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Characteristics of Motorcyclists in Baghdad City

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Abstract

In recent years, Baghdad City has experienced a remarkable increase in the number of motorcyclists. Considerable numbers of motorcyclists are driving against the direction of traffic flow. This has had a negative impact on the safety of roads network. Based on that, studying the characteristics and performance of those users is essential. To collect the required data, a questionnaire was designed and distributed to motorcyclists. The results revealed that most of the motorcyclists in Baghdad are in the age group 20 to 30 years old; about 80% are not wearing helmets, 10% have no level of education, and most have had accidents of varying severity. Managing this safety problem required a collaboration of different authorities. A framework of requirements to improve motorcyclists' safety in Baghdad city was proposed. In addition, a road network modification was presented by selecting suitable roads in Baghdad city to be used for creating an exclusive lane for the proposed motorcyclists' network. Besides that, the geometric and marking enhancements of current intersections.

Keywords: Accidents, Helmet, Motorcycle, Safety Requirements.

1. Introduction

The number of motorcycles in Iraq has increased in recent years [1]. The World Health Organization (WHO) [2] reported that there are large numbers of registered motorcycles all over the world. About 80% of these motorcycles are concentrated in Asia [3], [4], whereas about 15% of motorcycles were found in Europe and the United States of America [4], [5]. The remaining motorcycles were distributed to the rest of the world.

Saini et al. [3] reported that the reason for using motorcycles varies between developed and developing countries. In developing countries, transport and delivery purposes are the reasons for using motorcycles. While in developed countries, the reason for using is for commuting and tourist purposes. They mentioned that people used motorcycles for various reasons, including good accessibility, ease of use, and low cost, characterized by a lot of accidents to which motorcyclists are exposed [3], [6], which has risen over the years. WHO [2] reported that 28% of deaths worldwide are due to road accidents, especially motorcycle accidents, and this percentage has risen over the years. In the United States of America, the number of current registered motorcycles reached about $8*10^6$ motorcycles [7]. Globally, the number of current registered motorcycles reaches about $2*10^8$ motorcycles [8]. While in developing countries, motorcycles created an important percentage of roads.

This mode of transportation received significant importance globally, but in Iraq, it didn't receive adequate attention. To fill this gap, it is important to study the characteristics of motorcyclists in Baghdad city.

This study will help in understanding this mode and establishing a framework that aggregates the main institutions that deal with this mode of transport and shows their contribution in improving its effectiveness and safety. In addition, an isolated network for motorcycles is proposed to decrease the interaction of this mode with current traffic by allocating lanes from selected roads to form a network for motorcyclists in Baghdad city.

2. Methodology

As revealed in the introduction, the study of the motorcycle mode of transport is necessary for improving this mode and avoiding the existing problems. Accordingly, this study is focused on this field of transport. The adopted methodology of this study is presented in a flowchart shown in Fig. 1. The main steps of the adopted methodology are listed as follows:

- Reviewing the main studies related to this mode of transport,
- Studying the properties of motorcycle mode in Baghdad city by analyzing the results of users' responses on a distributed questionnaire for a selected sample size,
- Proposing a framework that aggregates the institutions that deal with this type of transport and shows their responsibilities, which can improve the efficiency and safety of this sector or transportation.
- Suggesting a network for motorcyclists by allocating individual lanes on selected roads of Baghdad city road network to separate this mode from the current traffic and increase its efficiency.

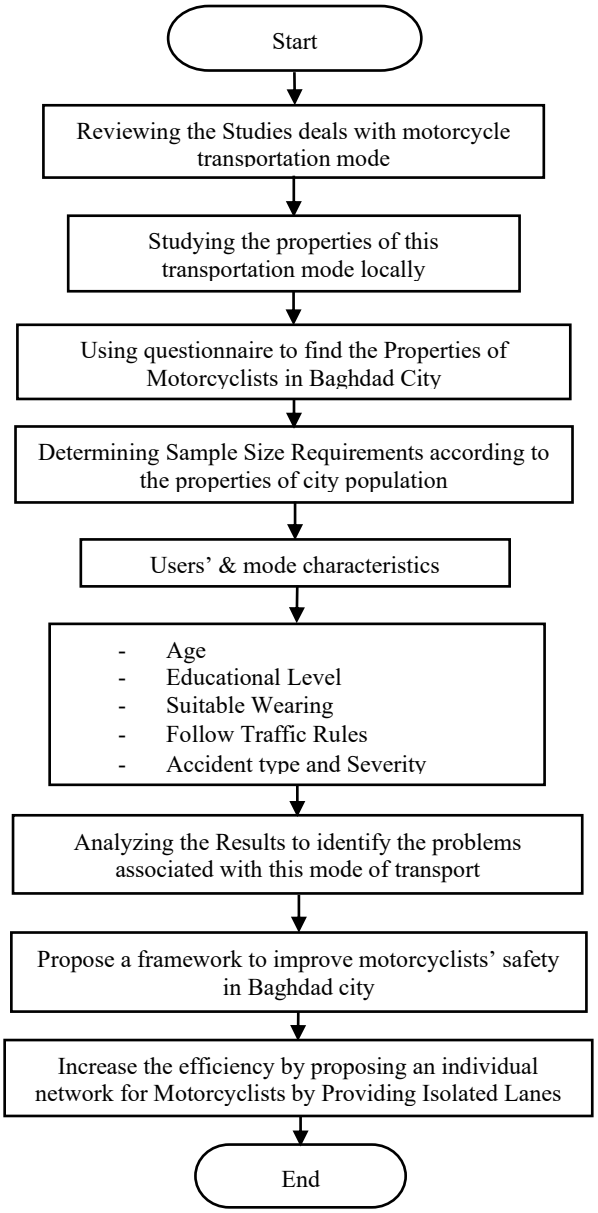

Figure 1. The main steps of the adopted methodology.

2.1. Background

The study of the characteristics of motorcyclists has highlighted great importance worldwide because of the large number of accidents and the nature of these accidents, in addition to an increase in the number of users for this type of transport, especially in developing countries [9]. The problem in Iraq is the lack of this type of study due to the absence of a study and a database for motorcyclists. Yousif et al. [10] summed up more than 100 articles that were published worldwide over nearly 20 years. These articles focused on different motorcyclists' issues, such as their driving speed, visibility, and alertness. As a result, these studies proposed the following recommendations to decrease motorcycle accidents:

1. applying the Intelligent Transportation System (ITS),

2. wearing a fluorescent jacket [11],

3. using the headlight of a motorcycle,

4. Using sensors on the steering wheel to raise the alertness of motorcyclists.

2.2. Questionnaire

To determine the required sample size, i.e., the number of cases for which the questionnaire should be distributed. The population statistical summary of Baghdad City, one of the Iraqi Central Statistical Organization (ICSO) [12] publications, was used. Table 1 shows the population statistics for Baghdad City in 2022.

Table 1. The estimated demographic indices of Baghdad city [12].

Demographic indices of Baghdad city	2022
Population (capita)	9,006,001
Male	4,569,768
Female	4,436,233
Urban Population	7,879,500
Rural Population	1,126,501
Urban Population (%)	87.5
Rural Population (%)	12.5
Age of Person (0 – 4) year (%)	13.5
Age of Person (5 – 14) year (%)	23.5
Age of Person (15 – 64) year (%)	59.5
Age of Person ≥ 65 year (%)	3.5
Total Area (Km^2)	4555
Population Density (Person/Km^2)	1977.2

According to the statistical data of the city, the number of people who may be able to have a motorcycle can be estimated by taking the number of males in the urban part with a range of age between (15 – 65), about 2,325,000. Unfortunately, there is no documented number of users for this mode; therefore, the unlimited population size was adopted in this study. Using the sample size calculator [13], the required sample size was 385 cases with a confidence level of 95%, as shown in (1).

$$n = \frac{z^2 * \rho(1-\rho)}{\varepsilon^2} \quad (1)$$

Where:

z: the z score, for confidence level = 95% , z = 1.96, ε: the margin of error, n: the population size, and p: the population proportion.

The decision was made to select 500 motorcyclists, and the questionnaire was distributed to them. About 10% of responses were neglected due to missing data. Accordingly, about 450 cases were used as a sample size for this study.

The questionnaire was dedicated to collecting required data represented by age, education level, using a helmet, following the traffic rules or not, the number of accidents, and their severity. The questionnaire was distributed to diverse kinds of users and different regions of the city to cover the variation in population.

3. Results and Discussion

3.1 Motorcyclists Characteristics

Most motorcyclists in Baghdad are male. This is due to the social and moral reasons related to this country. It is worth mentioning that there are many reasons behind using motorcycles in Baghdad, which were obtained from a questionnaire, such as: for living purposes (delivery) (30%), for avoiding road congestion (27%), and for other reasons (43%). The characteristics of motorcyclists in Baghdad city can be divided as follows:

3.1.1. Age

One of the most important effects on driver behavior is age [14]- [19]. The results obtained from the questionnaire showed that about 29% of motorcyclists in Baghdad city were under the age of 20 years. Moreover, around 43% of those users were aged 20-30 years, about 20% were aged 30-40 years, and about 20% were aged 30-40 years. Males over the age of 40 years were only 9 percent, as shown in Fig. 2.

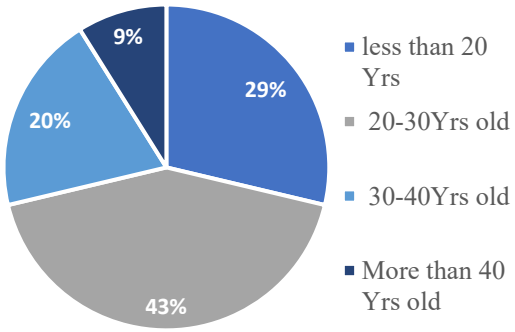

Figure 2. Age distribution of motorcyclists in Baghdad city.

3.1.2. Educational Achievement for Motorcyclists

It is known that the educational achievement of the individual is of great importance in terms of their awareness and actions [20]. This also applies to his knowledge of traffic rules and following the guidelines that will protect him and all the road users. The result obtained from the questionnaire is that the highest percentage of motorcyclists in Baghdad finished their secondary school (41%), while the lowest percentage has no education at all (10%). Moreover, nearly 16% completed only primary school, and 33% of motorcyclists were university graduates, as shown in Fig. 3.

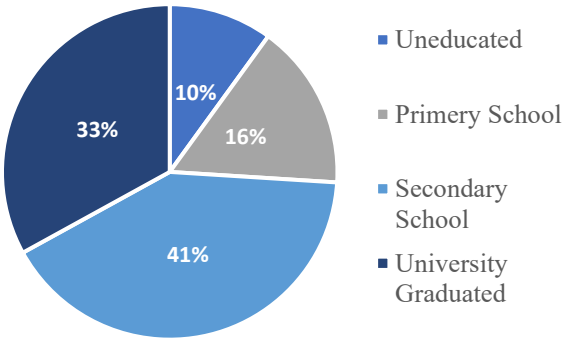

Figure 3. Percentages of Educational Achievement of motorcyclists in Baghdad.

3.1.3. Wearing Helmet

One of the means of safety for motorcyclists is using a protective helmet [21]- [23]. In Iraq, most motorcyclists do not use helmets to protect their heads when driving, with a percentage of about 80%, which is clear from the results obtained from the questionnaire, as shown in Fig. 4.

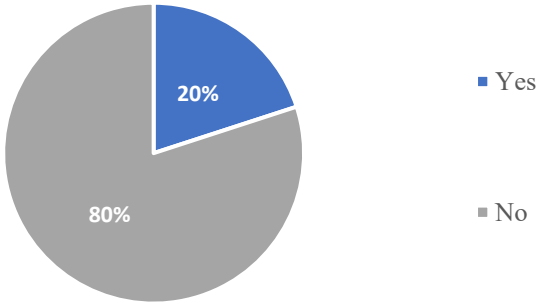

Figure 4. Percentages of motorcyclists who wear helmets in Baghdad.

3.1.4. Driving Against Traffic Direction

The main problem facing people in Baghdad city, especially road users, whether drivers or pedestrians, is that most motorcyclists are moving in the opposite direction of traffic. This problem exists even in Baghdad's main streets. It is clear from Fig. 5 that less than 30% of motorcyclists are driving with the traffic direction, while about 15% of motorcyclists are driving against the traffic direction. The 58% of motorcyclists may drive with or against the traffic direction.

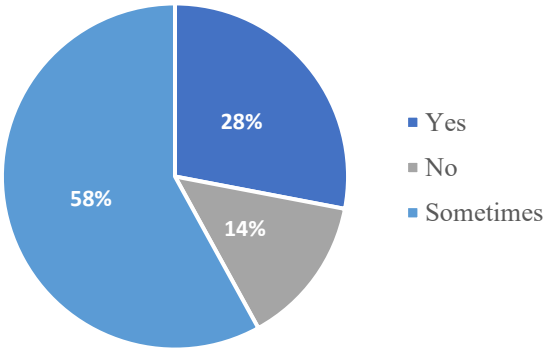

Figure 5. Percentages of motorcyclists who are driving against the traffic direction in Baghdad.

3.2. Accidents

Many researchers stated that motorcyclists were exposed to a number of accidents many times greater than the accidents of car drivers [6], [10], [18], [24]- [28]. This is due to the behavior of motorcyclists through driving [10], [29]-[32] as they preferred higher speed [33]-[38], smaller gaps [39]- [42] and more maneuvering than that of car drivers [43]- [47]. One of the characteristics obtained from the questionnaire was the proportion of motorcyclists who had been exposed to traffic accidents in Baghdad City. The percentage of motorcyclists who were exposed to accidents was 81%, while those who did not have any accidents were equal to 19% from the total motorcyclists in Baghdad city. The severity of traffic accidents can be divided into about 18% of high severity, 40% of moderate severity, and 42% of low severity accidents, as shown in Fig. 6.

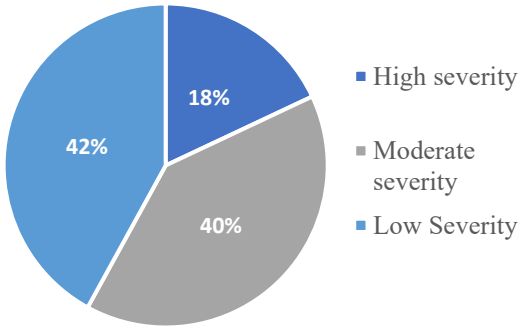

Figure 6. Traffic accident severity.

3.3. Framework of Motorcyclists' Safety Requirements

The carried-out survey revealed many attributes of motorcyclists in Baghdad city. These attributes can be summarized by the fact that most of them are between 20 and 40 years old, a few of them are uneducated, most of the users are not wearing helmets, about half of them are not following the traffic rules, and more than seventy-five percent of users were exposed to accidents with different levels of severity. These attributes are very helpful in understanding motorcyclists' behavior and how it can be improved to reduce the number of accidents and increase the safety of the road network. Based on these results, a framework that represents the requirements of improving the motorcyclists' safety is proposed with six approaches as listed in Table 2.

The following diagram, presented in Fig. 7, shows the proposed framework with the responsible authorities for adopting each approach and their roles.

3.4. Proposed Roads Network for Motorcyclists in Baghdad City

The current road network of Baghdad city needs enhancements to be safer for motorcyclists. This improvement comprises an additional exclusive lane for motorcyclists for selected roads with functions and geometries that permit development, such as minor arterials with multilane. In addition, the intersections' markings and geometry should be modified to decrease the interaction between motorcyclists and other users. As well as using the ITS to facilitate and manage the traffic flow

The selection of roads to be modified depends on their functions and location. Accordingly, roads with high design speeds should be avoided, like expressways (major arterials), which are dedicated to mobility, and choosing the roads with moderate design speed, like collectors or distributors, in addition to local streets, which are devoted to accessibility. The location means the roads that lie within the regions that have a considerable number of motorcyclists or connect between these regions themselves and the center of the city. Most motorcyclists are concentrated in the low-income districts, as given by Asmael and Waheed [48]. These districts are Al Sadder City, Baghdad Al Jadida, Al Shaab, and some parts of Al Adhamia on the east side of Baghdad City. On the west side, motorcyclists are concentrated in Al Huria, Al Shula, parts of Dura, Ghazalia, and Kadhumia. Fig. 8 shows the Baghdad zones of low income, which were indicated by circles.

The following roads of the Baghdad network, presented in Fig. 9 and Table 3, are proposed to be modified by adding an exclusive lane for motorcyclists. It is worth mentioning here that these proposed roads need a detailed analysis for traffic and geometric conditions before deciding to add an exclusive lane for motorcyclists, as presented in Table 3.

Table 2. Proposed framework to increase the motorcyclists' performance and ensure their safety.

Approach	Roles and authorities
I. Education:	Based on the survey results, most motorcyclists are educated at different levels. So, the training courses will be very helpful to teach them the traffic rules, first aid, and basics of motorcycle's mechanical parts that can help to ensure the suitability of the motorcycle. These courses should be designed with different levels and by professionals to ensure that they will achieve their targets. This education role should be supervised by the ministries of interior, health, and education.
II. Insurance:	Due to the unsuitable wearing of most motorcyclists in Baghdad city, the imposition of appropriate wearing is required, which helps to be seen by other road users, as well as reduces the effects of the accident in case of its occurrence, such as helmets, headsets, eye protection, reflective clothing, and boots. This approach must be under the supervision of insurance companies and the Interior Ministry Department of Traffic Police.
III. Institutions:	Ensure the suitability of the motorcycle for use. This check-up should be carried out by independent agencies under the supervision of the government authority. Besides the engine, these tests should include brakes, lights, and reflectors. Identify the authorities that are responsible for importing motorcycles so that they are monitoring the importing process. Furthermore, determining the types that are safer for motorcyclists, taking into account the economic aspect. A driving license should be adopted for motorcyclists to ensure their driving skills, knowledge of traffic laws, and instructions. These roles should be administered by the Ministry of Interior, Department of Roads, Traffic, and the Central Organization for Standardization and Quality Control.
IV. Law Enforcement:	Impressive fines and penalties for motorcyclists who are non-compliant with traffic laws and treated as vehicle users, especially for those moving in the wrong direction. Also, the motorcycle should not be used by more than one person unless the motorcycle is prepared for this purpose. This enforcement should be done under the authority of the interior ministry, the department of traffic police.
V. Statistics:	Create a database for motorcycles and motorcyclists to identify the owner of a motorcycle. Facilitate the procedures and reduce the costs of numbering the motorcycles, to encourage motorcyclists to register their motorcycles. In addition, the accidents should be documented with all related information. The responsibility of data collection and management is related to the central statistic organization, with the aid of the traffic police department.
VI. Roads Network Improvements:	Determine the roads that are appropriate for adding an exclusive lane for motorcycles, as well as prioritization in intersection areas, in addition to using the ITS to manage and facilitate the traffic movements. The state organization of roads and bridges, and the Ministry of Housing and Construction, are both responsible for roads. The Ministry of Housing and Construction is responsible for road network improvement.

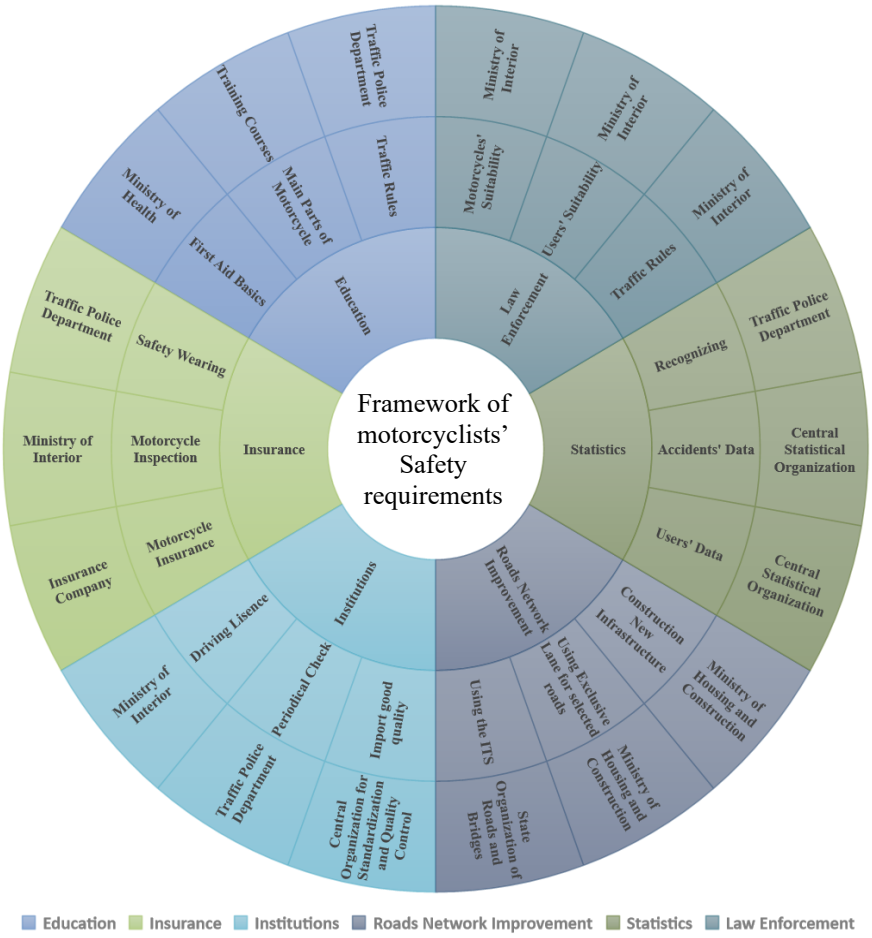

Figure 7. A framework of motorcyclists' Safety requirements.

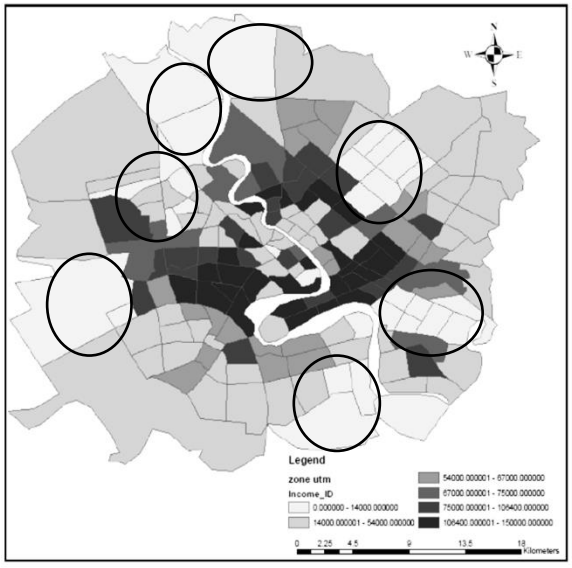

Figure 8. Baghdad zones of low income are indicated by circles (adopted from Asmael and Waheed [48]).

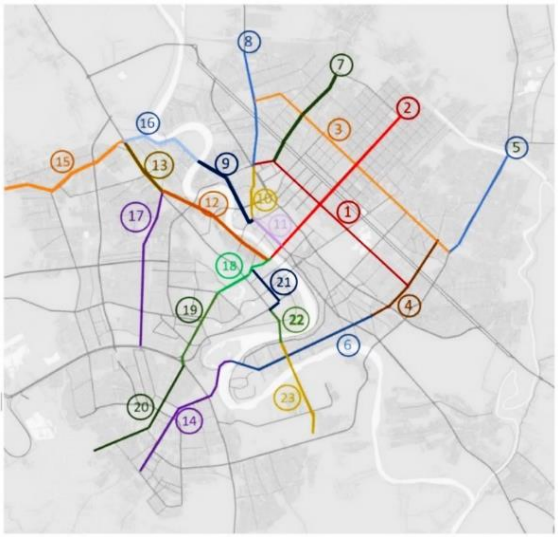

Figure 9. Proposed road network for a motorcyclist's exclusive lane.

Table 3. Proposed roads to be modified by adding an exclusive lane for motorcyclists.

	Road name		Length (km)	Number of lanes per direction	Direction width* (m)
1	Palestine street	East side	9.00	3	11.0-12.0
2	Thawra Street		7.00	3	10.0-11.0
3	Jamila and Qouds Street		11.80	3	10.0-11.0
4	Al Ghadeer Street		3.5	3	10.0 – 11.0
5	Al-Kamalia Street		5.70	2	7.0-8.0
6	Karada Kharidgh and Al-Jamia Street		8.60	3	10.0 – 11.0
7	Al-Binouk Street		8.10	2	7.0-8.0
8	Baqubah/Baghdad Street		3.50	3	11.0-12
9	Adhamia Street		5.1	3	10.0-11
10	Al-Waziria Street		1.70	3	10.0-11.0
11	Khulafa Street		3.30	3	10.0-11.0
12	Hifa Street	West side	11.50	3	10.0-11.0
13	Al Uruba Street		5.0	3	9.0-10.0
14	Qatr Al-Nada Street		8.0	3	10.0-11.0
15	Al Shula Street		7.0	3	10.0 – 11.0
16	Al Muhit Street		4.5	3	9.0-10.0
17	Al-Rabie Street		10.5	3	10.0-11.0
18	Damascus Street		5.0	3	11.0-12.0
19	Jinub Street		3.0	3	10.0-11.0
20	Al Muataz Street		7.0	3	10.0-11.0
21	Yafa Street		2.5	3	10.0-11.0
22	Arbataash Tamuz Street		1.5	3	11.0-12.0
23	Two-Story Bridge Street		6.5	3	11.0-12.0

* From Table 3, it is important to know that the number of lanes and the width per direction are not constant along the road; they change according to the access points, intersection geometry, and demand requirements. The mentioned number of lanes and width per direction have been taken as an average for the most frequent dimensions, including clearances along the road extension.

5. Conclusions

Based on the considerable number of motorcyclists in Baghdad city, the organization and suitable infrastructure should be provided for this mode of transport. To do this, the characteristics of motorcyclists in Baghdad city were studied in this study, and the main requirements for improving their performance were proposed.

The main characteristics and the proposed requirements drawn from this study are listed as follows:

A. The main characteristics of Baghdad city motorcyclists:

1. Most of them are between twenty and thirty years old. At the same time, the lower number of users is aged more than 40 years. Care should be given to young users to guarantee that they use the roads responsibly to prevent any problems.
2. They have different levels of education that help in teaching them the requirements of using a motorcycle safely and efficiently.
3. They are not wearing helmets. It is important to encourage users to wear helmets to ensure their safety,
4. Most motorcycle users are not following traffic rules, which requires applying the law, starting from preventing any user who does not have a license from using the road, and applying penalties against irresponsible users.
5. They had an accident, with different levels of severity. This requires improving the road network to be safer for motorcycle users, in addition to the requirements mentioned in previous points.

B. Based on the survey results and according to the revealed characteristics, a framework with six approaches was proposed to improve the performance and ensure the safety of motorcyclists in Baghdad city. These approaches were: Educational, Insurance, Institutional, Law enforcement, Statistical, and Road network improvements. For the approach of road network improvements, a modification for selected roads (11 on the east side and 12 on the west side) in Baghdad City was presented in this study by adding an exclusive lane for motorcyclists, in addition to improving intersections and using the traffic intelligent system, which are required to increase the network efficiency and reduce accidents.

5. Recommendations

According to the outcomes of this paper, the following recommendations can be listed:

1. Giving more attention to motorcyclists in Baghdad because of the high number they represent among road users. This can be done by collecting detailed data on motorcyclists.
2. For the safety of road users and especially motorcyclists, it is important to study, adopt, and activate the framework proposed in this study.

3. Improving the transportation network by adding an exclusive lane for motorcyclists and improving intersections to make it convenient for motorcyclists.
4. Apply the framework proposed in this study and improve it if required.
5. Studying the road network improvement proposed in this study in detail and applying it to the network.
6. Using modern technology to improve the management of the road network.

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Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Author Contribution Statement

Mohammed Zuhair Mohamedmeki: performed and described data collection and completed the analysis.
Maha Al-Mumaiz: contributed to developing the methodology and preparing the manuscript.

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