

RESIDENCE PLACE AS A RISK FACTOR IN DIFFERENT TYPES OF FATAL CAR
ACCIDENTS

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Abstract

The association between place of residence, population density, relief and type of event (collision or non-collision of the vehicle) has not been evaluated. The main objective of this study is to determine the differential factors associated with the occurrence of deaths of collision and non-collision automobile users in Patagonia, Argentina. A multiple logistic regression analysis was performed using as the dependent variable death by car accident (collision or non-collision of the vehicle) and sex, age, place of residence of the victim, relief and population density as the independent variables. Collision fatalities were related to areas of high population density, while non-collision fatalities were related to areas of low population density, mountainous landscape and place of residence of the victims outside the Patagonian region. The results obtained in this study indicate the need to develop differential primary prevention policies by place of residence of car occupants, focusing on Patagonia nonresident drivers and by emphasizing non-collision accidents.

Keywords: place of residence; population density; relief; collision; non-collision; fatalities.

INTRODUCTION

In southern Argentina, Patagonia (which comprises five provinces: Chubut, Neuquén, Rio Negro, Santa Cruz and Tierra del Fuego) is one of the biggest tourist attractions in the country, with large areas occupied by national parks, ski winter resorts and a variety of natural amenities. Although its low population density, the region has experienced the greatest population growth in recent decades, in relation to other regions of the country.

Patagonia has a population distribution in which the major cities are located along two axes. To the east, the coastal axis, which presents the most populous cities, and the mountain axis to the west end. In the central part of Patagonia, population areas of very low density predominate, so when people travel between these two axes they drive through areas with non-existing health services.

Deaths from traffic injuries (DTI) are the most frequent in the group of external cause deaths in Argentina. Within the group of DTI, the deaths of road users of four-wheeled vehicles rank first in this country (Ubeda et al., 2011). If we look at what happens in the different regions that make up the country, the Patagonia region had the highest rates of DTI, after the region of Cuyo, in the period 1999-2006. In turn, car users have the highest rates of mortality with respect to other types of transport (Ubeda et al., 2011).

Waller et al. (1964) have reported a higher frequency of deaths due to a single-vehicle accident (non-collision) in rural areas. They also found that almost three times as many of the fatalities in rural areas were to urban and out-of-state residents as in the urban areas. However, there are no studies linking mortality due to single-vehicle accidents and residency status in rural areas.

More recently, a few studies have been performed incorporating variables related to the distance of travel or place of residence of the victim as regards motor vehicle accidents. Crash fatalities have been linked to greater travel distances and longer exposure time (Chipman et al., 1993). On the other hand, residents in urban areas have a higher risk of fatality than those in rural areas of Utah, United States (Donaldson et al, 2006). With regard to population density, several studies have reported a negative relationship between mortality rates of traffic injuries and this variable (Baker et al, 1987; Lasarre and Thomas, 2005; Leveau and Ubeda, 2012). However, so far, the

association between place of residence, population density, topography and type of event (collision or non-collision of the vehicle) has not been evaluated.

The main objective of this study is to determine the differential factors associated with the occurrence of deaths of collision and non-collision automobile users in Patagonia, Argentina. This work also explores the spatial distribution patterns of this type of deaths and associated factors.

MATERIAL AND METHODS

Study Population

Data on fatal transport accidents of car users (codes V40-47, V49 and V48, except V49.3, V49.8, V49.9) occurred in Patagonia, Argentina, years 2001-2009.

Data Source

Data were obtained from the Statistics and Information Services (DEIS), Ministry of Health of Argentina. These databases contain data regarding age, sex, province and region of occurrence and residence of the victim, and cause of death according to the 10th Revision of the International Classification of Diseases (ICD-10) for each Department (administrative territory that comprise a Province). Population density data were obtained from the National Census of Population, Households and Housing of 2001, National Institute of Statistics and Censuses (INDEC). Data available at <http://www.indec.mecon.gov.ar>.

Selected Variables

Gender: male, female. Reference: male. Age in years, categorized as: 0-14, 15-34, 35-64, 65 and over. Reference: 0-14. Residence of the victim: it was reclassified according to five categories: resident in the same department of occurrence (category 'Residence1'), resident in the province of occurrence (category 'Residence2'), resident in another neighboring department to the department of occurrence (in or out of the Patagonian region, category 'Residence3'), resident of another Patagonian province (category 'Residence4') and resident outside the Patagonian region (inside or outside the country; category 'Residence5'). Reference: same department of occurrence. Relief: place of occurrence of the event, categorized as Andean and non-Andean

departments, taking into account whether its surface occupies all or part of the Andes, according to Capitanelli (1988). Reference: non-Andean departments. Population density in the area of occurrence expressed in inhabitants per km²: it was categorized as low (<0.42), medium (0.42 to 1.61), high (1.62 and above). Reference: low population density. Death by car accident, category 1: collision (crash) (V40-47, V49, except V49.3, V49.8 and V49.9), category 0: non-collision (includes overturning) death (V48).

Data Analysis

A multiple logistic regression analysis was performed using as the dependent variable death by car accident. As the independent variables: sex, age, place of residence of the victim, relief and population density.

RESULTS

During the period 2001-2009, there were 1021 deaths from car accidents in Patagonia. The analysis did not include 291 cases, because it was impossible to determine neither of the following facts: the cause of the accident (V49.8 and V49.9), the department of residence of those victims living in the same province of occurrence or if they resided in a neighboring province of the fatal event. Thus, we worked with 730 cases, 376 cases of deaths belonging to automobile collision accidents and 354 cases due to non-collision accidents.

As a result of the multiple logistic regression analysis, three variables showed significant values. Middle and high population density levels were related to fatal collision car accidents, while residents outside the Patagonian region and departments located in the Andean region were positively related to the occurrence of fatal non-collision car accidents (Table I).

Figure 1 shows the geographical distribution of the dependent variable (type of accident) and two independent variables that affect it significantly, according to multiple logistic regression analysis. The cases of death in non-collision accidents showed a more dispersed distribution with respect to collision fatalities, which were related to areas of higher population density.

Fatal victims residing in another neighboring department of the department of occurrence (in or out of the Patagonian region) are more frequently distributed in the provinces of Neuquen and

Rio Negro, in those departments bordering between the two provinces (Figure 1). Fatal victims residing outside the Patagonian region show a similar spatial pattern.

DISCUSSION

In this study, deaths from non-collisions (overturning) and collisions (crash) behaved differently with respect to population density, with a higher risk of dying in a car accident by non-collision in areas of low population density. Related to this, the role of access to health services has been questioned as a risk factor of mortality in rural or low population density areas (Chen et al., 1995; Gedeberg et al. 2010; Jones and Bentham, 1995). A study conducted in Michigan counties, United States, revealed that the proportion of preventable death in motor vehicle accidents was higher in non-rural areas (Chen et al., 1995). Another study reported a greater severity in motor vehicle accidents in rural areas (Maio et al., 1992). Future research should test the relationship between the severity of motor vehicle accidents and collision or non-collision deaths.

Regarding the place of residence, it is interesting to note that the risk of dying in a car accident due to a collision or non-collision circumstance was similar for those living in the place of occurrence of the event and those who reside in other provinces of Patagonia, considering that it is a vast region with long distances between its major cities. Between Rawson City, in the province of Chubut, and Rio Gallegos City, Santa Cruz, there is over 1100 km distance, while between Rawson and Buenos Aires City, which includes the largest agglomerate of the country and is located outside of the Patagonian region, there are just over 1300 km. It is possible that car occupants living in plain areas and not accustomed to travel on mountain roads present an increased risk of dying in an accident involving an overturned car, regardless of access to health or age structure. Thus, lack of adaptation to travel on mountain roads could act as a risk factor. In relation to this, Donaldson et al. (2006) found that urban vehicle users had a higher risk of fatality in rural areas compared to urban areas. They attributed the increased risk of fatality to an increase in speeding, decrease attentiveness, fatigue, different driving techniques or the level of familiarity with dangers of rural roads.

Chipman et al. (1993) found a positive relationship between travel distance and traffic accident mortality. Because this study could not calculate the distance traveled for different types of residents, it is impossible to determine if residents outside of Patagonia traveled greater distances. Nonetheless, it is possible that these residents, mostly tourists, were able to make stops in different cities and therefore, travel short distances to various destinations.

The increased risk of mortality in non-collision accidents by occupants of cars in mountainous areas and low density would rise by the existence of structural factors that are difficult to change, especially those aspects relating to the layout of the routes. Although the curvature of the roads does not seem to act as an important factor in fatal crashes of motor vehicles (Haynes et al., 2008), future investigations should test its impact on deaths due to non-collision car accidents.

The main limitation of this study lies in the characteristics of the data, because we can not guarantee the independence of the data analyzed: it is possible that two or more victims correspond to the same event. However, this deficiency can be similar between the different categories of residence of the victims.

CONCLUSIONS

This study revealed that the population density, the relief and the place of residence affect the deaths of car users differently by type of accident. Collision fatalities were related to areas of higher population density, while non-collision fatalities were related to areas of low population density, mountainous landscape and place of residence of the victims outside the Patagonia region.

The results obtained in this study indicate the need to develop differential primary prevention policies by place of residence of the occupants of cars, focusing on non-resident drivers in Patagonia and by emphasizing overturning accidents. It would also be necessary further studies to analyze behavioral and attitudinal aspects of such drivers.

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Table I. Variables related to deaths from car accidents due to collision (value = 1) and no collision (value = 0) in Patagonia, Argentina 2001-2009.

Variable	Category	Odds Ratio	Wald	P	95% CI
Age	0-14 years	1			
	15-34 years	1,31	0,75	0,39	0,71-2,44
	35-64 years	1,30	0,73	0,39	0,71-2,40
	65+ years	1,36	0,66	0,42	0,65-2,88
Gender	Male	1			
	Female	0,97	0,03	0,86	0,70-1,35
Residence status	Residence1	1			
	Residence2	0,77	1,67	0,20	0,51-1,15
	Residence3	0,99	0,00	0,96	0,57-1,71
	Residence4	0,54	1,61	0,21	0,21-1,40
	Residence5	0,50	8,55	<0,01	0,31-0,80
Density	Low	1			
	Medium	2,89	8,27	<0,01	1,40-5,97
	High	4,11	16,32	<0,01	2,07-8,16
Relief	Andean	0,50	18,39	<0,01	0,36-0,68

Figure 1. Geographical distribution of three variables analyzed in Patagonia, Argentina. A: population density (1 = <0.42 inhabitants/km², 2 => 0.42 - <1.62, 3 => 1.62), B-F: place of residence (%). B: Residence1, C: Residence2, D: Residence3, E: Residence4, F: Residence5; G: collision fatalities (%), H: no collision deaths (%).

