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Epidemiological characteristics analysis of pediatric burn patients in China from 2016 to 2019: A retrospective large-scale and multi-center study of 6741 cases

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Epidemiological characteristics analysis of pediatric burn patients in China from 2016 to 2019: A retrospective large-scale and multi-center study of 6741 cases

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Running title: Epidemiological characteristics analysis of pediatric burn patients in China

Abstract

Background: Epidemiological characteristics of pediatric burn can help to protect children from burn injuries. Most of previous studies have been conducted on small-scale and single-center in China. This study analyzed the epidemiological characteristics of pediatric burn using a large-scale and multi-center database from 23 children's hospitals in China to increase child protection against burn injuries, improve the quality of care, and reduce hospitalization costs.

Methods: Excerpted information from medical records of 6741 pediatric burn cases were extracted from the Futang Research Center of Pediatric Development (FRCPD) database from 2016 to 2019. The epidemiological characteristics of patients, including gender, age, cause of burn injury, complications, the timing of hospitalization (season and month), and hospitalization length and cost, were collected.

Results: Male gender (63.23%), aged 1-2 years (69.95%), and hydrothermal scald (80.57%) were significantly dominant among cases. Furthermore, complications were significantly associated with the age of patients. Pneumonia was the most common (21%) complication. Meanwhile, most pediatric burn injuries occurred in spring (26.73%), and hospitalization days and expenses significantly depended on the cause of the burn and surgical intervention.

Conclusions: This large-scale epidemiological study of pediatric burn in China revealed that 1-2-year-old boys with higher activity and lack of self-awareness are more likely to suffer from burn injuries by hydrothermal scald. In addition, complications, especially pneumonia need attention and early prevention in pediatric burn.

Keywords: Epidemiological characteristics analysis; pediatric burn patients; large-scale; multi-center

What is already known on this topic:

1. Burn injuries are the major common type of accidental injuries in children, which brings heavy economic and psychological burdens for families and society
2. As a country with a large population of children, China does not have adequate data analysis of the epidemiology of pediatric burns.
3. The most epidemiological characteristics analysis of pediatric burn patients is reported as small-scale and single-center studies.

What this study adds:

1. Our research analyzed the medical records of pediatric burn patients from large-scale and multi-center database hospitalized in 23 Chinese provincial and municipal medical institutions.
2. After summarized the complications and comorbidities (CC) of pediatric burn patients, we firstly studied the CC distribution of pediatric burn patients in different age groups.
3. In particular, we analyzed various factors influencing hospitalization time and cost.

Background

Burn injuries are the major type of accidental injuries in children globally [1], with heavy economic and psychological burdens for families and society [2, 3]. The children suffering from burn injury in Asia account for more than half of pediatric burn cases worldwide, most of whom require hospitalization [4, 5]. However, as a country with a huge number of children, China does not have adequate epidemiological information about the pediatric burn. Most of previous epidemiological reports on pediatric burn have been small-scale studies [6, 7]. A large-scale and multi-center study can provide much more accurate information about pediatric burn, which can be used to promote care quality in pediatric burn. Therefore, it is necessary to retrospectively analyze the epidemiological characteristics of pediatric burn in a large-scale and multi-center study.

The Futang Research Center of Pediatric Development (FRCPD) is a large medical consortium and a non-profit social service organization in China, greatly promoting research in the pediatric field [8]. The FRCPD covers almost one-third of children's hospitals in China. In our prior studies, we reported that exposure to hot materials is the fifth cause of morbidity and mortality by analyzing 122,284 medical records in the FRCPD database [9]. Using the FRCPD database in this study, we retrospectively analyzed the epidemiological characteristics of pediatric burn in a large-scale and multi-center study.

Herein, we collected the medical records of 6741 pediatric burn cases from 23 Chinese provincial and municipal medical institutions in the FRCPD database. Excerpt epidemiological data from the medical records were retrieved and analyzed. This large-

scale, multi-center study can describe the epidemiological characteristics of pediatric burn in China, which can increase child protection against burn injuries, improve the quality of care, and reduce hospitalization costs.

Methods

Data collection and inclusion criteria

In our study, 4,350,470 medical records were retrospectively investigated from the FRCPD database, and 6741 pediatric burn cases were extracted from January 1, 2016, to December 31, 2019 (Figure 1). The following patients were included: (a) ICD-10 code (the 10th revision of the international classification of diseases): “T20-T32 (no T26), T75”, “X00-X19 (no X06, X07, X14)”, and “W85-87, W94, W99”; (b) Only the first hospitalization of burn children was included.

The epidemiological characteristics of patients, including gender, age, cause of burn injury, complications, the timing of hospitalization (season and month), and hospitalization length and cost, were collected.

Based on their age, the patients were divided into four categories: < 1-year-old (infants), 1-2-year-old (toddlers), 3-5-year-old (preschoolers), and 6-15-year-old (schoolchildren). In addition, the cause of burn was grouped into six categories based on the ICD-10 codes: hydrothermal scald (X10-19), flame (W34, W36, W38-40, W92, Y25, Y27, X00, X02, X04-06, X08, X09, X97), electric (W85-87, X33), chemical (X29, X44, X46, X47, X49, X69, Y19, Y41, Y43, Y45, Y46, Y50, Y54, Y55, Y57, Y63), others (except for above four causes) and unknown (not described).

Fifteen common complications in pediatric burn patients were also collected, such as pneumonia, shock, and electrolyte disturbance (the detailed classification is shown in supplementary materials). According to the hospitalization season, we divided hospitalization timing into spring (March to May), summer (June to August), autumn (September to November), and winter (December to February) groups.

Statistical analysis

Categorical variables, including gender, age, cause of burn injuries, complications, and the timing of hospitalization, were compared using chi-square tests and are expressed as numbers (N) and percentages (%). Continuous variables, including hospitalization length (days) and costs, were compared using the Kruskal–Wallis tests and are expressed as median and interquartile ranges. Post-hoc tests were conducted using the Steel-Dwass method. $P < 0.05$ was considered statistically significant. Statistical analyses were performed using JMP Pro 15 software.

Results

Gender and age of patients

A total of 6741 medical records were collected. Males accounted for 63.23%, and females accounted for 36.77% (Table 1), with a male-female ratio of 1.72:1. Our results showed that males were markedly more than females in all age groups and cause of burn injuries groups (Figure 2A and Table 2, $p = 0.048$ or $p = 0.013$, respectively).

The age of patients ranged from 1 day to 15 years. As shown in Table 1, 1-2 years old patients were dominant (69.95%), while < 1 -year-old patients had the prevalence

(5.43%).

Cause of pediatric burn

Among the 6741 hospitalized cases (Table 1), the most common cause of burn injury was hydrothermal scald (80.57%), followed by flame (3.06%), electricity (1.26%), chemicals (1.25%), others (1.48%), and unknown (12.39%). As shown in Table 3, the percentage of burn caused by hydrothermal scald was over 50% in different age groups, especially in 1-2-year-old children (85.24%). Thus, the cause distribution was related to the age of the patients ($p < 0.001$, Table 3). Moreover, we have drawn the population pyramid for the age-gender distribution of pediatric burn patients with different causes of burn injuries (Figure 2B).

The complications of pediatric burn

The complications of burn injury had a great impact on disease prognosis, and many patients suffered from more than one complication. The fifteen most common complications were summarized in Figure 3. Pneumonia (21%), shock (17%), and electrolyte disturbance (13%) were the top 3 complications of pediatric burn. In addition, Table 4 reveals that the age of patients was significantly associated with electrolyte disturbance ($p = 0.003$), cardiovascular complications ($p = 0.017$), hypoproteinemia ($p = 0.014$), intestinal infection ($p = 0.002$), aspiration injury ($p < 0.001$), hepatic complications ($p = 0.047$), and renal complications ($p < 0.001$).

The timing, length, and cost of pediatric burn in different ages, cause of burn injuries, and surgical intervention groups

Regarding the hospitalization season, our study found that children were mostly admitted to the hospital during spring (26.73%), summer (25.69%), autumn (22.10%), and winter (25.47%), respectively. In particular, the number of pediatric burn patients was minimum in November (7.24%) and maximum in May (9.24%, Figure 4). In the present study, the hospitalization season distribution was significantly correlated with the cause of burn injury ($p < 0.001$, Table 5). Furthermore, the incidence of burn injury caused by hydrothermal scald was maximum in spring (26.90%), while the flame was more in summer (39.32%), the electric burn was in winter (44.71%), and chemical burn in autumn (32.14%).

The median hospitalization length was 8 days for pediatric burn in this study. There were no significant differences in age groups ($p = 0.065$, Table 6). Interestingly, our results showed that the hospitalization days significantly differed based on the cause of burn injury ($p < 0.001$, Table 6). The length of hospitalization was the longest in patients burned by flame (the average was ten days). In addition, surgical intervention significantly increased the length of hospital stay, and the median hospitalization days was 15 days among those who underwent surgery ($p < 0.001$, Table 6).

The hospitalization expenses were considered the total expenses of inpatients, including treatment, medications, materials, lab tests, nursing care, and additional expenses. Table 6 revealed that the hospitalization expenses were significantly associated with age ($p = 0.003$), cause of burn ($p < 0.001$), and surgical intervention ($p < 0.001$) among all 6471 cases. The hospitalization expenses were highest in pediatric inpatients with < 1 year old or burns caused by flame.

Discussion

In the current study, we found that among pediatric burn patients, male gender, 1-2 years of age, and hydrothermal scald were more common. Pneumonia was the most common complication in pediatric burn, and the age of patients was significantly associated with burn complications, including electrolyte disturbance, cardiac complications, hypoproteinemia, intestinal infection, aspiration injury, hepatic complications, and renal complications. The number of pediatric burn patients increased in spring, and the median hospitalization length was eight days. Furthermore, the hospitalization length significantly differed according to surgical intervention and cause of burn. The hospitalization expenses were significant association with age, surgical intervention, and cause of burn.

Gender and age

Gender and age are significant risk factors for burn injuries. In most developing countries, burn injuries are more common among adult females due to cooking and heating fuels. In contrast, in developed countries, burn injuries are more common among adult males due to industrial accidents [10]. Previous reports revealed that boys are more susceptible to burn injuries because of impulsivity, curiosity, hyperactivity, and lack of self-awareness [11, 12, 13]. Consistent with these reports, the incidence of burn injuries was much higher in males than females in this study. Furthermore, the number of males who experienced burn injury was much higher than that of females in different age and cause of burn groups.

Pediatric burn primarily occurred in children younger than five years old [14], and our data also showed that 1-2-year-old children were more susceptible. Moreover, accidental burns were less common in infants (<1 year old) who did not walk, preschoolers (3-5-year-old), and school children (6-15-year-old) who recognized the danger. Thus, it is essential to remind and educate caretakers, especially toddler (1-2-year-old) caretakers, about burn prevention [15]. Notably, we cannot assume that 15-18-year-old children do not suffer from burn injuries, because children over 14 years are often admitted to adult hospitals in China.

Cause of burn injury

Children are susceptible to burn injuries, especially to hydrothermal scald. Various types of burn are related to eating or bathing habits, clothes, and environmental temperature. Toddlers are often burned during bathing and eating. For instance, they are usually burned by boiling water, hot soup, and hot milk [16], whereas burn injuries in young adults are often related to flame or electrical injuries [17, 18]. In our study, 1-2-year-old children are mainly burned by hydrothermal scald, and 6-15-year-old schoolchildren are more likely burned by flames. Therefore, the necessary preventive measures, such as testing the water temperature before bathing, could protect children from burns caused by hydrothermal scalds. In addition, the mental health of adolescents needs serious attention, although only three 6-15-year-old boys with burn injuries caused by intentional self-injury were identified among our cases.

Complications

Burn-related complications, such as abdominal compartment syndrome, acute respiratory distress syndrome (ARDS), septic shock, acute kidney injury (AKI), and pneumonia, were the leading causes of mortality in pediatric burn [19]. Compared with burns in adults, burns in children less than four years of age were easily complicated due to weak skin barriers [20]. Furthermore, severe burn injuries led to organ damage/failure in children [21]. Heat damage and irritants lead to the release of inflammatory mediators in the upper respiratory tract and increased vascular permeability leading to edema [22]. In our study, pneumonia was the most common complication of burn. Thus, supportive treatment for respiratory failure should be considered to attenuate the inflammatory process. Loss of circulating blood results in hypovolemic shock, peripheral edema, multiorgan failure, and even death [23]. Children are more susceptible to burn shock than adults due to lower circulating blood volume. Therefore, effective anti-inflammatory agents and resuscitation are needed to alleviate pneumonia and hypovolemia and prevent hypovolemic shock and organ failure.

Hospitalization timing, cost, and length

The seasonal variation, rather than the yearly variation, seems more statistically valuable in burn. Summer was the peak of severe burn patients admitted to the eight public hospitals [20]. Nevertheless, our study verified that the number of pediatric burn patients was higher in the spring and May. Most likely, the cold weather limits children's outdoor activities. Hydrothermal solutions and electric sockets are more accessible during indoor activities of children. Inversely, hydrothermal scald injuries

are milder when children wear thick clothing, which may partly explain why November had the lowest number of pediatric burn hospitalization.

Besides, a previous study showed that hospitalization length is related to the extent of body surface area [23]. Moreover, a study found that the median hospitalization length of burn patients increased to 14 days due to severe injury and prolonged rehabilitation [20]. The median hospitalization length was eight days in this study. Furthermore, the hospitalization length was correlated with the cause of burn and surgical intervention. Pediatric burn caused by flame or surgery may increase median hospitalization length. Hospitalization expenses were significantly associated with age, surgical intervention, and cause of burn. A study found that medications, particularly antibiotics, were the leading cause of hospitalization costs in pediatric burn [4]. Similarly, treatment and medications were the main costs in this study, and hospitalization expenses significantly increased in patients <1 year old or undergoing surgery. Our results also confirmed that hospitalization length and expenses of pediatric burn were higher when burn was caused by flame. Therefore, it is essential to reduce the incidence of flame injuries, considering the hospitalization length and expenses of pediatric burn. Active intervention for flame burns, shortening the interval between two surgeries, and increasing the treatment area of a single surgery may reduce the length of hospital stay.

Conclusion

Burn injuries are devastating in children, often leading to lifelong physical and psychological impairments. Thanks to the FRCPD database, this large-scale and multi-center study from 2016 to 2019 revealed the epidemiological characteristics of pediatric

burn. Overactive 1-2-year-old boys who lack self-awareness are more likely to suffer from burn, and parents should pay more attention to preventing hydrothermal scald. Pneumonia was the most common complication of burn, which needs more attention and early prevention. Herein, we recommended some measures to protect children from burn injuries, improve treatment, and reduce hospitalization costs in pediatric burn. We have planned to collect more data such as body surface area (TBSA) and severity degree of burn injury from the medical records.

Declarations

Our screening process was followed by the approval of Ethic Committee in Beijing Children's Hospital. Ethical approval: All patient records were pseudonymised by the data providers through encryption of personal identifiers. Ethical approval to hold and analyse the data set was obtained from the Ethics Committee of Beijing Children's Hospital, Capital Medical University (Approval Number: 2020-k-10).

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Authors' contributions

The authors' contributions were as follows. YG and XN contributed to the conception and design of the study. KC, JL, XW contributed to acquisition, analysis and

interpretation of the data. KC, JL wrote the MS. PC, GF, YZ, XX revised the MS. All authors read and approved the final manuscript.

Competing interests

The authors have no conflicting interest associated with this manuscript.

Figure legends

Figure 1 The flow diagram of the database search.

Figure 2 (A) Gender distribution of pediatric burn patients in different age or cause groups. (B) Population pyramid graph for the age-gender distribution of pediatric burn patients with different cause of burn injuries.

Figure 3 The proportion of common complications and comorbidities in pediatric burn patients.

Figure 4 The hospitalization month distribution of pediatric burn patients in different age groups.

Table 1 The baseline characteristics of included pediatric burn patients.

Table 2 Gender distribution of pediatric burn patients in different age and cause of burn injuries groups.

Table 3 Cause distribution of pediatric burn patients in different age groups.

Table 4 The complication and comorbidity distribution of pediatric burn patients in different age groups.

Table 5 Hospitalization season distribution of pediatric burn patients in different cause

of burn injuries groups.

Table 6 The hospitalization days and expenses of pediatric burn patients in different age, cause of burn injuries and surgical intervention groups.

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The detailed classification of the complications in pediatric inpatients with burn injuries:

- (1) Pneumonia: whooping cough, lung infection, mycoplasma pneumonia, community-acquired pneumonia, severe pneumonia.
- (2) Shock: hypovolemic shock, hemorrhagic shock, traumatic shock, septic shock, lightning shock, toxic shock.
- (3) Electrolyte disturbance: low sodium, high sodium, low potassium, high potassium, low chloride, high chlorine, low calcium, high calcium, metabolic acidosis, dehydration.
- (4) Septicopyemia: sepsis, bacteremia.
- (5) Cardiac diseases: myocardial damage, myocardial strain, heart failure.
- (6) Hypoproteinemia: albumin abnormality.
- (7) Intestinal infection: Diarrhea, enteritis, bacterial intestinal infection, rotavirus enteritis;
- (8) Convulsion: febrile convulsions, seizure.
- (9) Aspiration injury;
- (10) Alimentary tract hemorrhage; stress ulcer
- (11) Liver diseases: abnormal liver function, liver insufficiency, liver injury, liver failure, hepatic coma.
- (12) Renal diseases: Renal insufficiency, renal failure, tubular necrosis;
- (13) Multiple organ dysfunction: multiple organ failure; multiple organ dysfunction

syndrome

(14) Successful resuscitation from cardiac arrest;

(15) Systemic inflammatory response syndrome.

Sup Table 1 Age distribution of pediatric burn patients in different hospitalization month.

Month	Total (N, percent)	<1 years old	1-2 years old	3-5 years old	6-15 years old
January	596, 8.84%	41	380	129	46
February	522, 7.74%	15	315	128	64
March	588, 8.72%	7	405	131	45
April	589, 8.74%	8	441	108	32
May	623, 9.24%	13	458	111	41
June	602, 8.93%	11	458	94	39
July	587, 8.71%	15	431	91	50
August	560, 8.31%	26	403	79	52
September	541, 8.03%	26	408	75	32
October	505, 7.49%	48	356	69	32
November	488, 7.24%	71	320	68	29
December	540, 8.01%	85	340	75	40

Table 1 The baseline characteristics of included pediatric burn patients.

Pediatric inpatients		
Characteristics	(N)	Percent
Gender		
Male	4262	63.23%
Female	2479	36.77%
Age		
<1 years old	366	5.43%
1-2 years old	4715	69.95%
3-5 years old	1158	17.18%
6-15 years old	502	7.45%
Cause of burn injuries		
Hydrothermal scald	5431	80.57%
Flame	206	3.06%
Electric	85	1.26%
Chemical	84	1.25%
Others	100	1.48%
Unknown	835	12.39%
Surgical intervention		
yes	1090	16.17%
no	5651	83.83%

Table 2 Gender distribution of pediatric burn patients in different age and cause of burn injuries groups.

		N	Male (n, row percent)	Female (n, row percent)	χ^2	P
Age					7.905	0.048
	<1 years old	366	211, 57.65%	155, 42.35%		
	1-2 years old	4715	2992, 63.46%	1723, 36.54%		
	3-5 years old	1158	724, 62.52%	434, 37.48%		
	6-15 years old	502	335, 66.73%	167, 33.27%		
Cause of burn injuries					14.544	0.013
	Hydrothermal scald	5431	3399, 62.59%	2032, 37.41%		
	Flame	206	137, 66.50%	69, 33.50%		
	Electric	85	69, 81.18%	16, 18.82%		
	Chemical	84	53, 63.10%	31, 36.90%		
	Others	100	66, 66.00%	34, 34.00%		
	Unknown	835	538, 64.43%	297, 35.57%		

Table 3 Cause distribution of pediatric burn patients in different age groups.

		N	<1 years old (n, column percent)	1-2 years old (n, column percent)	3-5 years old (n, column percent)	6-15 years old (n, column percent)	χ^2	P
Cause of burn injuries							665.049	<0.001

Hydrothermal scald	5431	254, 69.40%	4019, 85.24%	882, 76.17%	276, 54.98%
Flame	206	8, 2.19%	62, 1.31%	46, 3.97%	90, 17.93%
Electric	85	1, 0.27%	31, 0.66%	28, 2.42%	25, 4.98%
Chemical	84	3, 0.82%	49, 1.04%	17, 1.47%	15, 2.99%
Others	100	8, 2.19%	55, 1.17%	18, 1.55%	19, 3.78%
Unknown	835	92, 25.14%	499, 10.58%	167, 14.42%	77, 15.34%

Table 4 The complication and comorbidity distribution of pediatric inpatients in different age groups.

Complication and comorbidity	N	Yes or no	<1 years old (n, row percent)	1-2 years old (n, row percent)	3-5 years old (n, row percent)	6-15 years old (n, row percent)	χ^2	P
Pneumonia	222	1	16, 7.21%	151, 68.02%	35, 15.76%	20, 9.01%	2.477	0.480
	6519	0	350, 5.37%	4564, 70.01%	1123, 17.23%	482, 7.39%		
Shock	176	1	12, 6.82%	125, 71.02%	29, 16.48%	10, 5.68%	1.480	0.687
	6565	0	354, 5.39%	4590, 69.92%	1129, 17.20%	492, 7.49%		
Electrolyte disturbance	134	1	15, 11.19%	83, 61.94%	20, 14.93%	16, 11.94%	13.731	0.003
	6607	0	351, 5.31%	4632, 70.11%	1138, 17.22%	486, 7.36%		
Septicopyemia	122	1	13, 10.66%	79, 64.75%	22, 18.03%	8, 6.56%	6.914	0.075
	6619	0	353, 5.34%	4636, 70.04%	1136, 17.16%	494, 7.46%		
Cardiac diseases	117	1	7, 5.98%	70, 59.83%	23, 19.66%	17, 14.53%	10.257	0.017
	6624	0	359, 5.42%	4645, 70.12%	1135, 17.14%	485, 7.32%		
Hypoproteinemia	82	1	10, 12.20%	49, 59.75%	19, 23.17%	4, 4.88%	10.701	0.014
	6659	0	356, 5.35%	4666, 70.07%	1139, 17.10%	498, 7.48%		
Intestinal infection	68	1	9, 13.24%	53, 77.94%	4, 5.88%	2, 2.94%	15.312	0.002

	6673	0	357, 5.35%	4662, 69.87%	1154, 17.29%	500, 7.49%		
Convulsion	37	1	0, 0.00%	30, 81.08%	5, 13.51%	2, 5.41%	Fisher	0.485
	6704	0	366, 5.46%	4685, 69.88%	1153, 17.20%	500, 7.46%		
Aspiration injury	27	1	3, 11.11%	9, 33.33%	5, 18.52%	10, 37.04%	Fisher	<0.001
	6714	0	363, 5.41%	4706, 70.09%	1153, 17.17%	492, 7.33%		
Alimentary tract hemorrhage and stress ulcer	24	1	1, 4.17%	13, 54.17%	5, 20.83%	5, 20.83%	Fisher	0.083
	6717	0	365, 5.43%	4702, 70.00%	1153, 17.17%	497, 7.40%		
Liver diseases	18	1	4, 22.22%	10, 55.55%	3, 16.67%	1, 5.56%	Fisher	0.047
	6723	0	362, 5.39%	4705, 69.98%	1155, 17.18%	501, 7.45%		
Renal diseases	10	1	1, 10.00%	2, 20.00%	3, 30.00%	4, 40.00%	Fisher	<0.001
	6731	0	365, 5.42%	4713, 70.02%	1155, 17.16%	498, 7.40%		
Multiple organ dysfunction	9	1	0, 0.00%	6, 66.67%	3, 33.33%	0, 0.00%	Fisher	0.629
	6732	0	366, 5.44%	4709, 69.95%	1155, 17.15%	502, 7.46%		
Successful resuscitation from Cardiac arrest	9	1	0, 0.00%	7, 77.78%	2, 22.22%	0, 0.00%	Fisher	0.912
	6732	0	366, 5.44%	4708, 69.93%	1156, 17.17%	502, 7.46%		
Systemic inflammatory response syndrome	8	1	1, 12.50%	7, 87.50%	0, 0.00%	0, 0.00%	Fisher	0.3459
	6733	0	365, 5.42%	4708, 69.92%	1158, 17.20%	502, 7.46%		

Table 5 Hospitalization season distribution of pediatric burn patients in different cause of burn injuries group.

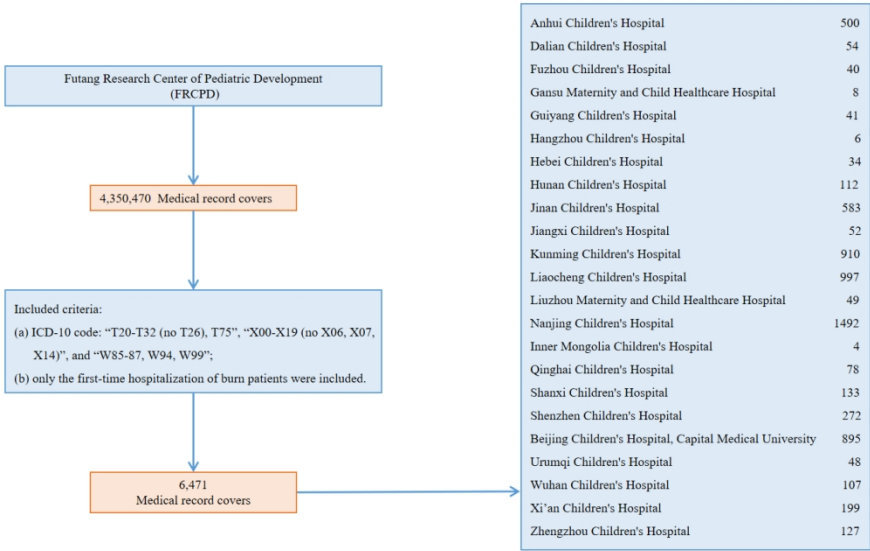
	N	Hydrothermal scald (n, row percent)	Flame (n, row percent)	Electric (n, row percent)	Chemical (n, row percent)	Others (n, row percent)	Unknown (n, row percent)	χ^2	P
Hospitalization season								68.610	<0.001
Spring	1802	1461, 26.90%	47, 22.82%	18, 21.28%	21, 25.00%	22, 22.00%	233, 27.90%		
Summer	1732	1333, 24.54%	81, 39.32%	7, 8.24%	26, 30.95%	30, 30.00%	240, 28.74%		
Autumn	1490	1205, 22.19%	35, 16.99%	22, 25.88%	27, 32.14%	23, 23.00%	178, 21.32%		
Winter	1717	1432, 26.37%	43, 20.87%	38, 44.71%	10, 11.90%	25, 25.00%	184, 22.04%		

Table 6 The hospitalization days and expense of pediatric burn patients in different age, cause of burn injuries and surgical intervention groups.

	N	Hospitalization days	χ^2	P	Hospitalization expense	χ^2	P
Age			7.241	0.065		13.807	0.003
<1 years old	366	9 (5, 16)			8364.905 (4726.540, 15865.008)		
1-2 years old	4715	8 (5, 13)			7651.290 (4340.300, 13849.540)		
3-5 years old	1158	9 (6, 14)			8197.555 (4563.660, 15960.208)		
6-15 years old	502	8 (5, 15)			7604.705 (4308.363, 16412.910)		
Cause of burn			84.825	<0.001		101.697	<0.001

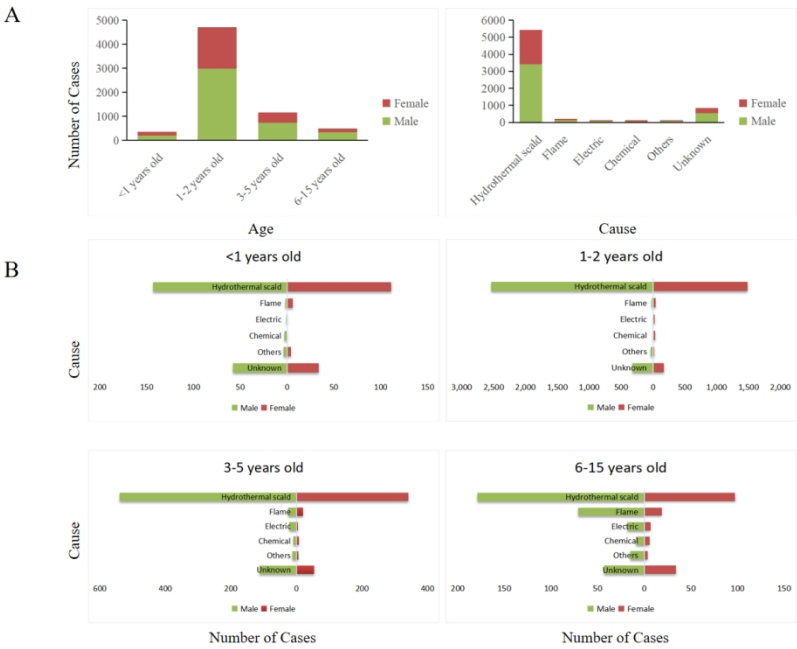
injuries					
Hydrothermal scald	5431	9 (6, 14)		8087.280	
				(4544.11, 14745.15)	
Flame	206	10 (6, 22)		11333.825	
				(5341.2275, 32354.395)	
Electric	85	7 (3, 19)		8295.440	
				(4180.000, 20183.535)	
Chemical	84	6 (3, 15)		7360.185	
				(2867.095, 23227.935)	
Others	100	8 (4, 12)		6683.780	
				(3974.323, 11361.275)	
Unknown	835	7 (5, 11)		5905.230	
				(3829.800, 10576.620)	
Surgical intervention			552.466 <0.001		1375.611 <0.001
yes	1090	15 (9, 26)		24529.945	
				(12745.078, 42988.745)	
no	5651	8 (5, 12)		6647.910	
				(4026.300, 11183.100)	

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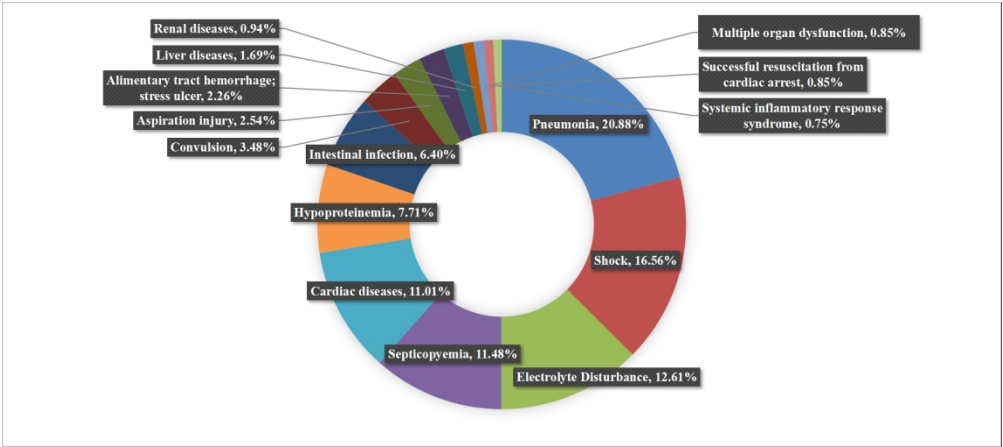


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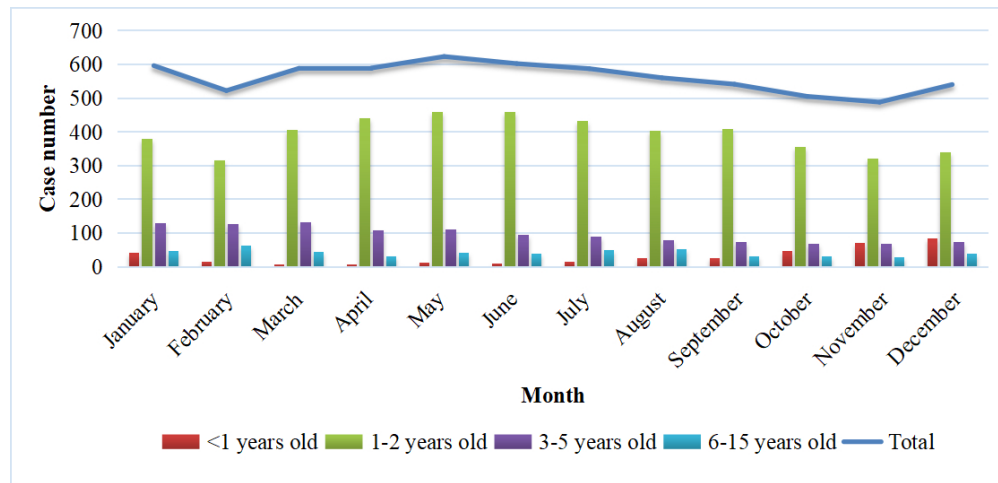
Figure 2



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Epidemiological characteristics of paediatric burn patients in China from 2016 to 2019: A retrospective study

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Running title: Epidemiological characteristics of paediatric burn patients in China

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Abstract

Background: Epidemiological characteristics of pediatric burn can help to protect children from burn injuries. Most of previous studies have been conducted on small-scale and single-center in China. This study analyzed the epidemiological characteristics of pediatric burn using a large-scale and multi-center database from 23 children’s hospitals in China to increase child protection against burn injuries, improve the quality of care, and reduce hospitalization costs.

Methods: Excerpted information from medical records of 6741 paediatric burn cases were extracted from the Futang Research Center of Pediatric Development (FRCPD) database from 2016 to 2019. The epidemiological characteristics of patients, including gender, age, cause of burn injuries, complication, the timing of hospitalization (season and month), and hospitalization length and cost, were collected.

Results: Male gender (63.23%), aged 1-2 years (69.95%), and hydrothermal scald (80.57%) were significantly dominant among cases. Furthermore, complications were significantly different among groups with different age of patients. Pneumonia was the most common complication (21%). Meanwhile, most pediatric burn occurred in spring (26.73%), and hospitalization length and cost significantly depended on the cause of the burn injuries and surgical intervention.

Conclusions: This large-scale epidemiological study of pediatric burn in China revealed that 1-2-year-old boys with higher activity and lack of self-awareness are more likely to suffer from burn injuries by hydrothermal scald. In addition, complications, especially pneumonia need attention and early prevention in pediatric burn.

Keywords: Epidemiological characteristics; paediatric burn patients; large-scale; multi-center

What is already known on this topic:

Burn injuries are the main type of accidental injuries in children and most of the epidemiological studies on this topic in China are small-scale and single-center.

What this study adds:

(1) Scalds were the most frequent cause of burn injuries.

(2) Toddlers aged 1 to 2 years were the most frequently affected group.

(3) Pneumonia was the most frequent complication.

How this study might affect research, practice or policy section:

Education programs for burn prevention targeting families, schools and child-care facilities are an important public health initiative to reduce the burn burden. According to the epidemiological information of pediatric burns, medical centers can devote intensive resources to prepare each patient and provide the best service. More effective evidence-based, individualized programs should be developed to treat pediatric burn with high complication rates.

Background

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1 Burn injuries are the major type of accidental injuries in children globally^[1], with heavy
2 economic and psychological burdens for families and society^[2,3]. The children suffering
3 from burn injuries in Asia account for more than half of paediatric burn cases
4 worldwide, most of whom require hospitalization^[4,5]. However, as a country with a
5 huge number of children, China does not have adequate epidemiological information
6 about the pediatric burn. Most of previous epidemiological reports on pediatric burn
7 have been small-scale studies^[6,7]. A large-scale and multi-center study can provide
8 much more accurate information about pediatric burn, which can be used to promote
9 care quality in pediatric burn. Therefore, it is necessary to retrospectively analyze the
10 epidemiological characteristics of pediatric burn in a large-scale and multi-center study.

11 The Futang Research Center of Pediatric Development (FRCPD) is a large medical
12 consortium and a non-profit social service organization in China, greatly promoting
13 research in the paediatric field^[8]. The FRCPD covers almost one-third of children's
14 hospitals in China. In our prior studies, we reported that exposure to hot materials is the
15 fifth cause of morbidity and mortality by analyzing 122,284 medical records in the
16 FRCPD database^[9]. Using the FRCPD database in this study, we retrospectively
17 analyzed the epidemiological characteristics of pediatric burn in a large-scale and multi-
18 center study.

19 Herein, we collected the medical records of 6741 paediatric burn cases from 23 Chinese
20 provincial and municipal medical institutions in the FRCPD database. Excerpt
21 epidemiological data from the medical records were retrieved and analyzed. This large-
22 scale, multi-center study can describe the epidemiological characteristics of pediatric

burn in China, which can increase child protection against burn injuries, improve the quality of care, and reduce hospitalization costs.

Methods

Data collection and inclusion criteria

In our study, 4,350,470 medical records were retrospectively investigated from the FRCPD database, and 6741 pediatric burn cases were extracted from January 1, 2016, to December 31, 2019 (Figure 1). The following patients were included: (a) ICD-10 code (the 10th revision of the international classification of diseases): “T20-T32 (no T26), T75”, “X00-X19 (no X06, X07, X14)”, and “W85-87, W94, W99”; (b) Only the first hospitalization of burn children was included. The exclusion criteria were as follow: (a) patients aged >18 years who belonged to general hospitals with adult departments. (b) data of children who had unclear demographic characteristics. The epidemiological characteristics of patients, including gender, age, cause of burn injuries, complication, the timing of hospitalization (season and month), and hospitalization length and cost, were collected.

Based on their age, the patients were divided into four categories: < 1-year-old (infants), 1-2-year-old (toddlers), 3-5-year-old (preschoolers), and 6-15-year-old (schoolchildren). In addition, the cause of burns was grouped into six categories based on the ICD-10 codes: hydrothermal scald (X10-19), flame (W34, W36, W38-40, W92, Y25, Y27, X00, X02, X04-06, X08, X09, X97), electric (W85-87, X33), chemical (X29, X44, X46, X47, X49, X69, Y19, Y41, Y43, Y45, Y46, Y50, Y54, Y55, Y57, Y63),

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1 others (except for above four causes) and unknown (not described).
2 Fifteen common complications in paediatric burn patients were also collected, such as
3 pneumonia, shock, and electrolyte disturbance (the detailed classification is shown in
4 supplementary materials). According to the hospitalization season, we divided
5 hospitalization timing into spring (March to May), summer (June to August), autumn
6 (September to November), and winter (December to February) groups.

7 **Patient and Public Involvement**

8 Patients or the public were not involved in the design, or conduct, or reporting, or
9 dissemination plans of our research.

10 **Statistical analysis**

11 Categorical variables, including gender, age, cause of burn injuries, complication, and
12 the timing of hospitalization were expressed as numbers (N) and percentages (%), and
13 were compared among different groups using Pearson chi-square tests or when there
14 were cells whose count was less than 5 and did not satisfy the requirements of Pearson
15 chi-square tests, Fisher's exact tests. Continuous variables included in this study,
16 namely hospitalization length and cost, were both non-normally distributed according
17 to Shapiro-Wilk tests. Therefore, they were expressed as median and interquartile
18 ranges, and compared using Kruskal–Wallis tests. Post-hoc tests were conducted using
19 the Steel-Dwass method. $P < 0.05$ was considered statistically significant. Statistical
20 analyses were performed using JMP Pro 15 software.

21 **Results**

1 Gender and age of patients

2 A total of 6741 medical records were collected. Males accounted for 63.23%, and
3 females accounted for 36.77% (Table 1), with a male-female ratio of 1.72:1. Our results
4 showed that males were markedly more than females in all age groups and cause of
5 burn injuries groups (Figure 2A,B and Sup Table 1, $p = 0.048$ or $p = 0.013$, respectively).
6 The age of patients ranged from 1 day to 15 years. As shown in Table 1, 1-2 years old
7 patients were dominant (69.95%), while < 1-year-old patients had the prevalence
8 (5.43%).

9 Cause of pediatric burn

10 Among the 6741 hospitalized cases (Table 1), the most common cause of burn injuries
11 was hydrothermal scald (80.57%), followed by flame (3.06%), electricity (1.26%),
12 chemicals (1.25%), others (1.48%), and unknown (12.39%). As shown in Sup Table 2,
13 the percentage of burn caused by hydrothermal scald was over 50% in different age
14 groups, especially in 1-2-year-old children (85.24%). Thus, the cause distribution was
15 significantly differed with age of the patients ($p < 0.001$, Sup Table 2). Moreover, we
16 have drawn the mosaic plot for the age distribution of paediatric burn patients with
17 different causes of burn injuries (Figure 2C).

18 The complications of pediatric burn

19 The complications of burn injuries had a great impact on disease prognosis, and many
20 patients suffered from more than one complication. The fifteen most common
21 complications were summarized in Figure 3. Pneumonia (21%), shock (17%), and

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1 electrolyte disturbance (13%) were the top 3 complications of pediatric burn. In
2 addition, Table 2 reveals that the age of patients was significantly different with
3 electrolyte disturbance ($p = 0.003$), cardiovascular complications ($p = 0.017$),
4 hypoproteinemia ($p = 0.014$), intestinal infection ($p = 0.002$), aspiration injury ($p <$
5 0.001), hepatic complications ($p = 0.047$), and renal complications ($p < 0.001$).

6 **The timing, length, and cost of pediatric burn in different age, cause of burn**
7 **injuries, and surgical intervention groups**

8 Regarding the hospitalization season, our study found that children were mostly
9 admitted to the hospital during spring (26.73%), summer (25.69%), autumn (22.10%),
10 and winter (25.47%), respectively. In particular, the number of paediatric burn patients
11 was minimum in November (7.24%) and maximum in May (9.24%, Figure 4 and Sup
12 Table 3). In the present study, the hospitalization season distribution was significantly
13 different among the groups of different cause of burn injuries ($p < 0.001$, Sup Table 4).
14 Furthermore, the incidence of burn injuries caused by hydrothermal scald was
15 maximum in spring (26.90%), while the flame was more in summer (39.32%), the
16 electric burn was in winter (44.71%), and chemical burn in autumn (32.14%).

17 The median hospitalization length was 8 days for pediatric burn in this study. There
18 were no significant differences in age groups ($p = 0.065$, Table 3). Interestingly, our
19 results showed that the hospitalization days significantly differed based on the cause of
20 burn injuries ($p < 0.001$, Table 3). The length of hospitalization was the longest in
21 patients burned by flame (the average was 10 days). In addition, surgical intervention

1 significantly increased the length of hospital stay, and the median hospitalization days
2 was 15 days among those who underwent surgery ($p < 0.001$, Table 3).

3 The hospitalization costs were considered the total expenses of inpatients, including
4 treatment, medications, materials, lab tests, nursing care, and additional expenses.
5 Table 3 revealed that the hospitalization costs were significantly differed with age ($p =$
6 0.003), cause of burn injuries ($p < 0.001$), and surgical intervention ($p < 0.001$) among
7 all 6471 cases. The hospitalization costs were highest in pediatric inpatients with < 1
8 year old or burns caused by flame.

9 **Discussion**

10 In the current study, we found that among paediatric burn patients, male gender, 1-2
11 years of age, and hydrothermal scald were more common. Pneumonia was the most
12 common complication in pediatric burn, and the age of patients was significantly
13 differed with burn complications, including electrolyte disturbance, cardiac
14 complications, hypoproteinemia, intestinal infection, aspiration injury, hepatic
15 complications, and renal complications. The number of paediatric burn patients
16 increased in spring, and the median hospitalization length was 8 days. Furthermore, the
17 hospitalization length significantly differed according to surgical intervention and
18 cause of burn injuries. The hospitalization costs were significant difference with age,
19 surgical intervention, and cause of burn injuries.

20 **Gender and age**

21 Gender and age are significant risk factors for burn injuries. In most developing

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1 countries, burn injuries are more common among adult females due to cooking and
2 heating fuels. In contrast, in developed countries, burn injuries are more common
3 among adult males due to industrial accidents^[1]. Previous reports revealed that boys are
4 more susceptible to burn injuries because of impulsivity, curiosity, hyperactivity, and
5 lack of self-awareness^[10-12]. Consistent with these reports, the incidence of burn injuries
6 was much higher in males than females in this study. Furthermore, the number of males
7 who experienced burn injury was much higher than that of females in different age and
8 cause of burn groups.

9 Pediatric burn primarily occurred in children younger than five years old^[13], and our
10 data also showed that 1-2-year-old children were more susceptible. Moreover,
11 accidental burns were less common in infants (<1 year old) who did not walk,
12 preschoolers (3-5-year-old), and school children (6-15-year-old) who recognized the
13 danger. Given that the age distribution of burned children is wide-ranging, education
14 programs for burn prevention targeting families, schools and child-care facilities are an
15 important public health initiative to reduce the burn burden. For example, it is essential
16 to remind and educate caretakers especially toddler (1-2-year-old) caretakers, about
17 burn prevention^[14]. Notably, we cannot assume that 15-18-year-old children do not
18 suffer from burn injuries, because children over 14 years are often admitted to adult
19 hospitals in China.

20 **Cause of burn injuries**

21 Children are susceptible to burn injuries, especially to hydrothermal scald. Various

1 types of burn are related to eating or bathing habits, clothes, and environmental
2 temperature. Toddlers are often burned during bathing and eating. For instance, they
3 are usually burned by boiling water, hot soup, and hot milk^[15], whereas burn injuries in
4 young adults are often related to flame or electrical injuries^[16,17]. In our study, 1-2-year-
5 old children are mainly burned by hydrothermal scald, and 6-15-year-old
6 schoolchildren are more likely burned by flames. Therefore, the necessary preventive
7 measures, such as keeping hot water bottles out of sight of children, or testing the water
8 temperature before bathing, could protect children from burns caused by hydrothermal
9 scalds. In addition, the mental health of adolescents needs serious attention, although
10 only three 6-15-year-old boys with burn injuries caused by intentional self-injury were
11 identified among our cases.

12 **Complications**

13 In addition, more attention should be paid to complications during hospitalization.
14 Burn-related complications, such as abdominal compartment syndrome, acute
15 respiratory distress syndrome (ARDS), septic shock, acute kidney injury (AKI), and
16 pneumonia, were the leading causes of mortality in pediatric burn^[18]. Compared with
17 burns in adults, burns in children less than four years of age were easily complicated
18 due to weak skin barriers^[19]. Furthermore, severe burn injuries led to organ
19 damage/failure in children^[20]. Among the observation in our study, the most common
20 complications was pneumonia. Heat damage and irritants lead to the release of
21 inflammatory mediators in the upper respiratory tract and increased vascular
22 permeability leading to edema^[21]. Currently, the treatment of respiratory injury

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1 included antibiotics, airway control, and mechanical ventilation. In addition, loss of
2 circulating blood results in hypovolemic shock, peripheral edema, multiorgan failure,
3 and even death^[22]. Children are more susceptible to burn shock than adults due to lower
4 circulating blood volume. According to the epidemiological information of pediatric
5 burns, medical centers can devote intensive resources to prepare each patient and
6 provide the best service. More effective evidence-based, individualized programs
7 should be developed to treat pediatric burn with high complication rates.

8 **Hospitalization timing, length, and cost**

9 The seasonal variation, rather than the yearly variation, seems more statistically
10 valuable in burn injuries. Summer was the peak of severe burn patients admitted to the
11 eight public hospitals^[19]. Nevertheless, our study verified that the number of paediatric
12 burn patients was higher in the spring. Most likely, the cold weather limits children's
13 outdoor activities. Hydrothermal solutions and electric sockets are more accessible
14 during indoor activities of children. Inversely, hydrothermal scald injuries are milder
15 when children wear thick clothing, which may partly explain why November had the
16 lowest number of pediatric burn hospitalization.

17 Besides, a previous study showed that hospitalization length is related to the extent of
18 body surface area^[23]. A study found that the median hospitalization length of burn
19 patients increased to 14 days due to severe injury and prolonged rehabilitation^[19]. The
20 median hospitalization length was eight days in this study. Furthermore, the
21 hospitalization length was significantly different among groups with different cause of

burn and surgical intervention. Pediatric burn caused by flame or surgery may increase median hospitalization length. Hospitalization costs were significantly associated with age, surgical intervention, and cause of burn injuries. A study found that medications, particularly antibiotics, were the leading cause of hospitalization costs in pediatric burn^[4]. Similarly, treatment and medications were the main costs in this study, and hospitalization expenses significantly increased in patients <1 year old or undergoing surgery. Our results also confirmed that hospitalization length and costs of pediatric burn were higher when burn was caused by flame. Therefore, it is essential to reduce the incidence of flame injuries, considering the hospitalization length and expenses of pediatric burn. Active intervention for flame burns, shortening the interval between two surgeries, and increasing the treatment area of a single surgery may reduce the length of hospital stay.

Severity of Burns is very important criteria in all type of burn injuries, ultimately affecting morbidity, mortality, complications, hospital stay, hospital expenses and surgical interventions etc. Unfortunately, severity of Burns (% total body surface area (TBSA) and depth of burn injuries) in all participants weren't analyzed in present study due to incomplete diagnosis of included homepage information. In addition, some children with mild burn injuries received only outpatient treatment, and this might excluded the number of mild burn cases, and influence the distribution of children patients.

Conclusion

Burn injuries are devastating in children, often leading to lifelong physical and

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1 psychological impairments. According to the FRCPD database, this large-scale and
2 multi-center study from 2016 to 2019 revealed the epidemiological characteristics of
3 pediatric burn. Overactive 1-2-year-old boys who lack self-awareness are more likely
4 to suffer from burn, and parents should pay more attention to preventing hydrothermal
5 scald. Pneumonia was the most common complication of burn injuries, which needs
6 more attention and early prevention. Herein, we recommended some measures to
7 protect children from burn injuries, improve treatment, and reduce hospitalization costs
8 in pediatric burn.

9 **Declarations**

10 Our screening process was followed by the approval of Ethic Committee in Beijing
11 Children’s Hospital. Ethical approval: All patient records were pseudonymised by the
12 data providers through encryption of personal identifiers. Ethical approval to hold and
13 analyse the data set was obtained from the Ethics Committee of Beijing Children’s
14 Hospital, Capital Medical University (Approval Number: 2020-k-10).

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18 J200004).

19 **Competing Interests Statement**

20 The authors have no conflicting interest associated with this manuscript.

21 **Contributorship Statement**

22 The authors’ contributions were as follows. YG and XN contributed to the conception

and design of the study. KC, JL, XW contributed to acquisition, analysis and interpretation of the data. KC, JL wrote the MS. PC, GF, YZ, XX revised the MS. All authors read and approved the final manuscript.

Figure legends

Figure 1 The flow diagram of the database search.

Figure 2 The distributions of the hospitalized cases of burn injuries based on the age and gender (A), gender and causes (B) and age and causes (C) of the inpatients, respectively.

Figure 3 The proportion of common complications in pediatric burn patients.

Figure 4 The hospitalization month distribution of pediatric burn patients in different age groups.

Table 1 The baseline characteristics of included pediatric burn patients.

Characteristics	Pediatric inpatients	
	(N)	Percent
Gender		
Male	4262	63.23%
Female	2479	36.77%

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1	Age			
2		<1 years old	366	5.43%
3	2	1-2 years old	4715	69.95%
4		3-5 years old	1158	17.18%
5	3	6-15 years old	502	7.45%
6	Cause of burn injuries			
7		Hydrothermal scald	5431	80.57%
8		Flame	206	3.06%
9	5	Electric	85	1.26%
10		Chemical	84	1.25%
11	6	Others	100	1.48%
12		Unknown	835	12.39%
13	7	Surgical intervention		
14		yes	1090	16.17%
15	8	no	5651	83.83%

Table 2 The complication and comorbidity distribution of pediatric burn patients in different age groups.

Complication and comorbidity	N	Yes or no	<1 years old (n, row percent)	1-2 years old (n, row percent)	3-5 years old (n, row percent)	6-15 years old (n, row percent)	χ^2	P
Pneumonia	222	1	16, 7.21%	151, 68.02%	35, 15.76%	20, 9.01%	2.477	0.480
	6519	0	350, 5.37%	4564, 70.01%	1123, 17.23%	482, 7.39%		
Shock	176	1	12, 6.82%	125, 71.02%	29, 16.48%	10, 5.68%	1.480	0.687
	6565	0	354, 5.39%	4590, 69.92%	1129, 17.20%	492, 7.49%		
Electrolyte disturbance	134	1	15, 11.19%	83, 61.94%	20, 14.93%	16, 11.94%	13.731	0.003
	6607	0	351, 5.31%	4632, 70.11%	1138, 17.22%	486, 7.36%		
Septicopyemia	122	1	13, 10.66%	79, 64.75%	22, 18.03%	8, 6.56%	6.914	0.075

	6619	0	353,	4636,	1136,	494,		
			5.34%	70.04%	17.16%	7.46%		
Cardiac diseases	117	1	7, 5.98%	70, 23, 19.66%	17, 10.257	0.017		
				59.83%	14.53%			
	6624	0	359,	4645,	1135,	485,		
			5.42%	70.12%	17.14%	7.32%		
Hypoproteinemia	82	1	10,	49, 19, 23.17%	4, 4.88%	10.701	0.014	
			12.20%	59.75%				
	6659	0	356,	4666,	1139,	498,		
			5.35%	70.07%	17.10%	7.48%		
Intestinal infection	68	1	9, 13.24%	53,	4, 5.88%	2, 2.94%	15.312	0.002
				77.94%				
	6673	0	357,	4662,	1154,	500,		
			5.35%	69.87%	17.29%	7.49%		
Convulsion	37	1	0, 0.00%	30,	5, 13.51%	2, 5.41%	Fisher	0.485
				81.08%				
	6704	0	366,	4685,	1153,	500,		
			5.46%	69.88%	17.20%	7.46%		
Aspiration injury	27	1	3, 11.11%	9, 33.33%	5, 18.52%	10,	Fisher	<0.001
						37.04%		
	6714	0	363,	4706,	1153,	492,		
			5.41%	70.09%	17.17%	7.33%		
Alimentary tract	24	1	1, 4.17%	13,	5, 20.83%	5, 20.83%	Fisher	0.083
hemorrhage				54.17%				
and stress ulcer								
	6717	0	365,	4702,	1153,	497,		
			5.43%	70.00%	17.17%	7.40%		
Liver diseases	18	1	4, 22.22%	10,	3, 16.67%	1, 5.56%	Fisher	0.047
				55.55%				
	6723	0	362,	4705,	1155,	501,		
			5.39%	69.98%	17.18%	7.45%		
Renal diseases	10	1	1, 10.00%	2, 20.00%	3, 30.00%	4, 40.00%	Fisher	<0.001
	6731	0	365,	4713,	1155,	498,		
			5.42%	70.02%	17.16%	7.40%		
Multiple organ	9	1	0, 0.00%	6, 66.67%	3, 33.33%	0, 0.00%	Fisher	0.629
dysfunction								
	6732	0	366,	4709,	1155,	502,		
			5.44%	69.95%	17.15%	7.46%		
Successful	9	1	0, 0.00%	7, 77.78%	2, 22.22%	0, 0.00%	Fisher	0.912
resuscitation from								
Cardiac arrest								
	6732	0	366,	4708,	1156,	502,		
			5.44%	69.93%	17.17%	7.46%		
Systemic	8	1	1, 12.50%	7, 87.50%	0, 0.00%	0, 0.00%	Fisher	0.346

inflammatory response syndrome						
	6733	0	365,	4708,	1158,	502,
			5.42%	69.92%	17.20%	7.46%

Table 3 The hospitalization days and expenses of pediatric burn patients in different age, cause of burn injuries and surgical intervention groups.

	N	Hospitalization days	χ^2	P	Hospitalization expense	χ^2	P
Age			7.241	0.065		13.807	0.003
<1 years old	366	9 (5, 16)			8364.905 (4726.540, 15865.008)		
1-2 years old	4715	8 (5, 13)			7651.290 (4340.300, 13849.540)		
3-5 years old	1158	9 (6, 14)			8197.555 (4563.660, 15960.208)		
6-15 years old	502	8 (5, 15)			7604.705 (4308.363, 16412.910)		
Cause of burn injuries			84.825	<0.001		101.697	<0.001
Hydrothermal scald	5431	9 (6, 14)			8087.280 (4544.11, 14745.15)		
Flame	206	10 (6, 22)			11333.825 (5341.2275, 32354.395)		
Electric	85	7 (3, 19)			8295.440 (4180.000, 20183.535)		
Chemical	84	6 (3, 15)			7360.185 (2867.095, 23227.935)		
Others	100	8 (4, 12)			6683.780 (3974.323, 11361.275)		
Unknown	835	7 (5, 11)			5905.230 (3829.800, 10576.620)		
Surgical intervention			552.466	<0.001		1375.611	<0.001
yes	1090	15 (9, 26)			24529.945 (12745.078, 42988.745)		
no	5651	8 (5, 12)			6647.910 (4026.300, 11183.100)		

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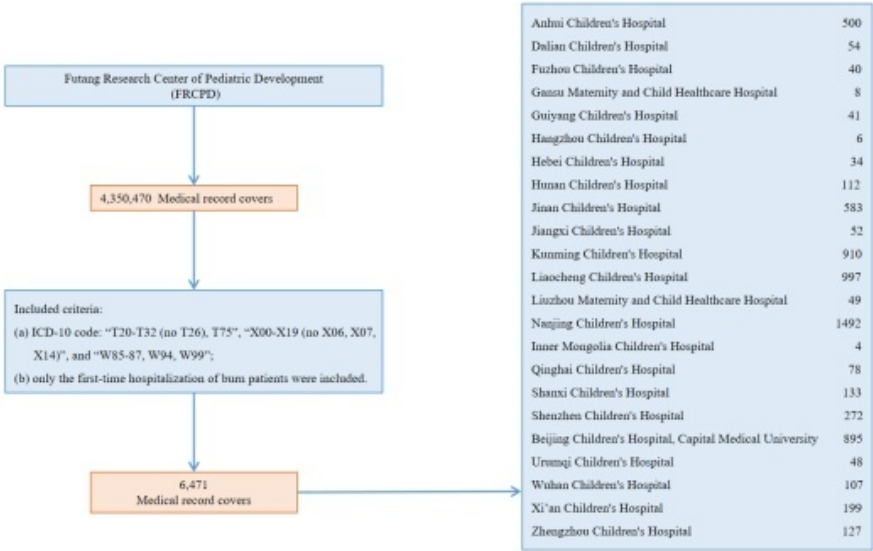
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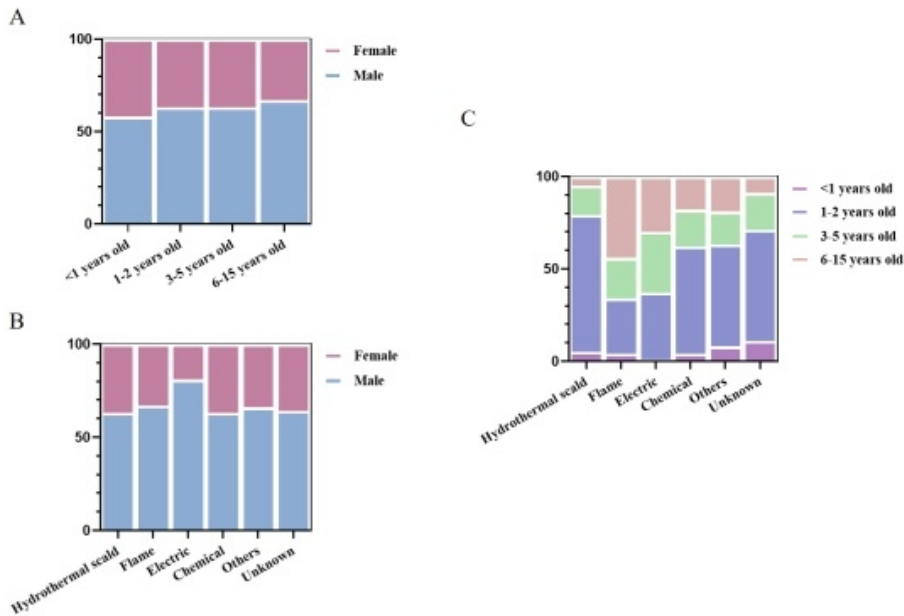
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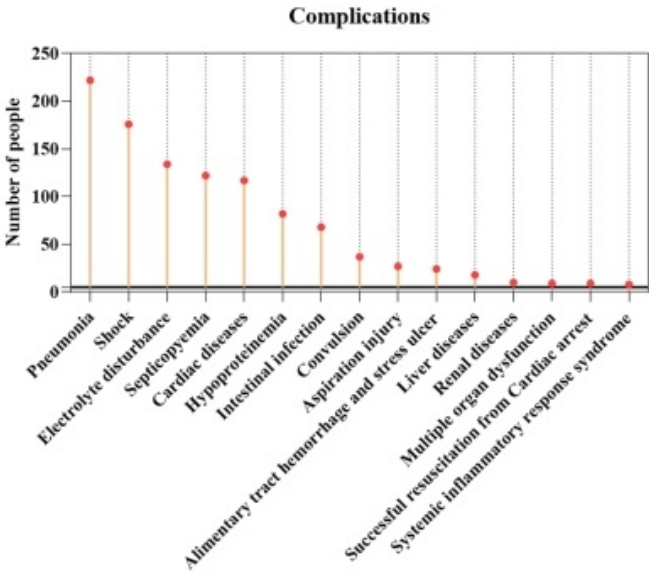
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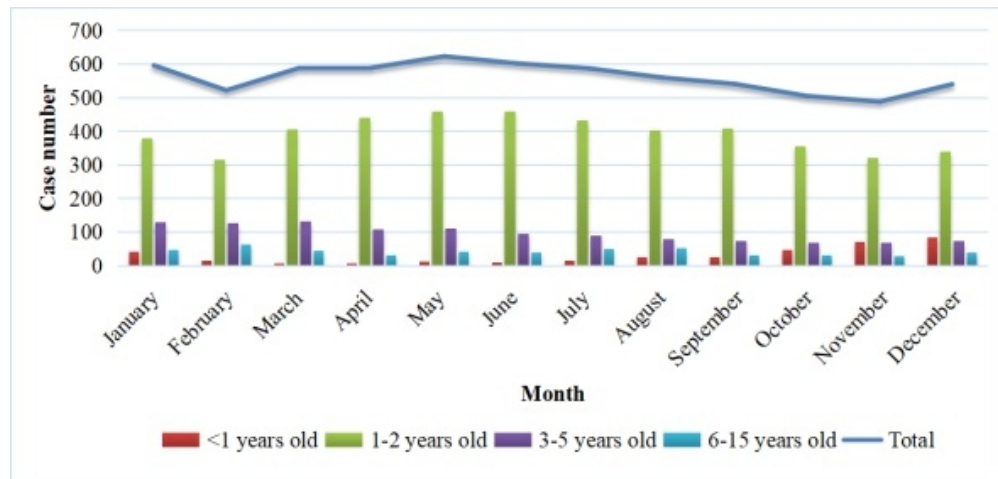
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The detailed classification of the complications in pediatric burn patients:

- (1) Pneumonia: whooping cough, lung infection, mycoplasma pneumonia, community-acquired pneumonia, severe pneumonia.
- (2) Shock: hypovolemic shock, hemorrhagic shock, traumatic shock, septic shock, lightning shock, toxic shock.
- (3) Electrolyte disturbance: low sodium, high sodium, low potassium, high potassium, low chloride, high chlorine, low calcium, high calcium, metabolic acidosis, dehydration.
- (4) Septicopyemia: sepsis, bacteremia.
- (5) Cardiac diseases: myocardial damage, myocardial strain, heart failure.
- (6) Hypoproteinemia: albumin abnormality.
- (7) Intestinal infection: Diarrhea, enteritis, bacterial intestinal infection, rotavirus enteritis.
- (8) Convulsion: febrile convulsions, seizure.
- (9) Aspiration injury.
- (10) Alimentary tract hemorrhage; stress ulcer.
- (11) Liver diseases: abnormal liver function, liver insufficiency, liver injury, liver failure, hepatic coma.
- (12) Renal diseases: Renal insufficiency, renal failure, tubular necrosis.
- (13) Multiple organ dysfunction: multiple organ failure; multiple organ dysfunction syndrome.
- (14) Successful resuscitation from cardiac arrest.
- (15) Systemic inflammatory response syndrome.

Sup Table 1 Gender distribution of pediatric burn patients in different age and cause of burn injuries groups.

	N	Male (n, row percent)	Female (n, row percent)	χ^2	P
Age				7.905	0.048
<1 years old	366	211, 57.65%	155, 42.35%		
1-2 years old	4715	2992, 63.46%	1723, 36.54%		
3-5 years old	1158	724, 62.52%	434, 37.48%		
6-15 years old	502	335, 66.73%	167, 33.27%		
Cause of burn injuries				14.544	0.013
Hydrothermal scald	5431	3399, 62.59%	2032, 37.41%		
Flame	206	137, 66.50%	69, 33.50%		
Electric	85	69, 81.18%	16, 18.82%		
Chemical	84	53, 63.10%	31, 36.90%		
Others	100	66, 66.00%	34, 34.00%		
Unknown	835	538, 64.43%	297, 35.57%		

Sup Table 2 Cause distribution of pediatric burn patients in different age groups.

	N	<1 years old (n, column percent)	1-2 years old (n, column percent)	3-5 years old (n, column percent)	6-15 years old (n, column percent)	χ^2	P
Cause of burn injuries						665.049	<0.001
Hydrothermal scald	5431	254, 69.40%	4019, 85.24%	882, 76.17%	276, 54.98%		
Flame	206	8, 2.19%	62, 1.31%	46, 3.97%	90, 17.93%		
Electric	85	1, 0.27%	31, 0.66%	28, 2.42%	25, 4.98%		
Chemical	84	3, 0.82%	49, 1.04%	17, 1.47%	15, 2.99%		
Others	100	8, 2.19%	55, 1.17%	18, 1.55%	19, 3.78%		
Unknown	835	92, 25.14%	499, 10.58%	167, 14.42%	77, 15.34%		

Sup Table 3 Age distribution of pediatric burn patients in different hospitalization

month.

Month	Total (N, percent)	<1 years old	1-2 years old	3-5 years old	6-15 years old
January	596, 8.84%	41	380	129	46
February	522, 7.74%	15	315	128	64
March	588, 8.72%	7	405	131	45
April	589, 8.74%	8	441	108	32
May	623, 9.24%	13	458	111	41
June	602, 8.93%	11	458	94	39
July	587, 8.71%	15	431	91	50
August	560, 8.31%	26	403	79	52
September	541, 8.03%	26	408	75	32
October	505, 7.49%	48	356	69	32
November	488, 7.24%	71	320	68	29
December	540, 8.01%	85	340	75	40

Sup Table 4 Hospitalization season distribution of pediatric burn patients in different cause of burn injuries groups.

	N	Hydrother mal scald (n, row percent)	Flame (n, row percent)	Electric (n, row percent)	Chemica l (n, row percent)	Others (n, row percent)	Unknow n (n, row percent)	χ^2	P
Hospital ization season								68.610	<0.001
Spring	1802	1461, 26.90%	47, 22.82%	18, 21.28%	21, 25.00%	22, 22.00%	233, 27.90%		
Summer	1732	1333, 24.54%	81, 39.32%	7, 8.24%	26, 30.95%	30, 30.00%	240, 28.74%		
Autumn	1490	1205, 22.19%	35, 16.99%	22, 25.88%	27, 32.14%	23, 23.00%	178, 21.32%		
Winter	1717	1432, 26.37%	43, 20.87%	38, 44.71%	10, 11.90%	25, 25.00%	184, 22.04%		