

ASSOCIATION BETWEEN MANDATORY SEATBELT LAWS AND ROAD TRAFFIC INJURIES IN IRAN

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Abstract. This study investigated the efficacy of mandatory seatbelt legislation on traffic injuries and intensity of road traffic injuries (RTIs). We carried out a before- after interventional study. Data regarding road traffic accidents and injuries one year before and one and two years after the implementation of mandatory seatbelt legislation were obtained from the traffic police database. Traffic accident mortality was 13.0% of all RTIs during the year prior to implementation. This decreased to 9.7% and 11.4% during the first and second years after implementation, respectively ($p < 0.001$). The mortality rate was not consistent for seatbelt use since there was a slight increase in the mortality rate in second year after implementation of mandatory seatbelt use although this level was lower than the pre- implementation rate. Our findings suggest mandatory seatbelt use reduces the intensity of RTIs and reduces the crude number of RTIs.

Keywords: traffic injuries, seatbelt, accident, legislation, Iran

INTRODUCTION

Road traffic injuries are an emerging global epidemic; causing 13% of all injuries and 1.2 million deaths every year (WHO, 2004). During the next 20 years, there is expected to be a 65% increase in road traffic injuries; mainly in developing countries (WHO, 2004). Road traffic injuries (RTIs) are a major public health problem in Iran, causing 27,000 deaths annually, 65 deaths per day, and ten times this rate in disabilities according to the

traffic police (Nikzad, 2006). RTIs have increased in recent decades (WHO, 2009). The world-wide road traffic injury/death rate is 3 people per 10,000 vehicles, but in Iran it is 33 people per 10,000 vehicles (Nikzad, 2006). Lack of adequate legislations could result in an increase in traffic injuries and deaths by 67% by the year 2020 (WHO, 2004). This increase could be 83% in low and middle income countries but there is an expected decrease of 27% in high income countries (WHO, 2004; Crandon *et al*, 2006). Some studies have reported human factors have the most influence on RTIs; these factors include driver' behavior, speed, violation of traffic laws, poor driving skills, decentralization, fatigue, and physical disabilities (Farland and Moore, 1957; Evans, 2003; Hasselberg *et al*, 2008). The seatbelt legislation was

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Table 1
Number (%) of non- fatal and fatal motor vehicle injuries before and after seatbelt enforcement.

	Number (%)			
	Non-fatal	Fatal	Not recorded	Total
One year before seatbelt enforcement	136,141 (85.1)	20,880 (13.0)	3,042 (1.9)	160,063
One year after seat belt enforcement	133,568 (88.9)	14,609 (9.7) ^a	2,056 (1.4)	150,233
Two years after seat belt enforcement	121,872 (87.7)	15,881 (11.4)	1,213 (0.9)	136,966
Total	391,581	51,370	6,311	449,262

^a $p < 0.001$ comparing before, one year and two years after seatbelt enforcement.

introduced on 31 January 1933 in the UK and car crashes decreased about 10% during the post-legislation period (Thomas, 1990). Seatbelt usage has saved more lives than any other intervention; it has reduced mortality from road traffic injuries by 25-67% (Salzberg *et al*, 2004; Shults *et al*, 2004; Williams and Wells, 2004). Some studies in high income countries reported minimal reduction in traffic deaths after seatbelt law enforcement. There is a lack of data from low and middle income countries in this regard. Evans and Graham (1991) reported only an 8% reduction in traffic death after seatbelt law enforcement. Seatbelt legislation was passed in Iran in 2005. It stated front seat passengers only were required to wear seatbelts. The effect of seatbelt legislation on reduction in severity of traffic injuries has not studied. In this study the association between mandatory seatbelt use legislation and changes in road traffic injuries in Iran were investigated.

MATERIALS AND METHODS

Data regarding motor vehicle accidents and injuries from one year before until two years after implementation (2004-2006) of mandatory seatbelt legislations was obtained from the center for in-

formation and communication technology (ICT) of the traffic police department. The records on death cases from RTIs were collected by the legal-medicine organization of Iran and were added to the records for injury cases from the Emergency Medical Services (EMS) and merged with traffic police data on crashes. The deaths of passengers of buses, trucks and pedestrians were excluded. After data cleaning and stratification of RTIs to control for the main confounders (by cause of death or injury and type of accident), data regarding injuries and death before and after implementation of mandatory seatbelt use legislation were compared. The data were analyzed with SPSS software (version 13) and STATA. Variables, such as age and sex, were used for subgroups analysis. The chi-square test was carried out to compare fatal and non- fatal injuries before and after intervention.

RESULTS

The total number of RTIs during the study was 449,262. One year before seatbelt legislation the number of traffic injuries was 160,063 (35.7%) and during the first year after intervention this number was 150,233 (33.4%); two years after intervention it was 136,966 (30.9%). Table 1

Table 2
Number (%) of motor vehicle accident injured drivers by seatbelt use.

	Number (%)			Total
	Seatbelt use	Non- seatbelt use	Not recorded	
One year before seatbelt enforcement	8,470 (5.5)	151,192 (94.5)	131 (0.1)	160,063
One year after seat belt enforcement	13,633 (9.1) ^a	130,750 (87.0)	5,850 (3.9)	150,233
Two years after seat belt enforcement	18,595 (13.4)	98,869 (71.1)	21,502 (15.5)	138,966
Total	40,698 (9.1)	371,811 (82.8)	27,483 (6.1)	449,262

^a $p < 0.001$ comparing before, one year and two years after seatbelt enforcement.

shows the significant reduction in traffic deaths one year after seatbelt legislation of 9.7%, compared with one year prior to legislation (13.0%) ($p < 0.001$). During the second year this rate increased 1.7% but in comparison to one year prior to legislation, this was 1.6% lower. Seatbelt use significantly increased 3.6% in the first year and 7.9% in the second year after seatbelt legislation compared to one year prior to legislation ($p < 0.001$) (Table 2).

In all age groups seatbelt usage increased after intervention (Table 3). This trend is increasing. This figure was significantly higher among the 30-50 years old age group ($p < 0.001$) but lower among those >50 years old.

Fatal injuries in men decreased during the first year of seatbelt enforcement by 4.2% compared to one year prior to intervention (8.4%) ($p < 0.001$) (Table 4). During the second year this rate increased 2.4% but compared to one year prior to intervention deaths from RTIs decreased by 2.2%.

DISCUSSION

This study shows mandatory seatbelt legislation reduced the number of RTIs. During the second year after implementation there was an increase in injuries but

there was still better than the year before intervention. Statistics from the World Report on Road Traffic Injury Prevention shows seatbelt usage varies, from a high of 93% in the UK and Germany to lows of less than 60% in Albania and Bulgaria (McCarthy, 1989). Transport Canada's fact sheet, from January 2008 showed 92% of Canadians use seatbelts (O' Sullivan, 2009). After the world's first mandatory seatbelt law was passed in Victoria, Australia, in 1971, car occupant deaths fell by 18% in the following year and by 26% four years later (WHO, 2004). In the UK front passenger seatbelt usage was made mandatory in 1983. Usage jumped from 37% to >95% shortly afterwards. The United States allows each state to set seatbelt laws (Evans, 2003). The first mandatory seatbelt use law was in New York State in 1984 (Evans, 2003). Seatbelt laws are now in effect in 49 states and the District of Columbia, although the severity of the law differs from state to state (O' Sullivan, 2009). In the year 2000, seatbelt use in Korea was only 23% (O' Sullivan, 2009). After introduction of mandatory seatbelt laws, seatbelt use rose >95% (WHO, 2004). Figures from seatbelts and child restraints show that use of seatbelts reduces the chances of drivers and front seat passengers of being killed up to 50%

Table 3
Number (%) of motor vehicle accident injured drivers by age and seatbelt use.

	Number (percent)													
	<30 years				30-39 years				40-49 years				>50 years	
	Seatbelt using	Non-use of seatbelts	Not re-corded	Seatbelt using	Non-use of seatbelt	Not re-corded	Seatbelt using	Non-use of seatbelt	Not re-corded	Seatbelt using	Non-use of seatbelt	Not re-corded	Seatbelt using	Non-use of seatbelt
One year prior to seatbelt enforcement	2,423 (4.6)	49,920 (95.3)	55 (0.1)	2,131 (7.8)	25,324 (92.2)	18 (0.1)	1,402 (8.5)	14,997 (91.4)	18 (0.1)	795 (7.2)	10,274 (92.7)	13 (0.1)		
One year after seatbelt enforcement	4,246 (9.4)	38,851 (85.8)	2,189 (4.8)	2,802 (11.3)	20,893 (84.4)	1,055 (4.3)	1,765 (12.5)	11,718 (83.1)	613 (4.3)	1,106 (9.8)	9,722 (86.3)	434 (3.9)		
Two years after seatbelt enforcement	5,850 (15.2) ^a	27,577 (71.6)	5,059 (13.2)	4,118 (17.8)	16,066 (69.5)	2,937 (12.7)	2,101 (16.6)	8,857 (69.9)	1,722 (13.6)	1,680 (12.8)	10,213 (78.0)	1,200 (9.2)		

^a $p < 0.001$ comparing before, one year and two years after seatbelt enforcement.

Table 4
Number (%) of motor vehicle accident drivers by sex and fatality.

	Non-fatal						Fatal		Total
	Male			Female			Male	Female	
	Seatbelt using	Non-use of seatbelt	Not re-corded	Seatbelt using	Non-use of seatbelt	Not re-corded			
One year before seatbelt enforcement	66,938 (91.6)	67,739 (95.8)	61,100 (93.4)	69,203 (94.7)	65,829 (93.1)	60,772 (92.9)	12,804 (8.4)	8,076 (5.3)	160,063 (100)
One year after seatbelt enforcement	67,739 (95.8)	61,100 (93.4)	60,772 (92.9)	65,829 (93.1)	5,528 (4.2) ^a	7,651 (6.6)	5,528 (4.2) ^a	9,081 (6.9)	150,233 (100)
Two years after seatbelt enforcement	61,100 (93.4)	60,772 (92.9)	7,651 (6.6)	60,772 (92.9)	7,651 (6.6)	8,230 (7.1)	7,651 (6.6)	8,230 (7.1)	136,966 (100)

^a $p < 0.001$ comparing before, one year and two years after seatbelt enforcement.

and by nearly 25% for rear seat passengers (Laurence *et al*, 2002). Lawrence *et al* (2002) reported that in the intervention community seatbelt use among children riding in the front seats of vehicles increased from 47% to 57%. Another study showed after intervention an increase in the prevalence of seatbelt use for drivers and front seat passengers in Guangzhou, China (Science Daily, 2007). The intervention was evaluated using a comparison group pre-test post-test design which included an extensive cost effectiveness evaluation. Following the 12-month intervention period, the prevalence of seatbelt use increased significantly, from a prevalence of 50% (range: 30-62%) to a prevalence of 62% (range: 60-67%) in the intervention city (Science Daily, 2007). Thomas (1990) found the number of car accident cases decreased by about 10% in the post- legislation period after seatbelt enforcement.

There are significant differences between populations of seatbelt users and fatal injuries caused by traffic accidents. The severity of seatbelt laws does not reduce high risk behavior (Salzberg *et al*, 2002). A study showed the rate of fatal injuries was higher in non- seatbelt users. These results are in line with other countries findings (Alaa *et al*, 2011). It is possible high risk traffic behavior is more common among non- seatbelt using drivers. This hypothesis was validated in a study by Ferguson (2003) in the United States. Less severe seatbelt laws may have less of an impact in some countries (Nakahara *et al*, 2003).

Less common seatbelt use in men than women has been reported in some studies (Nelson *et al*, 1989; Preusser *et al*, 1991). In Japan after seatbelt enforcement the mortality rate, based on the traffic volume observed, reduced by 8%, which

was less than the expected rate reduction (Nakahara *et al*, 2003). There was a weak relationship between seatbelt use and driver mortality in England (McCarty, 1989). This may be due to a significant increase in traffic volume (Roberts, 1993). We studied the effect of seatbelt use in relationship to motor vehicle deaths and injuries. There was no parallel national campaign or intervention regarding speed limit or improvement in road conditions of the country.

A limitation of our study was uncontrolled factors, such as educational programs, which could have influenced seatbelt use. Seatbelt use was not pervasive among injured subjects; poor compliance with the laws was evident. Undocumented accidents may have increased during the study, but there could be a problem with data collection.

The use of seatbelts has been an effective road safety measure. Improvement in seatbelt use culture by education to increase awareness and continuing seatbelt enforcement are necessary for success.

In conclusion, this study shows mandatory seatbelt use reduces the frequency of RTIs. However, during the second year after implantation the efficiency of this intervention decreased. Continuous enforcement of seatbelt use is recommended.

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REFERENCES

- Alaa AK, Ashraf HF, Fikri Abu-Zidan M. Seatbelt compliance and mortality in the Gulf Cooperation Council countries in comparison with other high-income countries. *Ann Saudi Med J* 2011; 31: 347-50.
- Cohn LD, Hernandez D, Byrd T, Cortes M. A program to increase seatbelt use along the Texas-Mexico border. *Am J Public Health* 2002; 92: 1918-20.
- Crandon IW, Harding HE, Branday JM, et al. The prevalence of seatbelt use in Kingston, Jamaica: a follow-up observational study five years after the introduction of legislation. *West Indian Med J* 2006; 55: 327-9.
- Evans L. A new traffic safety vision for the United States. *Am J Public Health* 2003; 9: 1384-6.
- Evans WN, Graham JD. Risk reduction or risk compensation? The case of mandatory safety-belt use laws. *J Risk Uncertainty* 1991; 4: 61-73.
- Ferguson SA. Other high risk factors for young drivers: how provisional licensing does, doesn't, or could address them. *J Safety Res* 2003; 34: 71-7.
- Farland MC, Moore RC. Human factors in highway safety: a review and evaluation. *N Engl J Med* 1957; 256: 792.
- Hasselberg M, Laflamme L. Road traffic injuries among young car drivers by country of origin and socioeconomic position. *Int J Public Health* 2008; 53: 40-5.
- McCarthy M. The benefit of seatbelt legislation in the United Kingdom. *J Epidemiol Comm Health* 1989; 43: 218-22.
- Nakahara S, Ichikawa M, Wakai S. Seatbelt legislation in Japan: high risk driver mortality and seatbelt use. *Injury Prev* 2003; 9: 29-32.
- Nelson DE, Bolen J, Kresnow M. Trends in safety belt use by demographics and by type of state safety belt law, 1987 through 1993. *Am J Public Health* 1998; 88: 245-9.
- Nikzad F. First book related road traffic injuries in Iran and its damages, causes and factors to get out of problem. Tehran: Traffic Police of Iran, 2006 (in Persian).
- O'Sullivan L. 3 point seatbelt invention enhanced road safety anniversary of the modern safety belt that saved countless lives. *Suite 101.com*, 2009 Aug 28.
- Preusser DF, Williams AF, Lund AK. Characteristics of belted and unbelted drivers. *Accid Anal Prev* 1991; 23: 475-82.
- Roberts I. Why child pedestrian deaths have rates fallen? *BMJ* 1993; 306: 1737-9.
- Salzberg P, Yamada A, Saibel C, et al. Predicting seatbelt use in fatal motor vehicle crashes from observation surveys of belt use. *Accid Anal Prev* 2002; 34: 139-48.
- Salzberg PM, Moffat JM. Ninety-five percent: an evaluation of law, policy, and programs to promote seatbelt use in Washington State. *J Safety Res* 2004; 35: 215-22.
- Science Daily. Seatbelt intervention shows many lives can be saved on China's roads. *Science Daily* 2007 Apr 23.
- Shults RA, Nichols JL, Dinh-Zarr TB, et al. Effectiveness of primary enforcement safety belt laws and enhanced enforcement of safety belt laws: a summary of the Guide to Community Preventive Services systematic reviews. *J Safety Res* 2004; 35: 189-96.
- Thomas J. Road traffic accidents before and after seatbelt legislation- study in a district general hospital. *J R Soc Med* 1990; 2:79-81.
- Williams AF, Wells JK. The role of enforcement programs in increasing seatbelt use. *J Safety Res* 2004; 35: 175-80.
- World Health Organization (WHO), the World Bank. World report on road traffic injury prevention. Geneva: WHO, 2004. [Cited 2010 Apr 18]. Available from: URL: <http://www.who.int/world-health-day/2004/en>
- World Health Organization (WHO). Department of Violence and Injury Prevention and Disability (VIP). Global status report on road safety time for action. Geneva: WHO, 2009. [Cited 2010 Apr 18]. Available from: URL: www.who.int/violence_injury_prevention