Trauma Mon. 2017 March; 22(2):e27577.
doi: 10.5812/traumamon.27577.
Published online 2016 January 20.
Research Article

Access and Necessity for Road Emergency Sites

Enayatollah Homaie Rad,[1] Ali Kazemi Karyani,[2] and Hamed Zandian[3,*]
[1]Guilan Road Trauma Research Center, Guilan University of Medical Sciences, Rasht, Iran
[2]Research Center for Environmental Determinants of Health, Kermanshah University of Medical Sciences, Kermanshah, IR Iran
[3]School of Health, Ardabil University of Medical Sciences, Ardabil, IR Iran

[*]*Corresponding author*: Hamed Zandian, School of Health, Ardabil University of Medical Sciences, Ardabil, IR Iran. E-mail: hamedzandian899@gmail.com

Received 2015 February 05; **Revised** 2015 March 20; **Accepted** 2015 April 13.

Abstract

Background: Fatal road accidents are among the most important causes of mortality in the world; Iran has one of the world's highest accident fatality rates. Therefore, it is important to have efficient pre-hospital emergency services.
Objectives: The main aim of this study was to assess the road emergency sites (RECs) in Iran.
Materials and Methods: Provincial data were used for this purpose. Concentration index, concentration curve, Lorenz curve, and the Gini coefficient were calculated to assess the distribution of RECs.
Results: The results of this study showed that the distribution of RECs was in favor of provinces with higher road fatalities, but it was equal to the need for RECs. The results of the Poisson regression showed that RECs were not distributed by population density, but rather were distributed according to road injuries, needs and average yearly rainfall.
Conclusions: While the distribution of RECs is equal with regard to the need, the number of RECs is still inadequate.

Keywords: Inequality, Road Emergency Cites, Concentration Index, Fatal Accidents, Iran

1. Background

Road injuries are among the most important causes of death in the world. According to the world health organization (WHO), 3400 people die in accidents on the roads every day. Nearly 92% of these deaths have occurred in medium- and under-developed countries. Having road emergency sites (RECs) can save the lives of many people injured in road accidents (1). The WHO facts show that 111 countries have national emergency numbers, but only 59 countries have ambulances available to transfer injured people to hospitals. Because of the importance of road accidents to global health, world countries in 2010 named 2011 - 2020 the "decade of action for road safety". The goal of this was to decrease the high rate of fatalities in road accidents and save more than 5 million lives by the end of the decade (2). Increasing traffic fines, establishing new regulations in traffic laws, constructing safer roads, and making other roads safer are vital for decreasing the number of fatal accidents (3).

Road emergency sites are important also for decreasing the number of deaths (4). Iran has one of the highest accident fatality rates in the world (sixth in 2013) (1). New regulations of traffic laws, increased traffic fines, improved quality of roads, and driver training have decreased the number of fatal accidents in Iran in the last decade, but these measures have not been sufficient, and the accident rate is still high in Iran (5, 6). In Iran, road emergency sites are managed by two organizations: the ministry of health and the iran red crescent organization. The number of these sites are changed on some special days, such as Nowrooz. In 2013, the ministry of health had 1274, and the red crescent had 398 fixed sites (7). Because of different fatal accident rates in the provinces, the distribution of these sites is very important.

2. Objectives

In this study, we assess new evidence about the inequality in the distribution of road emergency sites in Iran.

3. Materials and Methods

3.1. Study Design and Data

This descriptive analytical study assessed provincial data from 2008 - 2013. Data from Alborz province were not available before 2011, and so they were calculated linearly. The Gini coefficient, concentration index (CI), and concentration curve (CC) were used for calculating inequalities in the distribution of RECs. A new indicator (ratio of fatality to injury) was calculated to show the need of each province for road emergency sites. A province with a higher rate of fatality to injury has a greater need for road emergency centers. A Poisson regression model for panel data was used for estimating the factors affecting inequality in the distribution of RECs.

3.2. Calculating the Lorenz curve, Gini Coefficient, CI, and CC

In the Lorenz curve, two dimensions are used. Along the y-axis, the cumulative percentages of RECs are shown, and along the x-axis the cumulative percentages of population are placed. The 45-degree line is the equality line. In a curve nearer to the equality line, an inequality in the distribution of RECs is lower than others. The Gini coefficient is calculated from the Lorenz curve. This index is used for showing the differences in the distribution of health resources. The Gini coefficient varies between zero and one, where zero is complete equality and one is complete inequality. The Gini coefficient shows the distribution without any connection to necessity (8-10).

The concentration curve (CC) has two dimensions, also. The cumulative percentage of RECs is given on the y-axis, while on the x-axis the cumulative percentage of population is placed. The difference between the Lorenz curve and CC is that the x-axis in the CC is ranked by need. In this study, two need indices were used: the number of injuries in road accidents and the fatality-to-injury rate.

The concentration index (CI) is twice the area between the CC and equality line. The CI summarizes the results of the CC as a number. The CI varies between [U+2012]1 and +1. In the present study, the negative values indicate those provinces with more injuries or fatality-to-injury rates, or where there are fewer RECs (and vice versa). If the concentration index has no significant values, it means that there is no inequality with regard to need (10, 11).

3.3. Estimating the Model

A panel-data Poisson regression was used to estimate the REC model. The model is given as:

$$\log(RECx)_{it} = \beta_0 + \beta_1 dens_{it} + \beta_2 rain_{it} + \beta_3 injur_{it} + \beta_4 fti_{it} + \mu_{it} \quad (1)$$

Where REC was the number of road emergency sites in each province between 2008 and 2013, dens was the population density of each province between 2008 and 2013, rain was the average yearly rainfall for each province between 2008 and 2013, injur was the number of people injured in road accidents for each province between 2008 and 2013, and fti was the fatality-to-injury ratio for each province between 2008 and 2013.

In the model, t indicates time, i indicates the provinces, μ equals the residuals of the model, and the βs are the coefficients. After estimating the model, a Hausman test was used to select between fixed- and random-effect models. If the P value of this test was under 0.05, the model had fixed effects, and vice versa.

4. Results

In Table 1, the results of descriptive statistics for 2013 is shown. In this road road fatalities, road injuries, fatality to injury, population density, and the number of RECs are shown. As shown in the table, Khuzestan, Markazi, and Alborz had the highest rates of fatality to injury. Guilan, Fars, and East Azerbaijan had the highest numbers of road-injured people. In addition, Khorasane Razavi, Fars, and Kerman had the most number of RECs. In Figure 1, the Lorenz curves for distribution of RECs are shown. The black line is the equality line, the blue line is the distribution of red crescent road sites, the green line is the distribution of ministry of health road sites, and the red line is the overall REC site distribution. In Table 2, the Gini coefficient for distribution of RECs is shown.

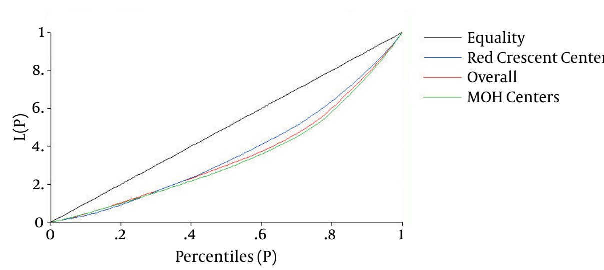

Figure 1. Lorenz Curves for Distribution of Road Emergency Centers in Iran

In Figures 2 and 3, the concentration curves for RECs are shown. As shown in the table, the results were significant in all three categories. These results showed that the distribution of RECs at the provincial level in Iran is not equal. Similar to the Lorenz curve, the black line is the equality line, blue represents the red crescent RECs, green represents the ministry of health RECs, and red is the overall REC distribution. In Figure 2, the provinces are ranked by the number of injuries in road accidents, and in Figure 3 they are ranked by the fatality-to-injury ratio.

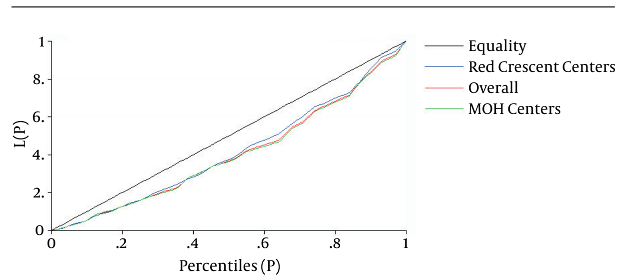

Figure 2. Concentration Curve for Road Emergency Centers Ranked by Injury

Table 1. Descriptive Statistics

Province	Road Injuries	Fatalities to Injuries	Population Density	RECs
East Azerbaijan	6013	0.049629	82.8021	95
West Azerbaijan	2875	0.094773	84.4671	49
Ardabil	482	0.112339	71.1798	33
Isfahan	5610	0.085127	46.3941	98
Alborz	423	0.228102	488.481	28
Ilam	1154	0.050987	28.2621	39
Bushehr	1009	0.127917	47.3552	37
Tehran	699	0.210169	908.049	63
Chahrmahal va Bakhtiari	1008	0.103203	55.9775	35
South Khorasan	1445	0.115667	7.86287	56
Khorasane Razavi	4889	0.079804	51.9222	122
North Khorasan	1562	0.062987	31.2302	33
Khuzestan	1027	0.290746	72.7344	91
Zanjan	1542	0.077199	47.6278	35
Semenan	2652	0.075314	6.67754	43
Sistan va Baluchestan	2414	0.148501	14.6272	98
Fars	5945	0.108696	38.2357	130
Qazvin	1570	0.111488	78.7563	36
Qom	774	0.170418	103.505	22
Kurdistan	1782	0.102719	51.9614	30
Kerman	1954	0.15338	16.7436	105
Kermanshah	1107	0.164528	78.4518	29
Kahkilooye va Biorahmad	330	0.195122	43.9241	23
Golestan	3428	0.056946	90.2931	37
Guilan	6323	0.023022	178.821	38
Lorestan	2386	0.090008	63.0876	53
Mazandaran	1407	0.162998	131.155	71
Markazi	777	0.285189	49.5073	36
Hormozgan	1357	0.123951	23.2259	38
Hamedan	1765	0.129255	91.7493	36
Yazd	1196	0.068536	8.09065	33

Table 2. Gini Coefficient for Distribution of RECs

	Ministry of Health	Red Crescent	Overall
Gini Coefficient	0.31159	0.26374	0.28994
Standard Error	0.02717	0.030036	0.02579

In Table 3, the CI results for RECs are shown. The provinces are ranked by the number of injuries and fatality-to-injury ratios. As shown in the table, the results of injury-ranked CIs were significant but the results of fatality-to-injury-ranked CIs were not significant. These results show that the distribution of RECs are unequal in cases of more road injuries. On the other hand, provinces with higher numbers of road injuries had more RECs. In addition, the distribution of RECs was not unequal with regard to the fatality-to-injury rate.

In estimating the model, first it was estimated by both

Table 3. Concentration Index for the Distribution of RECs Ranked by Injury and Fatality to Injury

Cis	Ministry of Health	Red Crescent	Overall
Ranked by Injury	0.17835	0.16501	0.17518
Standard Error	0.05303	0.04517	0.04868
Ranked by Fatality to Injury	0.007342	-0.05641	-0.00783
Standard Error	0.059075	0.046699	0.054259

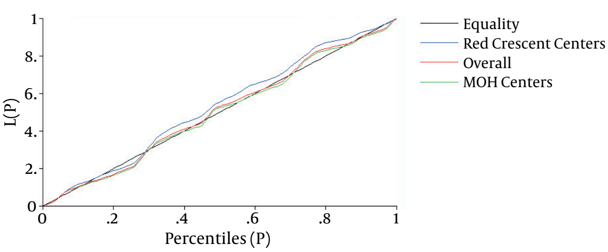

Figure 3. Concentration Curve of RECs Ranked by Fatality to Injury

fixed- and random-effect, and then by using a Hausman test, the best effect was selected. The P value for the Hausman test was 0.093, so the random-effect model is better than the fixed-effect. In Table 4, the results of estimation of the model with a panel-data, random-effect Poisson regression are shown.

As shown in the table, the t-statistics of rain and injury were more than 1.96 (P = 0.012), and the coefficients of these variables were positive, so yearly amounts of rain and the number of road-injured people had a positive relationship with the number of RECs. No significant relationships were found for fatality to injury (P = 0.107) and population density (P = 0.647), because the absolute values of the t-statistics for these variables were under 1.96.

5. Discussion

The distribution of RECs is very important for decreasing the number of fatal road accidents. The Gini coefficient showed that this distribution is unequal, but the CI showed that this inequality is in favor of provinces with higher numbers of road injuries. Altogether, it seems that the distribution of RECs in the country is appropriate but the number of RECs are not sufficient, and by increasing the number of RECs, it will be possible to decrease the number of fatalities in accidents (12, 13). In this study, fatality-to-injury rate was used to show the amounts of need for RECs in the country. The CI results showed that when we took note of need, the distributions of RECs were equal. Population density is a reason for higher numbers of fatal accidents. In a region with higher population density, the number of trips will increase and the roads will be more crowded (14). On these roads, the likelihood of having accidents will increase as well (15). The results of the regression model showed that the RECs were not distributed by population density. For decreasing the number of fatalities in accidents, it is important to notice the population density. On rainy roads, the likelihood increases that the number of accidents will increase as well (16). Therefore, in the distribution of RECs, it is important to note the amount of rain. It seems that, in Iran, for distributing RECs, rain is taken into account. As shown in the regression model, in those provinces with higher amounts of rain, there were more RECs. The results of the Poisson regression also confirmed that there was an inequality in the distribution of RECs with regard to road injuries. In provinces with higher numbers of road injuries, there are more RECs. Also, the need index did not have any relationship with the number of RECs. Therefore, from the regression it was confirmed that the distribution of RECs was equal in terms of need.

Haghparast Bidgoli et al. in a study done in 2006 in Iran, calculated the Gini coefficient for pre-hospital trauma care services. The Gini coefficient for the number of ambulances was 0.19, for emergency sites it was 0.21 and for emergency staffs it was 0.20. In this study, the authors did not notice need, and only showed the distribution of services in provinces of Iran (17). Khorasani-Zavareh et al. in a qualitative study in Iran, assessed post-crash management of road-traffic injury. They found that the quality of post-crash management was poor, and shortages of infrastructures and inadequate pre-hospital services were some of the reason for this (12). Yazdani et al. in a study done in Mazandaran, Iran, found that there is a positive relationship between population density and fatal accidents, and that the mortality is higher on urban in comparison with rural roads (18). In a study done in Japan, the Gini coefficient of accessibility time to emergency care services was 0.410. In that study, the authors found that, by increasing the accessibility time, the injury mortality also increased (19). Goldstein et al. in a study done in 2011 in the United States, assessed the inequality in traffic mortality rates. In that study, using a decomposing of conditional probabili-

Table 4. Panel-Data Poisson Regression of the Factors Affecting RECs in Iran

Variable	Coefficient	Standard Error	Z Statistics	P Value
Dens	0.0002421	0.0005284	0.46	0.647
Rain	0.0003848	0.0001524	2.53	0.012
Injur	0.0000279	0.0000104	2.69	0.007
Fti	-0.4356182	0.2704504	-1.61	0.107
Constant Variable	3.665779	0.1164812	31.47	0.000

ties, they found that there was an inequality in fatal accidents between rural and urban regions (20). In another study done in the United States, Haskins et al. assessed racial disparities in survival of injured people. Data from 9 years (2000 - 2008) were used for this purpose, and they found that there were no disparities in survival among blacks and others in pre-hospitalization services, but that there was a disparity in survival after hospitalization (21). This study had some limitations. First, the data from other health providers, such as military medicine organizations, were not available; second, data for this study were at a provincial level. Using microdata may show the inequality in RECs more clearly.

In this study, the distribution of RECs were assessed. The results of this study showed that RECs were distributed equally in regard to the need of services, but because of high rates of fatal accidents, the number of RECs are inadequate. Health policy makers must consider more roadside pre-hospital infrastructures and improve them. One of these infrastructures is the REC. Increasing the number of RECs on the roads is vital for decreasing the number of fatal accidents.

Footnote

Authors' Contribution: EH Rad, H Zandian conceived and designed the experiment. EH Rad, H Zandian and AK Karyani were involved in acqusition, analysis and interpretation of data. Also all authors had equal contribution in drafting the article and revising it. All authors read and approved the final version of article, too.

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