

Productivity and Years of Life Lost Due to Fatal Traffic Injuries in Shiraz Shahid Rajaei Hospital during 2009–2013

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Abstract

Background: Road traffic injuries (RTIs) are an important public health concern, and one of the main causes of death leading to loss of productive and effectual years of life. This study aimed to determine the economic burden of fatal crashes for about 5 years in Shahid Rajaei Hospital in Shiraz. **Methods:** In this cross-sectional study, cost and demographic data related to the people who died in the hospital due to RTIs, during 2009–2013, were obtained from medical records. Economic burden of traffic accidents that led to death was estimated using human capital as direct costs of treatment and potential years of life lost (PYLL) and lost productivity as indirect costs. **Results:** During 2009–2013, 989 individuals died from traffic accidents in Shiraz, imposing 1.58 million US dollars to hospital costs, 41,298 PYLL, and 67 million US dollars productivity lost. In this study, the mean age of the dead people was 43.3 ± 22.24 , and the productivity lost per capita was 67,000 \$US. **Conclusions:** The economic burdens of traumatic brain injuries were high in fatal accidents in Fars Province equivalent to 0.0003% of Iran's gross domestic product in 2013. Thus, special attention should be directed toward prevention measures for fatal traffic accidents.

Keywords: Economic burden, fatal traffic injuries, road traffic injuries, Shiraz

INTRODUCTION

Road traffic injuries (RTIs) are a global problem.^[1] Road traffic accidents were for the most part responsible for deaths and disabilities, especially in developing countries.^[2] One million people killed due to road accidents in developing countries and half of this occurring in Asia.^[1] In industrialized countries, road accident is more common among young people. RTIs are accounted for 65% of all deaths in developing countries.^[3] The cost of RTI varies between 1% and 3% of the gross domestic product (GDP) in the low- and middle-income countries.^[1]

Iran is among the high-ranked countries in the world, considering road accidents, and the number of deaths reaches

30/1000.^[4] Many of the injured people are young and are in productive years of their life (20–30 years of age).^[5] The economic cost in terms of medical treatment, rehabilitation, and loss of productivity is high, with direct outcomes in societies.^[6] Based on the global burden of disease study, deaths from traffic accidents in 2020 will be the sixth leading cause of death, globally. Traffic accidents are the second leading cause of life years lost in low-income countries.^[7] RTIs and deaths cause

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considerable economic loss in developing countries.^[8,9] The direct and indirect costs (lost productive years) determine the cost per fatal injury plus a value of safety per case.^[10]

Objectives

This economic evaluation study aimed at determining the economic burden of traffic accidents leading to death for 5 years as the total of direct and indirect costs in Shiraz (South of Iran).

METHODS

This cross-sectional study was carried out in 2013. The study population was deaths due to traffic accidents occurring in Shahid Rajaei Hospital (a traumatic hospital affiliated to Shiraz University of Medical Sciences and Health Services) during the second half of 2009 to early 2013. We used the macro (aggregate numbers) and the community approach to assess the overall burden of the traumatic brain injuries. Direct costs associated with RTI, including hospital charges, social cost in terms of years of potential life loss, and the indirect cost in terms of loss of productivity due to premature death for RTI were determined.

Data sources

To collect the required data, a phone call interview with the patient's family members was used as well as medical records investigation. Hence, cost-related and demographic data (age, sex, marital status, place of residence, patient education, occupation, and patient's insurance type) were extracted.

Hospital costs

Hospital-related costs such as hospitalization, medical costs, cost of surgery, fees for doctor's examinations, costs of radiology and medical imaging, costs of physiotherapy and rehabilitations, laboratory services, ambulance and transportation of the patient, and other fees were recorded in hospital bills.

Funeral cost

In this study, the average funeral cost was 202 \$US for each patient who had died according to Rezaei *et al.* (2014),^[11] and funeral cost paid to dead people's family by social insurance.^[12] Hence, the total costs were estimated by multiplying by the number of dead in the amount of fees.

Determination of potential years of life lost

The lost years due to premature death were calculated according to the standard of life expectancy years of life lost (YLL). The total value was estimated for each age stratum by considering 3% discount rate and using the following formula:^[13]

$$YLL = N C e^{(ra)} / (\beta + r)^2 (e^{-[\beta + r][L + a]} [-(\beta + r) (L + a) - 1] - e^{-[\beta + r] a} [-(\beta + r) a - 1]).$$

In this formula: where N = Number of the dead at a given age and gender;

L = Standard of life expectancy of the deceased is given the same age and sex;

R = Discount rate (3%);

B = Contract rate to calculate value of age (0.04);

C = Constant (0.1658).

Costs of lost potential productivity

Per capita GDP was used to calculate the cost of lost potential productivity according to the formula:^[11]

$$\text{Potential production lost from fatal injuries} = \sum w (1 + g)^i / (1 + r)^i$$

r = discount rate (0.05);^[11]

i = Average number of years lost per crash;

w = Average annual GDP per capita;

g = Economic growth rate (3.7%, mean economic growth in the past 30 years);^[14]

According to the World Bank database, the average GDP per capita in Iran was 7177 \$US in 2013.^[15,16] In this study, the mean ages of people who died for every year from 2009 to 2013 were 43, 42, 42, 45, and 41 years, respectively. Assuming that the life expectancy is 74 years, the average number of lost years by each death was calculated for each year (e.g. 2013, 74-41 = 33). All analyses were performed using Excel software version 2013.

RESULTS

During 2009–2013, RTIs were registered as the underlying cause of 989 deaths in Shahid Rajaei Hospital; 808 (81.7%) were men and 726 of them (73.4%) were married. The mean age of those who died was 43.3 ± 22.24 years.

Most deaths had occurred in the age group of 15–29 years (311 = 31.1%). The time of death in 267 cases (27%) was before 24 h. All those who died had to stay in the hospital for 7584 days, and average length of stay time was 7.6 days. Most people (462 persons or 46.7%) died in the intensive care unit (ICU) of the hospital. Three major underlying causes of death were car accident (521 cases, 52.7%), motorcycle accidents (252 patients, 25.5%) and pedestrian accidents (216 cases, 21.8%), respectively. Regarding the place of residency, 64.8% of the patients (641 cases) were from Shiraz, and 27.7% (274 cases) were from other cities of Fars Province. About 7.5% of the patients (23 cases) were referred from outside Fars Province (neighboring provinces).

Hospital and funeral costs

Review of hospital records of patients who died shows the costs of hospitalization, hoteling, and treatment cost were 1.58 million dollars, 93% of which is paid by the government adoption of article 92 of the Fourth Development Plan. The total funeral cost was 199,600 US \$. Most of the total costs are belonged to hospitalization costs [Table 1].

Life lost to premature death

The number of lost years as an indicator of indirect social cost was calculated as 41, 298.12 years for all death

during the study (34,399.05 for men and 6899.07 for women of all age groups). Maximum of lost years were observed among the 15–29 years of age group in both men and women [Table 2].

Potential productivity lost to death

Potential productivity lost was calculated as 67,700 \$ US for each dead person and 67 million US dollars for all dead cases during 2009–2013. The potential productivity and the YLL are shown in Table 3.

DISCUSSION

Our study showed that the total imposed cost by RTIs was 69 million US dollars between 2009 and 2013 with $\geq 97\%$ in lost productivity, which depends on the income and number of life years lost and other related medical expenses in Shahid Rajaei Hospital. This hospital is a referral center for patients with trauma injuries in Fars Province and Shiraz. According to the WHO's estimations, the cost of road accidents is 1% of the GDP in low-income countries, while this cost can reach to 1.5% and 2.0% of GDP in medium- and high-income countries, respectively. Although the present study was a local research, the total imposed cost was nearly 0.0003% of Iran's GDP in 2013. This decrease of GDP would oblige a considerable pressure on the economy of Iran as a developing country that is constantly facing international sanctions and economic pressures by Western governments, especially the United States. In some related studies,^[17,18] the lost revenue was considerable compared to GDP with regard to the number of premature deaths. In the present study, the total direct medical costs (hospital costs) during 2009–2013 were 1.58 million US Dollars, and the average direct medical costs were 1590 US Dollars, for each death regardless of the funeral expenses. These costs were reported to be 2952\$ in Jordan.^[19] In a study by Chen *et al.*^[20] in Canada, 46%–65% of direct medical costs were associated with intensive medical cares. Similarly, in the present study, 63% of the total direct medical costs were related to hospitalization services and intensive medical cares. Furthermore, the cost of hospitalization services as a part of the direct medical cost based on this study was 63%. Health-care costs associated with RTI for households could be catastrophic.^[21] In a study in India, only 22% had access to medical insurance. In Iran, however, the implementation of article 92 of the Iran's Fourth Development Plan seems to be effective in reducing patients' out of pocket expenses; this can help the health system to reach the goal of being fair in economic contribution.

The findings of the present study showed that the average life lost was 41.75 years per individual, which was higher than that of Rezaei's *et al.* study.^[11] This confirms that the dead people in our study population were younger, and 41,298.12 loss years were estimated as a result of premature deaths. Furthermore, in other studies, the life-years lost due to accidents were reported differently. For example, in Kayani's study, the number of life years lost due to premature deaths was reported as 48,501.^[17] In our study, maximum of lost years was observed among

Table 1: The average cost of hospital services for brain injury and death in accidents

| Cost component | Fee (\$US) | Percentage | Mean±SD (\$US) | Median (\$US) |
|-----------------|-------------|------------|----------------|---------------|
| Hospitalization | 711,000 | 44 | 35.8±192,895 | 357.2 |
| Hoteling | 10,000 | 0.65 | 53.7±57 | 33.9 |
| Operating room | 213,000 | 13 | 972.3±27,586.4 | 163.7 |
| Radiology | 69,000 | 4 | 473.6±1613.2 | 61.6 |
| Medicine | 427,000 | 27 | 517.9±1035.5 | 79.4 |
| Physiotherapy | 9800 | 0.62 | 10.1±12.1 | 5.9 |
| Laboratory | 93,000 | 5.9 | 65.7±90.8 | 19.8 |
| Visit | 51,000 | 3.6 | 228.8±848.2 | 37.2 |
| Others | 19,700 | 1.2 | | |
| Total | 1.5 million | | | |

SD: Standard deviation

Table 2: Life lost to premature death due to brain injury according to age and gender

| | Deaths | Average age at death | Standard life expectancy | YLLs |
|---------|--------|----------------------|--------------------------|-----------|
| Males | | | | |
| 0-4 | 30.00 | 1.00 | 79.10 | 1038.76 |
| 5-15 | 9.00 | 9.60 | 70.80 | 408.50 |
| 15-29 | 269.00 | 22.60 | 57.90 | 14,287.77 |
| 30-44 | 158.00 | 37.60 | 43.00 | 8328.67 |
| 45-59 | 111.00 | 52.60 | 28.70 | 4964.23 |
| 60-69 | 80.00 | 65.60 | 17.20 | 2590.06 |
| 70-79 | 107.00 | 75.60 | 10.10 | 2267.44 |
| 80.00 | 44.00 | 85.60 | 5.30 | 513.61 |
| Total | 808.00 | 12.50 | 68.10 | 34,399.05 |
| Females | | | | |
| 0-4 | 4.00 | 1.00 | 81.60 | 182.30 |
| 5-15 | 2.00 | 9.60 | 73.40 | 106.94 |
| 15-29 | 40.00 | 22.60 | 60.50 | 2141.69 |
| 30-44 | 31.00 | 37.60 | 45.90 | 1440.31 |
| 45-59 | 42.00 | 52.60 | 31.70 | 1480.15 |
| 60-69 | 23.00 | 65.60 | 20.00 | 554.46 |
| 70-79 | 25.00 | 75.60 | 12.10 | 314.95 |
| 80.00 | 14.00 | 85.60 | 5.80 | 678.27 |
| Total | 181.00 | 12.90 | 70.30 | 6899.07 |

YLLs: Years of life lost

Table 3: The potential productivity lost and the years of life lost in about 5 years*,**

| | Years | | | | |
|--|-------|------|--------------|---------------|------|
| | 2009 | 2010 | 2011 (%) | 2012 (%) | 2013 |
| Deaths | 95 | 240 | 243 | 247 | 164 |
| Lost years | 4022 | 9962 | 10,276 (3.1) | 10,054 (-2.1) | 6991 |
| Potential production lost (million \$US) | 6.4 | 16 | 16.8 (3.1) | 16 (-4.2) | 11.3 |

*Numbers in parentheses indicate changes as percentage, **Data in parentheses show percentage of changes of each variable between years (2010, 2011, and 2012), as the study population included cases from the second half of 2009 to early 2013, and data of 2009 and 2013 were not complete, so the changes were not calculated

the 15–29 years of age group in both men and women. The age group of 15–45 years is considered most productive age group. An injury affecting someone from this age group will have crucial impact on his or her future life.^[9] According to Kadivar *et al.*, traffic accidents are the third-highest cause of death in Fars Province based on potential YLL.^[22] In Hajivand's *et al.* study in Bushehr, Iran's other southern province, traffic accidents would generate more YLL than heart disease or cancer.^[23] As we showed in the present study, the lost productivity value was 67,000 US dollars per 1 death. Other studies in Iran reported this value differently, it was reported to be as 43,000 US \$/one death in Rezaei's *et al.* study,^[11] to 133,000 US \$/one death in Karimi *et al.*, study.^[18] Head injuries contribute more to costs than other injuries due to more likelihood of deaths as a result of brain trauma; in the present study, most of dead people had head injuries, which this result is in line with those of other studies.^[9,24] The 1st h after the crash is referred to as a golden time with regard to survival of the injured person.^[25,26] Hence, the emergency health system can play an important role by providing timely emergency services. According to the results of this study, economic burden of death as a result of traffic accidents is considerable. Iran is one of the top 10 countries in terms of YLL due to traffic accidents across the world.^[27,28] Reduction of the number of accidents improves the public health status by reducing lost years of life and years of living with disability and also can reduce additional costs on the public health system. Since majority fatalities occur in productive age groups of 15–29 years, these injuries have economic burden at the community level and family level. In addition, prolonged hospitalization in ICU is expensive^[29] and families of these patients faced with catastrophic costs. Hence, efforts to reduce fatal RTIs is essential through simple interventions such as the use of helmets or applying legal constraints for driving licenses and number of riders for motorcycle drivers, use of seat belts for drivers, and driving within allowed speed limits.

CONCLUSIONS

According to the results of the present study, to decrease fatal road traffic accidents, it is not necessary for health policymakers to think about complex decisions; sometimes, an inexpensive and uncomplicated intervention is more cost effective than other choices. Furthermore, it should be noted that the prevention of traffic accidents is a matter beyond the scope of public health system; therefore, the health system has to synchronize with other sectors to prevent the traffic accidents.

Teaching people, especially school children and establishing proper driving regulations, use of helmets by motorcyclists, use of seat belt of driver, and improving motor vehicles and road safety, are the most effective factors for reducing RTIs.^[30]

Limitations

This study does not encompass prehospital costs, as Iranian Health System does not consider it. In addition, the costs

associated with accidents such as damage to the car, which impose a high economic burden. Hence, limiting the study population to those who died in accidents, the estimates of the financial burden may be underestimated to some extents.

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Conflicts of interest

There are no conflicts of interest.

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