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Research Article

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Epidemiology and clinical characteristics of burns in mainland China from 2009 to 2018

Jie Yang[1,2,†], Guanglei Tian[1,†], Jianchao Liu[3,†], Huajuan Bai[3], Shuxu Yang[1,2], Mingzi Ran[1,4], Hongyu Li[1,2], Kui Ma[1], Siming Yang[1,2,*] and Xiaobing Fu[1,*]

[1]Research Center for Tissue Repair and Regeneration affiliated to the Medical Innovation Research Department, PLA General Hospital and PLA Medical College, Beijing, P.R. China 100853, [2]Department of Dermatology, 4th Medical Center, PLA General Hospital, Beijing, P.R. China 100048, [3]Department of Health Service, PLA General Hospital, Beijing, P.R. China 100853 and [4]Department of Anesthesiology, 4th Medical Center, PLA General Hospital, Beijing, P.R. China 100048

*Correspondence. Siming Yang, Email: ysm0117@126.com; Xiaobing Fu, Email: fuxiaobing@vip.sina.com

[†]These authors have contributed equally to this work.

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Abstract

Background: Burn injuries place a heavy burden on the global healthcare system. However, there is still a lack of nationwide studies on the epidemiological characteristics of burn patients in mainland China. The present study aims to accurately analyze the clinical characteristics of burn patients by collecting data in mainland China from 2009 to 2018, which will provide effective strategies for healthcare systems and the government in mainland China.

Methods: Patients admitted for burn injuries to 196 hospitals in 31 provinces, autonomous regions and municipalities in mainland China from 2009 to 2018 were included. The data collected included sex, age, month distribution, etiology, region, clinical outcome, injury anatomical location, total burn surface area and mortality. SPSS 19.0 software was used to analyze the data.

Results: From 2009 to 2018, the burn patients were 333,995 (0.76%), which included 222,480 (66.61%) males and 111,515 (33.39%) females. From 2009 to 2018, the number of individuals admitted to hospitals for burns showed a downward trend year by year. The burn patients accounted for the highest proportion of inpatients in 0–10 years (38.10%), followed by 40–50 years (13.14%). The highest cure ratio of burn inpatients was in the 20–30 age group (31 394, 71.53%). Among 31 provinces, autonomous regions and municipalities, the province with the highest proportion of total inpatients caused by burns was Inner Mongolia (4.61%), followed by Zhejiang (3.17%), Hainan (2.88%) and Xinjiang (2.64%). Summer (29.16%) was the season with the highest incidence of burn patients admitted to hospitals, followed by spring (25.6%). Scalding (60.19%) was the most frequent kind of burn treated, followed by fire (20.45%). The patients had multiple burn sites (68.89%) most often, followed by burns on the lower limbs (10.91%). From 0% to 10% total body surface area (TBSA) accounted for the highest ratio (37.19%), followed by 90–100% TBSA (21.74%).

Conclusions: The present study is the first to describe the associated situation and trends of burn patients in mainland China from 2009 to 2018. Our findings will serve as the latest clinical evidence for healthcare planning and prevention efforts in China and other countries.

Key words: Burns, Epidemiology, Multicentre, Mainland China, Clinical characteristics

Highlights

- Described the trend of burn inpatients of different ages, each year, gender, and seasons.
- Analyzed the relationship between burn sites and outcomes
- Described the incidence of burn inpatients in 31 provinces.
- Systematically analyzed the aetiology of burn inpatients.
- Discussed the relationship between TBSA and ages.

Background

In the present world, burns are devastating injuries that not only impair a patient's emotional well-being and quality of life but also burden the patients' families and society [1–3]. The World Health Organization (WHO) indicates that more than 300,000 people die annually from burns worldwide [4]. Moreover, burns are the leading cause of morbidity and mortality in the world with serious economic and social consequences and are a serious public health problem in developing countries [5,6]. Although clinical treatments have improved over time, such as fluid resuscitation, early enteral nutrition and aggressive surgery, the mortality rate for burns is still high, especially in the developing world [7]. However, as the world's largest developing country, there is still no systematic summarization of local data to describe the characteristics of burn inpatients at the national level in China to generate effective preventive measures, as in the United States with the American Burn Association [8]. With a population of more than 1.4 billion, China is geographically vast with rapid economic development and continuous improvement in the medical system. Therefore, it is necessary to make a unified collection of national burn data. In this study, 196 hospitals of various sizes were recruited from 31 administrative and provincial regions across the country from 2009 to 2018, and the associated characteristics of hospitalized patients with burns were analyzed.

Methods

Patient selection

A total of 333,995 inpatients from 196 hospitals in 31 provinces, autonomous regions and municipalities in mainland China from 2009 to 2018 were included as subjects by nonprobability sampling using SQL expression of Oracle databases. Records of hospitalized patients lacking any primary data, including hospital information, patient identity, diagnosis, or visiting times, were excluded. In addition, the following data were collected from electronic medical records: (1) demographic data, including age, sex, admission date, and discharge date; (2) injury-related data, including the etiology of burn injuries, depth and area of the burn, injured anatomic locations, and inhalation injury; and (3) treatment situation, including the length of hospitalization and patient outcomes. The etiologies of burn injuries included flame burns, scald burns, contact burns, electrical burns, chemical burns and explosion burns. The diagnosis and outcome of patients and the etiology of burn injuries are in accordance with ICD-10. The present study was approved by the institutional review boards of PLA General Hospital. The consent to participate has been reviewed by the institutional review boards.

Statistical analysis

Our analysis was performed on the basis of patients' health profiles and the medical burden of burns in more than 100 cities, which are either provincial capitals or cities in key regions, accounting for approximately 30% of the major cities in mainland China. Qualitative data are presented in the form of numbers and percentages. The chi-square test or the Kruskal–Wallis test was conducted to compare two or more medians of categorical variables. Data were primarily input and processed using Microsoft Excel 2007. Data analysis or illustration was performed with SPSS 19.0 software and R language(version 4.1.0). $P < 0.05$ was considered significant.

Results

Changes in the number and ratio of inpatients caused by burns from 2009 to 2018

Among all burn inpatients in 192 hospitals selected from various provinces in mainland China, the total number of inpatients showed a declining trend year by year. The two years with the highest proportion of inpatients caused by burns were 2009 (29,855, 0.93%) and 2013 (47,840, 0.95%), and the lowest proportion of inpatients was 2018 (21,993, 0.49%), followed by 2017 (22,407, 0.54%). Our data showed that since 2013, the number of burn patients has declined (Figure 1). Among all inpatients with burns, the ratio of males to females was 66.61% (222,480). The highest proportion of male burn patients was in 2009 (20,665, 69.22%) and the lowest was in 2013 (23,706, 63.69%), and showed a declining trend year by year. The highest proportion of female burn patients was in 2013 (17,370, 36.31%) and the lowest was in 2010 (10,451, 30.60%), and showed an increasing trend year by year (Figure 1).

Variation in the ages of burn patients from 2009 to 2018

The 0–10 age group (127,248, 38.10%) accounted for the highest proportion of total burn patients, followed by the 40–50 age group (48,952, 14.66%) and the 20–30 age group (43,888, 13.14%) (Figure 2a). The year 2013 had the most hospitalizations for burns of any age group. From 2009 to 2013, the number of hospitalizations caused by burns in all age groups showed an increasing trend, while the number of hospitalizations caused by burns showed a downward

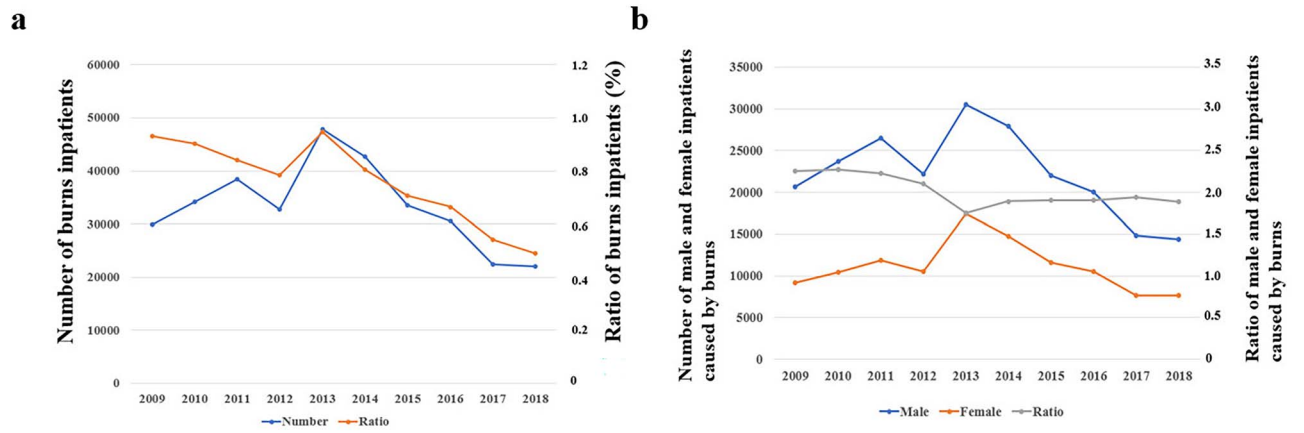

Figure 1. Changes in the number and ratio of inpatients caused by burns from 2009 to 2018. **(a)** Number and ratio of burns inpatients showed a decreasing trend from 2009 to 2018. **(b)** Number and ratio of burns inpatients being represented graphically according to years distribution in male and female groups from 2009 to 2018

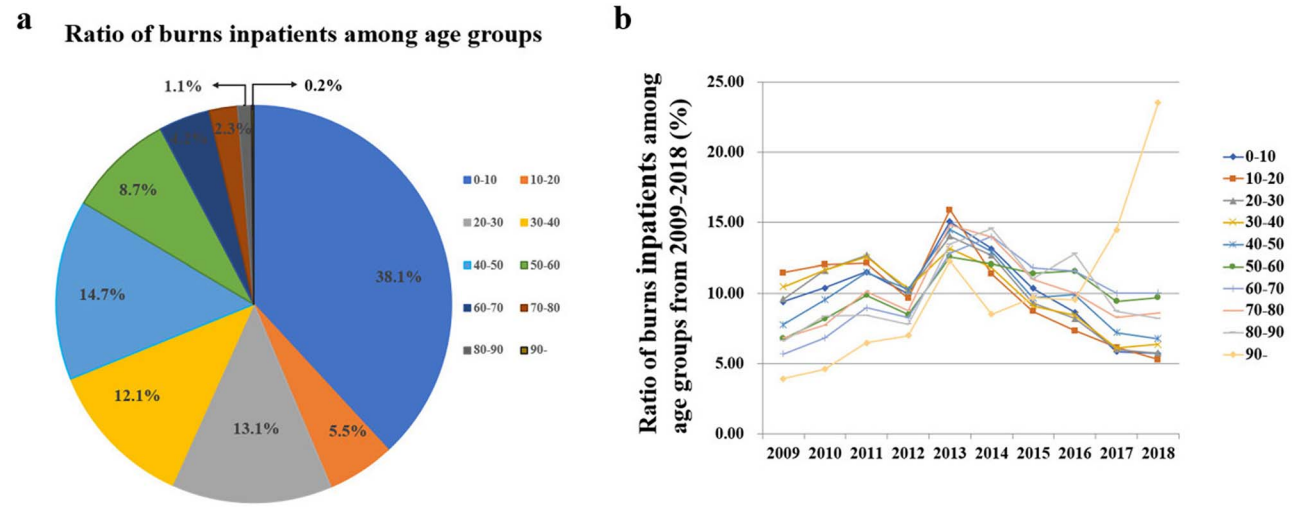

Figure 2. Changes in the ages of burn patients from 2009–2018. **(a)** Ratio and number of burns inpatients among all age groups. **(b)** Ratio of burns inpatients among all age groups changes from 2009 to 2018

trend after 2013, except in the 90+ age group, which had an increasing trend after 2013 and the highest ratio (138, 23.51%) in 2018 (Figure 2b).

Information on burn patients in mainland China

The province with the highest number of burn patients was Xinjiang (42,232), followed by Fujian (41,214) and Zhejiang (25,851). The province with the highest proportion of total burn patients was Inner Mongolia (15,381, 4.61%), followed by Zhejiang (25,851, 3.17%), Hainan (12,089, 2.88%) and Xinjiang (42,232, 2.64%). The province with the lowest proportion of total inpatients caused by burns was Guizhou (75, 0.05%), followed by Anhui (1215, 0.13%), Shanghai (4119, 0.17%) and Ningxia (305, 0.18%). The highest ratio of male burn patients among the provinces was found in Ningxia (male 267, 87.54%), followed by Guizhou (male 64, 85.33%), while the highest ratio of female burn patients was in Beijing (female 7834, 37.02%), followed by Hubei (female 1811, 35.99%). Interestingly, the provinces of Guizhou and Ningxia, with a lower ratio of burn patients, had a higher ratio of male than female burn patients (Figure 3).

Outcome of the burn patients

Our data showed various outcomes of burn patients as follows: improved (122,329, 63.25% male and 36.75% female), cured (207,691, 68.49% male and 31.51% female), died (1376, 77.98% male and 22.02% female), ineffective (290, 67.24% male and 32.76% female), untreated (920, 69.13% male and 30.87% female), and others (1389, 68.47% male and 31.53% female) (Figure 4a, b). Moreover, the ratio of improved male burn patients (34.78%) was lower than that of female burn patients (40.31%). The ratio of cured male inpatients (63.93%) caused by burns was higher than that of female inpatients (58.69%) caused by burns. However, the

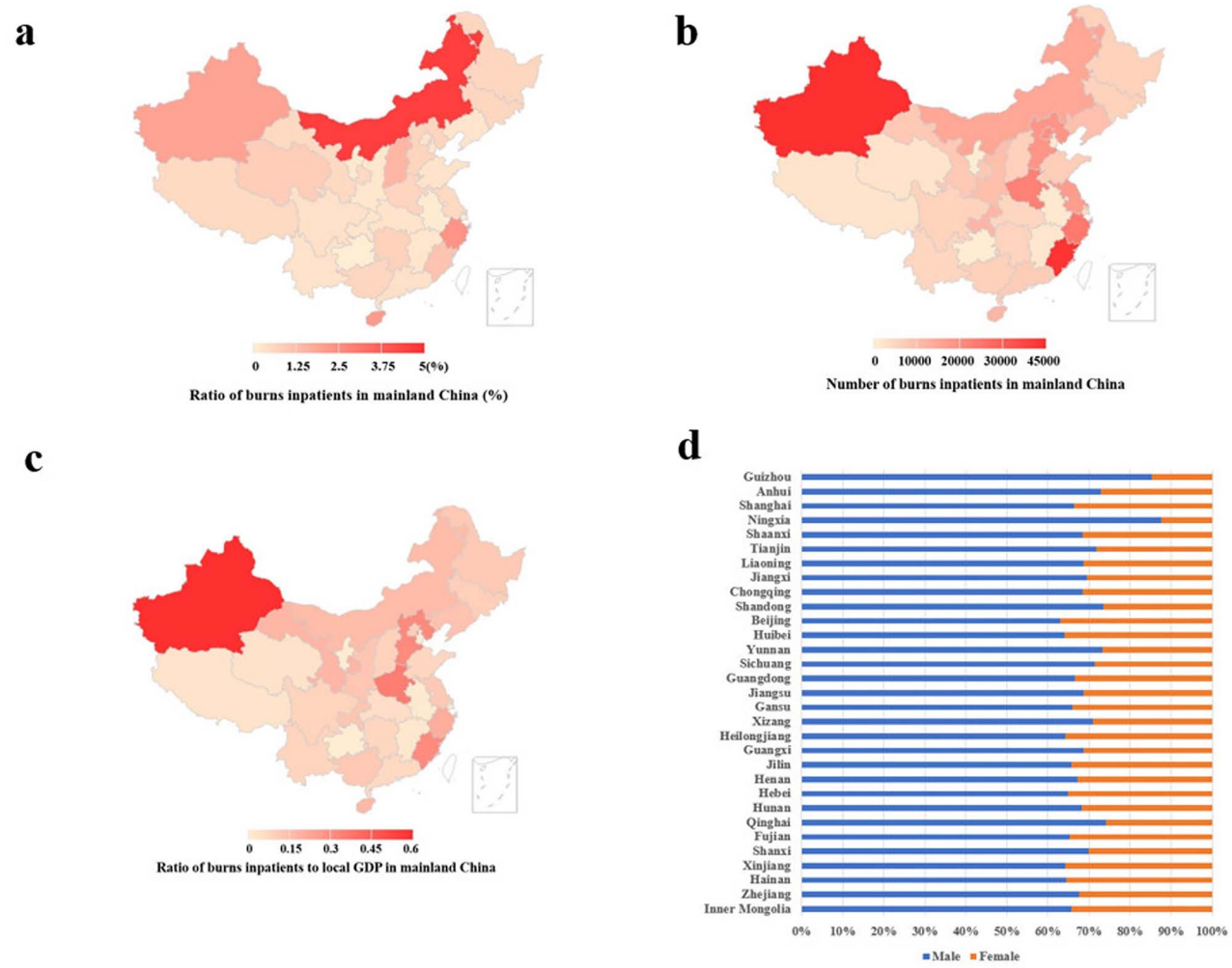

Figure 3. The heatmap of burns inpatients in each province of mainland China. **(a)** The extent of red indicates the ratio of burns inpatients to total inpatients in each province of mainland China. **(b)** The extent of red indicates the number of burns inpatients in each province of mainland China. **(c)** The extent of red indicates the ratio of burns inpatients to local GDP in each province of mainland China. (The ratio increases as the red color deepens.) **(d)** The ratio of male and female inpatients caused by burns in each province of mainland China

ratio of male burn patients who died (0.48%) was higher than that of female burn patients (0.27%) (Figure 4c, d).

Age is an important factor in the outcomes of burn patients. The lowest ratio of improved burn patients to the total burn patients by age group was in the 20–30 age group (12,093, 27.55%) and showed an increasing trend with age. The highest ratio of cured burn patients to the total burn patients by age group was also in the 20–30 age group (31,394, 71.53%) and showed a decreasing trend with age. In addition, the lowest ratio of burn patients who died to the total burn patients by age group was observed in the 0–10 age group (126, 0.10%) and showed an increasing trend with age, while the highest ratio was observed in the 80–90 age group (76, 2.02%). The lowest ratio of ineffective burn patients to the total burn patients by age group was the 20–30 age group (16, 0.036%), followed by the 10–20 age group (7, 0.038%) and 0–10 age group (53, 0.042%) and showed an increasing trend with age, while the highest ratio was observed in the 90+ age group (7, 0.96%) (Figure 5).

Burn sites of inpatients

Among burn sites, multiple burn sites (230,990, 68.89%) were the most common among burn patients, followed by burns to the lower limbs (36,439, 10.91%) (Figure 6a, b). Moreover, different burn sites had different outcomes. The highest ratio of improved burn patients to total burn patients with the same burn site was found for internal organs except the respiratory system (589, 65.15%), while the lowest ratio was for head and neck (5509, 30.88%). The highest ratio of cured burn patients to total burn patients with the same burn site was for head and neck (12,276, 68.82%), while the lowest ratio was found for internal organs except the respiratory system (296, 32.74%). The highest ratio of ineffective burn patients to the total burn patients with the same burn site was for internal organs except the respiratory system (4, 0.44%), while the lowest ratio was observed for the lower limbs (0). The highest ratio of patients who died to the total patients with the same burn site was for the respiratory tract (22, 1.61%), while

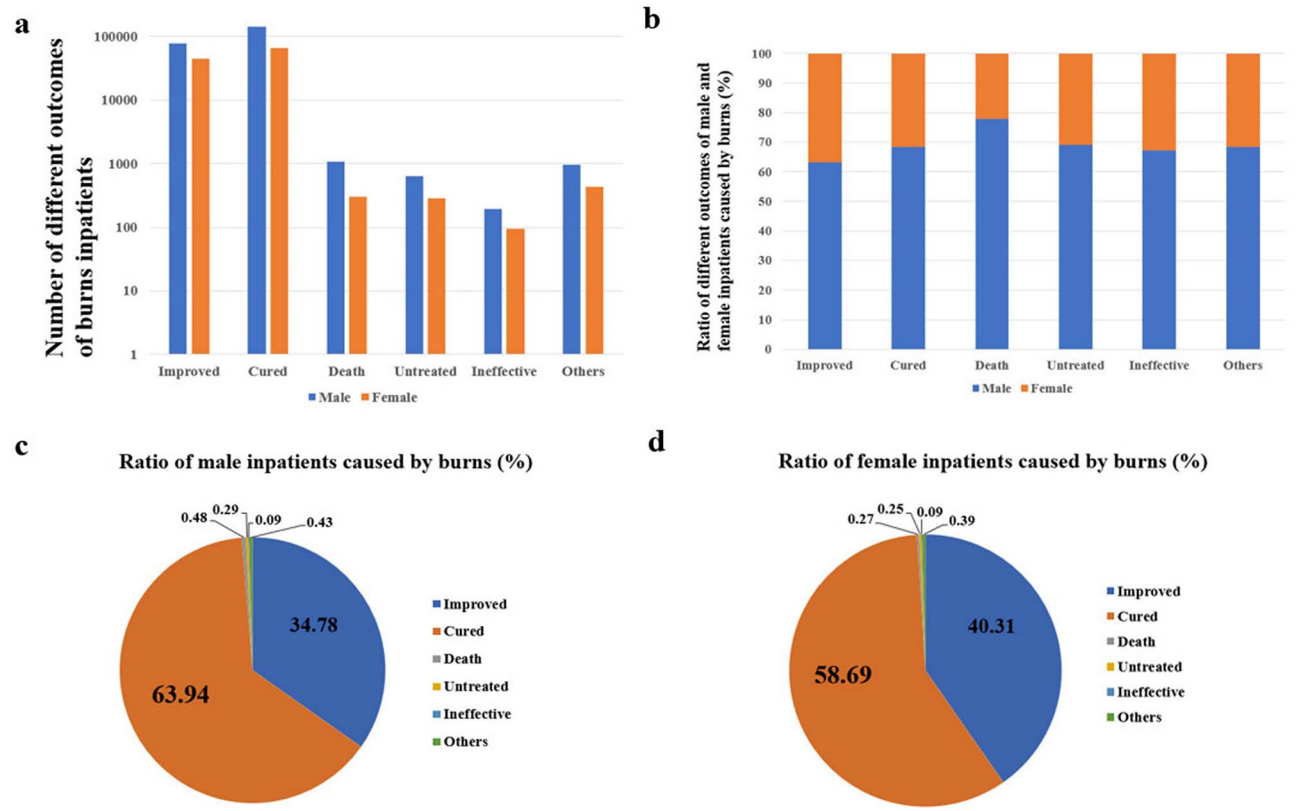

Figure 4. The ratio of outcomes of male and female inpatients caused by burns. (**a**) The number of different outcomes of burns inpatients variations between male and female. (**b**) The ratio of male and female inpatients to total inpatients caused by burns variations among different outcomes. (**c**) The ratio of male inpatients variations among different outcomes. (**d**) The ratio of female inpatients variations among different outcomes

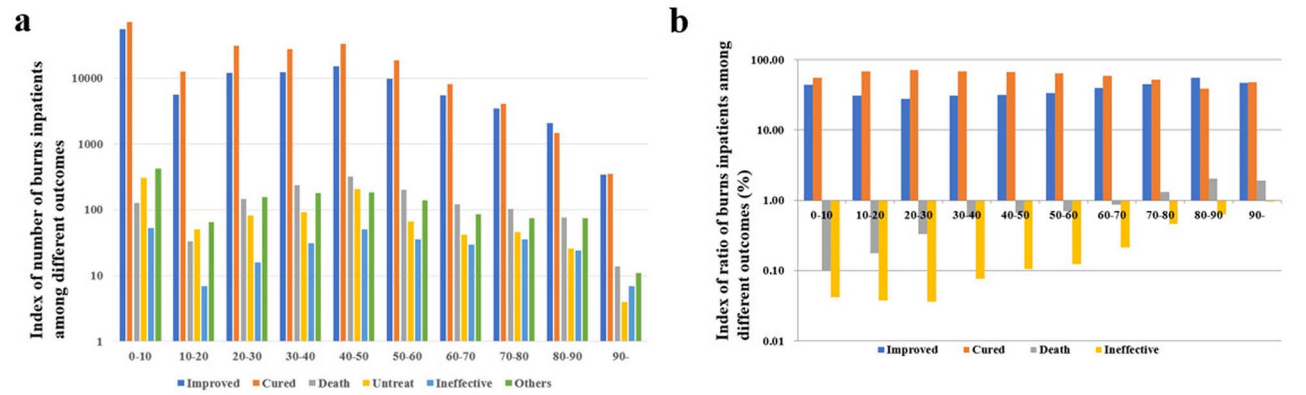

Figure 5. The ratio of outcomes of inpatients caused by burns among all age groups. (**a**) The index of number of burns inpatients in different age groups variations among different outcomes. (**b**) The index of ratio of burns inpatients with different outcomes to total burns inpatients variations among different age groups

the lowest ratio was observed for the upper limbs and eyes (0) (Figure 6c, d).

Analysis of etiology in burn patients

In accordance with ICD-10, we included seven different etiologies, including fire, scalding, chemical, electric, explosions, and others. Among the seven etiologies, scalding (60.19%) was the most frequent burn injury, followed by fires (20.45%). The lowest ratio of burn injury among patients was due to radiation (0.04%), followed by explosion (0.72%). Compared with female burn patients, male burn patients were more likely to be injured by electric injuries [OR (95% CI) = 10.44 (9.75–11.19)], followed by chemicals [OR (95% CI) = 2.40 (2.29–2.52)] and explosions [OR (95% CI) = 2.31 (2.08–2.56)], while the lowest likelihood was scalding [OR (95% CI) = 0.47 (0.46–0.48)] (Table 1).

Among all age groups, the highest ratio of scalding was in the 0–10 age group (88.68%), which also had the lowest ratio of fire injuries (4.89%) far less than that of other age groups, followed by the 90+ (56.22%) and 10–20 (54.2%)

Table 1. Etiology of burn inpatients by gender, age, outcome and provinces

Etiology	Fires	Scalding	Chemical	Electric	Explosion	Radiation	Others
Gender, %							
Total	20.45	60.19	3.47	5.22	0.72	0.04	9.90
Male	22.08	54.43	4.30	7.45	0.88	0.04	10.82
Female	17.20	71.69	1.84	0.77	0.38	0.04	8.07
OR (M to F)	1.36	0.47	2.40	10.44	2.31	0.93	1.38
95% CI	1.34–1.39	0.46–0.48	2.29–2.52	9.75–11.19	2.08–2.56	0.66–1.32	1.35–1.42
Age, %							
0–10	4.89	88.68	0.43	0.57	0.39	0.00	5.04
10–20	23.62	54.20	3.29	3.99	1.71	0.07	13.12
20–30	27.46	42.33	6.10	8.88	0.75	0.07	14.41
30–40	30.76	38.85	6.05	9.98	0.89	0.07	13.40
40–50	31.23	38.37	6.41	9.80	1.06	0.04	13.08
50–60	31.47	41.79	5.50	8.71	0.87	0.04	11.62
60–70	33.30	47.57	3.06	4.48	0.51	0.10	10.98
70–80	34.04	52.56	1.59	1.10	0.45	0.19	10.07
80–90	36.36	52.39	1.01	0.40	0.37	0.08	9.39
90-	31.52	56.22	2.39	0.51	0.00	0.17	9.20
							$P < 0.0001$
Outcome							
Improved	31.53	39.20	34.49	27.48	29.95	29.29	37.57
Cured	66.16	60.07	64.16	71.78	66.37	70.00	60.72
Death	1.18	0.14	0.28	0.17	2.51	0.00	0.52
Untreated	0.29	0.23	0.54	0.23	0.17	0.00	0.44
Ineffective	0.24	0.04	0.09	0.03	0.13	0.71	0.07
Others	0.60	0.31	0.44	0.32	0.88	0.00	0.68
							$P < 0.0001$
Ethnic group, %							
Han	21.11	58.56	3.39	5.63	0.64	0.04	10.63
Minorities	15.42	72.24	2.38	3.79	0.25	0.02	5.90
							$P = 0.0493$
Provinces, %							
Qinghai	28.23	35.80	9.18	12.41	0.31	0.00	14.07
Jiangsu	17.35	61.37	3.10	6.10	0.57	0.00	11.50
Hunan	22.86	60.51	4.49	5.51	1.27	0.00	5.36
Fujian	19.76	64.98	3.53	4.58	1.05	0.04	6.06
Yunnan	20.89	41.93	7.33	4.53	0.83	0.00	24.49
Guizhou	12.00	37.33	32.00	6.67	2.67	1.33	8.00
Zhejiang	29.30	49.91	4.76	5.69	0.33	0.09	9.93
Gansu	9.16	67.33	2.21	1.76	0.34	0.01	19.19
Beijing	18.85	59.17	2.63	4.57	0.71	0.07	14.00
Guangdong	25.58	61.36	2.26	1.42	1.37	0.03	7.99
Shaanxi	21.63	50.68	5.17	13.94	0.90	0.11	7.57
Chongqing	26.48	50.93	5.64	12.14	2.00	0.17	2.65
Xinjiang	17.09	67.99	2.82	5.15	0.25	0.01	6.69
Ningxia	9.51	12.46	1.64	0.66	0.33	0.00	75.41
Henan	21.57	62.55	2.56	4.86	0.42	0.00	8.04
Hebei	19.55	65.20	2.15	2.56	0.63	0.01	9.91
Tianjin	17.00	65.80	4.00	4.00	0.70	0.00	8.50
Shanxi	23.71	54.41	1.43	6.87	0.59	0.00	13.00
Xizang	24.31	48.47	0.99	7.28	0.64	0.00	18.32
Jiangxi	17.64	52.50	9.40	7.69	1.89	0.12	10.74
Shanghai	25.76	54.77	5.68	7.74	1.34	0.07	4.64
Hainan	12.87	82.28	1.13	1.62	0.16	0.05	1.89
Hubei	8.90	57.35	3.95	2.19	0.50	0.00	27.11
Jilin	26.34	62.61	2.52	3.34	0.50	0.03	4.66
Sichuan	18.62	39.07	1.84	6.75	0.42	0.00	33.31
Liaoning	22.38	43.56	3.41	2.69	0.77	0.05	27.14
Inner Mongolia	18.46	71.35	2.70	5.43	0.71	0.03	1.31
Shandong	16.44	50.61	9.18	4.86	1.32	0.04	17.54
Anhui	10.70	26.58	2.72	2.88	1.07	0.00	56.05
Heilongjiang	27.83	62.68	3.67	1.38	0.80	0.03	3.62
Guangxi	27.85	50.23	5.28	9.10	1.86	0.26	5.42
							$P < 0.0001$

CI confidence interval, *M* male, *F* female

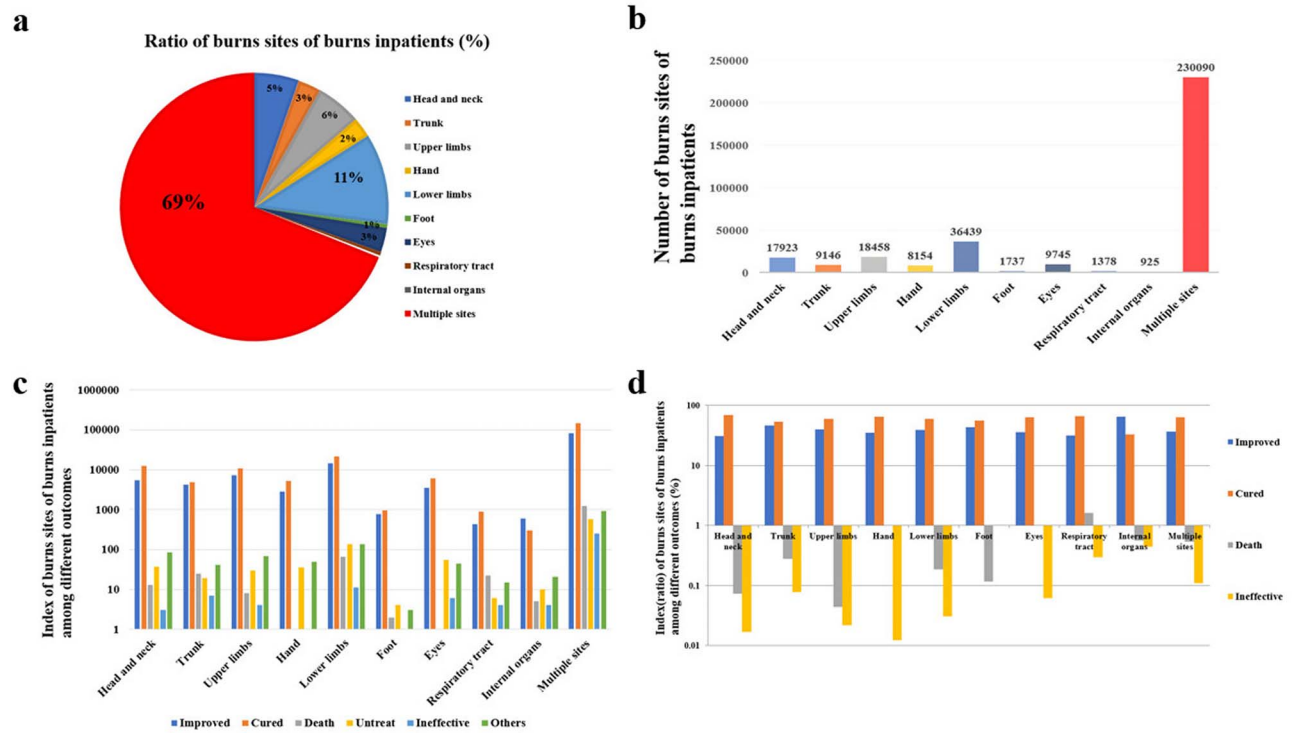

Figure 6. The variations of inpatients caused by burns among all burn sites. (**a**) The ratio of different burns sites of burns inpatients. (**b**) The number of different burns sites of burns inpatients. (**c**) The number of burns inpatients with different burns variations among all outcomes. (**d**) The ratio of burns inpatients with different burns variations among all outcomes

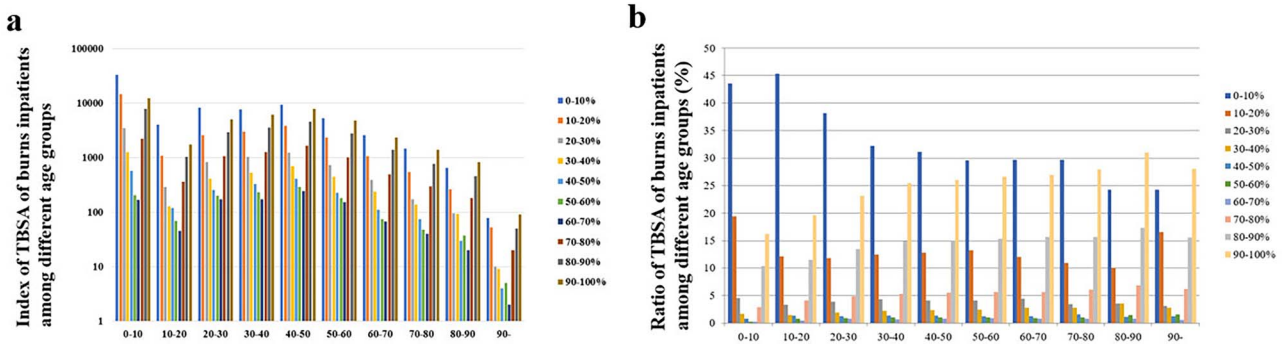

Figure 7. Total body surface area (TBSA) of inpatients caused by burns among all age groups. (**a**) The index of number of burns inpatients in different age groups variations among TBSA. (**b**) The ratio of burns inpatients in different age groups variations among TBSA

age groups. The highest ratio of explosion injuries was in the 10–20 (1.71%) age group, followed by the 40–50 (1.06%) and 30–40 (0.89%) age groups. In addition, the ratio of explosion, chemical and electric injuries had a higher trend in the age group 20–60 years, while the ratio of fire injuries had a lower trend in the age group 20–60 years (Table 1).

The highest ratio of improved patients to total patients with the same etiology was scalding (39.2%), while the lowest was electric injuries (27.48%), followed by radiation (29.29%). The highest ratio of cured patients was electric injuries (71.78%), while the lowest was scalding (60.07%). The highest ratio of ineffective patients was due to radiation (0.71%). The highest mortality of patients was explosion (2.51%), followed by fires (1.18%), while the lowest mortality was observed for scalding (0.14%), followed by electric injuries (0.17%) (Table 1).

In addition, our data showed that among the 31 provinces, the highest ratio of burns caused by fires was in Zhejiang (29.3%), followed by Qinghai (28.23%); the highest ratio of burns caused by scalding was in Hainan (82.28%), followed by Mongolia (71.35%); the highest ratio of burns caused by chemicals was Guizhou (32%), followed by Jiangxi (9.4%); the highest ratio of burns caused by electric injuries was Shaanxi (13.94%), followed by Qinghai (12.41%) and Chongqing (12.14%); the highest ratio of burns caused by explosion was Guizhou (2.67%), and the highest ratio

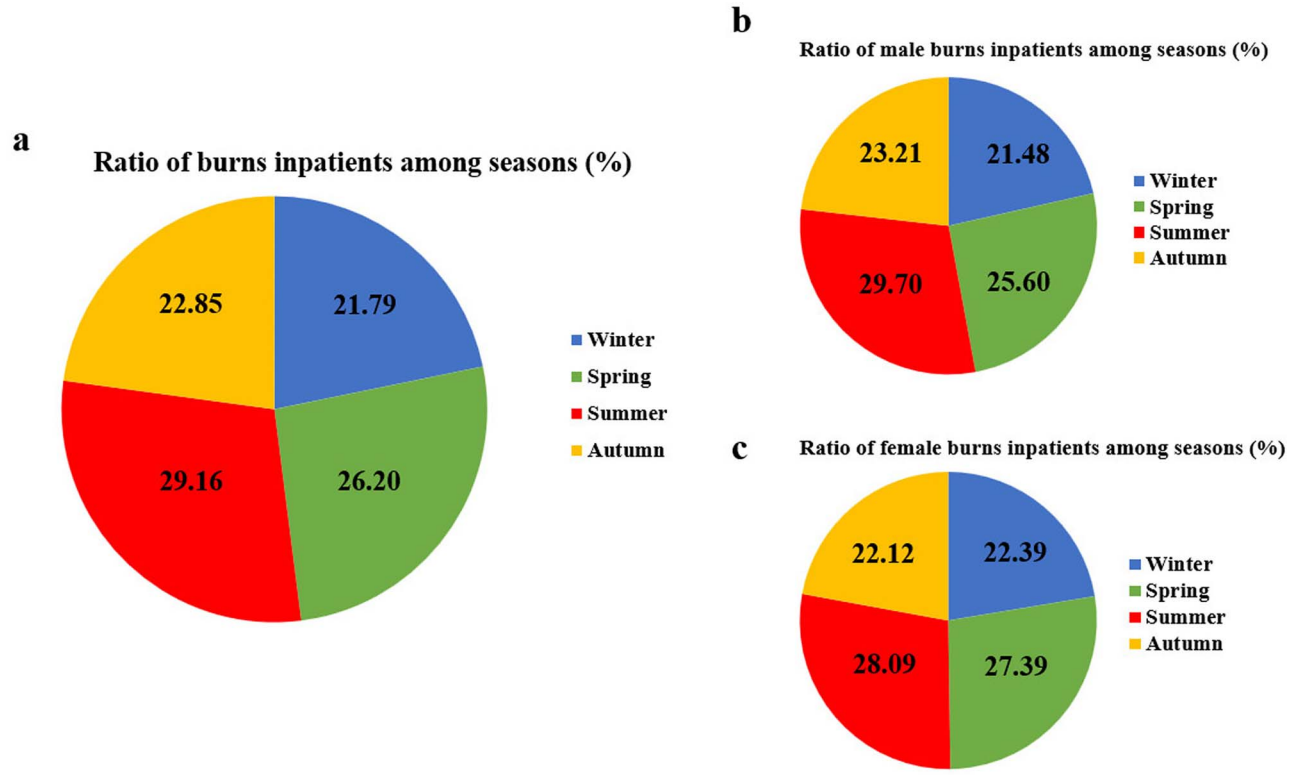

Figure 8. The ratio of inpatients caused by burns among all seasons. (**a**) The ratio of burns inpatients variations among seasons. (**b**) The ratio of male burns inpatients variations among seasons. (**c**) The ratio of female burns inpatients variations among seasons

of burns caused by radiation was also Guizhou (1.33%) (Table 1).

Analysis of TBSA in inpatients caused by burns

There were two higher ratios of burn patients with TBSA injuries, including 0–10% TBSA patients and 90%—whole patients. Among all age groups, there was higher 0–10% TBSA in the 0–10 (33,014, 43.60%) and 10–20 (4033, 45.37%) age groups, and these percentages showed a decreasing trend with advancing age. The lowest 0–10% was in the 90+ age group (78, 24.3%). Our data showed that from 30% to TBSA, which represented severe burns, there was an increasing trend with advancing age (Figure 7).

Analysis of the seasons for burn inpatients

We divided January to December into four seasons: spring (March to May), summer (June to August), autumn (September to November), and winter (December to February). The highest ratio of burn patients was in summer (97,408, 0.85%), followed by spring (87,510, 0.74%), autumn (76,315, 0.72%), and winter (72,762, 0.70%). The highest ratio of male-to-female patients was in summer [OR (95% CI) = 1.081 (1.064–1.099)] followed by autumn [OR (95% CI) = 1.064 (1.046–1.082)], while the lowest ratio was in spring [OR (95% CI) = 0.912 (0.898–0.927)] followed by winter [OR (95% CI) = 0.949 (0.932–0.965)] (Figure 8).

Discussion

As a serious trauma, burns can lead to significant physical and psychological disorders in burn patients and can cause considerable economic losses and place a heavy burden on families and society, which requires more attention from government [9,10]. Our data showed that burn patients as a percentage of total patients was declining from 2009 to 2018 in 196 hospitals in various provinces of mainland China. These results may be consistent with the gradual emphasis on burn prevention in our country [10–13]. Moreover, the ratio of male burn patients to female burn patients has decreased over time. The reason for that may be the increasing proportion of women in industrial work in China [14].

The higher ratio of burns patients in Inner Mongolia, Hainan, Zhejiang and Xinjiang may be due to two reasons. One is that long hours of sunshine, such as in Xinjiang and Hainan, can easily lead to fires and sunburn. The other is that there are many industries in these areas, such as the textile industry in Zhejiang, which is prone to fires [14]. The highest ratio of burns caused by scalding in Hainan may be caused by tourist cities with large transient populations, the nature of the locals' work and long daylight hours. More interestingly, the highest ratio of burns caused by chemical and explosions were both in Guizhou. The situation of burn patients in Guizhou may be consistent with locals' work, as Guizhou's phosphate industry ranks first in our country.

Our data showed that male burn patients are easier to cure than female patients, but female patients improve more quickly. However, the mortality of male burn patients is much higher than that of female patients not only in China but also worldwide [15–17]. This may be because of male occupations with more risk factors [14]. The best cure rates for burns are seen in patients of 20–30 years, which is possibly due to this age group being the strongest and able to withstand severe injuries and recover quickly [18–20]. The cure rates showed a decreasing trend with advancing age, which may be caused by physiological functions of the human body declining with age. However, mortality and ineffective rates of burn patients showed an increasing trend with aging [21,22]. The most frequently cured burn sites were the head and neck, which may be because of the rich blood circulation at these sites. Moreover, the highest mortality of burn sites was in the respiratory tract, where inhalation injury should be diagnosed and treated early [23,24].

Scalding is the most frequent of all burn etiologies, probably because scalding can occur in any place, followed by fire for the same reason. Men are more prone to electrical burns than women, followed by chemical and explosion injuries—three etiologies caused by occupational factors [25]. Children of 0–10 years old had the highest probability of being exposed to scalding, indicating that families are still lacking in nursing care for children, especially in remote areas [26]. The highest ratio of explosion injuries was in the 10–20 (1.71%) age group, which may occur because children aged 10–20 are more likely to be exposed to explosives such as firecrackers. Moreover, electrical burns had the highest cure rates and the lowest mortality, which could be due to very effective treatment methods for electrical burns. Last, explosions had the highest mortality, probably because the injuries caused by explosions are more serious [27].

Our data showed that higher 0–10% TBSA rates were in the 0–10 and 10–20 age groups and then declined with aging. Although adolescents are more prone to burns, most of them have accidents while under the care of their families and in non-hazardous environments and receive medical attention in time. As a result, the burn area and degree are small in adolescents [28]. In contrast, the probability of large-area burns showed an increasing trend with aging. This may be due to the nature of work on the one hand. On the other hand, a home fire can lead to very serious injuries among elderly individuals with limited mobility [29]. Finally, the highest ratio of burns occurred in summer, which may be the result of high temperatures causing fires.

Conclusions

As a result of the national emphasis on burns in China, it can be seen that the proportion of burn patients gradually decreased from 2009 to 2018. However, in some remote or industrialized areas, the local government does not pay enough attention to burns and actively insist on relevant policies to prevent the occurrence of burns. Based on these epidemiological characteristics, some specific suggestions should be made to strengthen health promotion, child supervision, labor protection, and so on, all of which may reduce the occurrence of burns. The China database of burns should be established to effectively designate burn prevention and treatment policies.

Abbreviations

TBSA: Total body surface area; CI: Confidence interval

Authors' contributions

JY, GT, JL, HB, SY and XF conceived and designed the project. JY, KM, SY, GT, MR, HL and SY performed all the experiments and prepared the figures. JY, SY and XF wrote the manuscript. All authors reviewed the manuscript.

Ethics approval and consent to participate

The present study was approved by the institutional review boards of PLA General Hospital. The consent to participate has been reviewed by the institutional review boards. This study used historical data and the consent may bring population selection bias. Patients' privacies have been eliminated before data analyses. This study was deemed minimal risk by the boards and waiver of consent was approved.

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Conflicts of interest

The authors declare that they have no competing interest.

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