, spreading public awareness about speed reduction to reduce violations and accidents is vital.

1. Introduction

The increase in the population in Baghdad City has led to an increase in traffic volumes and trip time, thus affecting drivers' behavior [1,2]. This research aims to study the drivers' behavior in terms of exceeding the speed limits in various types of road classifications as it is one of the main factors affecting accidents and violations. The previous studies concluded that the exceeding speed limit had been reported frequently, which is bad behavior that must be punished by law and impose several solutions, including improving engineering design and the design of newer vehicles, thus reducing traffic risks [3]. Speeding is one of the main causes of roads in the Netherlands, where the percentage of accidents due to speed is 65%, and the violations due to speed are 50%. It is found that on roads with one lane, one driver exceeds the speed limit [4]. Speeding also affects the distance needed to stop the vehicle; high speed increases the possibility of wheel slip [5]. As the drivers' behavior is affected by the road's engineering factors, it also impacts the vehicle's speed [6]. The vehicle speed exceeding the permissible limit contributes to accidents and traffic violations, so the driver must be fully aware of the dangers of speed. Therefore, converging operational speed with design speed to improve safety traffic is highly considered [7]. One of the most important factors that increase the possibility of accidents is the driver's fatigue while driving [8]. Therefore, the fatigue and exhaustion of drivers must be controlled to reduce accidents and traffic violations [9]. The factors that increase drivers' fatigue and exhaustion are the traffic volume, engineering design for the road, and the driver's age [10].

In addition, the driving style is an important cause of accidents. Violations, including driving in the opposite direction, not keeping the appropriate lane, using the phone, not complying with the seat belt [11], and aggressive driving that causes violations and traffic accidents [12], are examples of bad driving styles. Contrary to what was found during this study, some drivers were obliged to wear seat belts and not use their phones while driving. As for cyclists, injuries and deaths were found due to errors in not noticing the traffic lights [13].

The drivers' age and driving experience are also important factors; they directly impact violations and accidents. It was found that older drivers have more experience and make fewer mistakes and accidents [14]. These errors and violations can be reduced

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by reducing the annual distance traveled by vehicles [15]. It was also found in a study conducted on cyclists that their behaviors are related to the age factor, as drivers from the age of (26-50) are more aware of risks and knowledge of traffic rules than young drivers younger than 25 years [16]. Regarding the gender of drivers, it was found that males are the highest violator of traffic rules and the most frequent violations than females [17], and the same was true for the sample that was taken for this study. The older drivers were the least committed traffic violations, and males were more violators of traffic rules than females.

Several solutions have been proposed to try to improve the drivers' behavior in Baghdad city, including the proposal to apply smart solutions to the manufacture of vehicles. It has been proposed to implement a self-driving system in vehicle to reduce collisions and accidents [18]. In addition, it has been suggested to improve public transport by taking the necessary measures to solve traffic congestion [19].

Furthermore, drivers are not sufficiently aware of high-speed dangers. Thus, public awareness should be raised to improve driver behavior regarding reducing speed to reduce accidents and traffic violations [20]. Most drivers believe that the role of penalties is to educate drivers about traffic rules because the drivers' reckless behavior leads to an increase in the traffic accidents [21].

The approved proposed solutions include changes in the road's engineering design and reducing high speeds. These solutions have been approved by the drivers within the sample for this research. The number of road lanes can be increased to improve road performance and reduce accidents [22] as driver behaviors are affected by road engineering design. Therefore, improving the road's engineering design makes it possible to improve drivers' behavior on these roads [23]. This study aims to determine the type of roads where the speed limit is exceeded more frequently than other types of roads, the reasons for speeding, and propose solutions to control speeding in Baghdad City.

2. Data Collection

Drivers' data was collected using a distributed questionnaire. The questionnaire was distributed in two ways: the first was by conducting interviews with drivers, asking them questions, and recording their information. The second method was posting the questionnaire on social media to get driver information.

The respondents ranged from 18 to 70 years old, as illustrated in Figure 1, with an arithmetic average of 34, as presented in Table 1. For the sig. value, it was less than 0.05, so there are statistically significant differences between the ages of the participants in this study**.**

Drivers of different types of vehicles were included, varying between a car, a bus, a truck, and a motorcycle. This is because drivers' behavior varies according to the type of vehicle [24], as illustrated in Figure 2.

Table 1: Statistical analysis of the driver's age

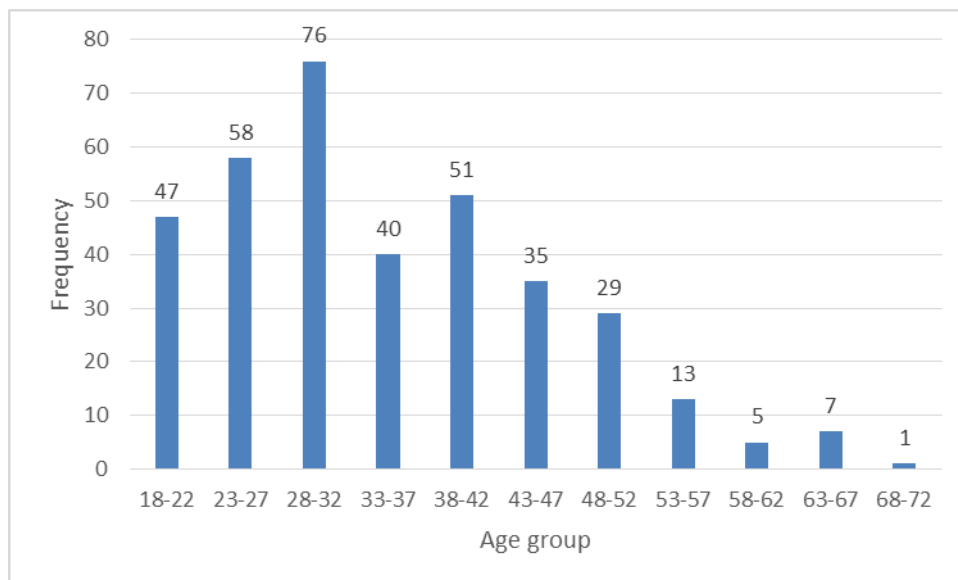| Age	N	Mean	Std. deviation	Sig. (2-tailed)
-	362	34.9	11.248	0.000

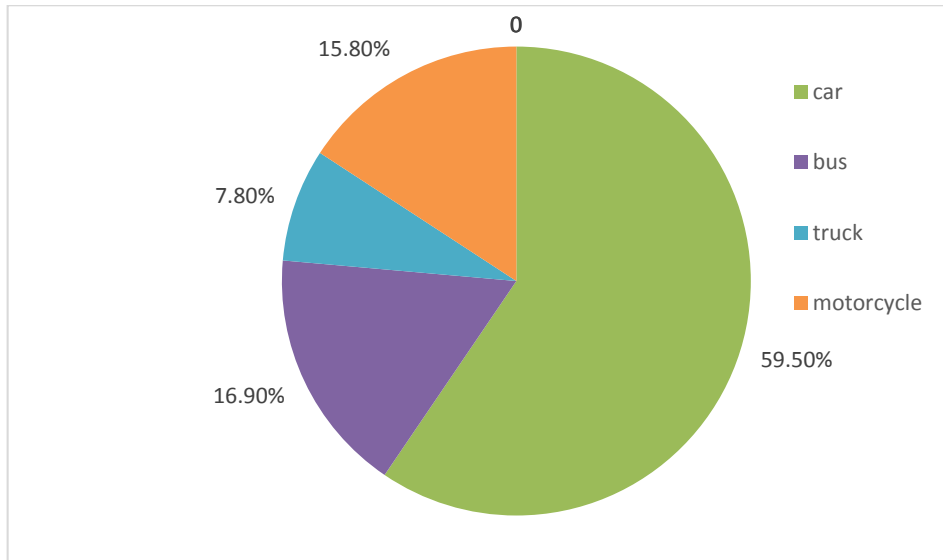**Figure 1:** Age of the drivers in this research

Figure 2: The vehicle type percentage used in the study

The questionnaire form is divided into four parts. The first part is about the demographic information of the drivers, including age, gender, and the most frequently used mode of transportation. The remaining three parts include the same question but for the various functional classifications of roads which are multi-lane, two-lane, and residential local roads. The questions in these three parts were about the distance traveled on the road, the safe speed that has not driven to accidents, the number of times the drivers driven on the road, the number of times they exceed the speed limit, and the main reasons, and the drivers' opinion about some proposed solutions.

3. Sample Size

The sample size for the study was chosen according to the [25] formula. This equation depends on three factors, which are the value of Z, the value of P, and the significant value, as the following:

$$n = Z^2 \, P \, (1-P) / \text{significant value}^2 \tag{1}$$

Where, n = sample size, Z = statistic for a level of confidence (when the level of confidence is 95%, Z equals 1.96)
P = expected prevalence or proportion (when it is unknown, it assumed to be the maximum value (0.5)). Significant value = precision (when proportion equal to 5%, significant value = 0.05).
So that, by applying the above equation, the resulted sample size will be:

$$n = (1.96)^2 \, (0.5) \, (1-0.5) / (0.05)^2 \tag{2}$$

$$n = 385$$

4. Results and Discussions

4.1 Statistical Values

4.1.1 Chi-squared test

The obtained results have been statically tested using the SPSS statistical program. In addition, a test of the normal distribution of these data was carried out according to the Kolmogorov-Smirnov test depending on the result of the significant value; if it is greater than zero, it is subject to a normal distribution. However, it does not follow the normal distribution if it equals zero. Therefore, the results of the data analysis show that they do not follow the normal distribution because the value of the significant value is zero.

Then the Chi-Squared test was conducted to determine the extent of population variance, the data's independence of the data or the existence of a relationship between them. This is based on the null hypothesis, which assumes no relationship between the data depending on the significant value. The alternative hypothesis, which assumes the existence of a relationship between the variables depending on the significant value.

According to the results of the significant value in Table 2, regarding the distance, the value is greater than 0.05. Therefore, the null hypothesis is accepted that there is no correlation between the distance traveled for each type of road during the week with the gender variable; thus, the variables are independent.

According to the significant value for safe speed, its value is greater than 0.05. Therefore, there is no correlation between safe speeds during driving for each type of road during the week with the gender variable; thus, the variables are independent.

Table 2: Chi-square test of the behavior of drivers on the different types of roads

	Multi-lane		Two-lane		Road within the residential area	
	Distance	*Safe speed*	*Distance*	*Safe speed*	*Distance*	*Safe speed*
Pearson chi-square	236.3	115.6	147.7	104.1	117	39.2
Df	216	111	225	108	183	84
Significant value	0.163	0.361	1	0.58	1	1

4.1.2 Anova test

ANOVA test is based on the statistical value of significance that shows the statistical significance of the results; because this value for the test has a meaning different from the other test. In this test, a 95% accuracy level was adopted, and the interval value was significant (0.05) when the resulting test value was significant. If the value is greater than (0.05), then accept the null hypothesis based on the absence of statistically significant differences between the variables and reject the alternative hypothesis based on the presence of statistically significant differences between the variables.

Table 3: ANOVA test of the behavior of drivers on the different types of roads

		Multi-lane roads	Two-lane roads	Roads within the residential area
Mean	Distance traveled on roads	113.4	96.95	42.58
	Safe speed of the vehicle	89	76.41	37.42
Significant value	Distance travelled on roads	0.343	0.276	0.478
	Safe speed of the vehicle	0.243	0.151	0.864
F value	Distance traveled on roads	1.082	1.128	1
	Safe speed of the vehicle	1.153	1.238	0.767
	Standard deviation	29.07	22.9	12.3
	Number of drivers	331	333	327

4.2 Distance Traveled on The Roads

According to the significant value in Table 3, there are no statistically significant differences between the variables related to the distance traveled on the three types of roads in Baghdad. This is because the significant value is greater than (0.05). According to the statistical analysis of the results, it was found that the longest trip is on roads with multiple lanes (mean = 113.4), (F = 1.082), (sig. value = 0.343).

Hence the two-lane roads come with an average distance during the week (mean = 96.95), (F = 1.128), (sig. value = 0.276)

For the streets inside the residential areas, they had an average distance during the week (mean = 42.58), (F = 1), (sig. value = 0.478).

For the number of times driving for each of the three types of roads mentioned in this study, it was within the multi-lane streets that most drivers sometimes drove, but on the two-lane streets, most drivers were driving on this type of road. As for the streets inside the residential areas, driving was always on these streets.

4.3 Safe Speed of The Vehicle

According to the significant value in Table 3, there are no statistically significant differences between the speed variables on the three types of roads in Baghdad. This is because the significant value is greater than (0.05). Regarding the statistical results, it was found that most drivers know the safe speed on various types of roads. The average safe speed, according to the opinions of the drivers themselves, for multi-lane roads, is found to be (89 km/hr), (F = 1.153), (sig. value = 0.243). For the number of speeding times, the highest percentage of drivers who exceeded the speed was sometimes frequent, while the lowest percentage always overtook the speed limits, as shown in Figure 3.
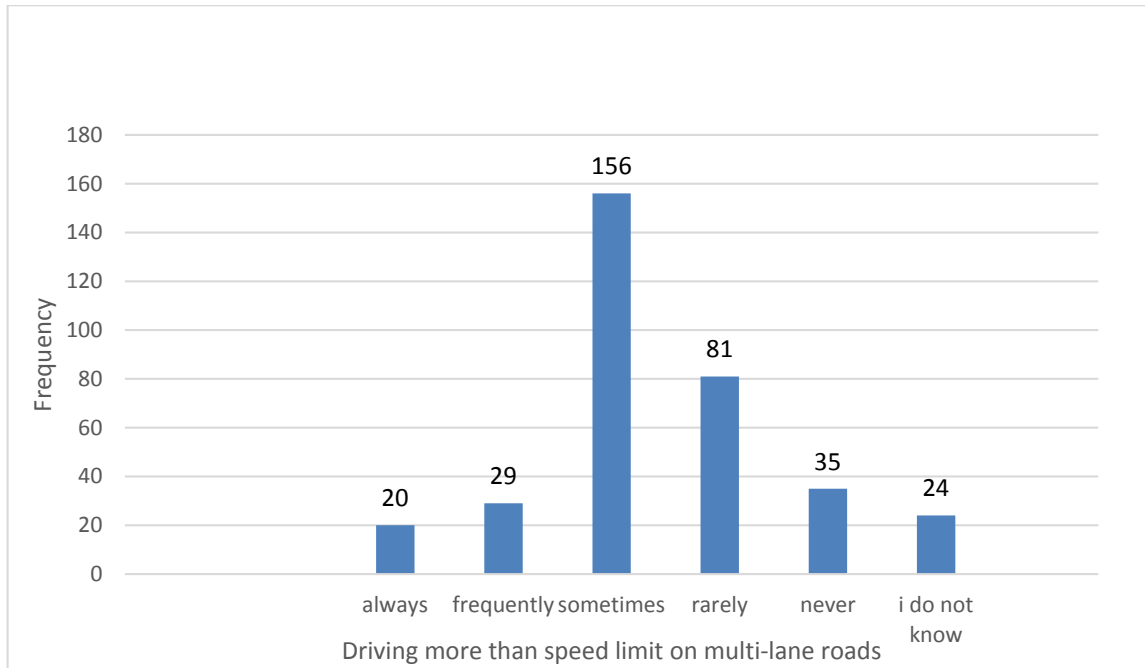
Figure 3: Number of times the drivers exceed speed on multi-lane roads

In the case of the two-lane roads, it was also found that there is knowledge of the safe speed limits, as the average safe speed was (mean = 76.41), (F = 1.238), (sig. value = 0.151). Likewise, as for the number of speeding times on this type of road, most drivers had it only occasionally, as in Figure 4.
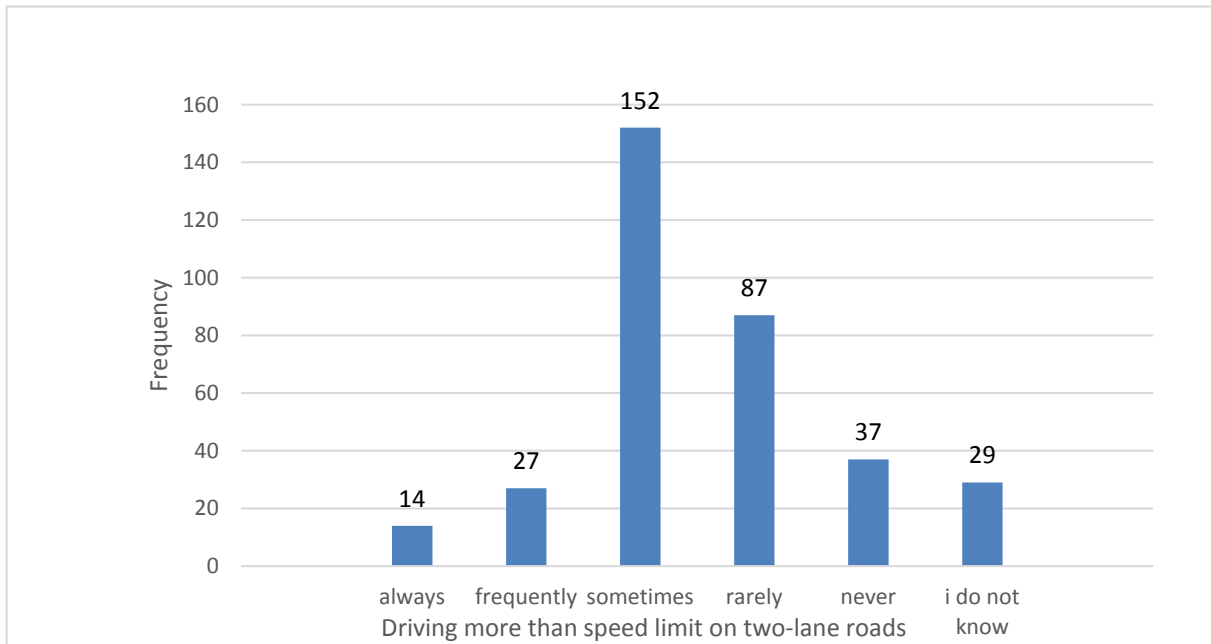

Figure 4: Number of times the drivers exceed speed on two-lane roads

The same analysis was adopted for the sub roads as well. There was knowledge of the safe speed limits, as the average safe speed for driving a vehicle on sub roads was (mean = 37.42), (F = 0.767), (sig. value = 0.864). The speed may sometimes be exceeded on the sub-roads, but for the drivers within the study sample, the highest percentage rarely exceeded the speed limits on this type of road, as shown in Figure 5.
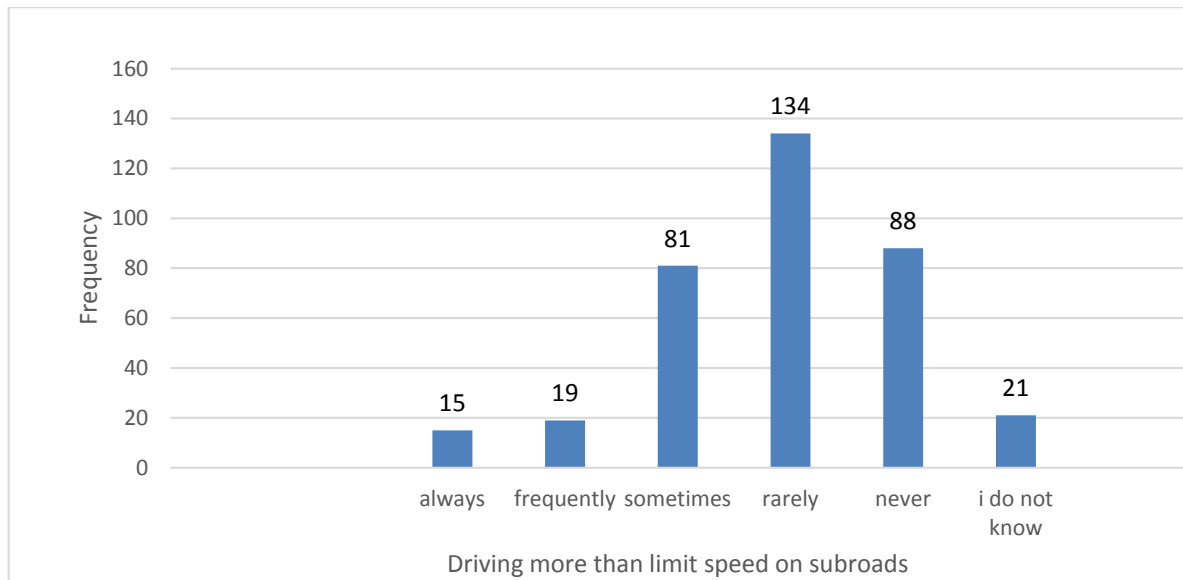
Figure 5: Number of times the drivers exceed speed on sub roads

Also, among the matters raised in this study are the reasons for speeding according to the overtaking drivers' viewpoint and the reasons for not exceeding the speed for those who do not exceed the speed limits. For example, one of the most important reasons for speeding was urgency, and the lowest percent of the reason for exceeding speed was unaware of speed risks, as illustrated in Figure 6.
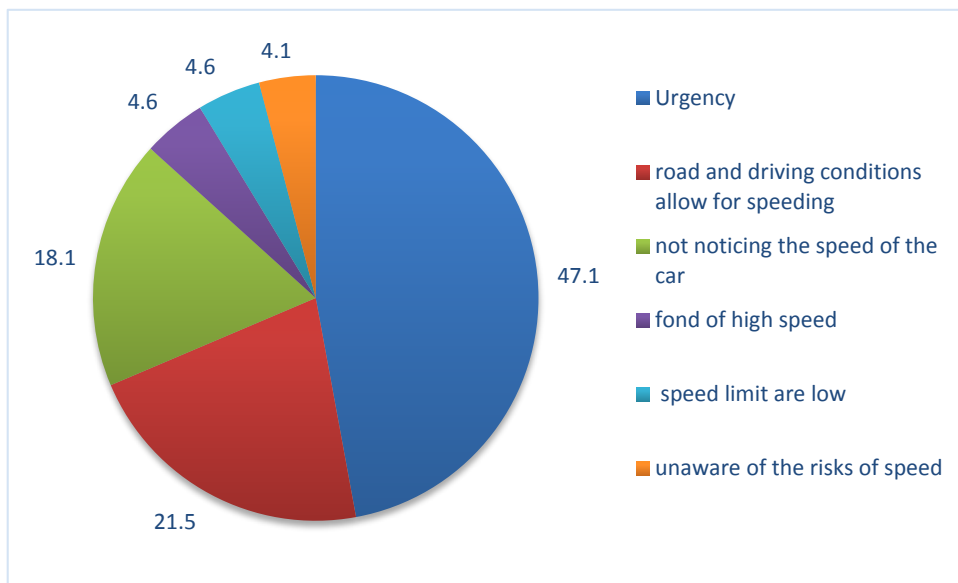

Figure 6: Distribution of reasons for exceeding the speeding

5. Some Suggested Solutions to Limit High Speed

Some drivers proposed solutions to address the high-speed problem of drivers and their view of health regarding these solutions. The main proposed solution is to increase fines for the speed increase. The largest number of drivers was (71.6%) with the application of this solution. The second proposed solution was to increase public awareness of the risk of speed increase. The highest result, 96.4%, approved of this solution, indicating the lack of general awareness of the reduced speed. Another solution that has been proposed is the creation of changes in the road design, such as creating humps in the road to reduce speed and increase the number of traffic circuits and electronic signals to warn of speed, as (78.1%) of the total number have agreed to this solution. The last solution included in the study, according to the drivers' opinions, was the presence of devices in vehicles. One of which records the speed data and submits it to the insurance company to reduce insurance fees when adhering to the speed limits. The other device slows the vehicle when it senses the presence of another vehicle near it, where the largest percentage of drivers (77 %) agreed to apply this solution.

6. Conclusions

The study conclusions can be stated as follows:

1) It has been shown that exceeding the speed limits depends on the type of road; the multi-lanes and two-lane roads witnessed more frequent speed limits than local residential roads. As for most of the driving times and the distance traveled during a specific time on any of these roads, it was found that the multi-lane roads are among the most used. Therefore, it is necessary to provide solutions to reduce speeding to avoid possible accidents, and then the two-lane roads come with the distance traveled by drivers on these roads.

2) The age factor is the more correlated factor to exceeding speed limits. The younger drivers are the most frequent speed limit offenses. This factor is closely related to the driver's experience on different roads and driving different types of vehicles.

3) According to its findings, this research recommends the provision of public transportation instead of private means of transport. Most drivers prefer to use a personal car and consider it safer than public transport. The use of private transportation is one of the reasons for many congestions in Baghdad city. Reducing congestion, it is recommended to spread awareness enough to use public transportation instead of private transportation.

Author contribution

All authors contributed equally to this work.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author.

Conflicts of interest

The authors declare that there is no conflict of interest.

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