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Original Article

Estimating the economic burden of emergency accidents in Yazd (2016)

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ABSTRACT

Introduction: Traffic accidents are the ninth leading cause of loss of useful life in the world. The purpose of this research was to estimate the economic burden of accidents in Yazd in 2016. **Methodology**: This was a cross-sectional descriptive-analytic study. The study population included all injured people and victims of road accidents in Yazd in 2016. In this study, like other studies, the human capital approach was used to estimate the costs of road traffic accidents and the costs were estimated in two ways: 1- Based on the type of costs (direct costs, indirect costs); 2- Based on the type of outcome (death, injury, and damage to equipment). The costs were divided into two categories; a: direct costs (pre-hospital costs, hospital costs, physiotherapy and rehabilitation costs, property damage costs, administrative costs, and burial costs), b: Indirect costs (costs of lost income or lost potential production, lost potential production for the outpatient injured persons, lost potential production for hospitalized injured persons). **Results**: In Yazd, 278 people were killed and 107973 were injured due to traffic accidents in 2016. The total costs associated with these incidents were estimated at ($ 1004240) as equal to 16.439.168.647 billion rials. The results showed that of the total accident costs, 86.11% were direct costs and 13.89% were indirect costs. **Conclusion**: The results of this research showed that the economic burden of accidents in Yazd constituted about 18% of 59467 trillion GDP of Iran in 2016.

Keywords: Emergency Accidents, Economic Burden, Costs

Introduction

Annual traffic accidents kill about 1.2 million people and do injure more than 50 million people worldwide, and are the ninth leading cause of the loss of useful life in the world and are predicted to increase 66 percent by 2020 and become the third factor. Road accidents daily kill 3,000 people and result in about 137,000 injuries, whose 5.2% occur in our country [1]. Over the past 50 years, the countries around the world have witnessed the increasing traffic accidents and resulting deaths, and according to the World Health Organization (WHO) reports, out of 190 countries, only 4 countries have had casualties due to traffic accidents more than Iran (World Health, 2002). Although Iran has less than 1% of the world's population and accounts for more than one-fourth of the world's traffic accidents, the most important cause of death in the age groups of one month to 50 years in Iran is unintentional accidents and at the forefront of all traffic accidents [2]. Surveying the number of crashes in the country between 1996 and 2005 indicated that more than 80 percent of the fatalities in Iran are men, with 47 percent of them in the age group of 20 to 50 years old. This comprises only 38%

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of the population. In addition, men of this age group, as productive human resources, play an important role in the national economy, national per capita income, and gross national product, which is directly correlated with the society's income, welfare, and general well-being. Because of the cultural conditions of the society, men are often the main source of income and the sole breadwinner of the household, and their absence creates irreversible financial and economic crises and has disastrous social effects that cannot be expressed in terms of cost and numbers. The reason behind is that only the observable and calculable costs are added to the total costs imposed on the society, which entails costs of up to 2000 billion rials per day [3]. They provide a framework for achieving community health goals and outline how resources can be used effectively to achieve those goals. On the other hand, they provide a clear analysis of the behaviors and motivations leading to health promotion and limit non-healthy behaviors and performances by calculating the costs incurred due to disregarding health tips. They also provide valuable information for planning, evaluating health promotion programs, and preventing damages [4]. One of the concerns of governments is to reduce health-related problems such as diseases, injury or the risk of any of these. The burden of health-related problems such as physical disability, disease and mortality, mental distress, social problems and social exclusion, and financial and economic losses can be measured by a number of health criteria such as: number of deaths and number of years of life lost due to the disease or in the form of monetary amounts such as the cost of health problems [1]. The economic costs of road accidents account for 2% in the developed countries and in the low- and middle-income countries up to 15% of GDP. In our country, this share also reached 5% of GDP in 2004. The estimated costs of road accidents in the world in 2004 were US $ 518 billion, of which US $ 453 billion (87%) was imposed on the less developed countries. In 2004, this number in Iran was estimated at 60 trillion rials [3]. Economic losses resulting from the accidents include the cost of life lost and life with disability, treatment and medical care costs, rehabilitation costs, burial cost for the dead, compensation for damages, administrative costs of Police and emergency services and the cost of survivals' injuries [2]. In the National Disease Burden Survey in 2003, it was found that the traffic accidents accounted for 15% of all lost years due to death and the men accounted for more than 80% of lost years and disabled life, and 57% (684210 years) of total years of life in the age group of 15-29 years have been lost. Traffic accidents in Iran as the first health problem annually waste more than 1, 200,000 years of life (disability-adjusted life expectancy). Disability-adjusted life expectancy is one year of life that must be healthy but it has been lost due to disability resulting from the disease or injury or premature death. The analyses of accident statistics in Yazd showed that there are about 11000 accidents in its different areas every year and about 5% of this number is related to pedestrians. So, in every one kilometer of arterial paths Grade 1 and Grade 2 and the distributing streets of the city, 40, 60, and 5 crashes occur per year [5].

Procedure

This research was a cross-sectional descriptive study whose population included all victims of road accidents in Yazd in 2016. In this study, similar to other studies, the human capital approach was used to estimate costs, which were estimated in two ways: 1) By the type of costs (direct costs, indirect costs) 2) By the type of outcome (death, injury, and damage to equipment). The costs have been divided into two categories: 1- Direct costs (pre-hospital costs, hospital costs, physiotherapy and rehabilitation costs, property damage costs, administrative costs, and funeral expenses), 2- Indirect Costs (Costs of Loss of Income or missed Potential Production). Given that Article 92 of the Fourth Schedule has so far allowed free treatment of road injuries in the public hospitals in the country, and these patients are normally transported by emergency department to the government trauma centers, it was assumed in this study that all the injured persons of the road accidents have been treated in the public hospitals, although these assumptions have limited our study. During the phone call with the injured or their families, the cost information was again retrieved to prevent a reminder error.

The study considered two modes for calculating pre-hospital costs:

- First mode: The injured person had referred to medical centers by the emergency system.
- Second mode: The injured person had referred himself to medical centers and the pre-hospital costs of the injured transferred by the emergency were calculated as follows:

(B / A) F: Pre-hospital costs of injured patients being transported to medical centers by emergency 115

A: Total number of accident missions of Yazd Emergency Center 115 in 2016

B: Total number of missions of Yazd Emergency Center 115 in 2016

F: Current Budget of Yazd Medical Emergency Center in 2016

The pre-hospital costs of the injured who referred themselves to the treatment centers were calculated as follows:

E (C-D): The pre-hospital costs of the injured who referred themselves to the treatment centers.

D: The number of injured and deaths of road accidents in 2016

C: The number of missions of emergency 115 for road accidents.

E: The average cost of transporting the injured to the treatment center.

Data on calculating pre-hospital costs were taken from Yazd Centre for Accident and Medical Emergency Management of the ministry of health, medical education and the total pre-hospital costs of road accidents in Yazd in 2016 were obtained from a combination of the two aforementioned modes [6].

Hospital, Outpatient, hospitalization, and medical costs of injuries included:

medicine, doctor's visits, medical tests, diagnostic services, food, etc., as well as public hospitals were selected for calculating the hospital costs in Yazd and, according to the Cochran statistical formula, the number of patients was determined proportionally to the number of hospital visits. Those records of patients were selected who received services in public hospitals in 2016, and by

studying the patients' files, the average duration of hospitalization and the cost of treatment were calculated and the total hospital cost was estimated [7]. In the present study, to calculate the cost of physiotherapy after selecting the samples, the amount of physiotherapy services and the average number of physiotherapy sessions per person were determined and generalized to the total number of accidents in 2016 and the percentage of accident patients who used rehabilitation services was inserted in the formula below:

P = cost of each treatment session

M = number of traffic injuries

Q = Average number of sessions needed for an orthopedic injury

(m) p) (q) = The cost of physiotherapy

In this study, in order to calculate the total cost of property damage, all available information was examined in terms of the type and number of accidents, and finally, by multiplying the number of vehicles involved in accidents at the average damage, the total cost of damage to vehicles was obtained. In addition, the administrative cost was calculated based on a questionnaire completed by all personnel involved in the administration of accidental patients and a questionnaire was used to calculate the funeral expenses of selected patients for the incurred expenses. The average burial cost was then estimated for each accidental death and multiplied by the cost and the total burial cost was obtained [8]. To calculate the potential production lost due to hospitalization, the average hospitalization day was calculated using a hospital record, multiplied by the number of hospitalized traffic injuries and by the country's daily wage rate of 812660 (2016). The total potential production lost was estimated for the hospitalized injuries; in calculating the average hospitalization day, the injured persons would not return immediately to work and would take a break to fully recover, thus it was needed to add a duration to the average hospitalization day. To calculate the potential production lost for the outpatient injuries, the average outpatient duration was obtained using the hospital records, multiplying this by the number of traffic injuries treated on the outpatient basis and by the daily wage rate; ultimately the total lost potential production was estimated for the outpatient injuries. In calculating the average duration of treatment, the outpatient-injured persons did not immediately return to their jobs and took a break to fully recover, thus one should be added to the average day of hospitalization.

Findings

Due to the traffic accidents in Yazd in 2016, 107973 people were injured and 278 died. In terms of gender, 83.2% of those died were male and the rest were female. In terms of the number of missions and deaths, there were 37 deaths from road traffic accidents, and 4146 people were the 115 emergency missions for road accidents.

1. Direct medical costs included pre-hospital costs, hospital costs, physiotherapy and rehabilitation costs, property damage costs, administrative costs, and burial costs.

- **Pre-hospital costs:**

The pre-hospital cost of the injured transported to the medical center was estimated at 15.6 billion rials ($ 47,851) and the pre-hospital cost of the injured who referred themselves was estimated to be 287.63 million rials ($ 8823). The total pre-hospital cost of the accidents in Yazd in 2016 was estimated to be 1847630000 rials ($ 56674).

1.560.000.000 = (2.000.000.000) (18773/14627)

287.630.000 = (37-4.146) 70.000

1.847.630.000 = 287.630.000 + 1.560.000.000

- **Hospital Cost:**

Examination of the hospital records showed that the mean age of the injured was 31.9%, of which 75% were male and 25% female. About 0.36% of the injured were treated outpatient and 0.64% were hospitalized. The average number of the hospitalization hours for the outpatients was 2.80 hours and for those who were hospitalized was 89.56 days. The total length of hospital stay was 18473.09 hours and 769.7 days. The number of the days of the hospitalized injured was between 1 and 300 days. The average cost of a hospitalized injured person was 10346293 rials ($ 317). According to the hospital records, the number of outpatient injuries of road accidents was 128 and the number of the injured hospitalized was 72. The total cost of hospitalized injured persons was estimated at 2069258666 million rials ($ 3260) and the total cost of outpatient injuries was 690581381 ($ 21183). The total cost of outpatient and hospitalized injuries in 2016 was estimated at 2.759.840.047 million rials ($ 84655).

- **Physiotherapy Cost:**

The total cost of physiotherapy and rehabilitation of traffic injuries in Yazd in 2016 was 8.750.000.000 rials ($ 268397) and the average cost of physiotherapy for one traffic accident in 2016 was 4.3750000 rials ($ 1342).

8.750.000.000 = (25.000) (35.000) (0.05) 200

43750000 = 200 / 8.750.000.000

- **Funeral Costs:**

A questionnaire was used to calculate funeral expenses. Then the average burial cost for each accidental death was estimated and multiplied by the cost, so, the total burial cost was obtained [1].

Total funeral cost ($ 13407) 437082449 = (48) 9105884.3500

Average burial cost per accidental death ($ 67) 2185412 = 200 / 437082448.8

- **Administrative Cost:**

To calculate the administrative cost, the questionnaire was completed by all the staff involved in the administrative affairs of the accident patients and the administrative costs were calculated and estimated:

Guardian 3117877 / Emergency medical technician, paramedic, aid worker 3515228 / Hospital admission 2800000 / Patient 1800000 / Emergency specialist 20000000 /. Then the administrative cost for each emergency injured was estimated to

be 156165.5 ($ 5) and the total administrative cost ($ 958) was estimated to be 31.233.105 million rials.

- **Property damage costs:**

In this study, the number of accidents in Yazd in 2016 was 109984. By multiplying the number of accidents by the factor of 2, the number of vehicles involved in the accidents was estimated to be 21997 machines. This estimated cost only was related to the direct damage to vehicles and did not include the cost of property within vehicles and the objects, which accounted for 0.05 of the total cost, according to Ayati et al. Finally, by multiplying the number of vehicles involved, 21997 accidents, in the average damage ($ 1015) 33.100.000, the total cost of damage to the vehicle was estimated. Under the heading of damage to vehicle property and stationary objects, the total cost of property damage was estimated to be 607900,000 million rials ($ 18,647).

Table 1: Total Cost of Vehicle Damage in the samples of Road Traffic Accidents in Yazd in 2016

Type of vehicle	Average price	Number of vehicles involved in accidents	Total damages
Pickup truck	5.400.000	33	178.200.000
motorcycle	900.000	113	101.700.000
Truck Trailer	22.000.000	4	88.0000.000
Public passenger service	4.800.000	50	240.000.000
total	33.100.000	200	607.900.000

Table 2: Average direct costs in the samples understudy

Statistical analysis of direct costs per person						
Pre-hospital Cost	Hospital Cost	Physiotherapeutic Cost	Property Damage Cost	Administrative Cost	Funeral Cost	Total
9.238.150	10.346.293	43.750.000	75.100.000	156.166	2.185.412	98.776.020

Table 3: Total direct costs in the samples understudy

Statistical analysis of total direct costs						
Pre-hospital Cost	Hospital Cost	Physiotherapeutic Cost	Property Damage Cost	Administrative Cost	Funeral Cost	Total
1.847.630.000	2.759.840.047	8.750.000.000	1.539.776.000	31.233.105	437.082.449	14.433.685.601

2. Indirect medical costs included (a) potential production of the lost income; the potential production lost for the hospitalized injured persons and the potential production for the outpatient injured.

- **costs of Income Loss (Potential Production):**

The potential lost production was 37.941.185 rials ($ 1164) for each deceased and 1.821.176.870 rials ($ 55863) for the total deceased.

Potential production of Income Loss (Potential Production) for every injured patient 37941184.8 = 48/1821176870

- **Lost Potential Production for hospitalized injured persons:**

According to the hospital records, the average number of days admitted for the road traffic injuries was 89.56 days, and the number of hospitalized traffic injuries equaled to 72 people; it was multiplied by a daily wage rate of 27072 and so the total potential production lost for the hospitalized injured in the road accidents in Yazd was estimated to be 174.568.919 rials ($ 5355).

The daily wage rate of the country in 2016, 27072 = 30/8121660

174568919 = 27072 (72) 89.56

Potential Production lost for each hospitalized injured person ($ 27) 872845 = 200/174568919

- **Potential production for Outpatient Injuries:**

According to the hospital records, the average duration of the outpatient injuries was 2.81 hours and the number of outpatient traffic injured persons was 128, multiplied by the country's daily wage rate of 27072 people. We estimated the total lost potential production for outpatient injuries due to the road traffic accidents in Yazd to be 9737257 rials ($ 299).

Lost Potential Production for each Outpatient Injured person ($ 1) 48686 = 200 / 9737256.96

The daily wage rate of the country in 2016

27072 = 30/8121660

Total lost potential production for outpatient injuries: 9737256.96 = (27072) (128) (2.81)

Table 4: Average indirect costs in the samples understudy

Statistical analysis of indirect costs per person

Potential Production for the Outpatient Injured persons	Lost Potential Production for hospitalized Injured persons	Costs of lost income (Potential Production)	Total
48.686	872.845	379.411.845	380.333.376

Table 5: Total indirect costs in the samples understudy

Statistical analysis of total indirect costs			
Potential Production for the Outpatient Injured persons	Lost Potential Production for hospitalized Injured persons	Costs of lost income (Potential Production)	Total
9.737.257	174.568.919	1.821.176.870	2.005.483.046

The results of the study showed that the total cost of production lost due to road accidents in Yazd was estimated to be 1.821.176.870 rials ($ 55863).

This study was an estimation of the economic burden of urban accidents in Yazd in 2016 using the human capital approach, which was the most important method for estimating the economic burden of the road accidents in developing countries. The total cost imposed by the urban traffic accidents in Yazd in 2016 was estimated to be 16.439.168.647 rials, which was approximately 86.11% of the direct costs, 13.89% of the indirect costs. In the urban accidents in Yazd in 2016, about 67.9 men were more likely to be injured and killed by road than women, which was similar to the studies done in the country. The results of the study showed that the average cost of hospitalization per injured person was 10346293 rials ($ 317) and the average outpatient cost for the outpatients was 690581381 rials ($ 21183); the average day of hospitalization for the traffic accident injured persons was 89.56 days. In this research, the average cost per death was estimated to be 37.941.185 rials ($ 1164) and is very important since it is the most palpable cost imposed on the family.

Discussion

The purpose of this research was to estimate the economic burden of accidents in Yazd in 2016. In this study, the hospital costs constituted the highest proportion of total costs in the direct cost group caused by emergency accidents in Yazd in 2016. These results were similar to the studies done in other countries. In their study regarding "Estimating the economic burden of road traffic accidents in Tehran province", Rezai et al. (2013) came to the following findings: The economic burden of road accidents in Tehran province is high between 0.2 and 0.4 of gross domestic product in 2009 [6]. In the research entitled "Calculating Costs of Vehicle damage in Road Accidents", Ayati et al. showed that over 6 billion rials were harmed to the economy of the country. This economic loss exceeded 0.5% of GDP. This reflects the increasing economic burden of emergency accidents in the country [8]. In the research entitled "Estimating Cost of Traffic Accidents Using the Willingness to Pay method", Eini et al. in 2015 found that the value of life statistics for one case death is 19713584906 rials ($ 604693) [9]; while in 2016, the lost potential production for each death in this study was estimated to be 9392450603426 rials ($ 12037,993) [7]. In a study entitled "Estimation of Final Cost of Activity Centers", which was done as a case study in one of the Armed Forces hospitals, Nouri et al. (2013) estimated total hospital costs in 2013 to be 244416,000 rials ($ 7497), with the direct costs of 0.52 and the indirect costs of 0.48 [8]. In a study entitled "Direct Costs and Indirect Costs of Cancer Patients Admitted to Cancer Center of Imam Khomeini Hospital in Tehran in 2010", Baziyar et al. (2010) estimated the average direct and indirect costs to be 2609,000 and 245,000 Tomans [10]. Between 2006 and 2010, with a study entitled "Estimating the Direct Costs of Hepatitis C", Ashtari et al. estimated the average direct cost of hepatitis C patients for a treatment period to be 11544061 rials [11]. In a study entitled "Direct Cost in Burn Patients Hospitalized in Imam Khomeini Hospital of Kermanshah Province in 2011", Rezaei et al. estimated the average cost per patient to be 20463227 rials, which was 22007182 and 19113198 for men and women, respectively; The highest percentage of the costs was for medicines and other consumables and hotel costs, accounting for 52% and 34% of total costs, respectively [12]. In a study done by Sahin et al., the average cost per patient was $ 1525 [7]. The study of Loftes showed that the average cost per patient was $ 46069. The study of Agondip in Nigeria showed that the average cost per burn patient is $ 274. A study done by Sánchez et al. showed that the average cost per patient, taking into account the labor force costs and social costs, is $ 95,551, which covers 10% of total health care costs. A study of Sánchez et al. (2003), Entitled Socioeconomic Costs and Quality of Life Related to Burn Patients in Spain, gradually showed that the average annual cost (direct and indirect cost) per patient was approximately $ 99773, about 0.20 of all costs related to the direct costs of health care. Although our nation's population is less than one percent of the world's population, its road victims are about 2% of global casualties and about one and a half times the global average. According to UN estimates, by 2020 the road loss statistics of developing countries will increase from 65% to 80%. In the absence of clear planning based on "scientifically experienced techniques", the road losses in Iran in 2020 would be around forty thousand and the injured would be about 520,000.

Therefore, a few suggestions, which can reduce the likelihood of an accident occurring have been presented:

- Providing cultural education to make more use of public transport
- Improving the safety and quality of urban roads
- Prioritizing incident points and providing credentials to secure these points
- Expansion and development of infrastructure of the smart transportation system in Urmia

- Decentralization of the central part of the city and equal distribution of attractive travel uses across all areas and levels of the city
- Encouraging people to use telecommunications or electronic communications to avoid unnecessary trips in the city
- Cultural education of observing traffic regulations for children as a practical unit in schools and kindergartens
- Using other countries' experiences to reduce accidents
- Using local and indigenous participation to enforce speed limits by municipalities in the form of cultural programs
- Installation of CCTV cameras in the streets where the most accidents occurred.
- Attention to increased road safety and reduction of accident points, as well as modification and completion of roads including Installation of warning signs and installation of resistant guardrails on roads, creation of roads crossing and lighting, as well as extensions of bridges and reconstruction of asphalt coatings, appropriate measures to solve the problem of driving such as creating suitable places by the Ministry of Road and Urban Development, speed control, necessity to use a seat belt, having airbags, use of firefighting capsules in cars, non-use of cell phone, as well as overseeing the enforcement of laws and imposing heavy fines on the incident police violators.
- Correct training and information and quality of driving education and the assessment of failures in training and use of other countries' experiences in driver training and driving licenses issued by traffic police.
- Monitoring the safety and standard of vehicles
- Appropriate measures to establish multiple rescue bases
- To cover families affected by car accidents by the support organizations including the Welfare Organization

The limitations of this study were as follows:

First: It was assumed that all patients were treated in public hospitals.

Second: In the estimation of some costs based on self-questioning and patient companionship, sometimes the data was uncertain, which may have affected the estimated economic burden.

Third: In estimating costs, the cost of informal care and the time spent by the patient's companion to care for the patient were not considered.

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