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Original article

Impact of subtropical climate on frequency of ambulance use for trauma patients in a coastal area of China

Yuqiang Chen [a, 1], Yucheng Lai [a, b, 1], Jiajie Ke [a, b], Yuefeng Chen [a, b], Yuling Xu [b], Yuqin Ma [b], Jiayin Yuan [b], Tian Liang [b], Pengzhan Mai [b], Changmin Lin [b], Yang Xie [a, *], Keng Huang [a, **]

[a] Emergency Department, the Second Affiliated Hospital of Shantou University Medical College, Guangdong 515041, China
[b] Emergency Department, Shantou University Medical College, Guangdong 515041, China

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ABSTRACT

Purpose: To explore the impact of subtropical maritime monsoon climate on the frequency of ambulance use for trauma patients in a coastal region in China.
Method: Statistical analysis of data on ambulance use from the 120 Emergency Command Center in Shantou City, Guangdong Province, from January to December 2012 as well as daily meteorological data from a Shantou observatory was performed to determine how climatic factors (seasons, time, and weather) affect the frequency of ambulance use for trauma patients.
Results: The daily ambulance use for trauma patients differed between spring and summer or autumn ($p < 0.05$), between sunny and rainy days ($p < 0.05$), and between cloudy and lightly or moderately rainy days ($p < 0.05$). We found a linear correlation between daily maximum temperature and daily ambulance use for trauma patients ($R^2 = 0.103$, $p < 0.05$). In addition, there was significant difference in ambulance use between good and bad weather ($p < 0.05$).
Conclusion: Frequency of ambulance use for trauma patients is affected by the subtropical maritime monsoon climate in the coastal region. Better weather contributes to increased daily frequency of ambulance use, which is the highest in autumn and lowest in spring.

1. Introduction

Trauma is a major cause of mortality and disability in both developed and developing countries.[1] Climate and weather affect our daily life and activity, which play an important role in the incidence of trauma.[2] Shantou City is located in 23°02′33″-23°38′50″ north latitude and 116°14′40″-117°19′35″ east longitude, between subtropical and tropical zones in the northern hemisphere. It is near the South China Sea and features a marine monsoon climate affected by a tropical low, subtropical high, and the ocean. Shantou City has changing seasons throughout the year. The spring is wet, the summer is hot and rainy, the autumn is cool and dry, and the winter is warm with less rain.

We analyzed the daily frequency of ambulance use and daily meteorological variables in Shantou City to determine their possible relationships and suggest some preventive measures to decrease the incidence of trauma and to adjust pre-hospital care according to weather information from the meteorological station. Moreover, we hope to provide some useful references for other cities with similar climates.

2. Material and methods

2.1. Data

This was a retrospective study analyzing ambulance calls from the 120 Emergency Command Center in Shantou City during 1 year (January to December 2012). We included 24,273 cases; 124 cases with incomplete records were excluded. The total number of ambulances calls for trauma patients was 13,308. The reasons for calling were *crash*, *falling*, *injury*, *burn*, *fracture*, *dislocation*, *explosion* and *machine injury*. The mean (SD) daily frequency of ambulance use for trauma patients was 36.26 (9.25). There were 8637 males

* Corresponding author. Tel.: +86 13642248221.
** Corresponding author. Tel.: +86 13502998930.
E-mail addresses: emergencyf2@outlook.com (Y. Xie), hkeng@126.com (K. Huang).
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[1] These authors contributed equally to the work.

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(65.0%) and 4671 females (35.0%) admitted to the emergency department (ED). Daily meteorological data were obtained from the Shantou Observatory and the following variables were used: daily temperature, weather and wind scale. The data were grouped by the different meteorological conditions.

2.2. Statistical analyses

Data were analyzed by SPSS 19.0 (SPSS Inc., Chicago, IL). The daily mean frequency of ambulance use followed a normal distribution, and one-way ANOVA was used to analyze the frequency by meteorological situations, with the Student–Newman–Keuls–q test to analyze daily frequency by weather and wind scale. Linear regression analysis was used to analyze daily frequency by temperature. $p < 0.05$ was considered statistically significant.

3. Results

Fig. 1 showed ambulance use for trauma patients by age group. The frequency of use increased with age at first, peaked at ages between 21 and 30 years, and then decreased gradually.

Ambulance use for trauma patients by hour of the day was shown in Fig. 2, which peaked between 21:00 to 21:59, and then decreased gradually. The frequency of use was the lowest at 05:00 to 05:59. We found a minor peak at 08:00 to 08:59 and 18:00 to 18:59.

Fig. 3 showed ambulance use for trauma patients by weekday and weekend. The frequency of ambulance use was relatively flat on the weekdays, then increased rapidly on the weekend and was the highest on Sunday.

According to longitude, latitude and climate, we classified March to May as spring, June to August as summer, September to November as autumn, and December to February as winter. The daily frequency of ambulance use for trauma patients differed in each season. It differed between spring and summer or autumn ($p < 0.05$). The mean daily frequency was the highest in autumn and the lowest in spring (Fig. 4).

We classified daily weather into six categories: sunny (including sunny, sunny to cloudy, cloudy to sunny), cloudy, overcast (including overcast, overcast to cloudy, cloudy to overcast) and lightly, moderately and heavily rainy (based on the amount of precipitation). The daily frequency of ambulance use significantly differed between sunny and rainy days ($p < 0.05$) and between cloudy and lightly or moderately rainy days ($p < 0.05$). The frequency was the highest on sunny days and was the lowest on moderate rainy days (Fig. 5).

We found a linear correlation between the daily maximum temperature and daily frequency of ambulance use for trauma patients ($R^2 = 0.103$, $p = 0.049$, Fig. 6).

Shantou City is located in a coastal area with the most common wind scale of 3–4. Based on the maximum wind scale per day in 2012, we classified wind scale into 3 categories: <3 (151 days), 3–4 (182 days), >4 (33 days) and found no difference in ambulance use for trauma among the levels. The daily mean ambulance use was higher when scale of 3–4 and lower when scale of >4 (Fig. 7).

We classified daily weather into three categories: good, normal or bad. On a good weather day, the maximum temperature was >20 °C without precipitation. Additionally, all day with maximum temperature >5 °C above the average of that month was also considered good weather. Bad weather was defined as a day with maximum temperature <15 °C or with precipitation. All days with maximum temperature >5 °C less than the average of that month and wind scale >5 was also considered as bad weather. The days not classified as good or as bad were defined as normal. The frequency of ambulance use for trauma patients significantly differed between good and bad weather days ($p < 0.05$). Good weather had the highest daily frequency (Fig. 8).

4. Discussion

From the observation of ambulance use for trauma patients in Shantou City in 2012, the use frequency was higher for male than female patients with a ratio of 1.849:1. The onset of ambulance use for trauma patients was typically between ages 21 and 50 years, with the peak between ages 21 and 30 years. Zhang et al[3] showed similar epidemiologic results for ambulance use. Young adults are often laborers or may have high-risk jobs, which may explain these results. The incidence rate of trauma may be reduced by providing safer work environment and promoting safety awareness.

The frequency of ambulance use for trauma patients differed in different times of the day. We found a minor peak of ambulance use in the rush hours (08:00–08:59, 18:00–18:59).[4,5] Road traffic injuries (RTIs) are the leading cause of death in young people aged 15–29 years[6] and 90% of the RTIs occurred in the developing countries.[7] We should highlight the importance of road traffic safety and have more traffic police on duty at that time. The peak frequency for ambulance use appeared in the early evening (21:00–21:59), which may be explained by the change from light to darkness, alcohol abuse, or fighting. Meanwhile, we found increased rates on the weekend because of more time spent on outdoor activities, which demonstrates that daily ambulance use for trauma is associated with human behavior.[4] Decision makers

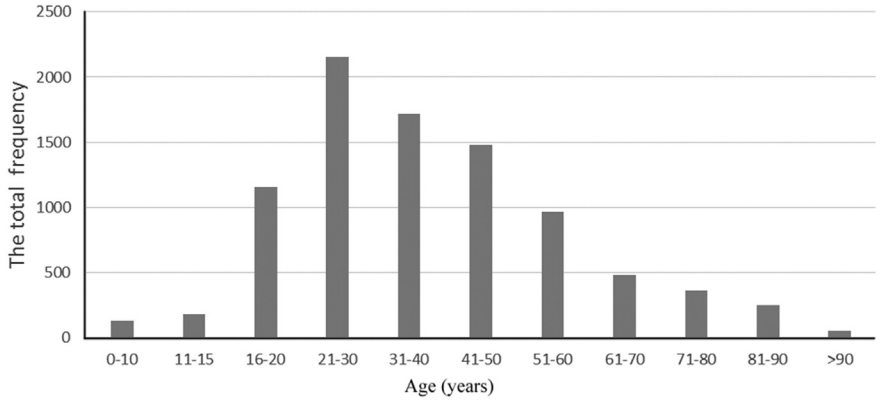

Fig. 1. Frequency distribution of patients by ages.