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Risk Factors of Road Traffic Accidents Associated Mortality in Northern Iran; A Single Center Experience Utilizing Oaxaca Blinder Decomposition

***Faranak Sherafati*[1], *Enayatollah Homaie-Rad*[2], *Abolhassan Afkar*[2]*, *Ramin Gholampoor-Sigaroodi*[2], *Soheil Sirusbakht*[2]**

[1]*Emergency Management Research Center, Iran University of Medical Sciences, Tehran, Iran*
[2]*Guilan Road Trauma Research Center, Guilan University of Medical Sciences, Rasht, Iran*

***Corresponding author:** *Abolhassan Afkar*
Address: School of Health, Guilan University of Medical Sciences, Rasht, Iran.
Tel: +98-13-33368773; **Fax:** +98-13-33311472
e-mail: ehomaie@gmail.com

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ABSTRACT

Objectives: To investigate the differences in death after receiving emergency services in traffic accidents between urban and rural regions, and decompose factors of the gap in Langerood, Northern Iran.
Methods: This cross-sectional study was conducted in Langrood, Northern Iran during a 1-year period from 2013 to 2014. The hospital data of traffic crashes were used. Data contained those patients who survived at the scene of accident. Injury severity score, time to admission, age, gender, season of crash and type of collision were variables used in this study. Oaxaca decomposition technique was used to show the amount of inequity. In addition, three regression models were used to show the reason of inequity.
Results: Overall 1520 patients with road traffic accidents were admitted to our center during the study period. The mean age of the patients was 35.45±17.9 years, and there were 1158 (76.1 %) men among the victims. Motorbike accidents accounted for 869 (57.1%) injuries and 833 (54.8 %) accidents occurred in rural regions. The in-hospital mortality rate was 60 (3.9%). The results of this study showed that 95% of inequity came from factors used in this study and 2.04% disadvantages were for rural crashes. Severity of crash and time to admission had relationship with death, while the effects of time to admission was higher in rural region and severity of the accident had more effect on mortality in urban regions in comparison with rural ones.
Conclusion: The high rate of fatal accidents could be decreased by deleting the gap of access to health care services between urban and rural regions. This study suggested that more efforts of health system are needed to reduce the gap.

Keywords: Urban; Rural; Road traffic death; Injury severity score; Iran.

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Introduction

Traffic accident is one of the most important causes of death in the world [1]. According to the World Health Organization factsheets, road accidents were the 9th cause of death in the world, while it was 4th in the United States. Fatal accidents are the second cause of death among Iranians. Most

of fatal accidents happen in low and middle income countries [2]. World Bank data in 2013 showed that traffic mortality in Iran was 32.1 in 100000 people which show the high prevalence of fatal accidents in the country (at the beginning of the list of fatal accidents in the world). Epidemiological analysis of fatal accidents has been conducted in many Iranian studies. Authors of these studies found several influencing factors for predicting the rate of fatal accidents. Factors like using drug, not using seat belt, being at rainy days, high risk roads, and absence of emergency care services, risky driving, and level of education etc were some of these factors [3-9]. In addition, trend analysis of fatal accidents in Iran showed a decreasing rate in the number of fatal accidents in the analysis periods [2, 8, 10].

Studies have shown that even though the number of accidents in rural regions is less than that in urban regions, fatal crashes are more common in rural regions [7, 11]. Severity of accidents might be a reason for the higher prevalence of mortality in rural regions [7]. In addition, the gap of accessibility to hospital care services between urban and rural regions might be another reason for higher prevalence of mortality in rural regions. Emergency care services are delivered later in rural regions and hospitals are further to rural regions. Studies have shown that less than half of fatal cases due to traffic accidents occur during the crash and most of them occur in hospitals or on the way to hospital in Iran [7, 11]. The high rate of fatal accidents could be decreased by mitigating the gap in accessibility of health care services between urban and rural regions. Langerood is a region in the north of Iran with the area of 480 km^2 and placed in a flat area with high population density. In addition, it is connected by two highways to other cities of Guilan province. Decomposing inequality in mortality between urban and rural regions after accidents could help researchers to find factors affecting this gap. In this study we aim to answer to this question using blinder Oaxaca methodology in Langerood, Iran.

Materials and Methods

Study Population and Protocol

In this cross sectional study, hospital based data of traffic accidents in Langerood, Iran was used. Data contained those cases that happened in the Langerood city in Guilan province, Iran and its Jurisdiction and did not die at the scene. Data contained all of the cases who were affiliated in to Amini hospital of Langerood between March 2013 and March 2014 for treatment of traffic crashes. The data contained 1520 people. Gathering data and research design were confirmed ethically in deputy of research of Guilan University of Medical Sciences (GUMS). The data contained sex, age, time from accident to admission of hospital, Type of collision, date of crash, injury severity score and death after admission to emergency services. Injury severity score is a scoring system which calculates the severity of trauma. Its scores vary between 1 and 75 and stand for the injury for six body regions: Head, Chest, Face, Abdomen, External and Extremities. Each body region is scored between one and six from minor injury to unsurvivable injury, respectively [12].

Statistical Analysis

Blinder Oaxaca decomposition method was used to show the gaps. Blinder Oaxaca method is a recently used method to decompose means of gaps based on regression models. This method divides the gaps into two parts of explained gap and unexplained one. The unexplained part of gaps could be indicated as discrimination. However this part of gaps might belong to those differences which had not been added as explanatory variables. Dependent variable was a binary variable with two values: injured person died (1), injured person rescued (0). Because of having binary outcome variables, in this study we used the extension of blinder Oaxaca decomposition for nonlinear models which has been designed in 2008 [13]. Neumark pooled model was used for weighting between urban and rural regions [14]. STATA SE v13.1, USA, was used for estimation the models and the gaps.

Results

Descriptive Statistics

Overall 1520 patients with road traffic accidents were admitted to our center during the study period. The mean age of the patients was 35.45±17.9 years, and there were 1158 (76.1 %) men among the victims. Motorbike accidents accounted for 869 (57.1%) injuries followed by motor vehicle accidents in 431 (28.3%) victims and 220 (14.6%) were pedestrian injuries. Overall, 833 (54.8 %) accidents occurred in rural regions. The in-hospital mortality rate was 60 (3.9%). The baseline characteristics of the study population is summarized in Table1.

Decomposing Inequality

In the Table 2, the results of estimating the general model of death are shown. As indicated before, data do not contain those injured people, who died before arriving emergency care services in the general model, whole data were estimated without notification to the region of crash. As shown in the table, the coefficient of time to admission was positive and significant, indicating that the increase in the time to admission increases the likelihood of death for injured person. Injury severity score had positive and significant relationship with death as well. This showed that in more severe injuries, the likelihood of death was higher. The number of deaths in autumn was less than that in other seasons due to negative and significant coefficient of autumn variable.

Table 1. The baseline characteristics of 1520 patients with road traffic accidents admitted to our center during the study period.

Variable	Value
Age	35.45±17.9
Gender	
Men (%)	1158 (76.1 %)
Women (%)	362 (23.9%)
Mechanism of Injury	
Motorbike accidents (%)	869 (57.1%)
Motor-vehicle accidents (%)	431 (28.3%)
Stuck as pedestrian (%)	220 (14.6%)
Season	
Spring (%)	470 (30.9 %)
Summer (%)	535 (35.1%)
Autumn (%)	236 (15.5%)
Winter (%)	279 (18.5%)
Location	
Rural (%)	833 (54.8 %)
Urban (%)	687 (45.2%)
Injury severity score	17.43±13.7
Time to admission	26.16±13.01
In-hospital mortality (%)	60 (3.9%)

In Tables 3 and 4, data were divided by the region of crash to urban and rural regions. Urban regions contained the places which were covered by urban emergency care services and rural regions contained those which were covered by road and rural emergency services. Both urban and rural injuries were affiliated to Amini hospital of Langerood. Table 3 shows the results of estimating the model for rural regions. Similar to general model, time to admission, injury severity score and autumn had direct relationship with death and the number of deaths was significantly less in autumn. In addition, the number of deaths for males was more than that for females in 90% confidence interval.

Table 4 shows the results of estimating the model for urban regions. Injury severity score has significant positive relationship with death and the number of death was significantly less in autumn. However, the time to admission has positive relationship with death in urban regions at 90% confidence interval.

If rural and urban region models are compared, it could be indicated that injury severity score had more effect in urban regions in comparison to rural regions; furthermore, time to admission had more effect on death in rural regions in comparison with urban ones.

In the table 5, the results of decomposing inequality in urban and rural regions are shown. As shown in the table, 95.49% of inequality comes from the differences in explanatory variables (time of crash, severity of crash, time to admission, etc.) added in

Table 2. General Logit model for effective factors of death in 1520 victims of road traffic accidents admitted to our center during the study period.

Variable	Coef.	Std. Err.	Z	*p* value
Sex-male	0.654173	0.488954	1.34	0.181
Age	0.143383	0.101612	1.41	0.158
Time to admission	0.086313	0.014398	5.99	0.000
Injury severity score	0.145722	0.015854	9.19	0.000
Season of accident-spring	Base			
Summer	-0.4033	0.488399	-0.83	0.409
Autumn	-2.6756	0.842126	-3.18	0.001
Winter	-0.92755	0.625029	-1.48	0.138
Type of collision – car	Base			
Motorbike	-0.26766	0.537832	-0.5	0.619
Pedestrian	0.671482	0.674225	1	0.319
Constant variable	-10.9799	1.213018	-9.05	0.000

Table 3. Rural regions logit model for effetcive factors of mortality in 1520 victims of road traffic accidents admitted to our center during the study period.

Variable	Coef.	Std. Err.	Z	*p* value
Sex-male	0.977288	0.575513	1.7	0.089
Age	0.1821	0.128662	1.42	0.157
Time to admission	0.085586	0.01842	4.65	0.000
Injury severity score	0.135503	0.017223	7.87	0.000
Season of accident-spring	Base			
Summer	-0.6955	0.597201	-1.16	0.244
Autumn	-2.58168	0.899564	-2.87	0.004
Winter	-0.72819	0.669601	-1.09	0.277
Type of collision - car	Base			
Motorbike	0.029043	0.639099	0.05	0.964
Pedestrian	0.175222	0.89397	0.2	0.845
Constant variable	-11.1256	1.503256	-7.4	0.000

Table 4. Urban regions logit model for effetcive factors of mortality 1520 victims of road traffic accidents admitted to our center during the study period.

Variable	Coef.	Std. Err.	z	*p* value
Sex-male	-0.44741	1.226546	-0.36	0.715
Age	0.166686	0.218628	0.76	0.446
Time to admission	0.067157	0.034672	1.94	0.053
Injury severity score	0.183997	0.046945	3.92	0.000
Season of accident-spring	Base			
Summer	1.81195	1.27272	1.48	0.141
Autumn	-4.0382	1.5976	-2.53	0.012
Winter	-0.69101	2.14084	-0.32	0.747
Type of collision - car	Base			
Motorbike	-0.53044	1.158043	-0.46	0.647
Pedestrian	1.382147	1.286543	1.07	0.283
Constant variable	-11.1681	2.911685	-3.84	0.000

Table 5. Oaxaca blinder decomposition results between urban and rural regions.

	Coefficient	Percentage
Difference due to different characteristics	-0.04088	95.49%
Urban regions	-0.00106	2.47%
Rural regions	-0.00087	2.04%
Raw data	-0.04281	100%

this study. 2.47% of inequality is in favor of urban regions and 2.04% of inequality is disadvantages of rural region crashes.

Discussion

The results of this study showed that there is a gap in favor of urban regions in rescue after crash in Langerood, Iran. 94% of this gap could be observed in this study. Time to admission had positive relationship with mortality in both urban and rural regions. Time to admission is a preventable factor. Time to admission in Iran is higher than the average of the world and it is important to improve it [15]. Time to admission had bigger coefficient in rural regions in comparison with urban places. So by improving it in rural regions, the urban-rural gap would be decreased. Iran has a good emergency calling system in the roads and all parts of Langerood villages and roads are covered by this system. So there is no matter for notification of emergency services and request for sending ambulances [16]. Studies have shown that there is inequality in access to road emergency sites in Iran [17]. Increasing the number of rural and road emergency care sites would be helpful to decrease time to admission [17, 18]. Other influencing factors, like age, season, type of collision, injury severity score predicted some parts of the gap. From these factors, injury severity score had relationship with death. The coefficient of ISS was bigger in urban regions in comparison with rural ones showing that severity of injury has more effect on death in urban regions. Use of seat belts and helmets are not controlled by police in urban regions as well as rural places in Iran and more control is needed in cities [19]. Using seat belts, helmets, decreasing speed of driving etc are some factors which decrease severity of crashes [3, 4, 20].

Only 5% of the gap, rise from those factors which were not observable in this study. Factors like lack of supervision of emergency care services in rural regions, less responsibility in rural crashes, insufficient medical treatments for rural emergency care services were not observed in this study [21]. A part of the gap may rise from systematic inequity between urban and rural regions as well. However, we will not able to show the extent of inequality related to the systematic inequity but it is necessarily less than unobserved part (4.51%). Haghparast *et al*. suggested that allocation of health resources must be changed to decrease inequality between areas [18]. The results of this study showed that mortality was not related to the type of collision and age. However, Ettehad *et al*. in Poursina hospital of Rasht found that there is relationship between type of collision and in-hospital mortality. However, in the results they found that there were differences in the age of died and rescued injuries, they did not adjust effective factors in it [22]. Similarly Mohtasham-amiri et al in their study found that age had association with road traffic mortality [23]. Injury severity had relationship with mortality. Haghparast *et al*. in another study found that there is relationship between injury severity and length of stay [24]. These findings were confirmed in another study [23]. Seasonal differences were found in death in this study. The number of deaths was lower in autumn in comparison to other months. Several studies found that crashes are more in the time when the traffic density is higher. For example, in the United Kingdom as well as in Canada, the number of crashes is higher

in summer [25, 26]. Iranian studies also showed that the prevalence of fatal crashes is higher in summer [20, 27]. However, some studies found that the number of crashes is higher in winter [2]. Traffic accidents have high economic burden for society [28]. Lack of airway rescue services was an important issue in decrease of mortality in severe accidents in less developed regions [29]. Furthermore, fragmentation of protocols between emergency services and hospitals may be a reason of higher time to admission [29]. It is better to use a standard protocol (like implementation of accreditation programs) for this purpose. The advantage of this study was employing new methods for inequality in road traffic death. This study had some limitations. Firstly, the results of this study could not be extended to other parts of country. Secondly, we did not have information about those injured people who did not affiliated to Amini hospital. For future studies it is suggested to use panel data Oaxaca model in more than one hospital.

In conclusion, this study used a new method in calculating gap in death after crashes between urban and rural regions of a city in the north of Iran. The high rate of fatal accidents could be decreased by deleting the gap of access to health care services between urban and rural regions. This study suggested that more efforts of health system are needed to reduce the gap.

Conflict of Interest: None declared.

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