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Review of the Road Crash Data Availability in Iraq

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***Abstract*—**Iraq is a middle income country where the road safety issue is considered one of the leading causes of deaths. To control the road risk issue, the Iraqi Ministry of Planning, General Statistical Organization started to organise a collection system of traffic accidents data with details related to their causes and severity. These data are published as an annual report. In this paper, a review of the available crash data in Iraq will be presented. The available data represent the rate of accidents in aggregated level and classified according to their types, road users' details, and crash severity, type of vehicles, causes and number of causalities. The review is according to the types of models used in road safety studies and research, and according to the required road safety data in the road constructions tasks. The available data are also compared with the road safety dataset published in the United Kingdom as an example of developed country. It is concluded that the data in Iraq are suitable for descriptive and exploratory models, aggregated level comparison analysis, and evaluation and monitoring the progress of the overall traffic safety performance. However, important traffic safety studies require disaggregated level of data and details related to the factors of the likelihood of traffic crashes. Some studies require spatial geographic details such as the location of the accidents which is essential in ranking the roads according to their level of safety, and name the most dangerous roads in Iraq which requires tactic plan to control this issue. Global Road safety agencies interested in solve this problem in low and middle-income countries have designed road safety assessment methodologies which are basing on the road attributes data only. Therefore, in this research it is recommended to use one of these methodologies.

***Keywords*—**Data availability, Iraq, road safety.

I. Introduction

ROAD safety issue has been considered as one of the important leading causes of deaths in the world. The latest WHO global reports on road safety show that about 1.25 million people are killed and about 50 to 80 million are injured yearly by road crashes [1], [2]. These reports show also that the rate of traffic mortality in low and middle income countries is about 90% of global traffic deaths which is double of those in high income countries especially European countries which have the least rate of traffic fatalities in the world [1], [2]. Actions have been taken by some global organizations such as WHO, the World Bank and the United Nations (UN) to control this problem and take lessons from interventions applied in the developed countries [3]-[5]. The Decade of Action of Road Safety (2011-2020) [6] is the most recent action which is announced officially by the UN General Assembly to encourage the world countries to address the road safety problem and implement interventions to reduce the rate of traffic and road crashes fatalities. This action is enhanced when its aim is included as the sixth target of the health improvement goal by the UN assembly in the 2030 Agenda for Sustainable Development [7].

Observable improvement in the level of road safety has been reported in the most of the developed countries with high income rate while the rate of traffic crashes still constant and increased in the developing countries with low and middle income rate [1], [2]. The WHO reports [1], [2] show that one of the main reasons behind that is the unsuccessful road safety management system applied in the developing countries. This system aims to implement some measures such as improving road safety legislation; managing speeds, harmonizing data collection, and developing minimum standards on road infrastructure and vehicle safety [1], [2]. Data unavailability is another reason behind the low level of road safety in low and middle income countries. The data are necessary for conducting scientific research needed to address the factors of high level of road risk and to study the impact of implementing countermeasures and interventions [8]. Different data analysis models are used in conducting such these research and studies as will be explained in Section III [9]. Therefore, it is essential to identify the data types needed for each type of model. It is also necessary to identify the data type needed for checking the road safety requirements in the road construction. The data are different according to the stage of the road construction as will be explained in Section V.

This paper aims to review of the data availability in the low and middle income countries where there is a problem of lacking road safety data as reported in the WHO [1], [2]. Iraq is one of these countries and it will be the case study of this paper.

To achieve the aim of the paper, the available data which are reported by official and governmental organisations in Iraq, The Central Statistical Organisation Iraq (CSO) [10] will be reviewed. Then, the available data will be compared with those available in one of the high income countries with successful road safety management system, the United Kingdom. An evaluation of the data requirement for road safety models will be presented according to the data required for road safety research models.

After the introduction part, road safety models will be reviewed to identify the road safety data needed for each model. The available data in Iraq will be shown in the third part with comparison of data details in the UK and Iraq. Some conclusion points will be drawn from the discussion of the presented data.

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II. Data Required for a System Management

Effective road safety management is the most successful solution to control the increase of road deaths and injuries. This system requires stable and high quality data collection system. The quality of the required data depends on the management functions. For example, research on operation management requires comprehensive and disaggregated data which can be collected for short length of road. On the other hand, summarised and aggregated data are required for strategic plan. Therefore, the most appropriate and cost-effective data level depends on the management function [9], [11].

III. Road Safety Data and Model Types

Road and traffic safety studies depend essentially on road safety data details. The type of data is different for various types of studies and research. The most required data are the data related to the number of crashes, causalities, and severity. These can be in terms of crash rate, or crash cost [12].

In order to identify the type of data needed, it is necessary to decide the type of model developed in the research and studies. Generally, for scientific research the simplest type of data analysis model is the descriptive model which is the first step and prior to more complicated models such as [13]

- Exploratory model which is used to find relationships between variables
- Inferential model in which a small dataset (cross sectional time study, observational, and randomly sampled population) is used in statistical models to estimate both the quantity and uncertainty of the estimation.
- Mechanistic model which is used to understand the exact changes in variables that lead to changes in other variables for individual objects, typically from engineering and physical sciences.

OECD has classified road safety models into four types: descriptive models, predictive models for aggregated data, risk models for non-aggregated data, and accident consequence models [14]

A. Descriptive Models

These models are used to describe the present situation and the magnitude of the problem, the trend of road safety problem within period of time or within a bounded area to make comparison of roads or areas according to the level of road safety. The data required for these type of models include accidents data, its severity and its exposure, which represents activities that may generate or increase traffic accidents such as vehicle trips [15], [16]. All quantitative studies will have some descriptive statistics. For example, sample size, maximum and minimum values, averages and measures of variation of the data about the average. In many studies this is a first step, prior to more complex inferential analysis [14]. It can be argued that these models depend on accident data availability and accuracy which some of low and middle income countries are lacking. Therefore, it is difficult to monitor the progress and the successes in the implementing interventions.

B. Predictive Models for Aggregated Data (Analytical Macro Models)

These models predict the trend of road safety and its level over time depending on the safety factors that may produce increase or decrease in traffic accidents. Therefore, these factors can be categorised into six groups as shown in [14]: "External (for example, weather), socio-economic (for example, unemployment), transportation (for example, infrastructure), data collection (for example, accident reporting accuracy), sheer randomness and finally countermeasure intervention" [14]. However, most predictive models have considered some of these factors not only to focus on the impact of one factor over time, but also to avoid the difficulties in predicting some variables, such as weather. Furthermore, researchers have been facing challenges in selecting the most proper statistical method in building models with high number of variables.

C. Risk Factor Models - Analytical Models on the Individual (Micro) Level

These types of model are used to analyse road risk factor in a way that can simplify the complexity of predictive models. The purpose of these models is either identifying or quantifying the risk factors. The road and vehicle characteristics are examples of risk factors. The variables of iRAP [17] protection score model are related to road measures such as, geometric characteristics and surface conditions while other risk analysis models are related to driver behaviour or vehicle design safety [14].

D. Applying Accident Consequence Models Aggregated Level Using Statistical Methods

These models consider the level of accident consequences' severity and the factors affecting it, especially road users' demographic factors [14]. Different types of data are needed for these types of models such as the road user's age and sex, the vehicle type and its design standards, speed, road design characteristics, and the alcohol using. The output of these models can be used in other studies, such as health assessment studies and economic studies. Road safety consequences are normally measured by the frequency of road crash fatalities and injuries. These data could be collected from more than one source such as: police reports and hospital records. However, many of the low and middle income countries suffer from under-reporting crash data, especially the slight sever crash records, and the inconsistency between data collected from different sources. For this and for requirements of comparison and ranking the road safety problem, the researcher found that it is necessary to measure the magnitude of the consequence of activities and exposures that generate this problem [14]. This requires considering other terms of data to study the road safety problem, such as the traffic conflicts and the cost of the problem. However, these types of measurements have lower validity than for accidents.

IV. Road Safety in Iraq

Iraq is a middle income country as classified by the Word

Bank [4], [18] and roads in Iraq are considered risk in terms of traffic crashes and their severity. Road accidents are considered one of the leading causes of increasing the death rate in Iraq [19], [20]. The rate of road fatalities is about 32 per 100000 people in 2010 which is nearly double the global rate of traffic fatalities and triple the rate of people killed by terrorism. Iraq is also ranked as the second highest among the nearby countries in the Middle East area [20], [21]. This has been attributed to the lack of successful and active strategic plan and road safety management system which depends on improvement the road user behavior and education by road safety law legislation. Irregular road safety data collection and rapid motorization are also reasons of the decline in road safety level in Iraq [20]-[23].

Actions have been taken by the Iraqi government to control the road risk problem by designing a plan to reduce the rate of road fatalities by 25% by 2020 in accordance with the Decade of Action for Road Safety 2011-2020 [20]. Iraq is also investing a project of improving the road infrastructure by rehabilitation of the main expressway in Iraq with the World Bank and Islamic development bank [24]. In addition, a data collection system has been developed in national scale and supported by police offices in all parts of Iraq to ensure standardization of data collection nationally [20]. The central of statistics in Iraq published has started to publish a yearly report of road safety data including the details shown in the first column of Table I. However, due to the insecurity and conflicts problems in Iraq which lead to limited human resources and poor road and vehicle standarisation programme, the national strategic plan is still ineffective [1], [2]. WHO [1] shows that the strategic plan in Iraq is unfunded and lack the measurable target which needs a historical crash data base. Therefore, these plans and projects require a reliable and updated road safety data. These data need to have geographical and spatial scopes to apply tactic and programming plans [21].

TABLE I
IRAQI ROAD SAFETY DATA EVALUATION ACCORDING TO ANALYSIS MODELS [10]

Crash Data Type	Exploratory model	Inferential/ predictive model	Mechanistic model
Aggregated Accident number, rate , and severity level by the whole country, the year (since 2011)			
Crash rate by severity level (fatal, non fata (serious injuries and light injuries)	x	x	
Crash rate by gender and marital status	x		
Crash rate by crash type (overturn, run over and others)	x		
Crash rate by road area type (main road, highway, sub road, and rural)	x		
Crash rate by road type (straight, curved , and flat road)	x		
Crash rate by time of day (sunrise daylight, sunset, , night)	x		
Crash rate by time of the year (by month)			
Crash rate by road user (driver, vehicle, passenger, pedestrian, and others)	x		
Crash rate by causes (moving car, motorcycles, parked car, roads and others)	x		
Crash rate by road user age group	x		
Crash rate by county (governorate)	x		
Causalities rate by vehicle type (car, bus, van, truck, and others)	x		
Causalities types by education level (illiterate primary school, high school, undergraduate, and postgraduate)	*x*		
Driver number using seat belt	x		

TABLE II
IRAQI ROAD SAFETY DATA EVALUATION ACCORDING TO ROAD SAFETY MODELS [10]

Crash Data Type	Descriptive Model	Risk factor Model	Applied Consequences Model
Aggregated Accident number, rate , and severity level by the whole country, the year (since 2011)			
Crash rate by severity level (fatal, non fata (serious injuries and light injuries)	x	x	x
Crash rate by gender and marital status	x		
Crash rate by crash type (overturn, run over and others)	x		
Crash rate by road area type (main road, highway, sub road, and rural)	x		
Crash rate by road type (straight, curved , and flat road)	x		
Crash rate by time of day (sunrise daylight, sunset, , night)			
Crash rate by time of the year (by month)			
Crash rate by road user (driver, vehicle, passenger, pedestrian, and others)	x		
Crash rate by causes (moving car, motorcycles, parked car, roads and others)	x		
Crash rate by road user age group	x		
Crash rate by county (governorate)	x		
Causalities rate by vehicle type (car, bus, van, truck, and others)	x		
Causalities types by education level (illiterate primary school, high school, undergraduate, and postgraduate)	*x*		
Driver number using seat belt	x		

V. ROAD SAFETY DATA IN EUROPE

In Europe, which presents a high decline in the road risk level, the road safety data have been expanded to include data related to exposure of road safety. The data are identified according to the requirements of a road construction task. These tasks are classified into [12]:

A. Pre-Construction Design Safety Check

The road safety data needed in this task include data related to road and vehicle safety standards in addition to environmental and traffic data. The data are used to assess the likelihood of crash happening using assessment models.

B. Routine Safety Management

This task aims to identify the road safety performance which requires crash data details in addition to exposure data related to the road, vehicle, road user behavior, traffic and environment details.

TABLE III
IRAQI ROAD SAFETY DATA EVALUATION ACCORDING TO ROAD DESIGN SAFETY CHECK [10]

Crash Data Type	Pre-construction	Routine Management	Safety Improvement	Safety Comparison
Aggregated Accident number, rate , and severity level by the whole country, the year (since 2011)				
Crash rate by severity level (fatal, non fata (serious injuries and light injuries)				x
Crash rate by gender and marital status				
Crash rate by crash type (overturn, run over and others)				
Crash rate by road area type (main road, highway, sub road, and rural)				
Crash rate by road type (straight, curved , and flat road)				
Crash rate by time of day (sunrise daylight, sunset, night)				
Crash rate by time of the year (by month)				
Crash rate by road user (driver, vehicle, passenger, pedestrian, and others)				
Crash rate by causes (moving car, motorcycles, parked car, roads and others)				
Crash rate by road user age group				
Crash rate by county (governorate)				
Causalities rate by vehicle type (car, bus, van, truck, and others)				
Causalities types by education level (illiterate primary school, high school, undergraduate, and postgraduate)				
Driver number using seat belt				

C. Road Safety Improvement

When records show a high level of crash rate, then road characteristics data are needed to improve the road design.

D. Road Safety Comparison

For this task, the road characteristics and traffic data are needed to assess the road safety level and make a comparison in regional and international level. iRAP [17] methodology is used to assess the level of road design safety in low and middle income countries. This methodology is based on the road attributes and supported traffic data.

In UK, road safety data are published for free using an official website [25] in which most of the data required for road safety check are available. The data are classified into: causalities details, vehicle details, accident details. The details show the location, road characteristics, vehicle, and road user details which could be used in inferential and risk assessment analysis in addition to the consequences analysis mentioned in Section III.

VI. ROAD SAFETY DATA EVALUATION

To evaluate the road safety data availability in Iraq, the publish road accident data by Iraqi CSO [10] are reviewed according to its:

- Source and publishing, types and
- Using in studies, research, and road design tasks.

A. Data Collection System and Sources

The system of road safety data collection has been managed recently when the agreement with the Decade of Road safety Action 2011-2020 was started. The source of the data is the police offices in different parts of Iraq where the traffic accidents are recorded. The data are organized and published by the Iraqi CSO. Hard copy of the data reports is available only. However, coordination between the police offices and the CSO with the Ministry of Health is required and recommended by the CSO to control of under-reporting data problem.

In comparison with the published road safety data in the UK, the United Kingdom has official online licensed website [25] providing detailed road safety data from 1979. The data are reported by the police, recorded using STATS19 accident reporting form and published officially by the department of transport.

B. Data Types

The required type of road safety data is different and can be identified according to the road design task as explained in Section V or to the research and analysis type as mentioned in Section III. Tables I and II show the type of road safety data and the details published in the Iraqi CSO reports. According to the results of evaluation which is shown in these tables, it can be demonstrated that the available data may be used in descriptive and explanatory models which require details of road crash. The aggregated form of the data makes it suitable for making comparison in national and international scale and for identifying the trend of traffic safety performance within a specific period. However, for more scientific research which requires evaluating and assessing the risk factors and the consequences of applying countermeasures, more details related to exposure data is required which is unavailable in the published reports.

According to the requirements of road safety check in the stages of road design which is shown in Table III, the Iraqi CSO reports have not presented the sufficient data which should include road, traffic, and road user data details by location and time. The data also need to include vehicle characteristics and environmental details.

In comparison with the available data in the UK, the provided online free data are classified into vehicle, casualties and accidents data. Each group contains list of data by location with latitude and longitude details. The spatial details with the other providing details help the researcher to use them in more complicated data analysis which is required for road safety studies. It is also helpful in road safety comparison and improvement stages which are required of road design according to road safety standards.

More efforts are needed by Iraqi government to improve the transport and road data collection system to be more qualified with needs of road safety improvement requirements. To

identify what data type and details required, it is needed to focus on the required data for road safety improvement. The improvement can be in the road user behavior, road design, and vehicle design. Because the road user behavior needs a long term program including enforcement and education program, and because Iraq is not a vehicle manufactured country, more efforts are required to improve the road infrastructures. This requires a developing of the road safety standards and presenting forgiving road infrastructures to correct the driver and vulnerable road users' errors [17]. These types of road infrastructures are suggested by iRAP as countermeasures to improve the level of road safety.

VII. iRAP Methodology

The International Road Assessment Program iRAP [17] is a non-profit agency aiming to improve the road safety level in low and middle income countries by quantifying the level of road risk in terms of star ratings. This assessment is based on road attributes and supported data such as traffic data and economic data. The assessment results help the national road agencies to diagnose the blackspot road sections and compare the road design alternatives to decide the safer one. This assessment could be also used to compare the level of road safety in regional and international scale if some aggregation procedures are followed.

The assessment methodology is not the unique aim of iRAP. iRAP also presents economic evaluation of the suggested countermeasures to decide the most proper one according to the level of risk and the available budget especially for partial funded road safety projects in the low and middle income countries.

VIII. Conclusion and Recommendation

The road safety data in Iraq need to be improved by collaboration of the health agencies with the police offices and the transport departments.

The available data are useful for describing the status of road safety in Iraq and comparing with other countries, but more details are needed to include exposure details such as road, traffic, vehicle, and environmental data with spatial and geographical details. The availability of such data could help in conducting more research and studies on road safety which Iraq is lacking.

iRAP Methodology is a helpful tool to the Iraqi transport agencies to consider the road safety standards which can be developed in star rating terms.

The available road data system in the United Kingdom is an excellent example of a dataset which includes the requirements of most of the road safety analysis models and the requirements of road safety design checks. This dataset can be followed by the Iraqi agencies to improve the road safety dataset in Iraq.

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