

Does ambulance utilization differ between urban and rural regions: a study of 112 services in a populated city, Izmir

Görkem Sariyer¹ · M. Gökalp Ataman² · Turhan Sofuoğlu³ · Zeynep Sofuoğlu⁴

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Abstract

Objective Emergency Medical Services (EMS) play an important role in health care systems, especially when well planned and well managed. The goal of this research was to characterize ambulance utilization rates and investigate associated factors. Such an analysis could make a contribution to operational planning of these services.

Materials and methods The data for this study were taken from the Izmir emergency ambulance service, known as the 112 service because of its call number. Total emergency demand made during 2013 was analyzed, and the data were categorized according to four sub-categories: gender, age, rural-urban, and reason for the call. For each category, an analysis was made in terms of the absolute number of calls and a relative measure. Hypothesis testing and correlation analysis were used to investigate the differences between the demand for each category and to compare demand across categories.

Results Although demand rates from males and females were very similar, a significant difference was observed in the daily utilization of these services by gender. The absolute number of calls from rural regions was less than for urban regions, but the rural regions had a higher proportion of calls (i.e., calls per 1000

people). Similarly, the absolute number of calls generated by the elderly was less than that generated by the young, but the elderly had a higher value in terms of relative measures. A medical condition was the most frequent reason for calls. A significant and positive relation was observed between male-female and elderly-young citizens, and there was a significant but negative relation between rural-urban demand.

Conclusion This study confirms that gender, age, and rural-urban distinctions are major factors that affect demand for these services and should therefore to be taken into consideration in operations management. It also highlights the need for a specific focus on rural regions and elderly citizens.

Keywords Ambulance utilization · The elderly · EMS · Public health · Rural · Urban

Introduction

Emergency Medical Services (EMS) comprise ambulances and other services that provide an entry point to health care. These services have a key function in health care systems and can make an important contribution to reducing avoidable deaths (Kobusingye et al. 2005; Hsia et al. 2010). However, a rapid increase in demand for these services is placing a growing burden on emergency care delivery, which requires that systems are well planned and managed, supported at national and provincial levels, and well-publicized among all segments of the community (Pitts et al. 2012). Understanding patterns of utilization is strategic from an operations management perspective. An analysis of the factors associated with the utilization of these services can play a key role in the operational and tactical decision-making process as they allow the efficient allocation of resources (Svenson 2000).

✉ Görkem Sariyer
gorkem.ataman@yasar.edu.tr

¹ Faculty of Business Administration, Yasar University, Bornova, 35100 Izmir, Turkey

² Department of Emergency Medicine, Çiğli Region Education and Research Hospital, Izmir, Turkey

³ Department of Emergency Medicine, Tepecik Education and Research Hospital, Izmir, Turkey

⁴ Training and Projects, Izmir Provincial Health Directorate, Emergency Ambulance Physicians Association, Izmir, Turkey

Geographic dispersion is one of the common factors associated with EMS and ambulance utilization. The geographic variation in demand (i.e., the difference between rural and urban regions) is well documented and directly affects the supply of health care resources and the level of public awareness (Brismar et al. 1984; Pritchard et al. 1998; Vesper et al. 2015; Zia et al. 2015). Studies have shown that increased demand and better managed care occur in urban areas, which are characterized by more readily available resources and higher levels of awareness (Goodman et al. 1997). Age is considered another important factor in the usage of these services. The numerous studies that conclude that the need for and use of EMS increase with age include Wofford et al. (1995), Burt et al. (2006), Squire et al. (2010), and Norman et al. (2016). Thus, providing emergency care in rural regions presents a unique challenge (Stripe and Susman 1991; Knott 2003; Joynt et al. 2011), since those on lower incomes, the elderly, and those in rural regions are less likely to have access to emergency care compared to those on higher incomes, the relatively young, and those in urban regions (Gordon 1995; Virmig et al. 2004). Many of the cited studies also focused on gender and the reason for the call as other factors influencing rates of EMS and ambulance utilization.

The main objective of the current study was to characterize EMS utilization and understand the factors associated with usage of ambulance services in order to facilitate the planning and management of service operations. We hypothesized that a significant difference exists in ambulance utilization in terms of four sub-categories: those between gender and age groups, rural and urban regions, and the reason for the call. In these analyses, we first considered the number of calls from each category since these are of key importance in allocating resources. We also used relative measures for each category, such as the number of calls expressed per 1000 citizens, to enable accurate comparisons. The data were taken from Izmir, the third most populous city of Turkey. To the best of our knowledge, this is the first comparative analysis of ambulance demand patterns based on a particular geographic region in Turkey. This article therefore has the potential to contribute to further research involving multi-national comparisons.

Methods

Data

The 2012–2013 statistics give the population of Izmir as 4,061,074. Numbers of male and female citizens are approximately equal, with percentages of 50.09 and 49.91, respectively. The percentage of elderly (aged 65 or older) is approximately 9.07. Regions having a population of less than 50,000 are described as rural and constitute approximately 8.58% of the total (Annual Health Statistics 2013).

This retrospective study was based on figures for the demand for State Provincial Health Directorate 112 ambulance services for Izmir during the year 2013. We excluded all non-emergency calls, i.e., false alarms (no verbal response, ending the call without giving any information, giving information unrelated to an emergency situation, and duplicate calls).

Demand was categorized based on gender, age, region, and reason for the call. We used two classifications based on age: elderly, age ≥ 65 ; young, age < 65 . Reasons for calls were classified into four groups: medical, traffic accidents, other accidents (such as occupational and home accidents), and a final category, others, which included all other injuries as well as suicide attempts. For convenience, the broad classification *medical reasons* covered a range of medical conditions such as trauma, stroke, and cardiac arrest.

Analysis

All analyses were performed using SPSS 17.00 (Statistical Package for Social Sciences, IBM, Chicago, IL, USA). In the frequency distribution tables, we first presented the absolute numbers and percentages of the demand based on these categories. We also listed the proportion of calls for each category, expressed as number per 1000 citizens, to be able to make comparisons across categories. To understand whether the statistical differences existing between ambulance utilizations were based on the aforementioned categories or factors, we constructed a separate hypothesis for each category. In hypothesis testing, we considered both the absolute number and proportionate number of calls. We used a 95% confidence interval, where $p < 0.05$ was considered statistically significant.

Results

Frequency distributions

In 2013, the total number of emergency calls to Izmir EMS 112 services was determined as 279,482.

In the third and fourth columns of Table 1, we present the absolute number of calls and percentages based on gender, age, and call region categories. In the fifth column, we present the proportion of calls for each category, expressed per 1000 citizens. The first row of the table shows that 147,965 calls (52.94%) were made by males during 2013. Since males constitute 49.91% of the Izmir population, after eliminating duplicate calls, we calculated that on average 73.01 per 1000 men made a call. The percentage and proportion of calls made by females are similar to the figures for males, with respective values of 47.06% and 64.65 calls per 1000 women. However, this closeness in values is not apparent in categories of age or call region. While the percentage of calls made by the elderly

Table 1 Frequency distribution based on gender, age, and call region

Category		n	%	No. of calls per 1000
Gender	Male	147,965	52.94	73.01
	Female	131,517	47.06	64.65
Age	Elderly	73,156	26.18	198.61
	Young	206,326	73.82	55.87
Call region	Rural	105,211	37.65	301.95
	Urban	174,271	62.35	46.94

was 26.18% and the proportion of calls was 198.61 per 1000, the respective values for the young were 73.82% and 55.87. Differences are also seen between regions; while 37.65% of calls were from rural regions, with a relative measure of 301.95 per 1000, for urban regions the figures were 62.35% with 46.94 calls per 1000.

Table 2 shows the numbers and percentages of the reason for the call. By far the highest proportion of EMS demand was for medical conditions, at 79.35%, with the second most frequent reason being traffic accidents, at 10.76%. A significant difference was found ($p < 0.05$) between the different reasons for calls.

We then identified the demand for rural and urban regions separately. In Table 1, it can be seen that 105,211 calls were from rural regions. The mean age of patients was 48.50 ± 21.15 . In Table 3, we present the absolute numbers and percentages of calls and the proportions of calls for each category for rural regions. Based on the values of this table, we observed that while call volume percentages for males and females were similar, with respective values of 50.56% and 49.44%, call volume percentages for the elderly and the young were clearly different, with respective values of 13.73% and 86.27%. However, the proportions of calls per 1000 citizens were approximately equal for males and females, as well as for the elderly and young. We also observed that percentages of calls arising from rural regions for medical reasons accounted for 85.28%, with a proportion of 256.90 per 1000. Calls made from rural regions due to traffic accidents, other accidents, and other categories were similar in both percentage and proportionate value, with respective percentages of 7.48, 4.88, and 2.36% and 22.53, 14.71, and 7.11 calls per 1000.

Finally, we analyzed the demand from urban regions, where the total demand was 174,271, with an average age of 52.50 ± 25.30 . A higher mean value and variation for age were found for the urban group. The frequency distribution of the demand from urban regions is given in Table 4. In this table, the pattern of demand according to gender is similar to that found in rural regions. Thus, when comparing rural and urban regions, there is little variation in the percentages and proportions for males and females with respective percentages of 54.38% and 45.62% and 51.24 and 42.69 calls per 1000

Table 2 Frequency distribution based on all data

Category	n	%	p-value
Medical	221,758	79.35	$p < 0.05$
Traffic accident	30,069	10.76	
Other accident	21,092	7.55	
Other	6563	2.34	

citizens. On the other hand, urban regions were notably different from rural regions in terms of age of caller for both the percentage of calls and proportion of calls as shown by the figures: 33.69% and 66.31% as well as 185.18 and 34.04 per 1000 citizens. Percentages and proportions of calls according to reason were also similar between the two region types, although the demand from the urban regions was more highly associated with medical conditions. Interestingly, when the proportions of calls for all categories across rural and urban regions were compared, it was observed that urban regions produce fewer calls per 1000.

Hypothesis testing

In this section, we made a number of different hypotheses in order to identify the most significant factors. These factors can then be considered in tactical decision-making in planning ambulance service operations. Allocating a suitable number of ambulances to each location for each day of the year is one of the main tactical decisions that EMS managers have to make. For these analyses, we calculated both the absolute numbers and the relative measures of daily calls for each of the categories for each day of the year.

Our hypotheses were as follows (Table 5):

A summary of hypothesis testing results is presented in Table 6.

The summary statistics show that for each of H1a, H1b, H2a, H2b, H3a, and H3b, we reject the null hypothesis. H1a and H1b state that for each day of the year both the absolute number and proportion of calls differ between males and females. H2a and H2b show that, although the absolute number of calls from the elderly is lower than that from the young, the reverse is true for the relative measures. Finally, H3a and H3b show that, while the absolute number of calls from rural regions is lower compared to that from urban regions, the reverse is true for the relative measures.

In Table 7, we summarize the correlation coefficient between different categories based on the absolute number of daily calls. Clearly, the same correlation values will apply for the relative measures.

From the values in Table 7, we observed that significant correlations exist among three (sets of) categories: male and female, elderly and young, and rural and urban. According to these correlation values, it can be concluded that, on any

Table 3 Frequency distribution of calls from rural regions

Category		n	% of calls	No. of calls per 1000
Gender	Male	53,194	50.56	299.73
	Female	52,017	49.44	302.81
Age	Elderly	14,441	13.73	281.95
	Young	90,770	86.27	304.56
Reason for call	Medical	89,722	85.28	256.90
	Traffic accident	7868	7.48	22.53
	Other accident	5138	4.88	14.71
	Other	2483	2.36	7.11

particular day, an increase in calls from males will be accompanied by a corresponding increase from females. Similarly, an increase in calls from the elderly leads to an increase in calls from the young. However, an inverse relationship is seen for regions: if the number of calls from rural regions increases, the number from urban regions decreases.

Discussion

The importance of efficient EMS planning has been widely discussed in the literature, including that on Turkey (Sariyer and Ataman 2015; Sariyer et al. 2016). To plan the operation of these systems, it is important to compare data for rural and urban settings and, especially, to identify any differences in patterns of EMS use across the two types of geographic areas (Beillon et al. 2009).

The results of our study showed a significant disparity in the utilization of EMS between rural and urban regions, and also between the elderly and the young, which is a similar result to that presented by Morrison et al. (2013) and Garberich et al. (2014). We were able to show that the absolute number of calls in urban regions is greater than that in rural regions, which clearly points to the need for a greater number of ambulances (or more EMS staff and equipment) in urban areas compared to rural areas. On the other hand, when relative measures were used for comparison, we observed that the proportion of calls (expressed per 1000 citizens) is greater for

rural regions. This can be explained by a variety of factors, including the high urbanization level of the city, which enables access to hospitals without the need for ambulance services, and a much lower number of hospitals in rural regions.

Another conclusion was that, due to the relatively young population of Izmir, the (overall) utilization of ambulances by the elderly was considerably lower than use by the young. A similar result has also been cited in other national studies (Dündar et al. 2006; Nur et al. 2008; Kidak et al. 2009; Eksi and Torlak 2011). However, since elderly citizens are more likely to use ambulances, especially for medical reasons, relative or proportionate usage by the elderly was much higher compared to the young. Regarding absolute usage by the elderly, this was observed to be much lower in rural regions compared to urban regions, in line with the results of Lishner et al. (2000). On the other hand, these results are not consistent with some other international studies, which found that elderly patients accounted for more than half of all ambulance calls in both rural and urban regions and which also concluded that there were no significant differences between urban and rural areas in terms of call percentage based on age (Brismar et al. 1984; Stripe and Susman 1991).

An analysis of the reasons for service demand shows that medical causes had the highest percentage, followed by traffic accidents. This finding is reflected in many other national and international studies in the literature (Burt et al. 2006; Kidak et al. 2009; Ozata et al. 2011; Bray et al. 2015). As discussed in the section on the age factor, the absolute number of calls

Table 4 Frequency distribution of calls from urban regions

Category		n	% of calls	No. of calls per 1000
Gender	Male	94,771	54.38	51.24
	Female	79,500	45.62	42.69
Age	Elderly	58,715	33.69	185.18
	Young	115,556	66.31	34.04
Reason for call	Medical	132,036	75.77	35.57
	Traffic accident	22,201	12.74	5.98
	Other accident	15,954	9.16	4.30
	Other	4080	2.33	1.10

Table 5 List of hypotheses

H1a	Null	For each day of the year, the total number of calls made by males and females is the same
	Alternative	For each day of the year, the total number of calls made by males and females differs
H1b	Null	For each day of the year, the proportion of calls (expressed per 1000 citizens) made by males and females is the same
	Alternative	For each day of the year, proportion of calls (expressed per 1000 citizens) made by males and females differs
H2a	Null	For each day of the year, the total number of calls made by the elderly and the young is the same
	Alternative	For each day of the year, the total number of calls made by the elderly is smaller than that made by the young
H2b	Null	For each day of the year, the proportion of calls (expressed per 1000 citizens) made by the elderly and the young is the same
	Alternative	For each day of the year, the proportion of calls (expressed per 1000 citizens) made by the elderly is greater than that made by the young
H3a	Null	For each day of the year, the total number of calls from rural regions is the same as that from urban regions
	Alternative	For each day of the year, the total number of calls from rural regions is smaller than that from urban regions
H3b	Null	For each day of the year, the proportion of calls (expressed per 1000 citizens) from rural regions is the same as that from urban regions
	Alternative	For each day of the year, the proportion of calls (expressed per 1000 citizens) from rural regions is greater than that from urban regions

for each of the four call reason categories was lower in rural regions. However, the numbers of calls per 1000 were greater in rural regions.

In this article, even though there is a balance of genders in the population and the demand from males and females was approximately equal, we observed a significant difference in daily ambulance usage according to gender, based on both the absolute numbers and relative measures. Thus, for this city, we concluded it may be important to consider a differentiation based on gender from the operational viewpoint.

When we analyzed the correlation between the absolute daily demand numbers for each category, we observed that significant relations exist between males and females, the elderly and the young, and rural and urban regions. Thus, in planning operations for any particular day, any increase in demand from males can be expected to be accompanied by a corresponding increase in demand from females. A similar pattern of mutual increase holds for demand from the elderly and the young. However, a negative relation is seen between the demand from rural and urban regions. This means that on

any one day, an increase in demand in rural regions would be expected to signal a decrease in demand from urban regions.

To sum up, in this descriptive research conducted in one of the most populated and urbanized cities of Turkey, we showed that utilization of ambulances depends on male-female, elderly-young, and rural-urban dichotomies. These findings should be taken into consideration when planning the required number of daily ambulances for each location. In addition, plans can be adjusted for any particular day, i.e., the number of ambulances can be decreased or increased according to location after considering correlation analyses between the different factors.

Limitations and future work

The data for this study were collected from a major city in Turkey, which limits generalization of the results. Although we highlighted the fact that all EMS service providers need to consider such rural-urban disparities in the initial planning stage and daily allocation of ambulances,

Table 6 Summary of hypothesis testing statistics

Hypothesis	Test for:	t-value	p-value
H1a	t-test of difference = 0 (or difference≠0)	-12.65	0.00
H1b	t-test of difference = 0 (or difference≠0)	-12.66	0.00
H2a	t-test of difference = 0 (or difference<0)	93.65	0.00
H2b	t-test of difference = 0 (or difference>0)	-97.00	0.00
H3a	t-test of difference = 0 (or difference<0)	19.55	0.00
H3b	t-test of difference = 0 (or difference>0)	-47.24	0.00

Table 7 Correlation coefficients

Categories/ t-values	Male	Female	Elderly	Young	Rural	Urban
Male	–	0.57*	0.59*	0.76*	0.10	0.49*
Female		–	0.76*	0.66*	0.18	0.34
Elderly			–	0.49*	0.17	0.36
Young				–	0.11	0.24
Rural					–	-0.71*

equipment, and personnel, we acknowledge that our results are more applicable to larger metropolitan areas. Due to the usage of secondary data in this research, we were unable to specify the reasons for calls more precisely, i.e., it was not possible to subdivide the general category of medical reasons. Since this study is also limited by its descriptive design, we believe that there may be considerable differences in the proportions of calls for descriptive variables such as gender, age, or reason for the call according to the geographical context. Thus, before taking this research as an archetype for the development of EMS in other Turkish cities, more research related to the design and planning of EMS should be performed in other contexts. Furthermore, longitudinal studies focusing on significant factors would enable the creation of statistical models that could be used to predict future requirements for these services.

Conclusions

In recent years, the worldwide demand for EMS, including ambulances, has increased rapidly, which makes the efficient planning of such systems vitally important. Since the utilization of these services correlates strongly with geographical regions and demographics, it is important to take these factors into account in operations planning and management.

This study is of great importance as it is the first study based on real data carried out in Turkey. Thus, it not only forms a basis for future research directions, but also provides data for multi-national comparisons.

Another contribution of this study is the finding that, according to the results of the proportionate analysis, rural regions, and elderly citizens in particular, need to be the focus at both the provincial and national level. This is desirable because of the challenge of providing health care in more remote regions and the additional issue in these areas of supporting health care access for the elderly, who constitute a small minority of the population in this research context.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This research was approved by the İzmir Katip Çelebi University, Atatürk Research and Training Hospital Local Ethics Committee.

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