JEMTAC
Journal of Emergency Medicine Trauma & Acute Care
A PEER REVIEWED JOURNAL

OPEN ACCESS

Research article

# Utilization of prehospital emergency medical services in Saudi Arabia: An urban versus rural comparison

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**ABSTRACT**

**Background:** There is limited research outside the USA, Europe, or Australia on the capacity, efficiency, and development of prehospital emergency medicine services (EMS) between urban and rural areas. This study aimed to examine the usage of prehospital EMS across rural and urban areas in Riyadh region in the Kingdom of Saudi Arabia.

**Methods:** A random sample of 800 (400 urban and 400 rural) emergency patient records from the Saudi Red Crescent Authority EMS was collected. The following variables were analyzed: patient demographics, clinical characteristics, length of hospital stay, and length of intensive care unit (ICU) stay.

**Results:** A skewed distribution was noted with respect to sex, i.e., 559 men versus 241 women. Rural patients were younger (42.75 vs. 39.72 years) and had significantly longer hospital (15 days versus 9 days) and ICU (5 days versus 2 days) stays than urban patients following transportation. All injury types were comparable, except for head injury, which was higher in the rural group than in the urban group. Advanced treatment and trauma transport were more often used in rural areas than in urban areas.

**Conclusions:** In this study, rural EMS users were more likely to experience trauma-related incidents that necessitate EMS transportation, while medical reasons were more common among urban EMS users. Moreover, men used EMS at much higher rates than women and were more likely to be transported to the hospital following a call-out.

*Keywords:* Rural; Urban; Emergency Medical Services; Saudi Arabia; Riyadh

http://dx.doi.org/10.5339/jemtac.2020.9

Submitted: 20 May 2020
Accepted: 21 September 2020


QSCIENCE
HAMAD BIN KHALIFA UNIVERSITY PRESS

Cite this article as: Alanazy ARM, Wark S, Fraser J, Nagle A. Utilization of prehospital emergency medical services in Saudi Arabia: An urban versus rural comparison, *Journal of Emergency Medicine, Trauma & Acute Care* **2020:9** http://dx.doi.org/10.5339/jemtac.2020.9

## INTRODUCTION

For a patient requiring urgent medical assistance, due to either traumatic injury or acute illness, one of the most significant factors affecting their short- and long-term health prognosis is time.[1] In particular, the time period before a patient starts receiving healthcare support, usually on site from an emergency medicine services (EMS), is considered a critical aspect of improving mortality rates and reducing both the magnitude and longevity of illness or incapacitation of an individual.[2] Similarly, the quality of EMS support, both initially and then during transportation to a clinical setting, can influence patient outcomes.

While there is existing research on the availability of EMS in different countries, there is less consistent evidence on the capacity, efficiency, and development of prehospital EMS structures across disparate geographic locations. However, some studies have reported a significant difference in EMS services between urban and rural areas within countries.[3,4] A recent systematic review concluded that EMS in rural areas were more likely to have longer response times, transport times, prehospital times, and on-scene times than urban areas. In addition, almost all relevant research was undertaken in the USA, Europe, or Australia.[5] As a simple example of how this difference manifests in patient outcomes, Jennings et al.[6] noted that the survival rate of patients following an emergency cardiac event was considerably higher in urban areas than in rural areas. Other studies have found a significant difference between urban and rural models as regards response and time transfer and that urban EMS are generally associated with enhanced performance measures, which in turn increased the survival rates of patients, compared with rural EMS.[7,8]

This study aimed to establish a general picture of patients' usage of prehospital EMS within the Riyadh region in the Kingdom of Saudi Arabia, with a specific focus on any variation in patient presentation between urban and rural locations. A literature search did not reveal any research in Riyadh that specifically examined this issue, and only a few studies were conducted outside the USA, Europe, and Australia that compared urban versus rural EMS outcomes. This paper is part of a larger research project examining issues associated with the performance of EMS in rural and urban locations within Saudi Arabia.

## METHODS

### Study design and setting

A cross-sectional study was conducted using emergency patient records (EPRs) collected over a period of one year from January 1, 2017, to December 31, 2017, by the Saudi Red Crescent Authority EMS in the Kingdom of Saudi Arabia. The Saudi Red Crescent Authority started providing EMS in the Kingdom in the early 1930s, and remains the primary provider of EMS in the Kingdom.[9] Ethical approval was obtained from the University of New England's Human Research Ethics Committee, Saudi Arabia Ministry of Health Ethical Committee, King Abdelaziz Medical Cities Ethical Committee, and Saudi Red Crescent Authority.

The geographic setting for this study was the Riyadh region in the Kingdom of Saudi Arabia. Riyadh is one of the 13 administrative regions and is located approximately in the center of the country. Initially, the project planned to focus on data from the Makkah administrative region, as it has the largest population base and highest EMS transportation rates. However, following a review of the region's general demographic data, it was not considered representative of all of Saudi Arabia. It has significant religious events (pilgrimage) that result in large numbers of international visitors; the General Authority for Statistics noted an annual 1.8 million visitors to the region.[10] Riyadh, the region with the second highest number of transported cases, was then reviewed and ultimately selected as the data source.[11] Riyadh region has an estimated population of eight million people, who live across a geographic area of 400,000 $km^2$, and includes the capital city of Saudi Arabia, also called Riyadh. In accordance with the geographic classification provided by the Saudi Red Crescent and use of EPR forms, individuals residing in Riyadh City were considered 'urban,' while all other areas of Riyadh region were defined as 'rural.'

### Data collection and analysis

A random sampling method was employed to select EPRs included in this study. While it would have been preferable to include all EPRs, there were no comprehensive electronic datasets of patient records available; therefore, each hard copy was physically read and data manually transcribed. To ensure a

suitable sample, a sample size was calculated prior to the commencement of the project[12] and was determined to be 392 EPRs. Prior to data collection, 400 EPRs would be selected from urban areas and 400 EPRs would be selected from rural areas, resulting in a total sample of 800.

The 800-item dataset was sourced from the hardcopy EPRs created following an EMS response to each emergency call-out. EPRs were stored at the Saudi Red Crescent central office in Riyadh City, including all forms submitted from each of the 78 EMS stations (30 rural and 48 urban sites) in Riyadh region. The files were selected using a computer-generated random number list, with a supervisor from Saudi Red Crescent, and all records that were randomly selected were then de-identified. These files were then provided to the lead author, and data were transcribed into IBM SPSS Statistics for Windows version 25 (IBM Corp., Armonk, NY, USA). Simple descriptive statistics were used to describe the cohort profile, while Chi-square tests were used for comparison purposes.

The following variables were collected from the EPRs:

1. *Patient demographics*

Demographic data included age, sex, and residential location (rural or urban).

2. *Clinical characteristics*

Clinical characteristic data included the on-scene outcome (treatment, nontreatment, transfer to hospital), type of on-site care provided (airway, breathing, circulation, extrication or immobilization), general classification of illness/injury (medical or trauma), and specific classification of illness/injury (head injury, dizziness, etc.).

3. *Length of hospital stay*

The length of stay in hospital was noted in whole days.

4. *Length of intensive care unit (ICU) stay*

The length of stay in an ICU was noted in whole days.

## RESULTS

### Differences in patient demographic data by sex

On initial inspection, there was a clear skew in data with respect to sex. Overall, the sample was composed of 559 men and 241 women. There was also a difference between sexes in terms of age, where female EMS users (41.2 years) were slightly older on average than male EMS users (39.72 years).

Basic support on the scene was far more common than advanced treatment for both sexes, with 551 men and 237 women receiving basic support in contrast to just eight male EMS users and four female EMS users receiving advanced treatments. There were 18 male deaths and three female deaths on scene. For male EMS users who were transported to a hospital from the scene, the reasons for transportation were evenly divided, with 282 for medical reasons and 277 for trauma reasons. This pattern was quite different for female EMS users, with 189 transports for medical reasons and 52 for trauma reasons, which represented a ratio of 3.6 medical cases to every one trauma case. Table 1 provides a summary of the key patient data for both male and female EMS users. The incident type 'no medical care provided' refers to situations in which patients were transferred between locations for

**Table 1. Key patient data for sex**

| Variables | | Male | Female | Sig. (*p* values) |
|---|---|---|---|---|
| Patient taken from scene to hospital | Yes | 70 | 32 | 0.046* |
| Incident type | No medical care provided | 18 | 6 | 0.578 |
| | Fracture/laceration | 94 | 17 | < 0.001* |
| | Head-neck injury | 85 | 15 | < 0.001* |
| | Chest injury | 22 | 3 | 0.045* |
| | Dizziness | 61 | 41 | 0.018* |
| | Wound/burn | 37 | 9 | 0.108 |
| | Cardiorespiratory | 22 | 10 | 0.887 |
| | Gastrointestinal | 25 | 14 | 0.420 |
| | Neurological | 14 | 13 | 0.830 |
| | Respiratory | 34 | 19 | 0.347 |
| | Others | 147 | 94 | < 0.001* |

treatments, such as for hemodialysis, and where the EMS was not required to provide any medical interventions.

Significant differences were noted in EMS usage between male and female EMS users. Male EMS users are more significantly likely than female EMS users to be taken to a hospital following an EMS call-out or to experience a fracture/laceration, head – neck injury, chest injury, or dizziness. Data for the incident type 'others' was also statistically significant, but the lack of details provided in the EPRs on this category makes any analysis attempts meaningless.

## Differences in patient demographic data by location

The sample was deliberately composed of an equal number (n = 400 each) of urban and rural residents. The urban group was composed of 264 (66%) male EMS users and 136 (34%) female EMS users, while the rural group included 295 (73.8%) male and 105 (26.3%) female EMS users. The mean age of the urban group was 42.75 years, while this dropped to 39.72 years for the rural cohort.

The number of advanced treatments was small overall when considered by geographic location. In total, 398 urban and 390 rural residents received basic treatment on scene, compared with just two urban and 10 rural people who received advanced treatment. The number of deaths on scene (n = 13) was higher in rural areas than in urban ones (n = 8), but the overall death rate was low. Medical reasons were more common reasons for transportation to hospital for urban EMS users (259 medical versus 141 trauma), which represents a ratio of 1.8 medical case for each one trauma case. However, this difference was smaller in rural locations (212 to 188), with a ratio of 1.1 medical case to one trauma case. Key demographic data are outlined in Table 2. Two significant differences were found between urban and rural EMS users: rural residents were more likely to experience fractures/lacerations, while urban residents were at greater risk of wounds/burns.

## Clinical characteristics: urban versus rural

A further analysis was undertaken to examine differences in the clinical characteristics of urban versus rural residents. Table 3 summarizes the difference in the presentation of body injury or illness according to the patient's geographic location. Head, face, and extremity injuries were more common in rural areas, while chest, abdomen, and back injuries were more common in urban areas; however, no significant difference was found between the groups, except for head injuries, which were higher in rural than in urban areas ($p = 0.018$). Otherwise, no other significant differences were observed based on injury type with respect to location.

The injury type, as opposed to the presentation of injury or illness, is outlined in Table 4. The patient outcome, in terms of the length of stay either in a hospital or an intensive care unit, is also noted. The lengths of stay for patients transported by EMS specifically into an ICU and generally in hospital are both significantly shorter in urban than in rural areas ($p < 0.001$).

No significant difference was found between urban and rural patients in terms of the provided care (Table 5) for airway treatment, breathing treatment, and extrication and immobilization treatment. However, a significant difference was found for circulation treatment, with urban patients more likely to receive this treatment.

**Table 2. Key patient data for urban and rural areas**

| Variables | | Urban | Rural | Sig. (*p* values) |
|---|---|---|---|---|
| Patient taken from scene to hospital | Yes | 43 | 59 | 0.114 |
| Incident type | No medical care provided | 15 | 9 | 0.214 |
| | Fracture/laceration | 45 | 66 | 0.032* |
| | Head-neck injury | 43 | 57 | 0.134 |
| | Chest injury | 15 | 10 | 0.310 |
| | Dizziness | 53 | 49 | 0.672 |
| | Wound/burn | 31 | 15 | 0.015* |
| | Cardiorespiratory | 17 | 15 | 0.718 |
| | Gastrointestinal | 20 | 19 | 0.870 |
| | Neurological | 15 | 12 | 0.557 |
| | Respiratory | 27 | 26 | 0.887 |
| | Others | 119 | 122 | 0.817 |

**Table 3. Presentation of injury or illness**

| Variables | | Frequency | | Sig. (*p* values) |
|---|---|---|---|---|
| | | Urban | Rural | |
| Head injury/illness | Yes | 43 | 67 | 0.018* |
| | No | 357 | 333 | |
| Facial injury/illness | Yes | 12 | 20 | 0.206 |
| | No | 388 | 380 | |
| Chest injury/illness | Yes | 20 | 18 | 0.868 |
| | No | 380 | 382 | |
| Abdominal injury/illness | Yes | 20 | 16 | 0.609 |
| | No | 380 | 384 | |
| Back injury/illness | Yes | 40 | 35 | 0.628 |
| | No | 360 | 365 | |
| Extremity injury/illness | Yes | 76 | 94 | 0.142 |
| | No | 324 | 306 | |

**Table 4. Injury type and length of stay in hospital or intensive care unit**

| Variable | | Urban | Rural | Sig. (*p* values) |
|---|---|---|---|---|
| Length of stay in hospital (days) | | 9 | 15 | <0.001* |
| Length of stay in ICU (days) | | 2 | 5 | <0.001* |
| Problem type | No medical care provided | 15 | 9 | 0.214 |
| | Fracture/laceration | 45 | 66 | 0.03* |
| | Head-neck injury | 43 | 57 | 0.134 |
| | Chest injury | 15 | 10 | 0.310 |
| | Dizziness | 53 | 49 | 0.672 |
| | Wound/burn | 31 | 15 | 0.150 |
| | Cardiorespiratory | 17 | 15 | 0.718 |
| | Gastrointestinal | 20 | 19 | 0.870 |
| | Neurological | 15 | 12 | 0.557 |
| | Respiratory | 27 | 26 | 0.887 |
| | Others | 119 | 122 | 0.817 |

**Table 5. Patients' treatment and progression frequency**

| Items | Frequency | Frequency | | Sig. (*p* values) |
|---|---|---|---|---|
| | | Urban | Rural | |
| Provide airway treatment | Yes | 16 | 15 | 0.999 |
| | No | 384 | 385 | |
| Provide breathing treatment | Yes | 169 | 167 | 0.943 |
| | No | 231 | 233 | |
| Provide circulation treatment | Yes | 147 | 111 | 0.008* |
| | No | 253 | 289 | |
| Provide extrication and immobilization treatment | Yes | 96 | 103 | 0.624 |
| | No | 304 | 297 | |

## DISCUSSION

Prehospital EMS are a critical element of modern health systems, and their performance is a vital component of any care model designed to improve patient outcomes associated with traumatic injuries and time-sensitive diseases.[1] However, there is still a significant need for current research to provide information on the strengths and weaknesses of prehospital EMS and particularly in relation to key demographic differences across rural and urban areas. A recent systematic review noted that almost all research undertaken in this area has focused on the USA, Europe, or Australia.[5] The likelihood of service discrepancies between rural and urban settings is arguably even higher in lower resourced countries due to the inaccessibility of health services in rural areas, with identified key factors potentially affecting patient outcomes.[13]

The present study examined a random sample of 800 EMS users within the Riyadh region in the Kingdom of Saudi Arabia. The purpose of this study was to establish a profile of both urban and rural EMS patients and to compare key demographic variables so as to identify any differences in outcomes.

Initial examination indicated a skew in data with respect to sex, so data analyses were performed separately with respect to both sex and geographic location. The findings associated with these analyses are discussed below.

### Differences by sex

The reasons for transport from the scene were categorized as either medical or trauma. The data showed nearly equal numbers for male EMS users, with 282 for medical reasons and 277 for trauma reasons. However, this pattern was quite different for female EMS users, with 189 medical reasons and 52 trauma reasons. The reasons for this skewness are not possible to determine accurately in a cross-sectional study; however, it is consistent with a previous study in Turkey showing that men use EMS at a higher rate than women,[14] although this finding contrasts with those in countries such as Australia and USA where an equal number of men and women utilize EMS.[15] Compared with previous studies, the percentage of using the ambulance according to sex were almost the same without huge differences.[16–18] The precise reasons are impossible to determine definitively, but it is hypothesized that men in Saudi Arabia are likely to have high exposure to potential traumatic events arising from high-speed vehicular accidents or higher-risk workplaces.[19] In this study, there were 18 male deaths and three female deaths on scene, and this difference was believed to be due to men's higher risk for significant trauma.

A difference was found between men and women with respect to the reason of transport to a hospital from the scene. For men, there was little distinction between those transported for medical reasons, such as illness and injury arising from trauma. However, over 3.5 times as many women were transported following a medical event than following a traumatic event. Men were also more likely than women to be taken to hospital and to have fractures or lacerations, head–neck injuries, or chest injuries. These differences are believed to arise from the fact that women have low exposure to potential risk factors that may result in traumatic injury, and there is little that EMS could do to proactively prevent the occurrence of such injuries in men. However, further research into these observed differences is recommended to better understand whether EMS needs to change on-scene management and transportation to address these issues.

### Differences by geographic location

Our data showed that medical problems were nearly twice as common as trauma when considering the reasons for transportation to hospital for urban EMS users. However, this difference was much smaller in rural areas than in urban areas and was close to parity with 1.1 medical problems for every trauma. As noted above in the section regarding sex differences, this difference was considered largely due to the increased risks of experiencing traumatic injuries arising from high-speed vehicular accidents or from farming or industrial workplaces. While there is limited research data from Saudi Arabia, studies conducted in USA and Sweden indicate that rural trauma cases often result in more severe injuries than urban cases.[20,21] The number of deaths on scene ($n = 13$) was higher in rural than in urban areas ($n = 8$), but the overall numbers were low.

Although the numbers were low, rural residents were significantly more likely to have longer hospital or ICU stay after being transported by EMS. This finding is inconsistent with those in other countries, with studies in the USA and Europe not reporting any significant differences in ICU and hospital stay between rural and urban EMS users.[22,23] It was not possible to determine the severity of injury or illness from the EMR forms; therefore, comparisons of whether rural patients had more serious health issues than urban patients could not be established. This issue requires additional exploration to consider whether rural factors, such as workplace exposures, may explain this difference. However, rural EMS may have lower levels of training and/or availability of equipment,[1–5] and this could account for some of the variance; thus, further research is required to examine this issue in more detail.

Another issue recommended for follow-up research is to evaluate whether there are any differences in response time and on-scene time for urban and rural EMS users, as this has been observed both in Saudi Arabia and in other countries.[5] The present data showed that rural people were five times as likely to receive advanced treatment, although the overall numbers were small. In other settings, any delays to the commencement of life-saving treatments, such as those that are likely to occur after significant trauma, may increase the need for advanced on-site treatment and lead to worse overall health outcomes for patients.[1,2,6–8] In rural areas, geographic distances that will naturally result in longer response times and longer subsequent transportation times to a major healthcare setting are key factors that require more detailed analysis within Saudi Arabia.

## LIMITATIONS

This cross-sectional study examined a random sample of 800 cases in the final dataset. While this sample size is sufficient with respect to the initial power calculation, it would have been desirable to include every EMS case in the Riyadh region. As EMS records were not electronic, data were manually extracted from original hard copies, and collating all such data was beyond the scope of this project.

## CONCLUSIONS

Analysis of this cross-sectional dataset by both geographic location and sex identified a number of key issues. One of the main differences was the greater likelihood of rural EMS users to experience trauma-related incidents that necessitate EMS transportation, while medical reasons were more common among urban EMS users. Moreover, men used EMS at much higher rates than women and were more likely to be transported to hospital following a call-out. Exploring the reasons for these findings was beyond the scope of the current study; thus, further investigation is required to better understand the observed outcomes.

## Conflict of interest

There were no conflicts of interest, perceived or otherwise. There is no funding to declare.

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