

## ORIGINAL ARTICLES

# Epidemiological characteristics and morbidity of Snake-bites in Zunyi city, China

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## ABSTRACT

**Objectives:** To investigate the epidemiological characteristics and morbidity of the snake-bite injury in Zunyi city, China, so as to provide the first aid guidance and public education for the prevention and treatment strategies of snake-bite injuries.

**Methods:** A cross-sectional study was conducted, and 548 cases of snake-bite were observed in this study between January 1, 2015 to December 31, 2017. They were identified from the Emergency Department of the Affiliated Hospital of Zunyi Medical University. A retrospective epidemiological survey was conducted to collect their information on sex, age, occupation, bite location, bite year and season, specific bite cause.

**Results:** The number of the patients of snake-bite was increased; however, the fatality rate gradually was decreased year by year during the investigating period. Seven patients died during year 2015-2017 and the 3-year total mortality was 2.9%. Among the dead, 59.31% were male and 40.69% were female. 19.70% of patients were between 41 and 50 years old, 17.70% were between 51 and 60 years and 16.79% of patients were between 61 and 70 years old. Moreover, 66.97% of patients were on the lower extremity and 31.93% of patients on the upper extremity. 83.39% of patients were bitten while farming and 12.04% of patients were bitten while walking. Most cases occurred during summer and autumn (7-9 months) seasons. The regional distributions of 548 snake-bites were 44.34% in the County and 33.94% in districts of Zunyi city.

**Conclusion:** Target preventive measures should be conducted in high risk populations in Zunyi city, especially in spring and summer.

**Key Words:** Snake, Snake-bite, Epidemiology Distribution, Zunyi

## 1. INTRODUCTION

Snake-bite is a serious and important medical issue in the world which is associated with high global mortality and morbidity.<sup>[1]</sup> Snake-bites are common in rural areas of tropical and subtropical regions, and they are more common in the South Asia, Southeast Asia, Africa, and Latin-America in the world.<sup>[1,2]</sup> Snake-bites are considered as a neglected

extrinsic disease by the World Health Organization.<sup>[1,3]</sup> It is reported that five million people are bitten by snakes every year around the world and about 12,000 patient deaths and 400,000 were crippled or disfigured for life.<sup>[4]</sup> Snakes are usually divided into non-poisonous snakes and poisonous snakes. There are more than three thousand species of snakes in the world, among which there are more than 660 kinds

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of poisonous snakes and about 60%-80% are nonvenomous bites.<sup>[5,6]</sup> Poisonous snake-bite can cause severe local and systemic symptoms and signs, including systemic muscular toxicity, systemic bleeding, tissue damage, and acute kidney injury<sup>[1,2]</sup> and even non-poisonous snake-bites have the possibility to cause moderate or severe damage, because there is an conceivable fear for a bite, such as numbness in the extremities, vasovagal shock, extreme agitation and loss of reason.<sup>[7,8]</sup> Study showed that most patients of snake-bite were adult males who are working outdoors, such as farmers, herder, and soldier who were little knowledge of snake-bites before they were bitten.<sup>[9-12]</sup> In China, most of the snakes are distributed in the south and southeast of the country.<sup>[5]</sup> There are about one hundred thousand person-times of snake-bite every year, and the fatality rate of snake-bite is 5%-10%.<sup>[13]</sup> The poisonous snakes with more than 50 species found are mainly distributed in Guizhou, Guangdong, Guangxi, Fujian, Yunnan, Sichuan and other places in the south of the Yangtze River. In recent years, the rescue level of critically injured snakes has been greatly improved. However, existing epidemiological data are limited and fragmented, and so, the true impact of snake-bites may be underestimated and the full burden of human suffering from snake-bites remains unknown.<sup>[2]</sup> Snake-bite and their management have also some reports in China.<sup>[5,14-17]</sup> There are still many problems in the treatment of snake bites, which are worthy of clinical attention. At present, China has not a unified standard for the diagnosis and treatment of snake-bite. Therefore, the prevention and treatment of snake-bite is still a huge challenge faced by all countries in the world. Zunyi of Guizhou province is a subtropical city in southwest China and the average altitude is 1-1.5 km.<sup>[18]</sup> There are many mountains and mountain forests and people are often bitten by snakes and there is no study has been reported about of snake-bites in Zunyi city, China. This study investigated the snake-bite patients admitted to the emergency department of the affiliated hospital of Zunyi Medical University in recent years, and we report, for the first time, the incidence and distribution of snake-bite in Zunyi. We survey the characteristics of the incidence and distribution of snake-bite in this region. The goal of this study was to provide some epidemiological data and improve the medical knowledge of snake-bite and provide help for the prevention and treatments of snake-bite, so as to reduce the morbidity and mortality of snake-bite in China.

## 2. METHODS

### 2.1 Sample and Data Collection

The research was a retrospective study. All admitted snake-bite patients was obtained from the medical record manage-

ment system of the Affiliated Hospital of Zunyi Medical University from 2015 to 2017 in Guizhou province, China. Five hundred and forty-eight snake-bite patients at this time were surveyed. The information of each patient was examined and sorted out one by one, and 548 patients cases of snake-bite in the past 2 years were studied retrospectively (from 2015 to 2017). In subsequent time, samples from inpatients and outpatients were included. Systematic information including initial hospitalization, treatment phase, outcomes and prognosis were collected. We abstracted individual patient data namely demographics, age, sex, occupation, medical and substance use history; and bite information including the time of the bite, bite site, the season of the bite, the reason of the bite, place of the bite, clinical signs and symptoms, diagnostic findings, treatments and complications. There coteries of discharged patients were collected follow up by telephone and popularize the treatment knowledge and conduct health education of snake-bite to the patients again.

**Table 1.** The distribution of snake bites in the population (n = 548)

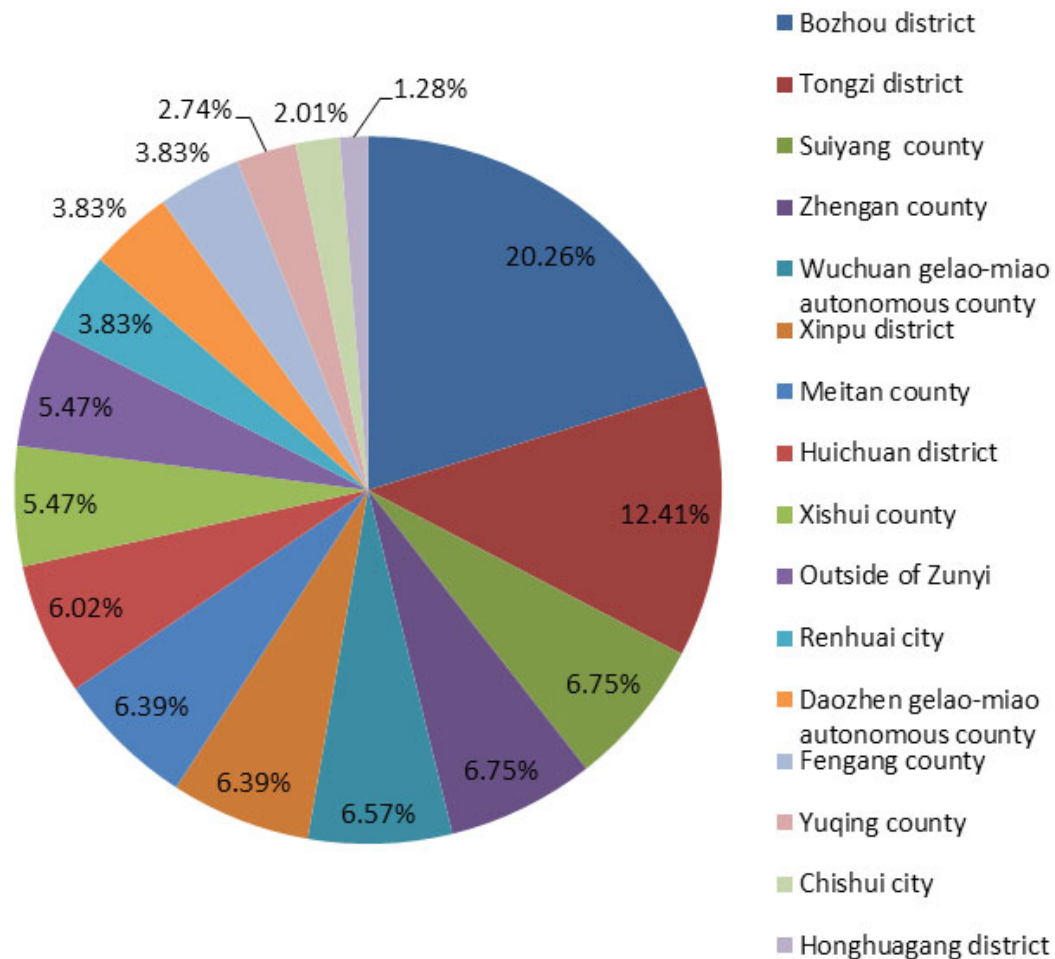
Distribution in the population	N (%)
<b>Gender</b>	
Male	325 (59.31)
Female	223 (40.69)
<b>Age</b>	
1-10	61 (11.13)
11-20	56 (10.22)
21-30	36 (6.57)
31-40	50 (9.12)
41-50	108 (19.71)
51-60	97 (17.70)
61-70	92 (16.79)
71-80	43 (7.85)
> 81	5 (0.91)
<b>Reason</b>	
Farming	457 (83.39)
Walking	66 (12.04)
Playing	15 (6.09)
Sleeping	3 (0.55)
Open defecation	4 (0.73)
Fishing	1 (0.18)
Snake catching	1 (0.18)
Cleaning the room	1 (0.18)
<b>Bite site</b>	
Lower limbs	367 (66.97)
Upper limb	175 (31.93)
Head and face	4 (0.73)
Buttocks	2 (0.36)

**Table 2.** Outbreaks and mortality from snake bites in the population (n = 548)

Year	Number of cases	Number of death	Fatality rate (%)	Chi-square	P-value
2015	141	4	2.84	200.00	< .001
2016	194	2	1.03		
2017	213	1	0.47		
Total	548	7	1.28		

**Table 3.** The influence of pre-hospital treatment on prognosis

Outcome	Pre-hospital treatment						Total	Proportion (%)
	Incision and drainage	Proportion (%)	Disinfectant medicated compress	Proportion (%)	Orally with traditional Chinese medicine	Proportion (%)		
Recovery	45	94	431	90	21	95	497	91
Not recovered	3	6	40	8	1	5	44	8
Death	0	0	7	2	0	0	7	1
Total	48	100	478	100	22	100	548	100



**Figure 1.** The distribution map of snake bite sites in 2015-2017

## 2.2 Statistical Analysis

All the data were collected by Excel and were analyzed using SPSS for Mac version 18.0 (IBM Corporation, Armonk, NY, USA) was used for statistical analysis; categorical variables data was described by counts, percentages, constituent ratio or rate, Chi-square test was used for compares between groups, and the significant level  $\alpha = 0.05$ .

## 3. RESULTS

### 3.1 Population distribution

A total of 548 snake-bite patients (325 males and 223 females) from Affiliated Hospital of Zunyi Medical University were surveyed for the study. The population distributions of 548 snake-bite patients are presented in Tables 1 and 2. A total of 59.31% (n = 325) of individuals reported that they are male, out of which 40.69% (n = 223) had been bitten by snakes are female. There was no significant difference between males and females during 3 years (Chi-square = 0.605,  $P > .05$ ). The survey revealed that the highest number of snake-bite injuries were in patients aged 41-50 ages (19.7%) followed by those 51-60 years old (17.7%). The result showed that the youngest patient was 6 months, which were bite while sleeping at home and 5 cases over 81 years of old. The vast majority reasons (83.39%) of Snake-bites were from farming, and the second is from walking (12.04%), and they also from playing (6.09%), sleeping (0.55%), open defecation (0.73%), fishing (0.18%), snake catching (0.18%), and cleaning the room (0.18%). Therefore, farmers are at high risk of Snake-bite, which is the focus of the prevention of Snake-bite. The sites of snake bites were mostly in the limbs, especially in the lower limbs (67.97%), followed by the upper limbs (31.93%), with occasional bites on the head, face (0.73%) and buttocks (0.36%). From 2015 to 2017, snake-bite cases admitted to the emergency department of the affiliated hospital of Zunyi medical university are occurring every year, as follows: 141 cases in 2015, 194 cases in 2016 and 213 cases in 2017. The number of snake-bite patients admitted and treated increasing trend year by year within three years, while the case of fatality rate decreased year by year, with a total of 7 deaths and the total fatality rate of 1.28%. Fatality rate is statistical difference between three years.

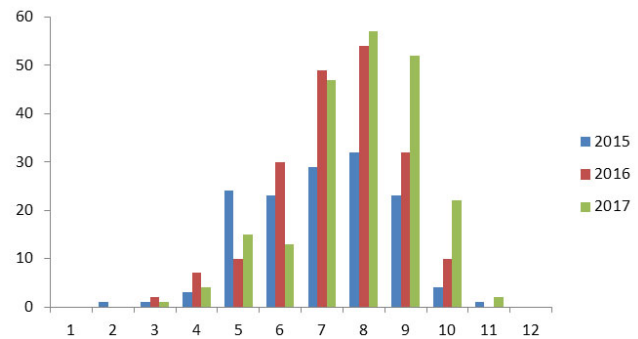
### 3.2 Regional distribution

The regional distributions of 548 snake-bite patients are presented in Figure 1. All of the areas including 4 districts, 2 county-level cities, 9 counties and 1 outside of Zunyi had patients of snakebite. The area with the most patients was Bozhou district (20.26%), and the second is Tongzi district (12.41%), and following areas were Suiyang

(6.75%), Zhengnan county (6.75%), Wuchuangelao-miao autonomous county (6.57%), Xinpu district (6.39%), Meitan county (6.39%), Huichuan district (6.02%), Xishui county (5.47%), Renhuai city (5.47%), Daozhengelao-miao autonomous county (3.83%), Fengang county (3.83%), Yuqing county (2.74%), Chishui (2.01%), Honghuagang district (1.28%), 5.47% were from outside of Zunyi.

### 3.3 Time distribution

The time distributions of 548 snake-bite patients are showed in Figure 2. There are two peaks in the number of snake-bite injuries, who admitted to the emergency department of the Affiliated Hospital of Zunyi Medical University. The peak is in July to September.



**Figure 2.** The distributions of 548 snake-bite patients in 12 months of 3 years

### 3.4 Pre-hospital treatment and treatment outcome

The prognosis is shown in the Table 3. Among the 548 patients, there were three main measures taken before admission: incision and drainage, Iodine volts or alcohol disinfection, dressing or taking orally with traditional Chinese medicine. 497 of the 548 patients were cured, with a total cure rate of 91%. The cure rates of the three pre-hospital treatments were all > 90% or above. The Chi-square test of the three different pre-hospital treatments showed  $P < .001$  and the difference was statistically significant.

## 4. DISCUSSION

Our results showed that the snake-bite patients were increasing in 3 years, but the death rates were decreasing year by year, which mainly arose from the constant increase of medical conditions in townships, economic conditions, and people's awareness of protection in each county of Zunyi city. The population distribution showed the incidence rate of males was higher than females but there is no significant difference between 3 years. The age distribution is mainly concentrated in 41-50 and 51-60 years old. These results may

be related with middle-aged and aged men of researchers are the mainstay of families' manual workers in family, and they have more activity range in farmland and mountain than others, so they have more chances to be bitten by snakes. Moreover the proportion of female being bitten by snake is lower than that of male, which also indicates that the rural areas are mainly male, who are engaged in field work, and the incidence of snake bites is greatly increased. Our results showed that the snake-bite mainly arose from farming and walking, indicating that farmers are at highest risk of snake-bite, which is the focus of the prevention of snake-bite. The proportion of farmers is the highest, which is mainly related with the outdoor field work, population proportion, poor economic conditions, living habits, medical education and the education level. Therefore, farmers have become the key group of snake-bite health education and they should be classified as the key group of snake bite health education. In our investigation, the majority sites of bite were arms and legs, especially lower limbs, which is similar to Duan's study.<sup>[19]</sup> Duan et al. found that the main bite site was the hand in Zunyi from January 1, 2012 to January 1, 2017. This is mainly because of the large amount of farmland in mountainous areas in Zunyi city and the higher utilization rate of the land, and the local crops are mainly rice, and they were bitten by snakes during barefoot work. Moreover, most farmers are lack of the medical knowledge and prevention consciousness of snake bites. This is consistent with the farming is the main reason of snake-bites. Our results showed that snake-bites are obviously regional. The main reasons are closely related to that county are rich land resources, higher land occupation area and large agricultural population. Mountains are the best habitat for snakes, and also the concentration of farmers' agricultural work, therefore, this study suggests that it is particularly important to publicize snake-bite knowledge and health education for agricultural workers in the county of Zunyi. The purpose of health education is to improve patients' understanding of diseases and develop good healthy behaviors.<sup>[20]</sup> The district ranked the second, which most because of they are close to the Affiliated Hospital of Zunyi Medical University. Zunyi city is located in the northeast of Yunnan-Guizhou plateau with the 1000-1500 meters, which is also located the slope area of transition from Yunnan-Guizhou plateau to Hunan hills and Sichuan basin. The topography of Zunyi city is undulating and the landform is complex, which the southern mountains one of the main bodies of Guizhou plateau with mainly consisting of low-middle hills and wide valley basins. Generally, the cultivated land of Zunyi city is concentrated and contiguous, and the rate of land utilization is high. It is the main producing area of grain and oil crops.

Climate of Zunyi city belongs to subtropical humid monsoon climate, which are high temperature and rain in summer. It is humid and abundant rainfall all the year round. These climatic features are particularly favorable for snakes. Snake-bites are very common in southern regions<sup>[20]</sup> and venomous snake-bites are common in rural and mountainous areas in the south,<sup>[20]</sup> especially in July, August and September. The number of cases in January and December was zero, which was related to more actives in summer with high temperature and hibernating habit in winter. Summer and autumn are the best time to plant crops and the farmers have a higher chance in the farming, so it is a key prevention and control of snake bites in summer and autumn season. Chen et al. found that snake-bite knowledge among Chinese field force members is inadequate and in some cases misleading, when focusing on manifestation, prevention, and first-aid. A pragmatic, intensive educational scheme should be undertaken in at-risk populations. Our study also showed that the patients must to know about the general knowledge about snake-bites, right treatments, and timely go to a hospital. At the same time the training of grassroots health workers must have attention. It is of positive significance to improve medical staff's first-aid skills for snake-bite, reduce the complications, and reduce the disability and mortality of snake-bite.<sup>[21]</sup> Correct early local treatment is crucial for effective treatment. There are common three different ways of early treatment for patients. The first method is incision drainage and bandaging, the second is a disinfection treatment or external application with Chinese herbs supply; the third is internal consumption of their own boiled Chinese herbs. The results indicated that the three different treatments had statistical significance for the prognosis. But the study was retrospective and the number of cases of this study is limited; it is worth further study the relationship between pretreatment and prognosis.

#### 4.1 Limitations

As the details of pre-hospital treatment and treatment outcome was not acquired enough, so the future study should continue to do a thorough analysis on that.

## 5. CONCLUSION

Our study showed that the number of the patient bitten by snake increased, however, the case fatality rate gradually decreased year by year during the investigating period. The vulnerable population of snake-bite in Zunyi is male, farmer, 41-50 years old. Target preventive measures should be conducted in these high risk populations, especially in spring and summer.

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## AUTHORS' CONTRIBUTION

HY with the assistance of HZ, MQ, YJ and XQ, performed the study design, data collection and analysis. All authors discussed the results and commented on the manuscript at every stage. HY contributed to the manuscript's writing and revision.

## CONFLICTS OF INTEREST DISCLOSURE

The authors declare no conflict of interest.

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