

RESEARCH ARTICLE

Road Traffic Accidents and Environmental Risk Factors in Erbil City

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Received: 03 March 2022

Accepted: 18 May 2022

Published: 14 August 2022

DOI

10.25156/ptj.v12n1y2022.pp108-118

ABSTRACT

Motorization has improved the lives of people and societies; these benefits have to go with a value. Though the number of lives lost in road accidents in high-income nations points to a downward style in recent decades, for many of the world's population, the liability of road-traffic injury in terms of social and economic costs is rising considerably. This study aims to determine the prevalence of the environmental factors associated with the outcomes in Erbil city. A community-based cross-sectional descriptive household visits survey study was carried out from March-November 2021 and was composed of 3743 individuals selected through a multi-stage sampling technique. A specially designed questionnaire was used to collect sociodemographic and environmental data from the participants through face-to-face interviews with the amount RTAs occurrence, Chi-square, and percent used with P-value ≤ 5 for significance. A total of 3743 road accidents were surveyed, and 675(18%) reported road accidents. Young males were main (53%), mean of age (28.5 ± 18.26) years old. statistically, the highest prevalence occurred in urban location 550(81.5%), by drivers 475(70.4%) at daylight 410(60.7%), during rush hours. A significant association was reported between death proportion and the rural crash, on 80 km street speed, wet weather, rollover type, at night-shift, on Sunday, in January. The outcome of the present study shows a significant relationship between environmental situations and road traffic accidents in Erbil.

Keywords: Accidents, Road, RTAs, Study, Value.

people and murdered individuals every day in the KRI, which

INTRODUCTION

Harmless, sustainable, and sound mobility is considered important requirements for a human being. Unfortunately, transport or mobility has grown into a 'global tragedy' creating an increase in accident patterns and characterizing the main source of premature disabilities and deaths globally (Das et al., 2016). An estimation by the World Health Organization (WHO) in 2018 that 1.35 million persons annually died from highway accidents, together with the extra 2050 million persons who are extremely hurt or disabled. Low and Middle-income nations, which community further than half (60%) of the biosphere' automobiles, bring the majority (90%) of RTA-associated morbidities and deaths (Kourouma et al., 2019). In general, Iraq is unsafe in the quantity and severity of happenings due to insufficient traffic protection systems stem (Al-Jameel, 2016). Kurdistan has not different from Iraq in the expressions of protection stage and the absence of a coincidence reporting system another connected significant evidence system like sources of an incident. Traffic accidents are the source cause of deaths in the Kurdistan Region of Iraq (KRI), Reports from the Ministry of Health in the KRI claimed that RTA injured 28

earnings about 10,000 injuries and 850 deaths yearly (Rudow, 2017). A lot of studies showed that road accidents have complex results in which human is the main impact, as automobile, and ecological factors (Khosravi et al., 2012; Bahadorimonfared et al., 2013). Grounded in a study of topographical differences and RTAs conducted in England, an important friendship originated among foggy and rainy days and the number of RTAs (Jones et al., 2008). According to Norman et al., research on the effect of street indirectness as a result of climate upsurge in the south of Sweden of accidents, and awarding the categorization scheme of roads' slipperiness, found that providing necessary alerts when the climate is not normal (Manochehr and Ali, 2012). In another study of the influence of weather on the happening of Canadian RTAs, the influence of the average temperature, rain, and snow between 1990 and 1992 was studied and included a suggestion that the significant impacts of these three influences on RTAs, although the snowy climate was more in effect (Papa, 2014). Agreeing to the research of weather influences on the system of transportation in the USA on roads, these influences have been raised lately; critical weather situations decrease the

traffic speed and increase the occurrence of crashes (Strong et al., 2010), another study on RTAs showed an increase on some holidays days as a result of unfavorable weather on the utmost of the days, in another period it was due to the increase in travel (Manochehr and Ali, 2012). Thus, ecological factors have extraordinary significance because of their harshness and damage to road accidents. A lot of studies conducted in Iraq for the RTAs such as those by Leidman et al., (2016) and the Kurdistan Region of Iraq (KRI) such as (Nakshabandi, 2007; Leidman et al., 2016; Jaff, 2018; Gökçekuş et al., 2020) demonstrated different manners but this subject so that this study aimed to identify the environmental risk factors of road traffic accidents in Erbil city.

Objectives of the study:

- 1) Identifying certain sociodemographic and environmental risk factors.
- 2) Find out the associations between environmental

characteristics of RTA victims and clinical outcomes.

SUBJECTIVE AND METHODS

This cross-sectional descriptive survey was conducted from the 1st, March-15th, November 2021, in Erbil city this study was done, in the Iraqi Kurdistan capital, a municipal-based cross-sectional investigation based on family visits was carried out for this subject. A multi-stage sampling method was used to collect the study subjects. In the first stage, Erbil city was divided into 37 quarters based on the directorial map of the city, and a systematic random sampling technique was used to select 40 families in each neighborhood. We strongminded a sampling interval k^{th} for each neighborhood as the proportion of the valued quarter extent to the sample size of 40. The first household in each quarter was selected randomly, and the following families were nominated by choosing every k^{th} domestic. The study populace included all the adult populations of these families aged <2 years or over.

Table 1: Distribution of the sample size according to catchment allowing the Erbil City zone

Erbil city Sectors	Residence	250/100000	Area	Area sample 25%	Required sample size	Individual taken/each area
First	45576	202.3244	11	3	200	67
Second	96276	427.397	22	6	421	71
Third	110964	492.5997	26	7	485	70
Fourth	338100	1500.919	34	9	1478	165
Fifth	97884	434.534	23	6	428	72
Sixth	117040	519.573	25	6	512	86
Total	805,537	3577	141	37	3524	3550

1. Inclusion criteria

Individuals previously experienced road traffic accidents during the years 2017,2018, and 2019.

2. Exclusion criteria

Road traffic accident victims before 2017 and after 2019, under 2 years of age victims.

Data Collection

A face-to-face interview data collection using a special questionnaire was intended for this study and designed by the researcher. The questionnaire involved personal and sociodemographic statistics such as age, gender, marital status, educational level, and occupation type. Besides, encompassed questions on RTAs location, municipality, road situation, climate facts, and the automobile kind involved, also the time features comprised in particulars. For testing the validity and reliability of the questionnaire and based on that modifications were made accordingly. The pilot study showed that the Cronbach's alpha (internal consistency) approximation of the questionnaire was 0.81 and the coefficient reliability was 0.81., the sample size was calculated assuming that the prevalence of RTAs in Erbil city

is similar to the previously reported 11.7% for the Iraqi individuals (CSO, 2019). Using the Epi-info (CDC, 2021), it was found that the sample size of 3550 was adequate to reach a 95% confidence interval for the prevalence ($\pm 2\%$) of these residents. The sample was increased to 3743 to accommodate for nonresponse. We assumed that each household would have 4 individuals at any age who may have previously suffered from RTAs then visiting 888 families will produce a sample of around 3550 or more respondents. Then, we selected 30 households in each of the 37 quarters. The Chi-square test was used for comparing rates. A P value ≤ 0.05 was used as statistically significant.

RESULTS

This survey of 3743 individuals to identify the road traffic accident victims between the years (2017-2019) was conducted in Erbil. The mean \pm SD age of the participants was 28.5 ± 18.26 years. The highest proportion of participants aged 10-19 years reported by one-fourth were 921(24.6%) and the amongst gender participated in the survey were male 1983(53%),1138(30.4%) of the participants graduated from secondary school, less than that founded among \leq Preschool

345(9.2%) one-fifth (18.4%) had an occupation of Semiskilled manual (Table 2.). The victims of RTAs showed 675(11.23%) in this study the highest proportion of victims aged in the 2nd decade of their lives (10-19) that represented about one-fourth (24.9%), mean \pm SD was (29.7 \pm 15.9), the majority (74.2%) were males, 42.5% were married and 40.1% were single, the majority of RTAs victims number was graduated from either college (28.6%) or secondary school (28.4%) respectively, 27% had a work of Semiskilled manual, finally, 38.2% of them were single (unmarried).

Table 2: The studied sample's basic characteristics

Variables	Features	Household individuals		RTA Victims	
		No.	(%)	No.	(%)
Age	< 10	564	(15.1)	120	(17.8)
	10-19	921	(24.6)	168	(24.9)
	20-29	652	(17.4)	117	(17.3)
	30-39	547	(14.6)	106	(15.7)
	40-49	498	(13.3)	81	(12.0)
	50-59	298	(8.0)	37	(5.5)
	≥ 60	263	(7.0)	46	(6.8)
Gender	Male	1983	(53.0)	501	(74.2)
	Female	1760	(47.0)	174	(25.8)
Educational status	Illiterate	359	(9.6)	55	(8.1)
	\leq Preschool	345	(9.2)	32	(4.7)
	Read and write	476	(12.7)	69	(10.2)
	Primary	570	(15.2)	134	(19.9)
Occupation	Secondary School	1138	(30.4)	193	(28.6)
	College +	855	(22.8)	192	(28.4)
	Housewife or Unemployed	626	(16.7)	48	(7.1)
	Unskilled Manual	357	(9.5)	94	(13.9)
	Semiskilled manual	689	(18.4)	182	(27.0)
	Skilled manual and non-manual	344	(9.2)	99	(14.7)
	Associate professional	69	(1.8)	19	(2.8)
	Skilled professional or senior managerial	35	(0.9)	7	(1.0)
	Highly skilled professional	3	(0.1)	1	(0.1)
	Child	345	(9.2)	32	(4.7)
Marital status	Student	1275	(34.1)	193	(28.6)
	Single	1430	(38.2)	271	(40.1)
	Married	1380	(36.9)	287	(42.5)
	Divorced	25	(0.7)	7	(1.0)
	Widowed	96	(2.6)	9	(1.3)
Total	Child	812	(21.7)	101	(15.0)
		3743	(100.0)	675	(100.0)

In the present survey, 888 households composing of 3743 individuals (male and female) participated in the study survey, among the total shared respondents in Erbil city with a completely 6 municipalities, only 675(18%) of them experienced previous road traffic accidents (RTAs) between the years of 2017, 2018, and 2019, the detail of RTAs period explained in Figure 1

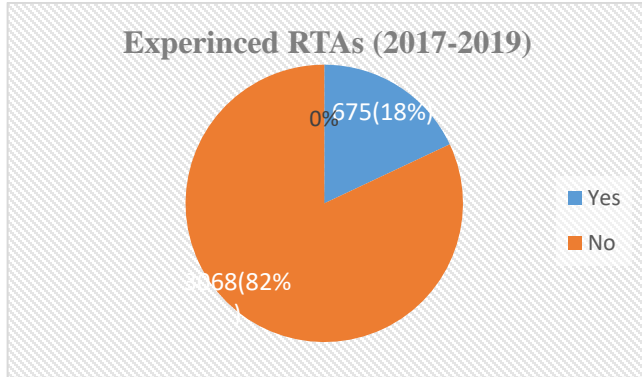


Figure 1: The prevalence of RTAs among respondents

RTAs in urban places was 550(81.5%), whereas the other one happened in rural places was 125(18.5%), as shown in Table 3. While the highest prevalence recorded in the municipality four 299(44.3%), the lowest sector recorded in the first one was 49(7.3%), the highest proportion of RTAs victims witnessed in the 40 km, though the lowest rate prevalence of 1.6% was recorded in the street 120m, 40 meters, and the center respectively. The highest proportion of victims witnessed RTAs in clear dry weather 583(86.4%), and the lowest one was recorded in Cloud 5(0.7%), the most victims involved in this survey reported driver by 475(70.4%), while less than was among pedestrians 61(9%), finally, Rear-End collision 189(28%) and Single Vehicle Accidents 178(26.4%) as the highest proportion prevalence of RTAs types, while Multiple vehicle pile-up recorded types than percent reported were 19(2.8%).

In the present study, the highest proportion prevalence of

Table 3: Environmental condition prevalence of RTAs victims

Variables	Features	No.	(%)
Place	Urban	550	81.5
	Rural	125	18.5
Municipality	One	49	7.3
	Two	92	13.6
	Three	97	14.4
	Four	299	44.3
	Five	72	10.7
	Six	66	9.8
Street	30 Meter	19	2.8
	60 Meter	47	7.0
	100 Meter	77	11.4
	120 Meter	11	1.6
	100 Km	68	10.1
	60 Km	132	19.6
	40 Km	203	30.1
	80 Km	96	14.2
	40 Meter	11	1.6
	Center	11	1.6
Weather condition	Dry	583	86.4
	Rainy	46	6.8
	Wet	41	6.1
	Cloud	5	0.7
Victims type	Driver	475	70.4

RTA type	Passenger	139	20.6
	Pedestrian	61	9.0
	Rear-End collision	189	28.0
	Multiple vehicle pile-up	19	2.8
	Single Vehicle Accidents	178	26.4
	Rollover of Vehicle	28	4.1
	Head-on collisions	35	5.2
	Side-impact collision	82	12.1
	Sideswipe Collisions	70	10.4
	Pedestrian-Related Crashes	74	11.0
Total		675	(100.0)

As shown in Figure 1, the highest rate prevalence of RTAs occurred at daylight 410(60.7%), on Tuesdays and Wednesdays by 17% (Fig. 2), in July 130(19.3%) (Fig 3) and at daylight period (60.7%) (Figure 4), nearly half (49.9%) of these accidents was at rush hours (sunset) period (Figure 5), in Summer were 265(39.3%) (Figure 6). The lowest proportional prevalence of RTAs at night was 265(39.3%), on Saturday 76(11.2%) on October 21(3.1%), and particularly at midnight 10(1.5%), in Autumn 37(5.5%).

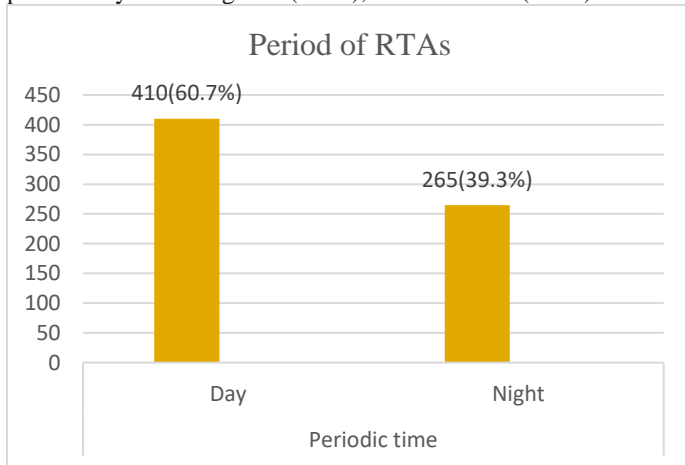


Figure 2: Distribution of the RTAs victims by the period

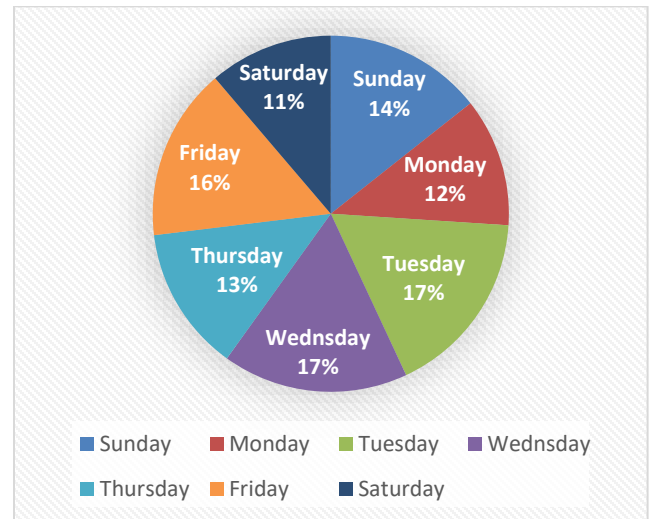


Figure 3: Days week distribution based on the victims' number of RTAs

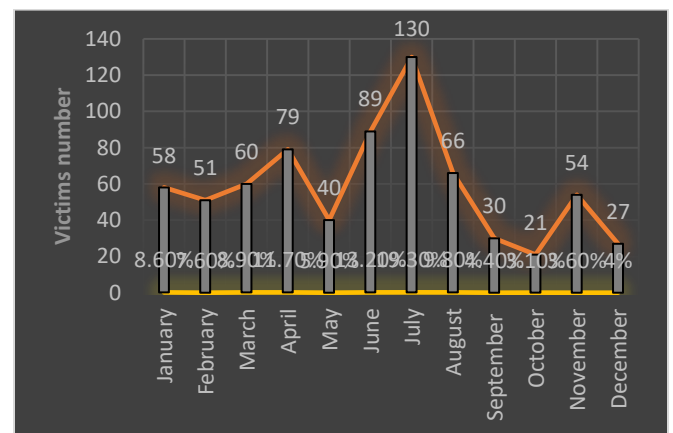


Figure 4: Months distribution based on the victims' number of RTAs

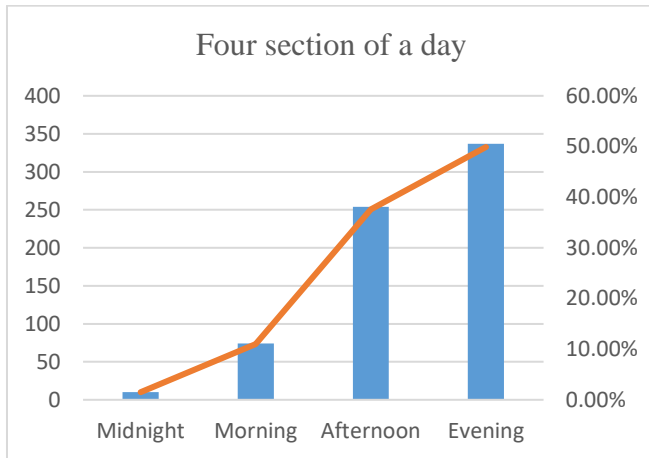


Figure 5: Periodic time of RTAs distribution by the victim's amounts

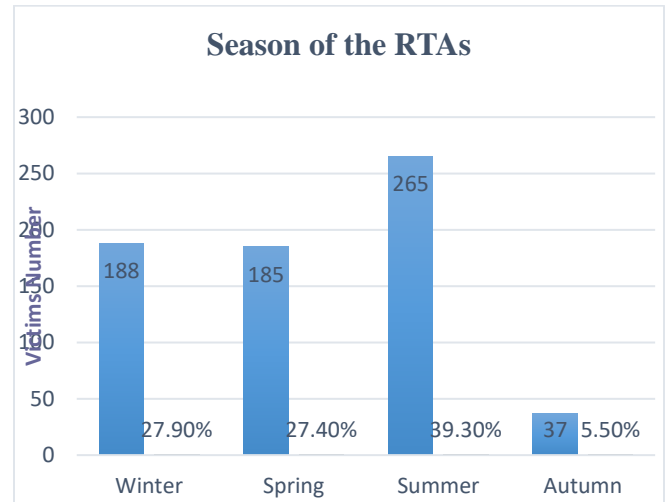


Figure 6: Distribution of RTAs victims by the season period

It appears from the results of Table 4, that there was a statistically significant association between the environment and the road accidents feature lace (P-value=0.42) with the highest death proportion in the rural areas by 6(4. %), in the municipality six 7(10.6%) (P-value<0.001), street victims (P-value=0.009), 5(12.2%) of deaths rate occurred in wet weather condition (P-value=0.006), the driver 4(6.6%) victims involved (P-value=0.004), and crash type (P-value<0.001) which present rollover as the main responsibility of death by 6(21.4%).

Table 4: Association between the environmental condition of victims and the outcomes

Variables	Features	Outcomes			P-value
		Alive No. (%)	Dead No. (%)	Total No. (%)	
Crash place	Urban	541(98.4)	9(1.6)	550(100)	0.042
	Rural	119(95.2)	6(4.8)	125(100)	
Municipality	One	49(100)	0(0.0)	49(100)	<0.001
	Two	91(98.9)	1(1.1)	92(100)	
	Three	90(92.8)	7(7.2)	97(100)	
	Four	299(100)	0(0.0)	299(100)	
	Five	72(100)	0(0.0)	72(100)	
	Six	59(89.4)	7(10.6)	66(100)	
Street	30 Meter	18(94.7)	1(5.3)	19(100)	0.009
	60 Meter	46(97.9)	1(2.1)	47(100)	
	100 Meter	77(100)	0(0.0)	77(100)	
	120 Meter	11(100)	0(0.0)	11(100)	
	100 Km	66(97.1)	2(2.9)	68(100)	
	60 Km	128(97)	4(3.0)	132(100)	
	40 Km	203(100)	0(0.0)	203(100)	
	80 Km	89(92.7)	7(7.3)	96(100)	
	40 Meter	11(100)	0(0.0)	11(100)	

Weather state	Center	11(100)	0(0.0)	11(100)	0.006
	Dry	573(98.3)	10(1.7)	583(100)	
	Rainy	46(100)	0(0.0)	46(100)	
	Wet	36(87.8)	5(12.2)	41(100)	
Victim type	Cloud	5(100)	0(0.0)	5(100)	0.004
	Driver	470(98.9)	5(1.1)	475(100)	
	Passenger	133(95.7)	6(4.3)	139(100)	
	Pedestrian	57(93.4)	4(6.6)	61(100)	
Types of crash	Rear-End collision	188(99.5)	1(0.5)	189(100)	<0.001
	Multiple vehicle pile-up	19(100)	0(0.0)	19(100)	
	Single Vehicle Accidents	175(98.3)	3(1.7)	178(100)	
	Rollover of Vehicle	22(78.6)	6(21.4)	28(100)	
	Head-on collisions	35(100)	0(0.0)	35(100)	
	Side-impact collision	81(98.8)	1(1.2)	82(100)	
	Sideswipe Collisions	70(100)	0(0.0)	70(100)	
	Pedestrian-Related Crashes	70(94.6)	4(5.4)	74(100)	
	Total	660(100.0)	15(100.0)	675 (100.0)	

This study showed a significant association between the time consequences of RTAs and the outcomes (Table 5.), the highest prevalence proportion witnessed RTAs as a result of deaths was in the night shift 12(4.5%) with a P-value of 0.001, at January 5(8.6%) (P-value=0.04%). In another hand non-statistically

significant relationship founded between them in Sundays 5(5.2%) (P-value=0.333%), at the evening period by one-third percent 11(3.3%) (P-value=0.177), in winter 8(4.3%) (P-value=0.165), at the year of 2017 6(3.4%).

Table 5: The time associated with the outcomes of RTAs victims

Variables	Features	Outcomes			P-value
		Alive	Dead	Total	
Time	Day	407(99.3)	3(0.7)	410(100)	0.001
	Night	253(95.5)	12(4.5)	265(100)	
Days	Sunday	91(94.8)	5(5.2)	96(100)	0.333
	Monday	78(98.7)	1(1.3)	79(100)	
	Tuesday	113(98.3)	2(1.7)	115(100)	
	Wednesday	111(97.4)	3(2.6)	114(100)	
	Thursday	87(96.7)	3(3.3)	90(100)	
	Friday	105(99.1)	1(0.9)	106(100)	
	Saturday	75(100)	0(0.0)	75(100)	
Months	January	53(91.4)	5(8.6)	58(100)	0.04
	February	49(96.1)	2(3.9)	51(100)	
	March	59(98.3)	1(1.7)	60(100)	
	April	78(98.7)	1(1.3)	79(100)	
	May	37(92.5)	3(7.5)	40(100)	
	June	88(98.9)	1(1.1)	89(100)	
	July	129(99.2)	1(0.8)	130(100)	
	August	66(100)	0(0.0)	66(100)	
	September	29(96.7)	1(3.3)	30(100)	
	October	21(100)	0(0.0)	21(100)	

Period	November	24(100)	0(0.0)	24(100)	0.177
	December	27(100)	0(0.0)	27(100)	
	Midnight	10(100)	0(0.0)	10(100)	
	Morning	72(97.3)	2(2.7)	74(100)	
	Afternoon	252(99.2)	2(0.8)	254(100)	
Season	Evening	326(96.7)	11(3.3)	337(100)	0.165
	Winter	180(95.7)	8(4.3)	188(100)	
	Spring	181(97.8)	4(2.2)	185(100)	
	Summer	262(98.9)	3(1.1)	265(100)	
	Autumn	37(100)	0(0.0)	37(100)	
Years	2017	169(96.6)	6(3.4)	175(100)	0.131
	2018	183(97.9)	4(2.1)	187(100)	
	2019	308(98.4)	5(1.6)	313(100)	
	Total	660(100.0)	15(100.0)	675 (100.0)	

DISCUSSION

In this study, the highest prevalence proportion of road traffic accidents was reported in urbanized places this study was in contrast with another one conducted in India which showed rural areas had the highest proportional prevalence by more than two-thirds (Kumar et al., 2020). This may be attributed to their high-speed driving environment and the much lower presence of pedestrians and other non-motorized traffic, or drivers feeling free, particularly at night. Besides, the roadway and traffic characteristics of rural roads and their surrounding environment are different from the urban streets. Most of the traffic accidents reported inside and outside the city were between the corridors of narrow houses, and approximately. The majority of accidents occurred reported in dry clear weather, another study accepted that the highest number of crashes was in the clear-dry climate in Iran (Lankarani et al., 2014; Jalilian et al., 2019). The driver is shown in the present study as having the highest prevalence because the fundamental factor of road accidents is the driver and this is normally shown noted in this study, this result can be seen in many studies. A rear-End collision is reported to be the highest proportion prevalence of road accidents, this result was in continue by (Xi et al., 2019) Analysis of influencing factors for rear-end collision on the freeway, which means speeding and destruction exactly with our results such speed on 80 km in Pirmam, Koysanjaq, and Gweir roads can be estimated occurring.

The daylight reported the highest rate of RTAs, this result was in connection with (Lankarani et al., 2014) and another result showed that under the significance level of 0.001, the probability of rear-end collision at night was 2.14 times higher than that of daytime (Xi et al., 2019).

The Summer season particularly July month had the highest proportion of RTAs a connection to a study in Iran (Bahadorimonfared et al., 2013) conducted the years (2004-to 2011), the analysis study showed that the frequency of such occasions was considerably raised during the summer day off, at sunset (rush hour) these results were in support with those with Lankarani et al, in 2014 at sunset and sunrise than those occurring during daytime (P less than 0.001), and about three-fourths of death-injury in that time (P-value=0.003) (Jalilian et al., 2019), whereas other study showed January as the most event of death rate (Kumar et al., 2020).

Results showed a statistically significant association between the environment and the rural death rate (P-value=0.42), In a study done on the foremost issues touching street accidents in Iran, it was reported that most rural mishaps happened on the foremost highway and roads. The main accident-related factors were denser traffic, wider roads, road narrowing, and discounting traffic rules. The road accident going on the road resulted from the lack of suitable street repair and fitting fit traffic signs (Lankarani et al., 2014; Kumar et al., 2020)., other studies showed higher crash severity is related to rural highways, main arterials, not at connection places, locations with curves (Wang and Zhang, 2017). In the municipality six with (P-value<0.001) deadly proportion was highly recorded, this municipality is considered the last in terms of its classification by the municipality of Erbil, where entry and exit to the city are considered modern, the purchasing and population acceptance is high in it, and many accidents have likely appeared for the reasons mentioned, and that why other significant association reported the edge of Erbil our results of street 80 Km rapidity (P-value=0.009).

Deaths rate occurred in wet weather conditions (P-value=0.006), a study conducted in the US reported

that driving during inclement weather (wet and cold) can more likely cause accidents supported by (Lankarani et al., 2014), and another result from a study showed ($P=0.001$), the likelihood of rear-end collision under the non-fine (rainy-snow) climate was 1.53 times higher than that under the good climate (Xi et al., 2019). Environmental influences may be distributed into time, weather, and location particularly when the mishaps are predisposed to arise, in another word climate, six studies stated that accident typically happens during rainy or wet street climate (Mondal et al., 2011; Jaroszweski and McNamara, 2014; Aron et al., 2015; Asefa et al., 2015; Saha et al., 2016; Black et al., 2017).

The driver involved ($P\text{-value}=0.004$), and which was in connection with another study in Iran $P\text{-value}=0.007$ with visual obstruction due to injury-death among 40% of victims, and other situations such as fatigue and poor vision due to the inadequate light-this condition tin were simply main to rear-end crash (Xi et al., 2019). About the crash type ($P\text{-value}<0.001$) which presents rollover by more than one-fifth, besides significant association between the times' consequences of RTAs due to deaths, the highest of prevalence proportion deaths was in the night shift ($P\text{-value}=0.001$), this study was supported by another one in which $P\text{-value}$ showed <0.001 and the night period with percent 23.8 showed more injury-death significant relationship (Lankarani et al., 2014), in our opinion daylight afford improved visibility and longer to the road user, particularly drivers and that why RTAs happen more in the night-time and this opinion supported by Huang and Levinson in 2010.

A statistically non-significant relationship founded between them on Sundays ($P\text{-value}=0.333\%$), in the evening ($P\text{-value}=0.177$), in winter ($P\text{-value}=0.165$), and in the year 2017, this is maybe returning to the geographical area and lifestyle of people involved in the present study. The majority of deaths were shown in this study in January ($P\text{-value}=0.04\%$). This result was supported by another one in India by Kumar et al (2020) showed that RTA victims according to the month of incidence mainstream were originated in January (12.5%), although our study showed the vast majority of RTAs occurrence in Summer yet, the highest proportion of death rate reported in the winter, according to a study by Petr (2019) Winter climate is particularly hazardous, frequently resultant in very slippery highways. An average of 688 mortalities from RTAs happen every year in the USA as a result of winter weather situations, which is further than all other formal climate threats combined.

CONCLUSION

This study reported that the vast majority of RTAs occurrence was the urban, in the fourth municipality, on the 40 km speed limit, with a clear-dry climate, in the daylight particularly at rush hours (evening) in summer particularly in July, by drivers as most involved victims, the outcome of the present study shows a significant relationship between environmental situations and death rate of the road traffic accidents in Erbil such as rural location, sixth municipality, 80 km speed, wet street, at night, particularly rollover and the last most people effected were pedestrian, these results are due to the subject concentration of this study on environmental factors.

Conflict of interest

The authors declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

Ethical considerations: The approval from the ethical committee from the college of medicine at Hawler Medical University was obtained to do this study. Official permission was obtained for doing this survey and verbal informed consent was taken from all the participants.

Limitations

Limitations were reported in the present study by having the sample containing mostly of particularly women as contributors. The household visits were done at daylight time when most household male members might be outside busy for their lifestyle logistical purposes. It was hard to make follow-up visits to the households to interview the absent male adults. Visiting the households for the survey purpose in the evening hours is also socially not preferable in those localities.

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