Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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The effect of COVID-19 in a newly established burn center

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ABSTRACT

Objective: This study aims to investigate the effects of COVID-19 on epidemiological features, burn agent, burn percentage, and hospitalization time in a burn center.
Methods: This single-center, retrospective study included a total of 401 patients admitted to our study center between October 2019 and July 2020. The patients who were admitted before March 1, 2020, were considered the pre-March group, and those who were admitted after March 1, 2020, were considered the post-March group. According to their age, the patients were further divided into groups as those aged ≤ 18 years and those aged > 18 years. Demographic and clinical characteristics of patients, burn agent, burn surface area, COVID-19 status, and treatment and follow-up data were recorded.
Results: Our study results showed no significant difference in the number of patient admission, age, and sex of patients, burn agents and length of hospital stay before and after the COVID-19 outbreak.
Conclusions: Burn centers can work safely in COVID-19 outbreak, paying special attention to precautions mandated by the national and global health authorities. However, the increase in pandemic burden may force the burn centers to be converted into alternate COVID-19 facilities. In such cases, the care of burn patients may pose a great problem.

1. Introduction

The emergence of severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2), which was later officially named novel coronavirus-2019 (COVID-19) in China in December 2019, has caused a global outbreak and become a major public health issue all over the world [1]. The COVID-19 first started to emerge in Wuhan City, Hubei province of China, at the end of December [2]. It has rapidly spread worldwide. The World Health Organization (WHO) has declared it as an international public health emergency and a pandemic on March 11, 2020 [3]. The first COVID-19 case in Turkey was reported on March 11, 2020, and the first death occurred on March 17, 2020 [4]. The total number of cases in Turkey as of April 15, 2020, was 69,392, and the total number of deaths was 1518 [5]. Republic of Turkey Health Ministry announced its website a daily number of cases and deaths with Covid-19 transparently [6].

According to official announcements and media reports, before reporting the first case in Turkey, which took various preventive measures in January and February. These measures include establishing a Scientific Committee, the control of passengers from abroad, especially from China and the Far East, with thermal cameras, the complete suspension of Chinese flights, and the closure of the Iranian border. They can be listed as suspensions of flights to Italy, Iraq, and South Korea [4].

On March 20, a circular was issued by the Ministry of Health stating that all hospitals with adequate specialist and tertiary adult intensive care beds are considered pandemic hospitals [4].

There has never been a pandemic of this magnitude before, which affected the whole globe. The COVID-19 has affected all aspects of life, not only the field of health. Currently, enormous endeavors have been made to understand this threat to the world better and achieve success.

At the time of the present study, >120,000 publications on COVID-19 are available in the literature, with an increasing number of publications every day. A literature review reveals some studies regarding the establishment and regulation of burn centers during the pandemic [7]. The epidemiology of burn has been often studied [8,9], and the epidemiological effect of the pandemic on burns has been recently investigated [10]. However, there is no study investigating the impact of COVID-19 on epidemiological features, burn agent, burn percentage, and hospitalization time in burn centers.

The hospital where we conducted our study was in Bursa. Bursa, which is located in the west of Turkey includes a 3–4 million population,

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is a big city. Bursa City hospital, affiliated with the University of Health Sciences, is a newly established hospital in a vast area, with a bed capacity of 1355 and 230 intensive care patient beds.

A newly established burn center where this study was conducted was officially opened in Bursa City Hospital in October 2019. This center has been continuing to work actively since then and is committed to meet the unmet needs during the COVID-19 outbreak. The number of patients admitted to our center has also been increasing recently. Only acute burning cases were accepted in our Burn Center.

In the present study, we aimed to investigate the effects of COVID-19 on epidemiological features, burn agent, burn percentage, and hospitalization time in a newly established burn center and to provide an insight into the healthcare workers fighting against this devastating pandemic.

2. Materials and methods

2.1. Study design and study population

This single-center, retrospective study was conducted at the burn center of the Republic of Turkey, Bursa City Hospital, between October 1, 2019, and July 31, 2020. A total of 401 patients admitted to our study center were analyzed according to their admission date. Since the first COVID-19 case was reported in March and the first death because of Covid-19 was in March in Turkey, we thought it would be more appropriate to divide our cases into two parts based on March [4].

The patients who were admitted before March 1, 2020, were considered the pre-March group (n = 145), and those who were admitted after March 1, 2020, were considered the post-March group (n = 256). The patients were further divided into the groups according to their age as those aged ≤ 18 years (n = 73 in the pre-March period and 72 in the post-March period) and those aged > 18 years (n = 136 in the pre-March period and 120 in the post-March period). Those who were admitted to the burn outpatient clinic were excluded. Demographic and clinical characteristics of the patients, burn agent, burn surface area, COVID-19 status, and treatment and follow-up data were recorded.

2.2. Statistical analysis

A Shapiro–Wilk test was used to assess whether the variables followed a normal distribution. Categorical variables were given as numbers and percentages, where continuous variables were median (min: max) and interquartile range. According to the normality test results, Mann Whitney *U* test was used to compare the groups. Categorical variables were compared by the Chi-square test and Fisher-Freeman-Halton test. The data were analyzed using the SPSS software (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp). A p-value of <0.05 was considered statistically significant.

2.3. Ethical considerations

All patients were informed about the nature of the study, and written informed consent was obtained from each patient and/or legal guardian. The Bursa City Hospital Ethics Committee approved the study protocol (Date: 29.07.2020-No. 2020-4/16). The study was conducted in accordance with the principles of the Declaration of Helsinki.

3. Results

A total of 401 patients, 145 were followed in the pre-March period, and 256 were followed in the post-March period. In the pre-March period, 35.9% of the patients (n = 52) were females, while 32.4% of the patients (n = 83) were females in the post-March period. Totally 53.3% of the patients (n = 73) in the pre-March group and 53.1% (n = 136) in the post-March group were under 18 years old. There was no significant difference according to the age of the patients who were admitted in the pre-March and post-March periods (p = 0.525). In addition, the number of patients aged ≤ 18 years and > 18 years did not significantly differ between the periods of hospital stay (p = 0.592). There was no significant difference between the periods of hospitality according to sex and nationality of hospitalized patients with burn (p = 0.484 and p = 0.724, respectively). Demographic characteristics of the patients according to the period of hospitalization are shown in Table 1and Fig. 1.

Our study had no attempt to rule out COVID-19 in every patient admitted to our burn center. If there were no symptoms of COVID-19 infection, a PCR test was not performed. Only ten patients were tested for COVID-19 in the post-March period due to preoperative test, and none of them tested positive for COVID-19. We followed our patients closely for three months in our follow-up protocol.

Fig. 2 shows the number of patients according to the month of admission. The number of patients in the burn center was steadily increasing over the months, and there was a significant increase in June and a decrease in July. The amount of increase in inpatients was calculated in the following months compared to October 2019 by referring to October 2019, when the burn unit began to accept patients. The percentage of median increase calculated according to the number of inpatients for the first month accepted as a reference in the pre-March period was determined as 110% (min–max: 66.67–180) and 220% (min–max: 166.67–380) in the post-March period. The increase in the rate of inpatients calculated in the post-March period was higher than in the pre-March period (p = 0.032).

Before March, excision and grafting were performed in 22 patients and after March in 64 patients. Most of the other cases were debrided in the operating room with anesthesia.

Two patients (1,3%) died before March, and 3(1,1%) patients died after March.

The patients admitted to the burn center were also divided according to the length of hospital stay, the percentage of burns, and the cause of the burn in the pre-and post-March groups (Table 2, Fig. 3). The median hospital stay was 4 (range, 0 to 73) days in the pre-March period and 3 (range, 0 to 65) days in the post-March period. The causes of burns were scalding in 62.1% of the patients (n = 90) in the pre-March group and in 60.9% of the patients (n = 156) in the post-March group. There was no significant difference in length of hospital stay between the two groups (p = 0.3). The median burn percentage was 5% (range, 1 to 41%) in the

Table 1
Demographic characteristics of patients according to the period of hospital admission.

	Period of Hospitalization		p-value[a]
	Pre-March (n = 145)	Post-March (n = 256)	
Age (years)			
0–2	52(35.9%)	83(32.4%)	
3–6	10(6.9%)	35(13.7%)	
7–12	7(4.8%)	12(4.7%)	
13–18	4(2.8%)	6(2.3%)	
19–25	9(6.2%)	10(3.9%)	0.525
26–44	31(21.4%)	62(24.2%)	
45–65	19(13.1%)	30(11.7%)	
>65	13(9%)	18(7%)	
Age (years)			
≤18	73(53.3%)	136(53.1%)	0.592
>18	72(49.7%)	120(46.9%)	
Sex			
Female	52(35.9%)	83(32.4%)	0.484
Male	93(64.1%)	173(67.6%)	
Nationality			
Turkish citizen	134(92.4%)	234(91.4%)	0.724
Other	11(7.6%)	22(8.6%)	

Data are given in number and percentage unless otherwise stated.
a: Chi-square test.

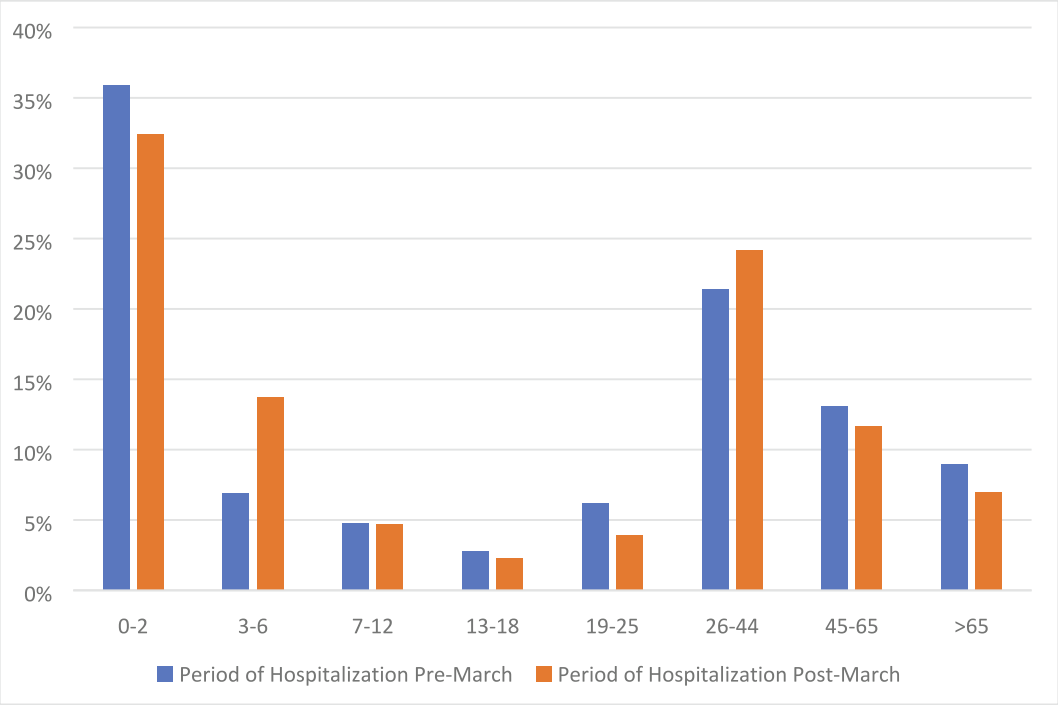

Fig. 1. Distribution of patients' ages according to the period of hospital admission.

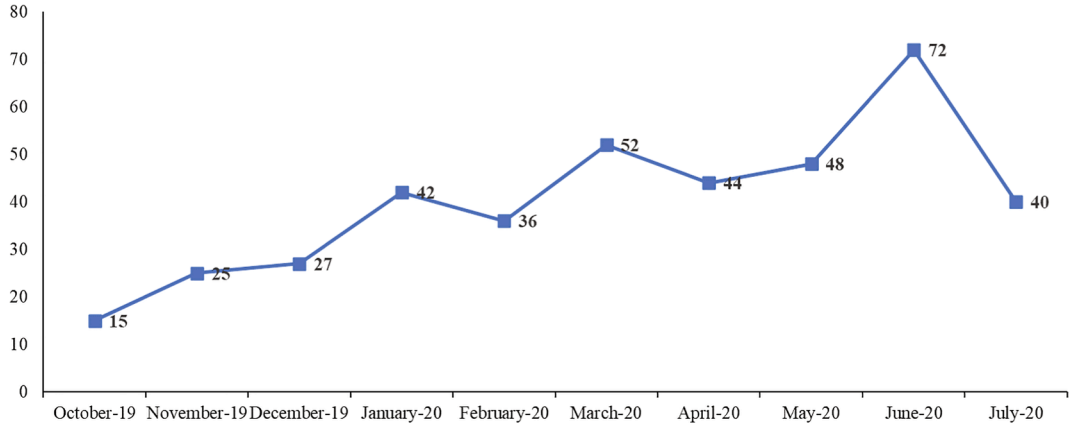

Fig. 2. Number of inpatients according to the month of admission.

Table 2
Distribution of patients according to the cause of burns, percentage of burns, and length of hospital stay.

	Period of Hospitalization		p-value
	Pre-March (n = 145)	Post-March (n = 256)	
Hospital stay (day)	4(0:73)	3(0:65)	0.372[b]
Burn Percentage	5(1:41)	5(1:81)	0.064[b]
Cause of Burn			
Scalding	90(62.1%)	157(61.3%)	
Flame	31(21.4%)	57(22.3%)	
Contact	12(8.3%)	14(5.5%)	
Chemical	9(6.2%)	15(5.9%)	0.529[c]
Electric	2(1.4%)	12(4.7%)	
Frostbite	1(0.7%)	1(0.4%)	

Data are given in median (min–max) and number and percentage unless otherwise stated.
b: Mann-Whitney *U* test, c: Fisher-Freeman-Halton test.

pre-March period and 5% (range, 1 to 81%) in the post-March period, indicating no statistically significant difference between the groups (p = 0.064). Scalding and flame were the most common causes of burns in both periods. There was no significant difference in the causes of burns between the two groups (p = 0.529). The patient distribution according to the cause of burns, percentage of burns, and hospital stay is presented in Table 2.

Furthermore, the causes of burns were compared between the Turkish citizens and Syrians according to the age groups (Table 3, Fig. 4). There was no significant difference between the Turkish and Syrian patients aged ≤ 18 years according to the causes of burns (p = 0.911).

The comparison of burn causes according to age groups is given in Table 4 and Fig. 5. Scalding was the most common burn agent in the patients aged ≤ 18 years both before and after March (72.6% *vs.* 73.5%, respectively). Although the rate was lower in the patients aged > 18 years, scalding was still the main cause of burns (51.4% *vs.* 47.5%, respectively). There was no significant difference between the pre-

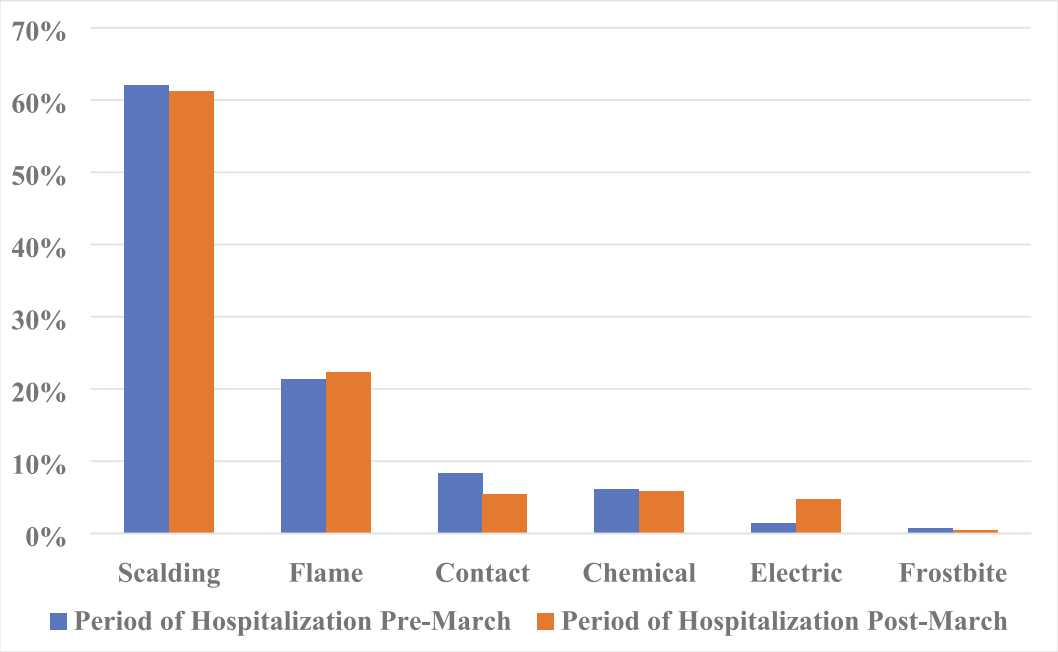

Fig. 3. Distribution of burn causes according to the period of hospital admission.

Table 3
Comparison of burn causes among Turkish citizens and Syrians according to age groups.

Age ≤ 18 years	Nationality		p-value
	Turkish Citizen (n = 184)	Syrian (n = 24)	
Cause of Burn			
Scalding	135(73.5%)	17(70.8%)	
Flame	26(14.1%)	4(16.7%)	
Contact	14(7.6%)	1(4.2%)	0.911[c]
Chemical	7(3.8%)	1(4.2%)	
Electric	2(1.1%)	1(4.2%)	
Age > 18 years	**Nationality**		**p-value[c]**
	Turkish Citizen (n = 184)	**Syrian (n = 5)**	
Cause of Burn			
Scalding	90(48.9%)	4(80%)	
Flame	55(29.9%)	1(20%)	
Contact	11(6%)	0	NA
Chemical	16(8.7%)	0	
Electric	10(5.4%)	0	
Frostbite	2(1.1%)	0	

Data are given in median (min–max) and number and percentage unless otherwise stated.
c: Fisher-Freeman-Halton test.

March and post-March periods according to the causes of burns (p = 0.493). Similarly, there was no significant difference in the causes of burns between the patients aged ≤ 18 years and > 18 years (p = 0.206). When the percentage of total burn area was examined, the median percentage was 5% (range, 1 to 40%) in the patients aged ≤ 18 years in the pre-March period and 5% (range, 1 to 23%) in the post-March period. The median percentage of total burn area was 4% (range, 1 to 41%) in the patients aged > 18 years in the pre-March period and 6% (range, 1 to 81%) in the post-March period. The median percentage of burns before and after March in the patients aged ≤ 18 years did not significantly differ between the pre-March and post-March periods (p = 0.651). The median percentage was considerably higher in the patients aged > 18 years in the pre-March period compared to the post-March period (p = 0.031).

The causes of the burns mainly were cooking, tea, and coffee spill in the scalding group, and work-related fires, picnic fires, and suicide incidents in the flame group.

4. Discussion

Our burn center was established in full service. It started patient admission in October 2019 with a total bed capacity of 26. The ward (12 beds) and intensive care units (14 beds) with 14 ventilators were arranged as single rooms, and only two rooms in the ward were arranged for double.

No patients were accepted at the burn center, except for patients with acute burns. Ventilators are used only when necessary for burn patients. Despite this, other hospital departments have been arranged to accept only emergency patients and patients with Covid-19.

Bursa City Hospital worked under quarantine conditions after March 2020. During March-July 2020, while 3913 patients with Covid-19 were followed in inpatients wards (mortality rate: 0,48%), 293 patients with Covid-19 were followed in intensive care units (mortality rate:47,7%).

We saw our patients one week after discharge, 15 days, first month, second month, and the third month in the outpatient clinic. Meanwhile, if they have different complaints, we recommended that they come early. We asked our patients whether they had COVID-19 or whether they had any findings of it during these controls. We did not find a positive answer for COVID-19 in any of them. We think that the absence of COVID-19 maybe because it is at the very beginning of the pandemic.

Republic of Turkey Health Ministry announced its website a daily number of cases and deaths with Covid-19 transparently [6]. We presented those data with a shortened graphic only March-July 2020 (Fig. 6).

Until March, healthcare workers continued to work under standard-setting in Turkey. After March, however, as a part of the pandemic measures, all burn units in the city stopped working, and our center was declared the only burn center was working in the area. The staff of our center followed the strict hygiene rules meticulously with the use of personal protective equipment; patient visits were not allowed, and only one person was admitted as a companion.

The number of patients in the burn center was steadily increasing

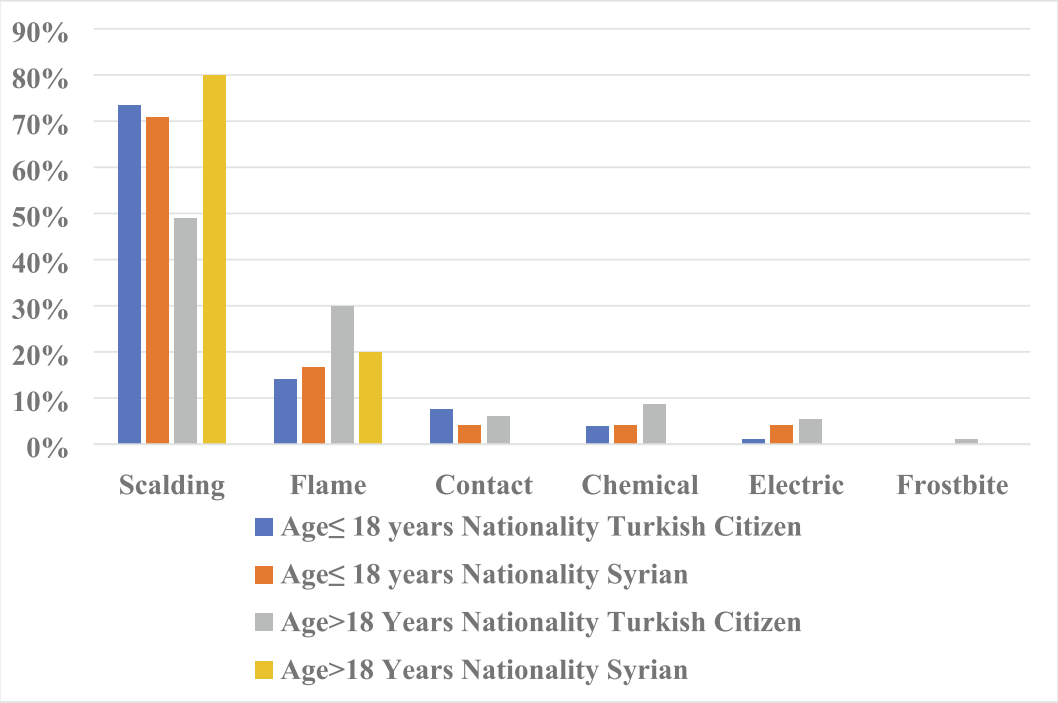

Fig. 4. Distribution of burn causes among Turkish Citizens and Syrians according to age groups.

Table 4
Comparison of burn causes between periods of hospitalization by age groups.

Age ≤ 18 years	Period		p-value
	Pre-March (n = 73)	Post-March (n = 136)	
Burn Surface Area	5(4) (1:40)	5(5) (1:23)	0.651[b]
Cause of Burn			
Scalding	53(72.6%)	100(73.5%)	
Flame	8(11%)	22(16.2%)	
Contact	6(8.2%)	9(6.6%)	0.493[c]
Chemical	5(6.8%)	3(2.2%)	
Electric	1(1.4%)	2(1.5%)	
Age > 18 years	**Period**		**p-value[c]**
	Pre-March (n = 72)	**Post-March (n = 120)**	
Burn Surface Area	4(5.75) (1:41)	6(9) (1:81)	**0.031[b]**
Cause of Burn			
Scalding	37(51.4%)	57(47.5%)	
Flame	23(31.9%)	35(29.2%)	
Contact	6(8.3%)	5(4.2%)	0.206[c]
Chemical	4(5.6%)	12(10%)	
Electric	1(1.4%)	10(8.3%)	
Frostbite	1(1.4%)	1(0.8%)	

Data are presented as median (Interquartile range) (minimum: maximum) and n %.
b: Mann-Whitney *U* test, c: Fisher-Freeman-Halton test.

over the months, and there was a significant increase in June and a decrease in July. This increase can be explained by the fact that it has become the only burn center in the region due to the COVID-19 pandemic. However, we think that evaluating the number of patients in the next years will reach a more accurate result in order to make an interpretation in terms of the difference between months.

However, Chu et al. [11] investigated patient admission rates at the burn center over the years and found a 28% decrease in the number of patients in 2020. D'Asta et al. [12] reported this decrease as 37%. They concluded that this was due to changing medical practices due to pandemic conditions and avoiding risk-related activities and that burns due to home accidents increased the most. Farroha et al. [10] also reported that the number of patients admitted to the burns ward decreased to 50% during the pandemic.

On the other hand, we often found a trend of increase in the number of admissions over the months. This increase in admission can be attributed to the fact that our center is the first burn center applied in the region. In addition, we found no significant difference between the pre-March and post-March periods in terms of home accidents or work accidents. This can be attributed to the fact that our center is the only burn center working, as the other burn centers started to provide service for COVID-19 only. We believe that further studies will provide more accurate results regarding the number and causes of patients in our burn center when the pandemic ends. Similar to our study, in the study of D'Asta et al. [12], scalding burns were the most common burns in children. Unlike this study, the length of hospital stay was not reduced in our study. These patients could have been followed in the outpatient setting; however, hospital discharge was postponed in many of them since the hospital visits might have been difficult due to lockdown on a regular basis across our country after March.

In December 2019, after the first COVID-19 cases were reported globally, necessary measures were taken in Turkey. Additional measures were taken with the first case reported in our country, and these were further tightened over time. Attention was made to gradual transitions in measures and practices. However, radical measures were introduced instantly, when necessary. In the study of Ince et al. [4], the first three weeks of the COVID-19 pandemic were evaluated using a chronological methodology, and measures for struggle with this pandemic were reviewed. Resources in many healthcare organizations were set up for COVID-19. Elective surgeries were postponed indefinitely. Nevertheless, since the burn center's patient profile was an unexpected group of diseases, the measures taken included preventive measures, and full capacity work continued. Interestingly, during lockdown days, when parents were at home, we encountered more frequent scalding cases in the pediatric age group, although this was not statistically significant than at other times.

In a study, Ma et al. [13] reported their experience with suggestions for medical practices for burn units during the COVID-19 outbreak. They

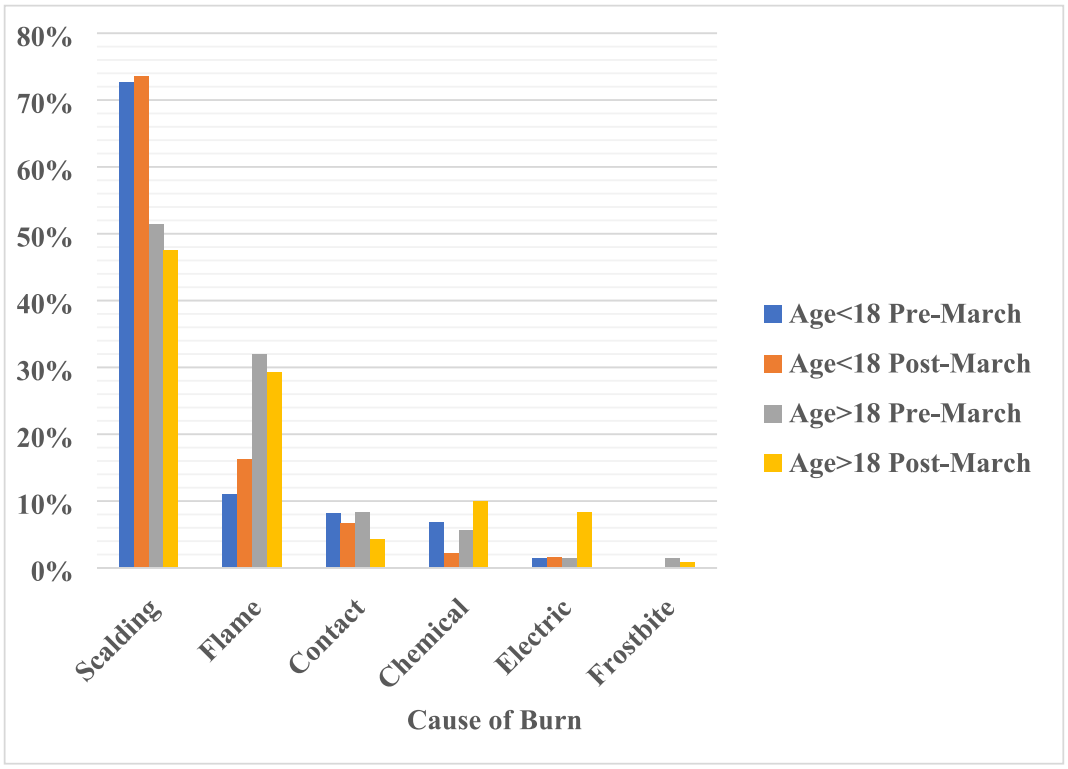

Fig. 5. Distribution of burn causes between periods of hospitalization by age groups.

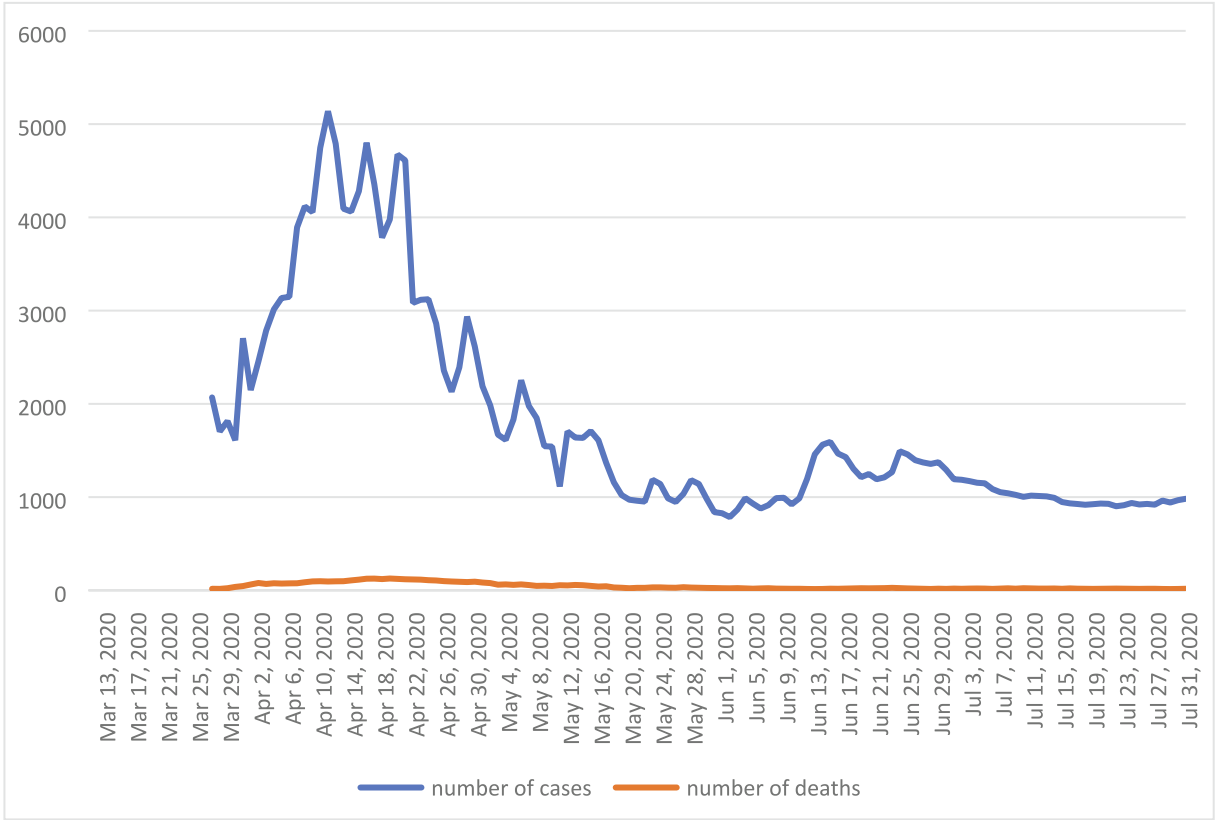

Fig. 6. Number of cases and deaths from COVID-19 in Turkey between March-July 2020 Until July 31, 2020, official Turkish statistics indicated a total of 230.873 Covid-19 cases, with 5691 fatalities.

suggested that for patients hospitalized for more than two weeks and had no symptoms of COVID-19 pneumonia, or newly admitted patients in whom COVID-19 infection was ruled out, surgical treatment could be arranged in a timely manner. In our study, we had no attempt to rule out COVID-19 in every patient admitted to our burn center. If there were no symptoms of COVID-19 infection, a PCR test was not performed. Only ten patients were tested for COVID-19 in the post-March period due to preoperative test, and none of them tested positive for COVID-19. In addition, twenty-two nurses are working in the burn center, and the nurses worked their scheduled shifts in the COVID-19 clinics on a monthly basis with a rotation to the burn center. The PCR test yielded seven nurses and a positive result for COVID-19 in two nurses, and they returned to work after quarantine and treatment.

In their study, Li et al. [7] designed their burn center as follows: all new inpatients, including pediatric burns, were isolated in a single room of the ward for 14 days without leaving the ward. Meanwhile, the patients with severe burns were admitted to the burn intensive care unit and were managed as a suspect of COVID-19 following the instruction of infectious disease specialists. After the new inpatients stayed in the ward for more than 14 days and the COVID-19 was ruled out, the patients were allowed to converge and stay in the ordinary ward. In our study, we had no such strict rules for quarantine. If the patient was not suspected of COVID-19, we applied routine treatment and care for burns. Also, we did not apply quarantine for 14 days after discharge. However, we advised on extra hygiene and safety measures. During follow-up, none of the patients had a COVID-19 infection. Based on these findings, we suggest that usual burn care and treatment can be maintained by applying extra-hygiene and safety measures in burn centers during the COVID-19 pandemic.

Hofmaenner et al. [14] reported no evident systemic findings in cases where the burn area was more than 15% of the enzymatic debridement. A study by Arkoulis et al. [15] stated that bromelain-based enzymatic debridement is a valuable tool in the burn unit. However, there is a need for studies that provide substantial evidence for its superiority to surgery. Ranno mentioned it in his letter as follows; In a study conducted in Italy, where the national healthcare system buckled under the weight of the COVID-19 pandemic, rapid enzymatic debridement significantly decreased the utilization of burn surgery. It was found to be effective in treating burns due to limited number of staff and decreased blood donation during pandemic [16]. However, as this treatment method has not been routinely applied in our center, we cannot provide a comment. Nonetheless, it is promising that enzymatic debridement reduces burn surgery and blood loss.

In addition, none of our patients in the study was positive for COVID-19, and, therefore, we are unable to comment on the treatment and follow-up of COVID-19 patients with burns. In the literature, there is no study on this subject; however, when we scanned the situation in patients who underwent major surgery and patients with COVID-19 from the literature, in a systematic review evaluating published literature on the management, clinical course, and outcome of COVID-19 infection in the liver, kidney, and heart solid organ transplant recipients. Aziz et al. [17] reported that COVID-19 infection had a similar presentation, clinical course, and outcome in the organ transplant patients as in the general surgical population. In the future, we are planning to report our results regarding burn patients with COVID-19 infection.

In an international, multi-center study evaluating burn center function during the COVID-19 pandemic, seven burns centers presented their experiences [18]. According to the results, each burn center should be prepared for burn care under harsh conditions, and in case of massive COVID-19 disease, the burn centers would be an important harbor for the healthcare workers, space, and equipment. In a report, Ilenghoven et al. [19] described their Malaysian experiences. They divided hospitals into three groups as *i)* full COVID-19 hospitals, *ii)* hybrid COVID-19 hospitals, and *iii)* non-COVID-19 hospitals. All COVID-19 burns were treated at full COVID-19 or hybrid COVID-19 hospitals, while non-burn COVID-19 patients were treated in non-COVID-19 and hybrid COVID-19 hospitals. The authors reported zero confirmed cases of transmission of COVID-19 infection to treating healthcare workers nationwide. In our study, none of the patients had COVID-19 infection and, thus, we were unable to share our experience. In our center, the nurses worked their scheduled shifts in the COVID-19 clinics on a monthly basis with a rotation to the burn center. The PCR test yielded a positive result for COVID-19 in two nurses, probable transmission from their families/relatives. They had a mild disease course and returned to work once the COVID-19 test negativity was achieved after quarantine and treatment. Although our hospital has active COVID-19 wards, no patient with COVID-19 visited our burn service until the end of July. As in all the world, the incidence of COVID-19 has been increasing in our country every day. From March to July 2020, there was no case infected with COVID-19 in our study. However, from the beginning of September 2020, COVID-19 positivity was confirmed in a few patients. In future studies, we are planning to study the effects of COVID-19 on burns.

Nonetheless, there are some limitations to this study. The very recent establishment history of our burn center, just a couple of months prior to the COVID-19 outbreak, limited the study period as before and after March. We believe that long-term results might have provided more accurate results since the distribution of burn patients may vary seasonally. In addition, the closure of burn centers and working as alternative pandemic hospitals at the beginning of the outbreak made our center the single burn center to be applied in the region. This may have precluded the accurate comparisons of the results.

5. Conclusion

In conclusion, burns are unforeseeable emergencies. Our study results showed no significant difference in the number of patient admissions, age and sex of the patients, burn agent, and length of hospital stay before and after the COVID-19 outbreak. All necessary preventive measures were applied in the burn center of the hospital. Meanwhile, Bursa City Hospital admitted such a large number of patients with COVID-19. Although burn patients were actively treated, we did not encounter any complications related to COVID-19. However, the pandemic affected all aspects of daily living. These findings may indicate that the burn center can work safely in the COVID-19 outbreak, paying special attention to the precautions mandated by the national and global health authorities.

However, the increase in the pandemic burden may force the burn centers to be converted into alternate COVID-19 facilities. In such cases, the care of burn patients may pose a great problem.

Ethical approval

This study was approved by the Bursa City Hospital Ethics Committee (Date: 29.07.2020-No. 2020-4/16).

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Conflict of interests

The authors declare they have no potential conflict of interest regarding the investigation, authorship, and/or publication of this article.

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Authors' contributions

S.D. concepted and designed the study; S.B. and Ş.A. collected data; S.D. wrote the manuscript. All authors read and approved the final manuscript.

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