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ORIGINAL ARTICLE

Evaluation of the Effect of Airbag and Seat Belt use on the Severity of Injury in Traffic Accidents

Davut Tekyol[1], Şahin Çolak[1], İsmail Tayfur[1], Nihat Müjdat Hökenek[2], Abdullah Algın[3]

[1]Department of Emergency Medicine, University of Health Sciences, Haydarpasa Numune Training and Research Hospital, Istanbul, Turkey
[2]Department of Emergency Medicine, University of Health Sciences, Kartal Dr Lutfi Kirdar Training and Research Hospital, Istanbul, Turkey
[3]Department of Emergency Medicine, University of Health Sciences, Umraniye Training and Research Hospital, Istanbul, Turkey

Abstract

Introduction: According to the report of the World Health Organization on the prevention of road traffic injuries, road traffic accidents result in the death of approximately 1.25 million people and injury or disability of 20 to 50 million people every year. In this study, we aimed to investigate the effects of seat belt and airbag use on the severity of injury in motor vehicle accidents.

Methods: A total of 274 patients involved in motor vehicle accidents were examined. The medical records of the patients were screened for responses to routine questions that aimed to predict the severity of injury, such as whether the patient was wearing a seat belt, if the airbag deployed and the approximate speed of the vehicle at the time of the accident.

Results: It was determined that the severity of injury and the hospitalization rate were lower in the restrained and airbag-deployed patient group. In unrestrained patients, airbag deployment alone did not reduce the severity of injury.

Discussion and Conclusion: Seat belt use and airbag deployment reduce the severity of injury and the hospitalization rate more than airbag deployment alone. Encouraging the wearing of seat belts is important to decrease the severity of injury and ensure that the airbag is activated during accidents.

Keywords: Airbag; seat belt; traffic accident.

Motor vehicles that have undergone extensive technological development and considerably grown in number within the last century have become a research and discussion topic in terms of not only their economic value, fuel requirement, and detrimental effects on the environment but also accidents with serious consequences. According to the report of the World Health Organization (WHO) on the prevention of road traffic injuries, road traffic accidents constitute a significant public health and development problem, resulting in the death of approximately 1.25 million people and injury or disability of 20 to 50 million people every year [1]. Despite the advancements in technology, scientists seeking ways to reduce deaths and serious accidents, and the development of new projects, the number of people that die in motor vehicle accidents continues to increase with every passing year.

Traffic accidents are evaluated in three groups: fatal injury, non-fatal injury, and property damage. In the event of a collision, a seat belt can protect the wearer in vehicle from possible general bodily trauma and prevents them

Correspondence (İletişim): Davut Tekyol, M.D. Saglik Bilimleri Universitesi, Haydarpasa Numune Egitim ve Arastirma Hastanesi, Acil Tip Anabilim Dali, Istanbul, Turkey
Phone (Telefon): +90 530 233 08 82 **E-mail (E-posta):** dtekyol34@hotmail.com
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from being thrown out of the vehicle [2]. In cases of front-impact accidents, airbags inflating at approximately 320 km/h are among the security measures designed to protect the head and chest regions of passengers [3]. Studies have shown that using a seat belt and airbag deployment which have become a legal requirement both in the world and in Turkey in the last 30 years have reduced the number of injuries and deaths associated with traffic accidents [4]. The current study aimed to investigate the relationship between the severity of injury and use of seat belt and airbag deployment in traffic accidents in the light of scientific data.

Materials and Methods

In this study, the medical records of 274 patients transported to the Emergency Service of Haydarpaşa Numune Training and Research Hospital between March 2016 and March 2017 after being involved in a motor vehicle accident as a passenger were analyzed. Of the 274 patients examined, 171 adults over 18 years of age were enrolled in the study. Patients aged below 18 years and those for whom medical records were unavailable or incomplete were excluded.

The detailed anamnesis section of the medical records contained responses to routine questions to predict the severity of injury, such as whether the patient was wearing a seat belt, if the airbag deployed and the approximate speed of the vehicle at the time of the accident. These three parameters were noted for all patients. Taking the Injury Severity Score (ISS) as reference, the injuries were classified according to the affected body area as head, neck, face, chest, abdomen, and extremities. Furthermore, to help determine the severity of injury, the presence of humeral, clavicle or femur fractures, and hospitalization/discharge status were investigated.

Statistical Analysis

Descriptive statistics (mean, standard deviation, minimum, median, maximum) were used to express continuous variables. The comparison of two independent and normally distributed continuous variables was performed using Student's t-test, and that of two independent variables without normal distribution was undertaken using the Mann-Whitney U test. Furthermore, the chi-square test (or Fisher's exact test) was employed to examine the relationship between categorical variables. The level of statistical significance was accepted as 0.05. All analyses were conducted using MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2013).

Results

Of the patients that presented to the University of Health Sciences Haydarpaşa Numune Training and Research Hospital between March 2016 and March 2017 after being involved in a traffic accident as a passenger, 171 cases, 109 (63.74%) male and 62 (36.26%) female, fulfilled the study criteria. The mean age of the patients was 34.2 years, ranging from 18 to 80 years.

It was determined that of the 171 cases, 87 (50.87%) were not wearing a seat belt while 84 (49.13%) were restrained during the accident. The mean ages of the restrained and unrestrained patients were 36.2 years and 32.1 years, respectively with no statistically significant difference. Similarly, the mean vehicle speed did not significantly differ between the restrained and unrestrained groups, being determined as 95.6 km/h and 95.9 km/h, respectively. However, a statistically significant difference was found between the restrained and unrestrained patients in terms of ISS (0.6 versus 2.8; $p<0.05$) (Table 1).

At the time of the accident, the airbag was deployed in 65 cases (38.01%) and was not activated in 106 cases (61.98%). When the ISS of the patients was examined according to the presence or absence of airbag deployment, no statistically significant difference was found between the two groups (2.6 versus 1.2; $p=0.399$). However, concerning the relationship between airbag deployment and the mean vehicle speed at the time of accident, the latter was statistically significantly higher in accidents in which the airbag was deployed compared to those without airbag deployment ($p>0.05$) (Table 2).

The ISS of unrestrained patients involved in a vehicle accident without airbag deployment was calculated as 1.8, which was statistically significantly higher than the score obtained for the restrained patients protected by the airbag (0.94) (Table 3).

This study also investigated the localization of the injuries

Table 1. Comparison of parameters according to the use of a seat belt during an accident.

	Seat Belt	n	Mean	Median	SD	Min	Max	p
Age	No	87	36.2	32	18.2	1	80	0.290
	Yes	84	32.1	29.5	12.7	9	80	
Speed	No	87	95.9	90	27.0	50	150	0.922
	Yes	84	95.6	95	20.0	50	150	
ISS	No	87	2.8	1	4.0	0	19	<0.05*
	Yes	84	0.6	0	2.4	0	19	

Yes: seat belt used. No: seat belt not used.

Table 2. Comparison of parameters according to airbag deployment during an accident.

	Airbag	n	Mean	Median	SD	Min	Max	p
Age	No	106	35.8	32	17.4	1	80	0.186
	Yes	65	31.7	28	12.4	15	75	
Speed	No	106	87.6	80	22.1	50	150	<0.05*
	Yes	65	109.1	110	20.3	70	150	
ISS	No	106	1.2	0	2.2	0	10	0.399
	Yes	65	2.6	0	4.8	0	19	

Yes: airbag deployed. No: airbag not deployed.

Table 3. Comparison of parameters according to the combined use of seat belt and airbag during an accident.

	Seat Belt and Airbag	n	Mean	Median	SD	Min	Max	p
Age	No	69	36.9	34	18.9	1	80	0.544
	Yes	47	31	28	11.4	15	62	
Speed	No	69	88.9	90	24.2	50	150	<0.001*
	Yes	47	104.04	100	17.9	70	150	
ISS	No	69	1.8	0	2.6	0	10	<0.001*
	Yes	47	0.94	0	3.2	0	19	

Yes: seat belt used and airbag deployed. No: seat belt not used and airbag not deployed.

inflicted on the 171 cases in relation to the use/non-use of the seat belt and deployment/undeployment of the airbag during the accident. The results revealed that wearing a seat belt statistically significantly reduced facial, thoracic, external, clavicular, humeral and extremity injuries. In addition, the use of the seat belt and deployment of the airbag were found to decrease the rate of hospitalization and statistically significantly increase the rate of discharge (Table 4).

Discussion

Injuries due to traffic accidents are generally observed in young and adult age groups. According to WHO and previous studies, the age range of people injured in traffic accidents is 15 to 44 years [1, 5]. In the current study, the mean age of the patients that had been involved in traffic accidents was calculated as 34.2±15.8 years.

In studies investigating the injury scores in traffic accident cases, the rates of restrained and unrestrained patients are reported to be 20 to 30% and 70 to 80%, respectively [6, 7]. Different from the literature, in the current study, 49% of the 171 cases involved in a motor vehicle accident as a passenger were restrained. This higher rate of seat belt use can be explained by the generally higher sociocultural status of people living in the area where the study was undertaken (Marmara Region of Turkey), which may have resulted in greater compliance with traffic safety rules.

Table 4. Comparison of injuries according to the combined or individual use of seat belt and airbag.

	Injured Body Area	Both Seat Belt and Airbag	Seat Belt Alone	Airbag Alone	Neither	p
Head - Neck	No	43 (91.5)	36 (97.3)	15 (83.3)	61 (88.4)	0.264
	Yes	4 (8.5)	1 (2.7)	3 (16.7)	8 (11.6)	
Face	No	46 (97.9)	36 (97.3)	14 (77.8)	64 (92.8)	0.034*
	Yes	1 (2.1)	1 (2.7)	4 (22.2)	5 (7.2)	
Thorax	No	45 (95.7)	37 (100.0)	11 (66.1)	61 (88.4)	<0.05*
	Yes	2 (4.3)	0 (0.0)	7 (38.9)	8 (11.6)	
Abdomen	No	45 (95.7)	36 (97.3)	15 (83.3)	63 (91.3)	0.214
	Yes	2 (4.3)	1 (2.7)	3 (16.7)	6 (8.7)	
Extremities	No	43 (93.5)	35 (94.6)	8 (44.4)	54 (78.3)	<0.05*
	Yes	3 (6.5)	2 (5.4)	10 (55.6)	15 (21.7)	
External	No	41 (87.2)	32 (86.5)	11 (61.1)	57 (82.6)	0.110
	Yes	6 (12.8)	5 (13.5)	7 (38.9)	12 (17.4)	
Clavicula	No	46 (97.9)	37 (100.0)	16 (88.9)	68 (98.6)	0.086
	Yes	1 (2.1)	0 (0.0)	2 (11.1)	1 (1.4)	
Humerus	No	47 (100.0)	37 (100.0)	16 (88.9)	68 (98.6)	0.039*
	Yes	0 (0.0)	0 (0.0)	2 (11.1)	1 (1.4)	
Hospitalization Status	Discharged	45 (95.7)	37 (100.0)	7 (38.9)	61 (88.4)	<0.05*
	Hospitalized	2 (4.3)	0 (0.0)	11 (61.1)	8 (11.6)	

Yes: Injury present. No: No injury.

The use of seat belts is estimated to reduce the severity of trauma by approximately 50%, particularly in traffic accidents that result in fatal or severe injuries [8]. In a study conducted with patients suffering from blunt trauma caused by motor vehicle accidents, the mean ISS was calculated as 7.62 for the restrained and 11.33 for the unrestrained passengers [9]. In another study investigating the protective effect of seat belt, ISS was found to be high in more than 50% of the unrestrained patients and in only 16% of those wearing a seat belt [7]. In our study, we determined that ISS and the rate of hospitalization were lower in the restrained group than in the unrestrained group. These findings support the idea presented in the literature that seat belt use is an effective method for reducing the severity of injury and increasing the survival rate in motor vehicle accidents

In traffic accident cases, the rate of thoracic, head, facial, abdomen, extremity and external injuries and length of hospitalization stay are higher in passengers that are not belted at the time of the accident. Accordingly, the severity of injury and the duration of hospital stay are lower in restrained individuals [10]. Similarly, in the current study, we observed that a higher number of patients with injuries to the head, neck, face, chest and abdomen, and extremity fractures were not wearing a seat belt at the time of the accident.

In a study that examined thoracolumbar junction injuries in motor vehicle collisions, it was revealed that critical injuries; e.g., pelvic fracture and visceral organ damage were more common in the unrestrained passenger group. In the same group, the presence of a higher rate of rib fracture, pulmonary contusion, liver laceration, traumatic brain injury, and scapula fracture compared to the restrained passengers. Most of the body injuries in the restrained group were not life-threatening [11].

Similar to seat belts, airbags are known to increase the likelihood of survival in accidents. In the case of car accidents and front-impact collisions, airbags are reported to have a protective effect and reduce fatality when combined with the use of seat belts [12, 13]. In a study on the use of airbag and seat belt together or alone, the risk of injury was shown to be reduced by 18% by the airbag alone, 42% by the seat belt alone, and by 46% when both were used together [14]. However, today, the most effective protection is still provided by seat belt [15]. In the current study, the airbag was deployed for eight of 21 patients that required hospitalization and did not deploy in the remaining 13. These findings indicate that airbag deployment without the use of a seat belt does not result in a statistically significant difference in the survival and injury rates.

The mechanism and function of an airbag in traffic accidents is to create a barrier between the vehicle and front-seat occupants during a collision, thus allowing them to make contact with the steering wheel or plastic dashboard in a controlled manner. In the current study, we found that airbag deployment alone did not significantly reduce the severity of accident-related injuries; however, when combined with the seat belt use, the severity of injury and length of hospitalization stay rate were decreased.

Conclusion

The severity of injury and hospitalization rate are lower in restrained and airbag-deployed traffic accident cases. Airbag deployment alone does not reduce the severity of injury. However, the combination of wearing a seat belt and airbag deployment during accidents statistically significantly decreases the severity of injury and hospitalization rate. Therefore, encouraging the wearing of seat belts is important to decrease the severity of injury and ensure that the airbag is activated during accidents. Accordingly, implementing stricter methods and measures to make seat belt use widespread will reduce the rate of injury in accidents.

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