



The Burden of Road Traffic Injuries in Yazd Province - Iran

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ABSTRACT

Objectives: To estimate the Disabled-adjusted Life Years (DALYs) of Road Traffic Accidents in patients referred to hospitals in Yazd Province, central Iran.

Methods: This cross-sectional study was conducted in Yazd province during 2010. To calculate the Years of Life Lost (YLL) due to premature death and to calculate the incidence of non-fatal injuries and Years Lost due to Disability (YLD), the data were collected from Yazd death registration system and hospital records. The causes of death and nature of non-fatal injuries were classified using International Classification of Diseases (ICD-10). We estimated Disability Adjusted Life Years (DALYs) on the guidelines of the Global Burden of Disease Study (discount rate: 0.03, age weight: 0.04, constant age weight correction factor: 0.165). Age and sex composition was taken from the National Statistical Center for the year 2010.

Results: During 2009, 483 deaths were caused by traffic accidents in Yazd Province, 382 (79.09%) of which were males, and 101 (20.91%) were females. The mortality rates for males and females were 70.98 and 20.15 in 100,000, respectively. The years of life lost due to premature deaths were 15.84/1000 in men and 4.75/1,000 in women. Total YLLs caused by traffic accidents were 10,908 years. The injuries caused by traffic accidents were calculated as 15.21 and 3.73/1,000 in males and females, respectively. The total YLDs was calculated 1.51/1,000. The total burden of Road Traffic Injuries in Yazd province was 12478 years (DALYs), 87.41% of which was due to premature death, and 12.59% was related to disability. Also, 78.32% was lost in males. The age specific peak of burden was in 15-29 year.

Conclusion: This study showed that traffic accidents in Yazd impose a high burden. It seems that it is one of the health sector priorities. It is recommended to revise laws on use of motorcycles, especially on helmet use for motorcyclists, enforce strict laws in residential areas, and review social determinant affecting the incidence of such accidents.

Keywords: Road traffic injuries; Yazd; Disability adjusted life years (DALYs).

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Introduction

Nowadays, with changes in the profiles of diseases and the epidemiologic transition, the traditional indicator of death rate cannot be the sole indicator of the health level of a community and is not enough for allocating the limited resources of health sector in order to provide and promote health [1-3]. Therefore, in addition to the premature deaths, it is essential to determine the disability loss caused by or followed by diseases and injuries in a standard form. This way, the contribution of each disease in the death and disability imposed on the community can be determined, and thereby, the health plans can be prioritized as the most important step in designing the interventions. Traffic accidents are a major problem for public health, and preventing them continuously and effectively have long been considered by policy makers. Throughout the world, annually more than 50 million people are injured, and 1.2 million people are killed by traffic accidents, 90% of which occur in low and middle income countries [4,5]. It was estimated that in 2004, traffic accidents, with rate of 2.6%, was the eighth cause of disease burden costing 518 billion dollars [6].

Traffic-related death rate has been reported 18.03, 21.3 per 100,000 people worldwide, in the Eastern Mediterranean region, respectively. For Iran, the number was estimated to be 32.9 [7]. Burden of disease is a quantitative indicator of health which, combined with information on death and non-fatal but debilitating outcomes of diseases and injuries, indicates years of life lost in a population due to premature deaths or disabilities [8]. Since the burden of disease published in the international reports are mainly estimations, it is recommended to calculate the burden of disease based on local data considering the differences in the traffic culture of different regions [9,10]. The use of burden of disease parameter was considered by researchers in several studies, and its usefulness in measurement and demonstration of the effect of road accidents on human health compared to that of other diseases and injuries has been determined in different geographical areas [11-17].

Calculation of burden of traffic accidents in Yazd Province along with description of the current situation could provide a good document to determine basic information for decision-makings about policies and designing appropriate interventions. The effect of interventions can also be evaluated by calculating it periodically. Therefore, this study was designed and conducted to calculate the burden of traffic injuries in the Yazd Province.

Materials and Methods

Study Population and Protocol

The study population was the population of Yazd Province in 2010. Population of urban areas in 2010 was estimated based on the base population in

2006, which was obtained from census, and using the *progressive* method considering a 1.2% growth. Population of the province rural areas was extracted from vital horoscope of health homes. Mortality data were collected from death registration system of the province health center. Mortality data from death registration system was collected based on the standard death certificate forms from all sources, such as hospitals, cemeteries, forensic medicine organization, and health centers. The Data on nonfatal injuries caused by traffic accidents were collected using census from the patient registration offices, emergency medical centers, and hospital records of the people injured by traffic accidents who were referred to all public and private hospitals in Yazd Province. In order to maintain comparability, the methodology used in the Global Burden of Disease Study 2003 was used here [18], and the burden of traffic accidents was calculated based on the DALY index. The lost standard life expectancy method was used to calculate the years of life lost due to premature deaths [19].

In the studies on burden of disease, a weight is defined between zero (perfect health) and one (death) for each non-fatal outcome, which specifies the portion of a period of time passed with a nonfatal outcome that should be considered, lost. Having approved by the panel of experts, the table of disability weight and duration of any injury used by Dutch was used in the present study [20].

The Excel table pattern provided by original designers of the burden of disease project, and the weighting the burden of the 2000 disease project, whose compatibility had been evaluated by the comments of Iranian experts, was used to calculate DALYs, YLDs, and YLLs using the following formula [17,19]:

$$YLL(3.1) = N \cdot Ce(ra) / (\beta + r)^2 [e - (\beta + r)(L + a) - (\beta + r)(L + a) - 1] - e - (\beta + r)a [- (\beta + r)a - 1]$$

Where:

N: Number of deceased with a certain age and gender.

L: Standard life expectancy of the deceased at the same certain age and gender

R: Rate of discount equal to 0.03

β : Contractual rate in the calculation of age value equal to 0.04

C: Constant number equal to 0.1658

$$YLD(3.1) = I * DW * Ce(ra) / (\beta + r)^2 [e - (\beta + r)(L + a) - (\beta + r)(L + a) - 1] - e - (\beta + r)a [- (\beta + r)a - 1]$$

Where:

I: The number of new cases of a disease or injury during a given time

L: Duration of the disease or complication

DW: Disability weight of the disease or complication

R: Rate of discount equal to 0.03

β : Contractual rate in calculation of the age value equal to 0.04

C: Constant number equal to 0.1658

And finally, the total years of life lost were

calculated by the following equation.

$$DALY=YLL+YLD$$

Results

During 2009, 483 deaths were caused by traffic accidents in Yazd Province, 382 (79.09%) of which were males, and 101 (20.91%) were females. The mortality rates for males and females were 70.98 and 20.15 in 100,000, respectively. The years of life lost due to premature deaths were 8524 years (15.84 per 1,000) in males and 2383 years in females (4.75 per 1,000). Total years of life lost due to premature deaths caused by traffic accidents in two genders were 10,908 years. The highest frequency of years of life lost due to premature death was in the age group of 15-29 (21.72 per 1,000) for males, and in the age group of 15-29 (12.79 per 1,000) for females (Table 1 and Figure 1).

A total number of 10,055 patients were hospitalized due to traffic accidents at Yazd Province in 2009,

8187 (81.4%) of which were males, and 1868 (18.6%) were females. The injuries caused by traffic accidents resulting in hospitalization were calculated as 15.21 and 3.73 per 1,000 in males and females, respectively (9.67 per 1,000 in both genders). The total years of life lost due to disability was calculated as 1571 (1.51 per 1,000). In men, the following injuries caused the highest years of life lost: spinal cord (692.3), foot nerves (179.5), lower limb amputation (150.9), *upper limb amputation* (80) and femur fracture (31.4). In women, the following injuries caused the highest years of life lost: spinal cord (238.2), foot nerves (22.7%) and lower limb amputation (18.8), femur fractures (8.5) and cranial injuries (6.1) in females, respectively (Table 2).

In 2009, a total of 12478 years of life was lost due to traffic accidents in Yazd Province, 10,908 (87.41%) of which was due to premature death, and 1571 (12.59%) was related to disability. Also, 9773 years (78.32%) was lost in males, and 2705 years (21.68%) was lost in females (Figure 2).

Table 1. Years of Life Lost (YLL) and Disabilities (YLD) due to traffic accidents death & injury by Sex, age group - Yazd

Age group	Male				Female				Total			
	YLLs	YLDs	DALYs	DALY/1000	YLLs	YLDs	DALYs	DALY/1000	YLLs	YLDs	DALYs	DALY/1000
0-4	272	44	315	6.93	486	22	508	11.62	758	66	824	9.23
5-14	646	59	705	8.72	384	34	418	5.51	1030	93	1123	7.17
15-29	3985	731	4715	25.71	557	189	746	4.34	4542	919	5461	15.37
30-44	1903	283	2186	19.02	506	43	549	5.36	2409	326	2735	12.58
45-59	1003	106	1109	16.78	263	26	289	4.79	1266	132	1398	11.06
60-69	337	18	355	15.92	75	3	77	3.36	412	20	433	9.54
70-79	284	5	289	16.64	77	3	80	4.72	361	8	369	10.73
≥80	95	4	99	12.91	35	2	37	5.28	130	6	136	9.25
Total	8524	1249	9773	18.16	2383	322	2705	5.40	10908	1571	12478	12.01

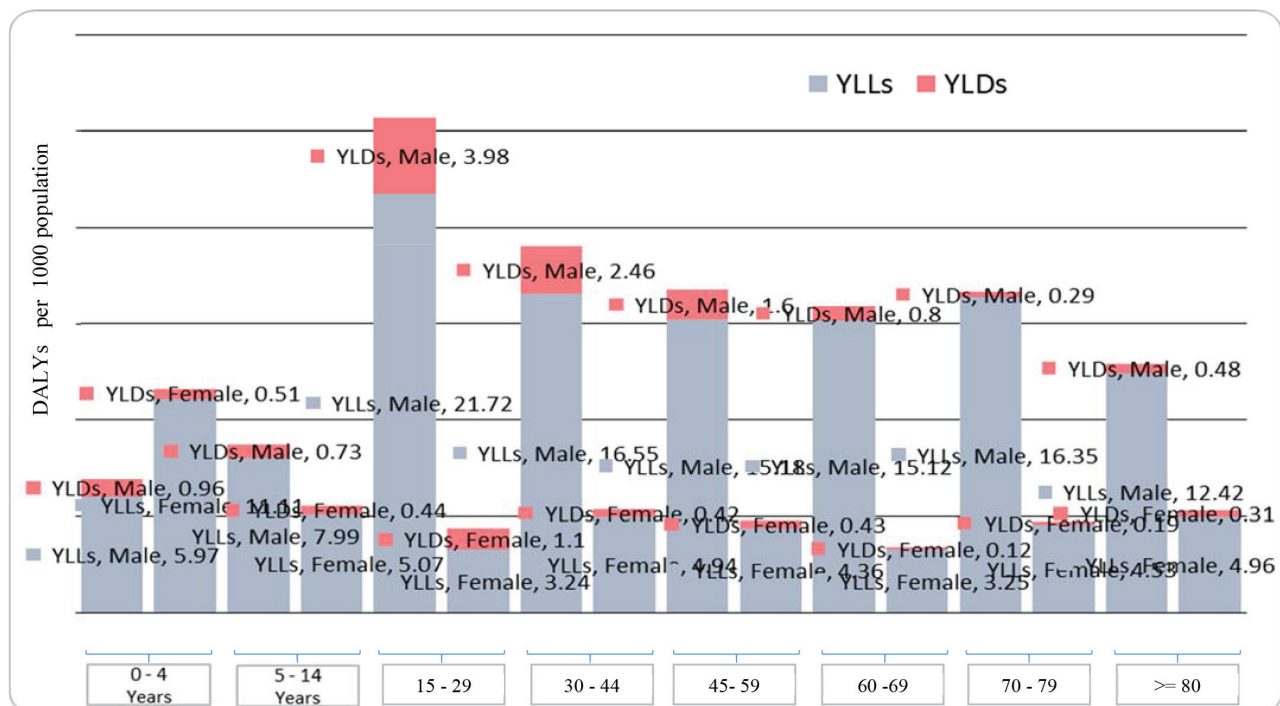
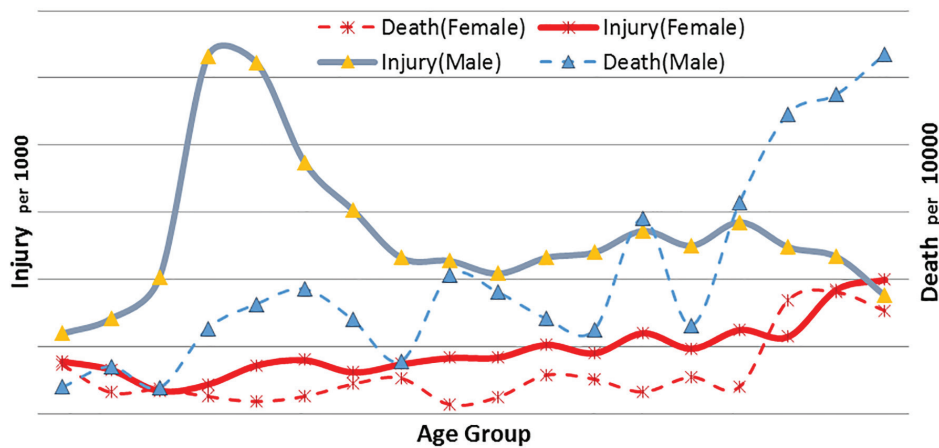


Fig. 1. Disability Adjusted Life Years (DALYs/1000) due to traffic accidents by Sex, age group Yazd

Table 2. The top 10 leading non-fatal injuries as a result of road traffic collisions, Yazd

Type of injury	Num.	Proportion of all		YLD per 1000		
		traffic injuries	Years Life Disability	Male	Female	Total
Spinal cord injury	66	0.66	59.23	692.35	238.23	930.58
Injury of nerves leg/foot	163	1.62	12.88	179.51	22.78	202.29
Amputation lower extremity	29	0.29	10.81	150.97	18.82	169.79
Amputation upper extremity	28	0.28	5.37	80.88	3.53	84.41
Fracture of femur shaft	774	7.7	2.51	31.42	8.51	39.93
Other skull-brain injury	853	8.48	1.9	23.69	6.12	29.81
Fracture of knee / lower leg	1536	15.28	1.72	23.55	3.51	27.06
Fracture facial bones	942	9.37	1.65	20.94	4.91	25.85
Fracture of elbow / forearm	808	8.04	0.88	10.66	3.16	13.82
Internal organ injury	1378	13.7	0.77	9.32	2.72	12.04

**Fig. 2.** Injury and Death rate per population due to traffic accidents by Sex, age group Yazd,

Discussion

The years of life lost due traffic-related injuries and deaths in Yazd Province showed that the number was 4 times higher in males than in females (15.2 versus 3.7 per 1,000) for injuries, and was 3.5 times higher in males than in females (15.84 vs. 4.75 per 1,000) for deaths. Results showed that Years of life Lost due to Death (YLL) and Years of life Lost due to Disability (YLD) caused by traffic accidents was higher in young age groups, especially in 15-29, which was higher than all age groups (53.4% of injured were in this age group.) Gender difference between these two parameters was in ways that in all age groups, except for the 0-4 year age group, males were more prone to traffic-related injury and death compared to females. The more frequent deaths in males were consistent with similar studies throughout the world [11,21-24]. Eastern Mediterranean Region [25,26], Iran [15,16,27-29], and the previous provincial studies [30]. This may be due to some reasons such as males being more at risk for job duties, higher number of male drivers, especially young drivers with risky behaviors including drug abuse, inattention to traffic laws, as well as using high-speed vehicles with low safety such as motorcycles. The effect of the debilitating outcomes of traffic accidents in males

and young people in imposing enormous economic burden on the society cannot be ignored, particularly in developing countries.

In this study, 87.4% of all DALYs were related to YLL. Higher value of burden of deaths in road accidents was reported compared to burden of inability in most studies (Iran 65%, Birjand 95%, France 65%, Thailand 88%, and Australia 73%) [14,17,28,31,32], however, this ratio was 17% in a study in Isfahan [15]. The difference in higher value of mortality rates due to road accidents compared to the burden of death due to injury in Yazd can be caused by the difference in the average age of the deceased due to death at younger ages due to the higher use of vehicles especially with lower safety, such as motorcycle with 20-fold increased risk of death for drivers of these vehicles compared to car passengers [33], risky behaviors while driving and inattention to traffic laws [34] as well as the lack of clear line between two-wheeled vehicles and four-wheeled vehicles on roads. The 2011 census showed that 58% of families in Yazd had a car, and 57% of them had motorcycle (the highest rate among all provinces). This indicator across Iran was 42 and 22%, respectively [35]. Underestimation of non-fatal injuries in road accidents due to unavailable data of cases referred the outpatient service clinics in

this study, severity of the incident and fatal injuries caused by it, and the quality of services provided to victims to save their lives, can directly affect the share of death rate in load of traffic accident, which will require a separate study in this regard.

The death rate of the traffic accidents was 46.4 per 100,000 people which were 1.5 times higher than the Iranian statistics [15,17] and 2.5 times higher than the world average statistics [7]. This difference can be observed in both males (70.98 per 100,000) and females (20.15 per 100,000).

Due to their lower agility and higher vulnerability, the elders are more vulnerable than other age groups in a traffic accident [36-41]. Thus, in this study, the incidence of death caused by traffic accidents increased with age in both gender groups (Figure 2). Results indicated a difference of traffic-related death rates between people under 60 (62 and 18 for males and females, per 100,000, respectively) and people above 60 (158 and 40 for males and females per 100,000, respectively). Both indicators were higher than that in Eastern Mediterranean Region which was reported 116 and 46 for males and females of 60 and older, respectively, and higher than that in Iran which was reported 88 for both males and females [42,43]. Unlike males, this age difference was observed in females in the traffic-related injuries. That is, the increased traffic injuries can be seen in females at above 60, and it is recommended to investigate the role of the injured people in traffic accidents (pedestrian, driver, or passenger) in further studies to determine the cause of this age-gender difference. Thus, given the aging of the population in the coming years, as well as the older women driving, it is expected that in case of absence of intervention, these indicators will be deteriorated due to their increased exposure.

The incidence rate of 9.67 per 1,000 injuries caused by traffic accidents resulting in admission in Yazd compared to the results of Isfahan (3.28 per 1,000) and Birjand (2.12 per 1,000) indicated the higher vulnerability of females and males in Yazd (12 and 14). Knee and leg fractures with 15.3%, internal organs injuries with 13.7%, facial bone fractures with 9.4%, and other skull injuries with 8.5% were the most frequent injuries leading to hospitalization in both genders, which showed the need for mandating the use of helmets for motorcyclists and embedding airbags for car passengers. These injuries were also consistent with studies conducted in Isfahan, Birjand and Shiraz [15,17,44] in terms of frequency. This requires the government intervention.

The total years of life lost due to disability was 1571 (1.51 per 1,000) which was more than the results of a study in South Khorasan and less than that of a study in Isfahan. The difference in the severity of injuries and lack of calculation of injuries leading to receive outpatient services were the causes of the differences.

The comparison between the results of this study and results of the study conducted in Yazd in 2003 showed that although the years of life lost due to premature deaths caused by traffic accidents (YLL) was decreased by 22% (reduction of 3026 years of life lost), this index had increased approximately 40% for females (676 years), in contrast to males, where it was reduced (3703 years = 30% reduction). A portion of such increase may be due to the increasing number of female drivers in recent years. Part of a 5-fold reduction of years of life lost due to disability (YLD) compared to the results of the study conducted in 2003 could be also due to the difference in calculation, especially not considering the co-morbidity in the present study. Lack of improvement in the traffic-related mortalities and injuries indices in females requires authorities to pay more attention to design and implement educational-executive interventions by evaluating risk factors of the occurrence of traffic accidents in females.

In conclusion, this study showed that traffic accidents in Yazd Province impose a high burden on the community. However, the reduction in the burden of traffic accidents can result from the enactment and enforcement of new laws with heavier penalties, especially in suburban roads, obligation of offenders to participate in training courses, increase of public awareness about the use of helmets along with removing accident-prone points in roads, and increasing the number of emergency stations on the road. In Iran's health Map in the Fifth Economic, Social, and Cultural Development Plan, reduction of the burden of traffic accidents by at least 20% compared to the base year is one of the macro-goals by the end of the Five-Year Plan. Therefore, it is recommended to revise laws on use of motorcycles, especially on helmet use for motorcyclists, enforce strict laws in residential areas, and review social determinant affecting the incidence of such accidents.

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