

## Evaluation of Most Influential Factors Affecting Road Traffic Accidents in Sidon, Lebanon

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### ABSTRACT

*Enlargement of the transportation industry in developing countries has had a tremendous impact on the advancement of those countries. This advancement has had both positive and negative impacts on society. Drawbacks primarily include the emission of harmful gases from vehicles, traffic overcrowding, and most importantly, injuries, and deaths by traffic accidents, which have increased significantly. This paper focuses on and investigates the human, vehicle and environmental factors affecting road traffic accidents in Lebanon in order to increase the knowledge surrounding how the elements have impacted the increase in accidents in Lebanon. A quantitative method (questionnaire) was used to collect data to understand the behavior of road users, while the relative importance index (RII) was used to analyze the data. The results illustrate that the top three vehicle-related factors that lead to an increase in the accidents in Lebanon according to the respondents are steering wheel defects with an RII of 3.807, mechanical faults with an RII of 3.489 and 2.934 for lack of vehicles among all the groups. Furthermore, the human factors were recognized to have a slight impact on road traffic accidents with the highest RII of 1.719 for failure to follow driving codes. In conclusion, a country's development not only depends on economic measure, but it is also determined based on how effective the traffic system infrastructure is and the steps taken to minimize injuries.*

*Keywords: Road traffic accidents; Lebanon; human factors; road factors; traffic congestion*

### INTRODUCTION

One of the major causes of death or injury in the 21<sup>st</sup> century is accidents on the roads (Yahia et al. 2017). Because of this issue, individuals from all age groups, ranging from the eldest to the youngest, cannot be assured of their safety when using any means of transport, which is a serious problem in the modern world. It is alarming that this problem continues to worsen and appropriate solutions have yet to be found. The development of traffic is leads to increase the causalities as the number of accident increased (Singh et al. 2016; Yahia and Ismail 2013). Traffic accidents represent one of the top three causes of death for people in the 5 to 44 year old age group (Grimm and Treibich 2010). The growing importance of traffic accidents as a cause of death was identified in 1990 as it was ranked 9th out of the top 100 causes of death. However, at the present time, it is now ranked in 6th place, according to reports from the World Health Organization (Simon et al. 2009; Ismail and Yahia 2013). In the Mediterranean region, cars are being increasingly used as they provide people with more convenience in society due to this; the authorities are forced to provide various types of transportation systems for the public. Mass public transportation systems are not only beneficial for economic and environmental reasons, but they can also reduce the number of causalities caused

by traffic accidents. The World Health Organization (WHO) has approximated the accidents caused by road traffic to be 32.3/100000 in the region, as compared to 13.4/100000 in the European continent and 18.8/100000 worldwide (Soori et al. 2011). Lebanon, which is considered to be one of the most developing countries in the Mediterranean region, has insufficient traffic management due to its high proportion of privately owned vehicles (Ali et al. 2018). Along with accidents, several detrimental effects are caused by the increasing population of vehicles such as the impact on the national economy, damage to natural resources, effect on culture and also the overdependence on vehicles for all sorts of work and entertainment (Hammad et al. 2019). The number of traffic accidents in Lebanon is a problem that needs to be addressed rapidly for the country's development as it is known that better traffic facilities with minimum causalities leads to more economic growth (Choueiri et al. 2010). The ultimate aim of this paper is to understand the theory by which the traffic is managed in Lebanon with a primary focus on accidents. It will also examine the solutions being developed to resolve the problem of traffic accidents. Also, because of the high dependency on vehicles, this will mean that the rate of accidents will increase given the poor control and management of traffic, which will be discussed in this article.

One of the major ongoing problems of traffic in Lebanon is the over-dependency of the population on privately owned cars rather than using the mass public transport systems as discussed in the introduction. The number of vehicles in Lebanon has raised from approximately 250,000 to 1,600,000 i.e. a 540 percent increase (M Choueiri et al. 2012). If the rate of car ownership is to be considered, then every 2.7 person in Lebanon owns a private vehicle, which stands out as one of the highest in the world. This fact couple with the bad infrastructure of the traffic system explains why Lebanon has one of the highest accident rates in the Mediterranean region. According to the World Health Organization (WHO), traffic accidents contribute to 3.34% of total deaths in the population. Casualties due to accidents are more prevalent among men (63%) than women (37%) even though the proportion of males and females is largely equivalent in Lebanon. Like many Eastern Mediterranean countries, Lebanon experiences excessive road traffic morbidity and mortality rates. According to the WHO Road Status Report 2018, the rate of road deaths in Lebanon was estimated at 18.1 per 100,000, with more than half of these victims below the age of 30.

As Lebanon could be counted as a third world country, there are limited entertainment resources and that itself is a reason why people consider driving as a major source of entertainment, particularly males. It is known that the more people consider it as a form of entertainment, the more the casualties will increase. The major class of victims due to traffic accidents are drivers with a percentage of 48%, with the second major contribution coming from the pedestrians (25%), followed by front-seat passengers (17%) and back-seat passengers (10%) (di Puchong, 2015). Due to the lack of road planning in Lebanon, the majority of the roads lack sidewalks and hence the pedestrians often use the same path used by vehicles, which is one of the primary causes of the high rate of pedestrian accidents. Age also plays a vital role in the occurrence of accidents. It is reported that the majority of casualties were under the age of 30, which is quite obvious due to the adrenalin that younger people possess. The primary victims of accidents are in the 20-29 age range, which represents 31% of the total number of victims.

Detrimental causes of accidents include over speeding in bad weather conditions, packed roads, traffic signals, etc. which contributed the highest percentage of 22%, while inattention to driving contributed to 21% of accidents. Not following the rules well contributes to the highest amount of accidents with 26% and the remainder is caused by the irresponsible movements of pedestrians 10%. Road type also plays a role in the cause of traffic accidents. It is reported that almost half of the accidents happen due to undivided two-way roads, while the rest occur on one-way and divided roads (Moradi et al. 2019; Castillo-Manzano et al. 2020). When undivided roads are

built, it also increases the possibility of accidents due to the recklessness of drivers, poor road conditions, and errors of judgment, etc.

On a monthly based timeline, the peak amount of accidents involving people in vehicles and pedestrians occurs during the summer months (July & August), mainly because the number of vehicles on the roads is the highest during this period (M Choueiri et al. 2012). This is mainly because this season represents the start of vacations and tourism as Lebanon offers opportunities for entertainment during the summer period. In contrast, the winter season usually generates far fewer accidents as there are fewer vehicles on the roads compared to the summer season. When it comes to a weekly timeline, weekends tend to be riskier days for driving as more vehicles are operating compared to the weekdays, the risk of intoxication is greater due to the availability of entertainment and younger people are more inclined to go out on the weekends. Out of all the days in the week, Tuesdays seem to be the least damaging in terms of traffic safety. The daily record of traffic accidents is a vital factor to take into consideration as it would further help us to understand at what period of the day more deaths or casualties occur. The majority of accidents appear to occur towards the end of the afternoon and at the start of the evening. This is mainly due to people returning to their homes after work to have some rest before setting out again. Also as the schools close at this time, this also contributes to the number of traffic casualties. In contrast, accident rates are lowest during the late midnight and early morning hours as there are fewer vehicles or pedestrians on the road. When it comes to accidents considering the time factor, it was expected that most fatalities would occur during the peak rush hours. From a study in 2011, it was reported that the highest number of accidents occurred between 3-6 pm when people were usually returning from their office/school. The second most deadly time period was between 6-9 pm when a substantial amount of people went out, mainly for leisure purposes. Only a few accidents were reported between 3-6 am as the lowest number of vehicles operated during that period (Choueiri et al. 2015).

#### METHODOLOGY AND STUDY AREA

The study focused on evaluating the most influential factors affecting road traffic accidents in Lebanon. The data was collected from a questionnaire designed according to the Likert scale using the normal degree of impacts ranging from 1-5. The questionnaire was divided into four sections. The first section dealt with the personal information of the respondents, the second section requested the respondents to provide their daily trip characteristics, while the third section asked the respondents to answer the questions to evaluate the most influential factors that affect road traffic accidents. Specifically, this part was divided into four sections, namely: human factors, vehicle factors, road factors, and environmental factors. Moreover, the number of

respondents (sample size) was 220 and the questionnaire was distributed using the online method by creating a Google Form file. Also, the Relative Importance Index (RII) method was used to evaluate the influential strength of the factors. The Relative Importance Index (RII) was calculated as in Eq.1.

$$RII = (\sum w) / w_{highest}^{xn} \quad (1)$$

Where: W: Weight/ rank of each answer, n: The total responses received or some respondents.

$W_{highest}$ : The highest rank/weight which is "5" that can be obtained

## RESULTS AND DISCUSSION

### DEMOGRAPHIC CHARACTERISTICS OF THE STUDY

One of the most important factors that can have an impact on any study is the demographic characteristics of the respondents. The information such as age, occupation, education level, driving experience and working days will help to understand the behavior of respondents and ensure the accuracy of the data collected. Figure 1 display the age of the respondents, which vary between 18 to above 45. It can be observed that the highest proportion of participants were in the 18-25 age group with 52%, which will have a positive influence on the study as people in this age group are most frequently involved in road traffic accidents. The smallest age group in the study was the over 45s with only 8%

Figure 2 illustrates the education level of the respondents who contributed to this study, which vary from no educational qualification to having a master's degree. In this study, most of the participants had a bachelor's degree (69%) while the remaining groups amounted to 31%. This indicates that a significant majority of the respondents were educated and their opinions regarding road traffic accident are important.

Figure 3 shows the number of working/studying days per week of the respondents, which ranges from two days to more than five days. As Lebanon is a fairly active country, the results were favorable as those who worked five days (mainly weekdays) accounted for 45%. Also, people who are active with vehicles on weekends as well (i.e. more than five days a week) amounted to 34%.

Figure 4 reveals the most important factor affecting road traffic accidents, which is driving experience. Drivers with experience of 1-3 years contributed to this study the most with 53%, which is obvious as a lack of experience contributes to more traffic accidents. Secondly, drivers with experience of more than 12 years and drivers with 4-7 years of experience both contributed to this study with 19%.

## FACTORS AFFECTING ROAD TRAFFIC ACCIDENTS

### EFFECTS OF HUMAN FACTORS ON ROAD TRAFFIC ACCIDENTS

The evaluation of human factors affecting road traffic accidents is presented in Figure 5. The results show that the most influential factor among the human factors is lack of adherence to driving codes with an RII of 1.719 followed by the inexperience of the drivers with RII of 1.548 and sleepiness and fatigue with RII of 1.277. The failure to obey traffic codes and traffic devices, which are the only means of communicating between traffic engineering and road users, always has a positive impact on the increase in road traffic accidents.

### EFFECTS OF VEHICLE FACTOR ON ROAD TRAFFIC ACCIDENTS

The safety of the drivers, passengers, and pedestrians is affected by the condition of vehicles and if they are regularly maintained, this can reduce the number of accidents caused by vehicles. The assessment and ranking of vehicle factors involved in road traffic accidents are shown in Figure 6, which shows that steering wheel defects ranked as the most effective factor with an RII of 3.807, while other mechanical factors were ranked as the second factor with an RII of 3.489. The sleepiness and fatigue as the third influential factor with an RII of 2.934. The evaluation of vehicle factors indicates that the drivers disregard regular maintenance and this issue causes a significant number of accidents in Lebanon.

### EFFECTS OF ROAD FACTORS ON ROAD TRAFFIC ACCIDENTS

The clearance of sight distance on the roads and the physical appearance of the road surface are very important to ensure the safety of road users. The ranking of road factors affecting road traffic accidents is presented in Figure 7. From Figure 7 it is obvious that the animals out of control ranked as the First with RII of 2.856 followed by Roadside details with RII of 2.338 and roadway geometries with RII of 1.614. Moreover, the animals out of control usually used the pavement surface in winter to warm their bodies and when the roadside details such as sing not clear to worn the drivers then lots of accidents will occur. Also, the geometric design of the road such as the width of the lanes, the radius of curvature and the clearance of road sings play a great role to reduce the accidents worldwide.

### EFFECTS OF ENVIRONMENTAL FACTORS ON ROAD TRAFFIC ACCIDENTS FACTORS

Lebanon has a variety of different terrains including mountains and coasts, and at winter, road users need to careful when driving because of the weather conditions. The investigation of environmental factors affecting road traffic accidents in Figure 8 shows that glare was classified as the most significant factor and this is an indication of poor illumination of the road, while weather conditions have a

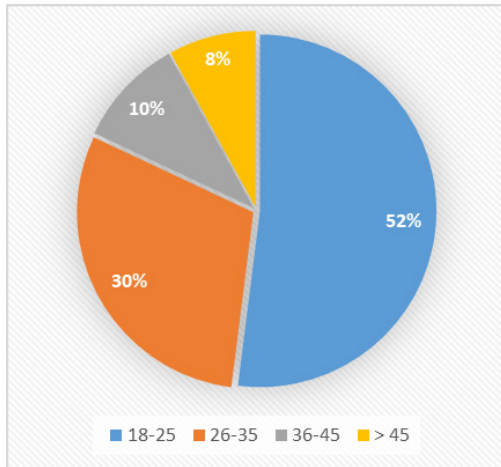


FIGURE 1. The age of the respondents

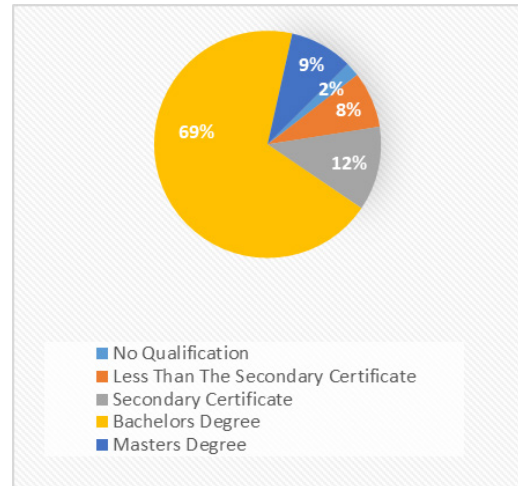


FIGURE 2. The education level of the respondents

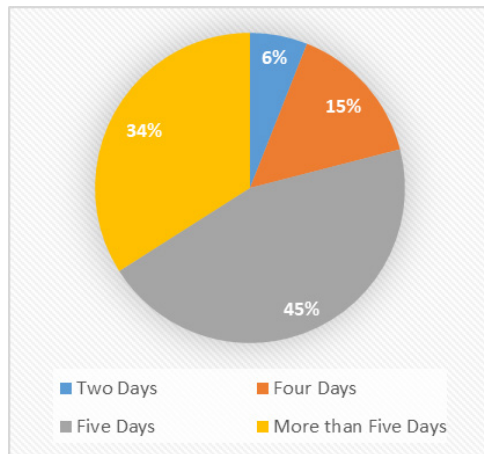


FIGURE 3. The number of working/studying days per week of the respondents

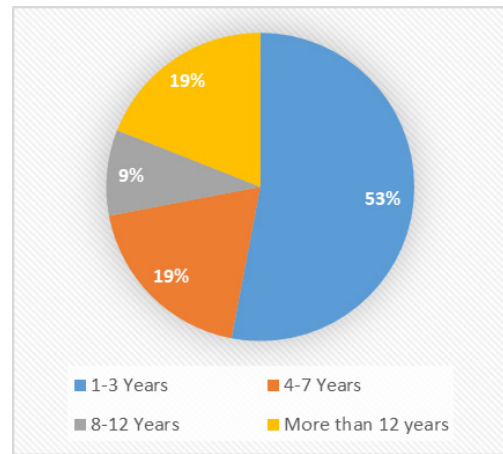


FIGURE 4. The driving experience of the respondents

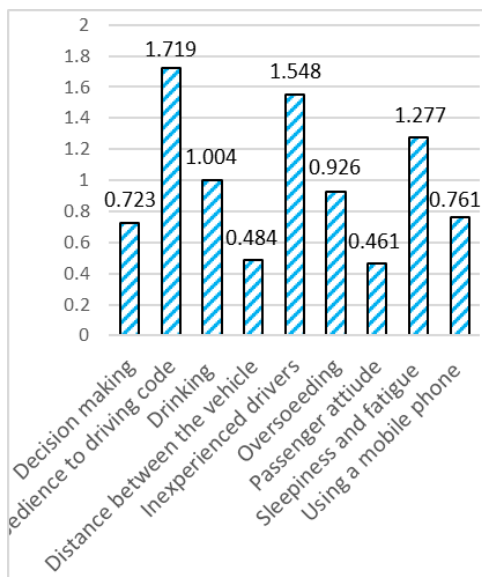


FIGURE 5. The RII of human factors

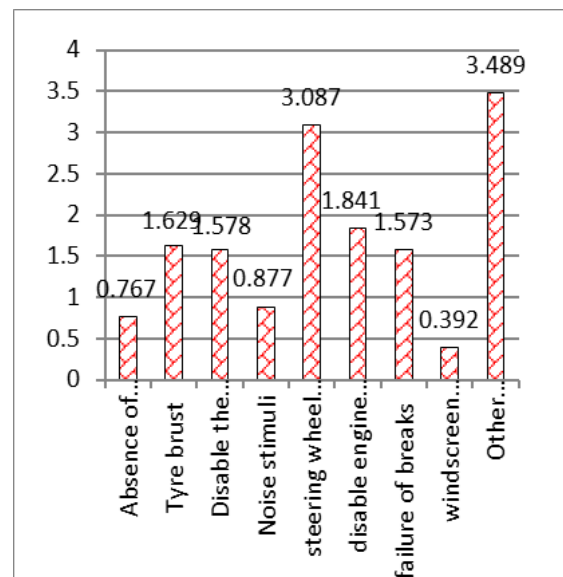


FIGURE 6. The RII of Vehicle factor



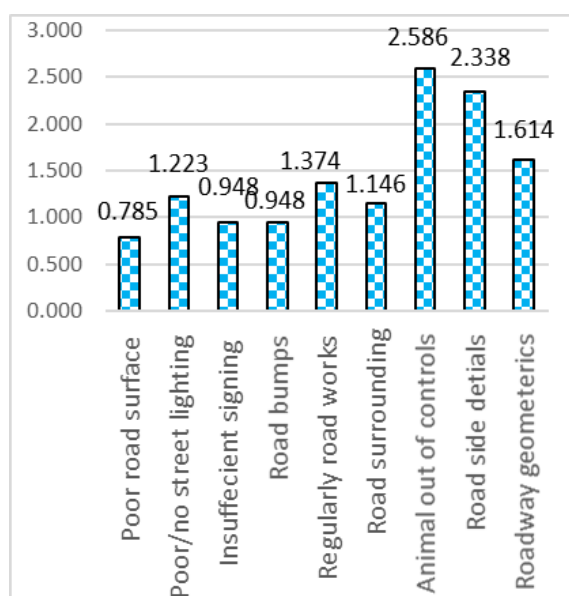


FIGURE 7. The RII Road factors

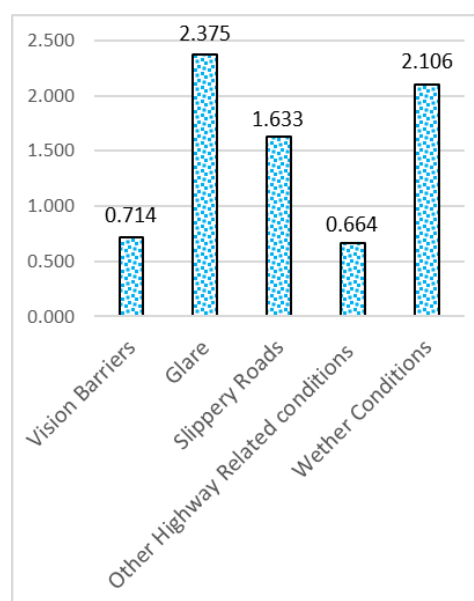


FIGURE 8. The RII of Environmental factors

considerable impact on road traffic accidents and slippery roads were ranked as the third factor.

Moreover, the following recommendations could be helpful to reduce accidents in the future:

1. The government should impose strake regulations about the regular maintenance of the vehicles and speared awareness about the importance of this issue.
2. Re-evaluation the procedures of issuing the driving license, as well-knowing that issuing the licence without proper examination leads to increase the accidents rates thus increase the proportion of casualties.
3. The traffic devices on the road are very important to guide the road users along with the road networks; sings should be clear and within the proper distance to allow the drivers to have a great reaction time for both expected and unexpected situations.

#### CONCLUSION

The road user's drivers, pedestrians, and passengers are the most significant elements of the traffic system, and the drivers are the most important as they operate the vehicles on the road. Also, the driver's behavior is one of the complex issues which need the proper devices and tools to achieve efficiency, safety and good utilization of the road. The paper was conducted to assess the factors affecting road traffic accidents in Lebanon, it was found that the vehicle factors have the highest influences on road traffic accidents according to the respondents among the groups with highest RII of 3.807, followed by the road factors with RII of 2,586 while environmental factors were ranked the third among the groups. The human factors were considered to have great impacts on the accidents in the study in comparison with other factors causes of accidents.

#### DECLARATION OF COMPETING INTEREST

None.

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