

# Epidemiological Characteristics and Disease Burden of Burns in Children in Northern Guizhou, China

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To the Editor: Burn is a type of injury that is common to children and is likely to endanger the child's lifelong health, reduce the family's well-being, and increase the social burden of disease and economic losses. A 2017 report by the World Health Organization indicated that an estimated 180,000 deaths every year were caused by burns, which occurred especially in low- and middle-income countries.<sup>[1]</sup> In developing countries, such as China, the hospitalization costs for pediatric burn patients have increased rapidly in recent years.<sup>[2]</sup> In addition, serious sequelae of burns such as cicatricial contracture cause dysfunction or disability and growth disturbances and affect the quality of life of children and their families. Multiple surgeries for dealing with burn scars lead to long length of hospital stay (LOS) and also cause children to be absent from school and reduce the working hours of parents.

The northern Guizhou Province is located in a remote area of southwest China at a high altitude. Although the winters are very cold and long, the homes have no central heating system. Because of the poor economy and cultural habit, people warm themselves in winter and spring by using coal stoves and hot water. Many parents work far away from home, and their children are mostly taken care of by grandparents who are only able to offer poor supervision.

To the best of our knowledge, few epidemiological studies have investigated hospitalized children with burns in Guizhou province. In this study, we analyzed the clinical data for children with burns who were admitted to the Affiliated Hospital of Zunyi Medical University. We aimed to detail the epidemiological characteristics and the burden of disease for children with burn and the possible factors affecting LOS and hospitalization cost to provide an approach for effective measures to prevent and manage pediatric burns.

Using the International Classification of Diseases-10, Chinese version, codes T20–T31, we retrieved data for hospitalized children with burns who were ≤18 years old from the medical records for burn patients hospitalized in the Affiliated Hospital of Zunyi Medical University from January 2014 to August 2016. We gathered data on general characteristics, the clinical situation of burns, and first aid after burns. Incomplete data were obtained by a follow-up call to parents. This study was approved by the Institutional Review

Board of the Affiliated Hospital of Zunyi Medical University and Zunyi Medical University (No. [2015]1-003).

Epidata 3.0 (EpiData Association, <http://www.epidata.dk/>, Denmark) was used to build the database. Chi-square test was used to compare differences in categorical data, and the rank sum test and generalized estimating equation (GEE) were used to analyze the factors affecting hospitalized cost and LOS. All statistical analyses were performed using the SPSS 18.0 (IBM Corp., Armonk, NY, USA). All tests were two-sided, with  $P < 0.05$  considered statistically significant.

This report investigated 465 children with burns (287 males; 61.7%), among whom 195 (41.9%) children were admitted to hospital in winter and 121 (26.0%) in spring and 330 (71.0%) children came from rural areas, 68 (14.6%) from cities, and 67 (14.4%) from small towns. The largest proportion of children was Han Chinese: 438/465 (94.2%). On examining the wounded part of burns with external treatment, 33/465 (7.1%) children had received traditional Chinese medicine and 17/465 (3.7%) toothpaste or egg white. The burn areas were distributed in multiple sites; the most vulnerable site was the trunk (322/465 children; 69.2%).

Hot liquid was the main etiology of burn in all age groups. The highest incidence of burns was in children 1–3 years old, and the difference was statistically significant for burns between age 1 and 3 years and other age groups ( $P < 0.001$ ). The incidence of burns was highest in winter, and the difference among the seasons was statistically significant ( $P < 0.001$ ). The activities when burns occurred showed that hot liquid was the main etiology for various activities. The main difference among the children's activities was statistically significant ( $P < 0.001$ ). The correlation between the

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burn location and burn mechanism showed that burns at home were mainly caused by hot liquid whereas burns in public places were mainly due to fire-related risk, and the difference was statistically significant ( $P < 0.001$ ). The trunk and lower limbs were easily burned by hot fluid, and the head-and-neck and upper limbs were easily burned by the flame. The upper limbs were high incidence sites of other etiologies. The difference was statistically significant ( $P < 0.001$ ). Superficial partial thickness and deep partial thickness were usually caused by hot-fluid, and the degree of burn caused by flame was deeper than that caused by hot fluid. The degree of burn caused by other etiologies was full thickness, and the difference was statistically significant ( $P < 0.001$ ). Although total body surface area (TBSA) caused by all burnt etiologies were  $<10\%$ , the difference was statistically significant ( $P = 0.021$ ).

The mean LOS in this study was 12.90 days. On univariate analysis, residence, TBSA, surgery, complications, fall injury, and outcome affected LOS. On GEE analysis, TBSA, surgery, and outcome affected LOS, and the partial regression coefficient for TBSA was 5.26, surgery 33.75, and outcome 2.08 [Table 1].

The average hospitalization cost was 1653 US dollars. On univariate analysis, age, TBSA, etiology, surgery, complications, and inhalation injury but not sex significantly affected hospitalization cost. GEE analysis showed that TBSA and surgery affected hospitalization cost, and the partial regression coefficients were 2348.98 and 6146.19, respectively [Table 1].

In the Zunyi area, Southwest China, the top incidence of burns in children was in winter, followed by spring. This possibly relates to the low temperature in winter and spring without central heating

systems in homes, and residents depend on coal stoves and hot water for heating. Moreover, the local residents have the custom of mixing very hot water with cold water, so children are more likely to be burned.

In this report, the ratio of males to females with burn was 1.6:1. Previously, the incidence of burns was also reported to be 1.5 times higher in females than in male.<sup>[3]</sup> Hence, we should focus on all children and provide safety education for them. In addition, rural children more frequently had burns than did children in cities and towns, which may be explained by the poor living environment in rural areas. As well, many rural adults go far away from home to work, and their children are attended by grandparents with low education and little knowledge of burn prevention.

The most effective treatment after burn is cold-water flushing for 10–30 min, with proper bandaging; however, no external medicines are recommended.<sup>[4]</sup> In our study, 13.3% of children received treatment with anti-infective drugs, Chinese medicine, toothpaste, egg white, and even lard and/or other mixtures to smear on the wound. Early treatment with Chinese medicine is mostly irregular. These applications deepen the wound and also hamper the evaluation and treatment of the wound. Although the sites of burns were distributed in multiple areas, the most common site was the trunk, followed by the lower limbs. Our result is slightly different from those of the previous studies reporting that upper limbs were especially prone to burn. Thus, no specific site is more commonly burnt.

Hot liquid was the main etiology in this research. Children aged 1–3 years had the highest incidence of burn. Such children have a

**Table 1: Results of the generalized estimating equation model for LOS and hospitalization costs in children with burns**

Items	LOS (days)					
	Median	IQR	B	SE	Wald $\chi^2$	P
TBSA						
<10%	7.00	4.00–12.00	5.262	1.25	17.79	<0.001
10–29%	13.00	8.00–21.00				
≥30%	39.00	16.25–46.25				
Surgery						
Yes	40.00	33.75–60.25	33.752	4.49	56.39	<0.001
No	7.00	4.00–13.00				
Outcome						
Recovery	5.00	3.00–7.00	2.075	0.97	4.56	0.033
Scar or physical disability	9.00	5.00–16.00				
Death	2.00	1.00–2.00				
Items	Hospitalized cost (US dollars)					
	Median	IQR	B	SE	Wald $\chi^2$	P
TBSA						
<10%	508.48	315.30–878.94	2348.98	588.12	38.51	<0.001
10–29%	1589.50	819.09–2756.86				
≥30%	8950.75	6426.36–11,340.61				
Surgery						
Yes	6794.47	3123.22–10,309.85	6146.19	1338.96	24.27	<0.001
No	590.30	355.72–1169.20				
Outcome						
Recovery	341.01	204.20–511.74	−90.87	333.09	0.074	0.785
Scar or physical disability	734.57	406.92–1651.96				
Death	528.70	145.80–3370.72				

LOS: Length of hospital stay; IQR: Interquartile range; B: Nonstandard coefficients; SE: Standard error; TBSA: Total body surface area.

high range of activities and are eager to explore the unknown world; however, they do not have the ability for self-protection. Hot liquid is easily obtained, such as cooking and drinking boiled water, and hot water for bathing, which puts them at high risk.

This report showed that different locations had different mechanisms of burns; at home, it was mainly hot liquid whereas burns in public were mainly fire related. Therefore, parents' safety education about burns for children must be strengthened to develop good habits, such as testing temperature before bathing, putting a hot-water switch in places where children cannot touch, placing hot soup away from children when they are eating, and supervising children when they do housework in kitchen.

The average LOS was 12.9 days. LOS was longer for rural children than those in cities and towns. Treatment of primary hospitals may not be effective; and the wound may become worse and complicated. Fall injuries commonly occur in patients with electrical injury, and these burn patients often have accompanying bone damage, which prolongs their LOS. However, our GEE analysis showed that fall injuries did not prolong the LOS, and the condition of the burn was the factor affecting LOS. Shorter LOS often corresponded with the degree of burn, TBSA, wound-smearing drugs, and clean-up time. The skin damage is more serious; hence, treatment time is relatively long. Severe burns (mainly due to fire-related accidents and electric shock) could lead to multiple organ dysfunction even death and had the shortest average LOS than other burns.

The average hospitalization cost was 1653 US dollars. The cost of burns increased with children's age when they were <6 years old and might be related to the degree of attention from their parents. Younger children are sent to a high-level hospital even though their burns are mild. Moreover, with increasing age, children's self-activity range increases, and a relative decline of parental supervision will lead to serious burns. Hospitalization costs for children aged 6–14 were lower than those for children under 6 years old. The main reason is that children in this older age range are at school, and they have less chance of exposure to a heat source. Moreover, they have learned some basic knowledge of burns at school. Children 14–18 years old had the highest hospitalization costs; most of these children have wide-area burns or electrical injury and some need surgical treatment because the wound is easily infected; the costs of medicine and nursing also increase.

TBSA and surgery were the significant factors affecting LOS and hospitalization costs. Ahn and Maitz<sup>[5]</sup> showed that TBSA was the most basic factor affecting the hospitalization cost for burns. TBSA affects the costs of hospitalization and also LOS. Greater TBSA (longer time needed for epithelial regeneration) and longer LOS add to costs. In addition, the treatment of large wounds requires more drugs and dressings, and the cost of nursing is higher with large than small wounds. Pediatric burn patients and their guardians are less receptive to autologous skin grafting or amputation; most prefer to adopt conservative treatment. They

choose surgery only when the wound healing is not good, which puts off the surgery for a long time, and hence, the cost is higher during this period because the postoperative recuperation time is longer.

This investigation was limited to our hospitalized patients and did not include multihospital patients and outpatients (such as patients from the emergency department). In the future, multicenter and multilevel hospital studies may be done to better reflect the overall characteristics and the burden of diseases in children with burn in northern Guizhou.

The government should popularize knowledge of burns, raise guardians' awareness to provide close supervision, and improve children's knowledge of first aid of burns. It should increase financial support so that burn patients receive better treatments and physicians receive rehabilitation training to lower the economic and disease burden and improve the prognosis of burns.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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