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Investigating the Relative Risk Factors of Injuries Caused by Accidents on Roads in the Mashhad Area in 2007

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Abstract

Background: Currently, accidents are the second highest cause of death in most societies. Traffic accidents account for the largest proportion of accidental deaths. The aim of this report was to identify the accidents that cause casualties on the roads around Mashhad.

Patients and Methods: This study was a case-control study, where the cases were drivers who had accidents resulted in casualties, and the controls were drivers who had accidents in the same locations without casualties. Variables included age, sex, seatbelt use, spontaneous combustion, entrapment within the vehicle, ejection from the vehicle, music playing in the vehicle at the time of the accident, use of cell phone, smoking at the time of the accident, the direction of the accident, the time of day, and the model of the vehicle.

Results: Interviews were conducted with the 90 % of the cases and the 93 % of the controls who consented to being interviewed. Females accounted for 16.2 % of the case group and 23.4 % of the control group, and males comprised 83.8 % of the cases and 76.6 % of the controls. The average age of the case group was 35.5 ± 10.5 and of the control group was 39.4 ± 9.8. The use of a seatbelt as a safety factor was significantly greater in the control group (OR = 0.44). Combustion occurred in approximately 21 % of the accidents in the case group, but in only 1.3 % of the accidents in the control group. Being trapped in and being ejected from the vehicle were significantly more prevalent in the case group.

Conclusions: According to the results of this study, the fastening of seatbelts had a significantly positive effect on reducing the injuries caused by an accident. Age was another significant indicator influencing the outcome of road accidents education through media seem to play agreat role in reducing mortality and morbidity due to road accident.

Keywords: Accidents; Case-control study; Mashhad

Introduction

According to the World Health Organization (WHO), an accident is defined as an incident with no history that causes recognizable harm. Based on the annual statistics of the WHO, approximately 1.2 million accidental deaths occur each year. Elsewhere, it has been reported that 226 deaths out of 1 million in 2000 can be attributed to accidents. It had been expected that accidental deaths will reach 1.8 million per year in 2010. It was predicted that, in 2010, the load caused by accidents will reach the 3rd level (1, 2). It has been reported that a higher number of accidental deaths occur in Iran than in East Mediterranean regions. Some studies have reported a value of 30 vehicular deaths per 100,000 people (3). According to a 2005 report, over 25,000 deaths due to car accidents were reported to legal medical centers, and this frequency was 17 % higher than that of the previous year. It is also estimated that 3 car accident-related deaths occur every hour (4).

Aside from the direct damage caused by car accidents,

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Table 1. Distribution of case and control by sex and age

	Case, No. (%)		**Control,** No. (%)		
	Female	**Male**	**Female**	**Male**	**Total,** No. (%)
Age, y					
< 20	0	3 (2.5)	2 (8)	5 (3.9)	10 (3.2)
20–29	4 (10.8)	20 (16.5)	8 (32)	45 (34.9)	77 (24.7)
30–39	32 (59.9)	49 (40.5)	1 (4)	45 (34.9)	117 (37.5)
40–49	9 (24.3)	30 (24.8)	14 (56)	22 (17.1)	24 (75)
50–59	2 (5.4)	16 (13.2)	0	10 (7.8)	28 (9)
> 60	0	3 (2.5)	0	2 (1.6)	5 (1.6)
	37 (100)	121 (100)	25 (100)	129 (100)	312 (100)

they have consequences that are detrimental in society, such as injuries and disabilities. In our country, the number of inpatients due to car accidents in 2000 was reported to be 88.4 per 10,000 people (3). Other than the immediate personal harm and damage caused by an accident, there might be injuries and disabilities that can affect the individual in the future and reduce his quality of life. In addition, accidents may have consequences for the economic well-being of the person. Most accidents cause unpredictable costs for society, and compensating for these costs is especially difficult in developing countries. In our country, the cost of car accidents is about 1000 billion Tomans per year (3). The aim of this study was to investigate factors that contributed to injuries from car accidents in the Mashhad area in 2007.

Patients and Methods

This study was a case-control study that was conducted from June to November 2007. The cases were drivers who experienced an injury-causing accident while driving during the aforementioned period. The control group was selected from drivers who had accidents in the same period but did not experience injuries. Most of the enquiries were conducted at the accident site or at nearby emergency centers. As much as was possible, the interview was performed with the driver in the control group. In the case group, depending upon the condition of the hurt persons and their level of consciousness, the interview was done with the driver or those persons accompanying him. In some cases, the interview was postponed to a time when the injured had regained awareness. The instrument for the enquiry was a questionnaire, which had a previously established reliability and validity. The interviewers had at least a high school diploma and were trained to minimize the measurement errors at the time of the investigation. In this study, the effect of 12 independent variables in the accidents was investigated. These included age, sex, seatbelt use, occurrence of spontaneous combustion at the accident, entrapment, ejection, music playing in the vehicle at the time of the accident, cell phone use, the direction of the accident, the time of day of the occurrence, smoking at the time of the accident, and the model of the vehicle. One of the aims of this study was to investigate the effect of seatbelt use in the outcome of accidents. In a previous study, we determined a chance ratio of 1.53 with an error of 5 % and power of 80 %, so we selected 170 samples for the case and control groups. Based on the type of study and the small sample size, the sampling was done by an objective-based sampling procedure, and continued until the sampling population was achieved. In this study, all samples were selected from Asian roads that lead to Mashhad, namely, the Mashhad-Nayshabur, the Mashhad-Torbat Heidariyeh, the Mashhad-Taybaad, and the Mashhad-Ghuchan. These roads were selected in order to cover all out-of-city trips from Mashhad in the study. The design of this study was similar to the design that Khalaji used in his previously published study (5). In addition, our questionnaires were similar. The objective for using the same instruments as Khalaji was to investigate the effect of the same variables under study and to apply the same methodology so that we were able to compare the studies directly. To analyses the data we used SPSS (IBM Corporation, Chicago, IL, USA) and STATA (Stata Corp LP, College Station, TX, USA) softwares, a chance indicator was implemented in order to confirm relationships that were estimated by a logistic regression model. After identifying the dangerous factors in different logistic regression models, backward logistic regression was applied to find the ultimate risk factors and purify them from the interrupters. In this model, the variables that had no correlation with one another in the multi-model based on the highest nonsignificant *P* value were omitted from the model. The ultimate model was based on those variables with *P* values below 0.05 in the multi-model consisting of all remaining variables.

Results

Among the people who fulfilled the required characteristics of the study, 90% in the case group and 93 % of the control group were willing or able to participate in an interview. As indicated in *Table 1*, approximately 80 % of the subjects (250 subjects) were male, and the 62 remaining subjects were female. Females comprised 16.2 %

of the case group and 23 % of the control group, while males made up 83.3 % of the case group and 76.6 % of the control group. Regression analyses did not indicate any significant relationship between injuries and sex in the case and control group ($P > 0.05$). The average age of the participants in this study was 37.4 ± 10.3 years. The age range of the participants was 18–69 years old. The mean age of the case group was 35.3 ± 10.5 and in the control group was 39.4 ± 9.8. The average age of the participants in the case group and control group was statistically different ($P < 0.001$), as indicated in *Table3*

At the time of the accident, 42.9% of the cases were using seatbelts, while 62.7 % in the control group were using seatbelts. This difference was statistically significant, and the protective effect of using a seatbelt was calculated as OR = 0.44 in the single variable model. To rephrase,

Table 2. Distribution of case and control by risk factors

Risk factor	Case, No. (%)	Control, No. (%)
Sex		
Male	129 (83.8)	121 (76.6)
Female	25 (16.2)	37 (23.4)
Fastening seatbelt		
No	88 (57.1)	59 (37.3)
Yes	66 (42.9)	99 (62.7)
Trapped within the car		
No	107 (69.5)	133 (84.2)
Yes	47 (30.5)	25 (15.8)
Ejection from the car		
No	109 (70.8)	149 (94.3)
Yes	45 (29.2)	9 (5.7)
Car Model		
No	69 (44.8)	77 (48.7)
Yes	85 (55.2)	81 (51.3)
Combustion		
No	121 (79.1)	156 (98.7)
Yes	32 (20.9)	2 (1.3)
Listening to music		
No	76 (49.4)	86 (54.4)
Yes	78 (50.6)	72 (45.6)
Smoking		
No	96 (62.7)	136 (86.1)
Yes	57 (37.3)	22 (13.9)
Using handheld phone		
No	131 (85.1)	137 (80.4)
Yes	23 (14.9)	31 (19.6)
Time of accident		
8:00–12:00	63 (40.9)	64 (40.5)
12:00–18:00	26 (16.9)	59 (37.3)
18:00–24:00	65 (42.2)	35 (22.2)
Direction of contact		
Behind	38 (24.7)	67 (42.4)
Front	84 (54.5)	48 (30.4)
Next	32 (20.8)	43 (27.2)
Total	154 (100)	158 (100)

Table 3. Association of physical accident with risk factors by logistic regression

Variable	OR [a]	95% CI [b]	*P* value
Age, y	0.96	0.93-0.98	< 0.001
Sex			0.114
Female	1	-	
Male	1.57	0.9-2.77	
Fastening seatbelt			< 0.001
Yes	1	-	
No	2.23	1.42-3.52	
Ejection from the car			< 0.001
No	1	-	
Yes	6.83	3.2-14.52	
Trapped within the car			0.002
No	1	-	
Yes	2.33	1.35-4.04	
Listening to music			0.369
No	1	-	
Yes	1.22	078-1.91	
Car Model			0.487
No	1	-	
Yes	1.17	0.75-1.82	
Combustion			< 0.001
No	1	-	
Yes	20.6	4.84-87.8	
Smoking			0.046
No	1	-	
Yes	1.81	0.39-1.03	
Using handheld phone			< 0.275
No	1	-	
Yes	0.71	0.39-1.3	
Time of accident			
8-12	1	-	0.006
12-18	0.44	0.25-0.79	
18-24	1.81	1.1-3.2	0.021
Direction of contact			
Behind	1	-	< 0.001
Front	3.08	1.81-5.25	
Next	1.31	0.71-2.40	0.38

[a] OR: Adjusted odds ratio
[b] CI: Confidentid interval

it was 2.5 times more likely to sustain an injury during an accident when not using a seatbelt then when a seatbelt was used. The relationship between sex and not using seatbelts and injuries was statistically significant in males ($P < 0.001$). In *Table 3*, single and multiple variable logistic regression models indicated the relationships of injuries with the variables investigated in this study. Women were 5 times more likely than men to fasten their seatbelts. The relationship between not fastening a seatbelt and sustaining an injury cannot be attributed to the interfering effect of sex, since there was no significant relationship between this event and sex.

As shown in *Tables 1, 2*, and 3, the model of the car had no statistical significance in the likelihood of sustaining injuries ($P > 0.05$). Combustion during the accident occurred in approximately 21 % of the cases and in 1.3 % of the controls, indicating that combustion occurred 20 times more in the case group than in the control group according to the single variable analysis. This variable, in comparison to other influencing variables, was significantly correlated with the degree of injuries caused by the accidents.

The results indicated that 30.5% of the cases and 15.8 % of controls were trapped in their vehicles at the time of the accident. This correlated significantly with the amount of injuries in both the single and multiple regression models ($p < 0.002$). This variable, along with the car model variable, had a weaker correlation in the case and control group, and it was again significant after the omission of the model of the car. The chances of becoming trapped in the car was significantly higher in less modern cars in both case and control groups ($P < 0.05$). The frequency of being ejected from the car was significantly different between the two groups ($P < 0.001$). The relationship indicated by the multiple variable analysis was significantly higher when taken together with not using seatbelts. After precise investigations, it was found that only 4.2 % of people with seatbelts had been ejected from the car, but 32 % of those not using seatbelts were ejected. Thus, the chance of being ejected from the car during an accident was 10.2 times more likely in those not using seatbelts ($P < 0.001$).

Table 4. Comparison with findings of Khalaji

	This study		Khalaji study	
	Case %	Contorol %	Case %	Contorol %
Fastening seatbelt	9.42	62.7	42.8	57.2
Being thrown out of the car	29.2	5.7	26.9	5.1
Car Model	55.2	51.3	53.1	50.9
Combustion	20.9	1.3	6.3	0
Direction of Contact				
Behind	24.7	42.4	12	16
Front	54.5	30.4	46.3	36
Next	20.8	27.2	41.2	47.9

Smoking at the time of the accident was also significant in the case group ($P < 0.05$). In the multiple variable model, this variable, together with sex, indicated no significant correlation. Other variables, such as listening to music or talking with a handheld phone, had no significant correlation with the extent of injuries. After entering all variables into a multiple logistic regression model, three variables, including age, not fastening the seatbelt, and combustion, were identified as factors that were more dangerous. Comparing *Table 3* and this finding indicated that smoking, the time of day, and the direction of the accident were among the variables that showed a significant correlation in the single variable model, but they were not found to be significant in the presence of other variables. In the basic multiple variable model, being ejected from the car and being trapped in the car remained in the model and correlated with the amount and severity of the injuries. However, since the frequency of being ejected from the car was significantly higher in cases not using seatbelts, this variable was omitted from the model, as was being trapped.

Discussion

This study is a case-control study aimed at investigating the dangerous factors of accidents occurring in the roads around Mashhad in 2007. The selection of controls in case-control studies is an important variable. The control group in this study was selected from drivers having accidents on the same roads as the case drivers. Due to demographic variables, some measurement errors may be limitations that may influence the accuracy of the study. Another factor affecting the accuracy of this study was the critical condition of the case group, which may have made them unable or unwilling to be interviewed. Therefore, some severe cases were automatically omitted from our study. Nonetheless, this limitation was minimized since we were able to study at least 90 % of the subjects in both groups. Another limitation of our study was that we could not obtain honest and clear answers about the influence of the use of drugs, and this may have interfered with or affected some relationships in a positive or negative way. Due to these limitations and the small number of participants, care must be taken when comparing the results of this study with other cases.

The severity of the accidents was another important factor, as similar studies have indicated that this factor may influence other variables. This factor is highly correlated with the speed and weight of the vehicle. However, it is important to remember that we have not focused on the severity of the accidents, and, thus, this can be considered as only an interrupting variable in our study. For instance, injuries, combustion, and entrapment may correlate with the severity effect, and, therefore, it is important to consider this variable when formulating conclusions. To facilitate comparisons, our results have been presented with Khalaji's results in *Table 4*.

Several similar studies have been conducted around

the world, but, due to differences in life style, road conditions, and other related factors, comparisons of their results and the results of this study may not be accurate. From studies conducted to date, the study of Khalaji on the Qazvin-Lushan road accidents that occurred in 2005, which used the same methodology, seems to be an appropriate case for comparison (5). Most studies of factors that contribute to car accidents in our country have been descriptive, so testing a hypothesis with analytical studies will contribute greatly to the existing knowledge base (6-13). Sex can be deemed as an important variable with which to begin the comparison of such studies, since this study indicated that sex had no significant effect on accidents in either the case or control groups. While the men had more accidents (12), most studies indicate that the severity of the accidents was similar in both groups (5, 14). Some studies have indicated that men have more severe accidents (15). The average age of the case group was 5 years less than the control group, and most studies indicate that a lower age in drivers correlates with the severity of accidents (15). Other studies, such as those of Norris and Khalaji, rejected the correlation of the age factor with the severity of accidents (5, 14). In Khalaji's study, 42.8 % of the cases and 57.2 % of the controls used protective tools, such as seatbelts (5). In the present study, 42.9 % of the cases and 62.7 % of the controls reported seatbelt use, demonstrating that our result matches that of Khalaji and supports the positive role of seatbelts in reducing the severity of injuries in an accident (5). The importance of using seatbelts is now obvious and has been proved in various studies. Seatbelt use can decrease the severity of accidents and the injuries caused by them, but it has no effect in preventing the occurrence of the accidents (1, 5, 10, 13, 16, 17). A study conducted in 2006 indicated that two-thirds of deaths in car accidents could be attributed to passengers and drivers not fastening seatbelts (18). The time of day that the accident occurred was considered another important factor to be studied. It is expected that decreased visibility at night might increase the number of accidents, but our results reject this assumption. In other studies, it was found that 72 % of accidents occurred from 6 am to 18 pm, but traffic police records indicate that most accidents occur between 5–8 am and 16–20 pm (4, 8, 13). These results cannot be generalized since they are descriptive, and they do not investigate the effect of the time of day that the accident occurred on the severity of the accident. The present study showed a correlation of the time of day of the accident with the severity of the accident. We found that the severity of accidents that occurred between 12-18 pm was less than those occurring between 6 am-12 pm. Furthermore, accidents occurring between 18-24 pm were more severe than those taking place between 6 am-12 pm. We indicated that 20.9 % of the case group in this study experienced combustion during the accident, while this number is reported at 1.3 % in the control group. The influence of this factor is important to the injuries to drivers and passengers, which are due both to the severe contact and to the subsequent fire. In Khalaji's study, 6.3 % of the case group and 0 % of the control group reported combustion, which is less than that found in this study (5). The modernity or model factor of the cars involved in the accident was also studied in both research groups. Although no significant difference was observed in either group, the number of modern cars was higher in the case group. This may relate to the higher speed of these cars or the relaxation effect caused by the comfort of more modern cars, which can make the driver less cautious while driving on the road and, consequently, promote an accident. Using seatbelts can decrease the severity of injuries caused by accidents or prevent injury to the driver. A younger age of the driver may also be considered as a dangerous factor that contributes to road accidents, which can be minimized by means of media awareness and training.

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Conflict of interest

None declared.

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