



Seasonal effects on the mechanisms of burn injuries

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ABSTRACT

Objective: This study aimed to evaluate seasonal effects on the mechanisms of burn injuries in patients requiring hospitalization.

Material and Methods: A retrospective evaluation was made using the information of 419 hospitalized burns patients, including demographic data, degree and percentage of burn injury, cause and mechanism of burn injury, morbidity and mortality. Burn mechanisms were grouped as thermal burns (flame, boiling liquid, contact), chemical burns and electrical burns. When calculating the percentage of body surface area burned, the rule of nines was applied. Seasonal classification was made appropriate to the northern hemisphere.

Results: According to the seasons, the most burns were seen in spring months (n= 130, 31.0%). In the examination of the mechanism of burn injury, the most common type of injury was boiling liquid in 159 patients followed by flame injury in 146 patients. There was an increase in electrical and chemical burns in spring and summer. A statistically significant difference was determined between the types of burns according to the seasons (p= 0.024). The burn injury occurred as a result of a workplace accident in 82 cases, the majority of which were in autumn, and summer, and the difference in the seasons was determined to be statistically significant (p= 0.045). There was a statistically significant increase in the exposure of individuals aged >65 years to boiling liquid burns in winter and summer months (p= 0.014).

Conclusion: The results of this study showed a seasonal effect on the types of burn injuries. A higher rate of thermal burns was expected to be found in winter, but this was not the case in patients with indications for hospitalization, as chemical and electrical burns in workplace accidents were seen more frequently in warmer seasons of spring and summer. In this context, burns units should be prepared for patient profiles to vary according to the season.

Keywords: Burn injury, etiology of burns, seasonal effects

INTRODUCTION

Burn injuries are the fourth most common type of all traumas, with approximately 90% seen in under-developed and developing countries, causing severe morbidity and mortality (1,2). Previous studies have reported that the frequency and mechanism of injury show differences according to age, sex, socio-economic status, and season (3-6). There are evaluations in the literature on the relationship between thermal burns and seasons or between the increase in the use of resources and the seasonal increase in patient rates (7). However, no study could be found in the literature on the subject of the seasonal links to less commonly seen burn types other than thermal burns. Providing informative education for the community on public health problems such as burns involving the whole society is known to reduce the frequency. Moreover, raising the awareness of physicians of this seasonal relationship will allow them to be better prepared for burn traumas.

The aim of this study was to determine whether or not there was any seasonal difference in types of burn injuries, primarily thermal burns, but also other less frequently seen burn types.

MATERIAL and METHODS

Approval for this retrospective study was granted by the Local Ethics Committee (Decision no: E-19-2543, Date: 21.02.2019). The study was conducted in the Burns Treatment Centre between January 2017 and September 2019. All study procedures were applied in compliance with the 1964 Helsinki Declaration and later revisions, and the ethical standards of the institutional and/or national research committee.

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Demographic data of the patients, physical examination findings, degree of burn, percentage of burned body surface area, mechanism of burn injury, cause of burn injury, morbidity, and mortality were retrieved from computer files, patient records, operating notes, and anesthesia follow-up forms. Burn mechanisms were grouped as thermal burns (flame, boiling liquid, contact), chemical burns and electrical burns. The degree of the burns was classified by a burns unit specialist physician, and when calculating the percentage of body surface area burned, the rule of nines was applied. Areas of first-degree burns were not included in the calculations.

As Turkey is geographically located in the northern hemisphere, seasonal classification was made accordingly; the months of December, January, and February were accepted as winter, March, April, and May as spring, June, July and August as summer, and September, October, and November as autumn.

Statistical Analysis

The conformity of the continuous numerical data to normal distribution was assessed with the Kolmogorov-Smirnov test. As the data were seen to be normally distributed, the relationship between the seasons and the continuous data of age and burn percentage was investigated with the Kruskal Wallis test. Chi-

square test was applied to categorical data. A value of $p < 0.05$ was accepted as statistically significant.

RESULTS

Evaluation was made on 419 patients comprising 288 (68.7%) males and 131 (31.3%) females with a mean age of 41.92 ± 19.71 years (range, 0-91 years). Mean percentage of burned body surface area was $12.11\% \pm 16.83\%$ (1%-97%), and mortality developed in 32 (7.60%) patients.

According to the seasons, the most burns were seen in spring months ($n = 130$, 31.0%). In the examination of the mechanism of burn injury, the most common type of injury was boiling liquid in 159 patients followed by flame injury in 146 patients. There was an increase in electrical and chemical burns in spring and summer. A statistically significant difference was determined between the types of burns according to the seasons ($p = 0.024$). The burn injury occurred as a result of a workplace accident in 82 cases, the majority of which were in autumn, and summer, and the difference in the seasons was determined to be statistically significant ($p = 0.045$) (Table 1).

No statistically significant seasonal change was observed according to age ($p = 0.805$). When the patients were evaluated according to age and season, no significant difference was de-

Table 1. Demographic variables of burn patients grouped according to seasons

	Winter n (%)	Spring n (%)	Summer n (%)	Autumn n (%)	Total n (%)	p	Effect Size
Age (years)							
mean \pm SD	45.55 \pm 19.21	43.02 \pm 19.58	41.91 \pm 18.18	43.61 \pm 17.30	43.94 \pm 18.50	0.790	0.060
≤ 65	63 (%15.0)	87 (%20.8)	115 (%27.4)	89 (%21.2)	344 (%82.1)	0.014	
> 65	24 (%5.7)	16 (%3.8)	15 (%3.6)	10 (%2.5)	67 (%17.9)		
Burn type							
Electrical	3 (%7.9)	13 (%34.2)	14 (%36.8)	8 (%21.1)	38 (%9.1)	0.024	0.236
Chemical	1 (%3.7)	7 (%25.9)	10 (%37.0)	9 (%33.3)	27 (%6.4)		
Hot liquids	41 (%25.8)	34 (%21.4)	57 (%35.8)	27 (%17.0)	159 (%38.0)		
Flame	33 (%22.6)	36 (%24.7)	33 (%22.6)	44 (%30.1)	146 (%34.8)		
Heat contact	9 (%18.4)	13 (%26.5)	16 (%32.7)	11 (%22.4)	49 (%11.7)		
Total	87 (%20.8)	103 (%24.6)	130 (%31.0)	99 (%23.6)	419 (%100)		
Mortality							0.132
Negative	78 (%20.2)	100 (%25.8)	122 (%31.5)	87 (%22.5)	387 (%92.4)	0.064	
Positive	9 (%28.1)	3 (%9.4)	8 (%25.0)	12 (%37.5)	32 (%7.6)		
Industrial injury							
Negative	76 (%22.6)	82 (%24.3)	108 (%32.0)	71 (%21.1)	337 (%80.4)	0.045	0.138
Positive	11 (%13.4)	21 (%25.6)	22 (%26.8)	28 (%34.1)	82 (%19.6)		
Sex							
Male	57 (%13.6)	70 (%16.3)	94 (%32.6)	67 (%23.3)	288 (%68.7)	0.736	0.055
Female	30 (%22.9)	33 (%25.2)	36 (%27.5)	32 (%24.4)	131 (%32.3)		

*Pearson's Chi-square test $p < 0.05$ was considered statistically significant.

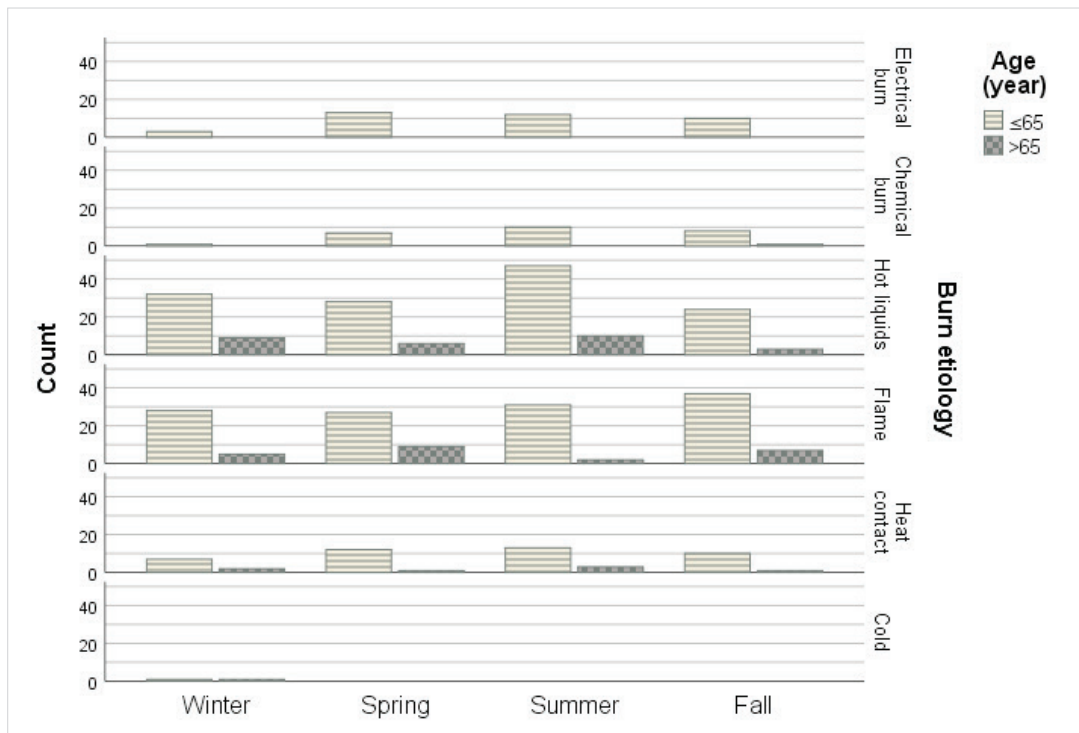


Figure 1. Burn causes classified by age.

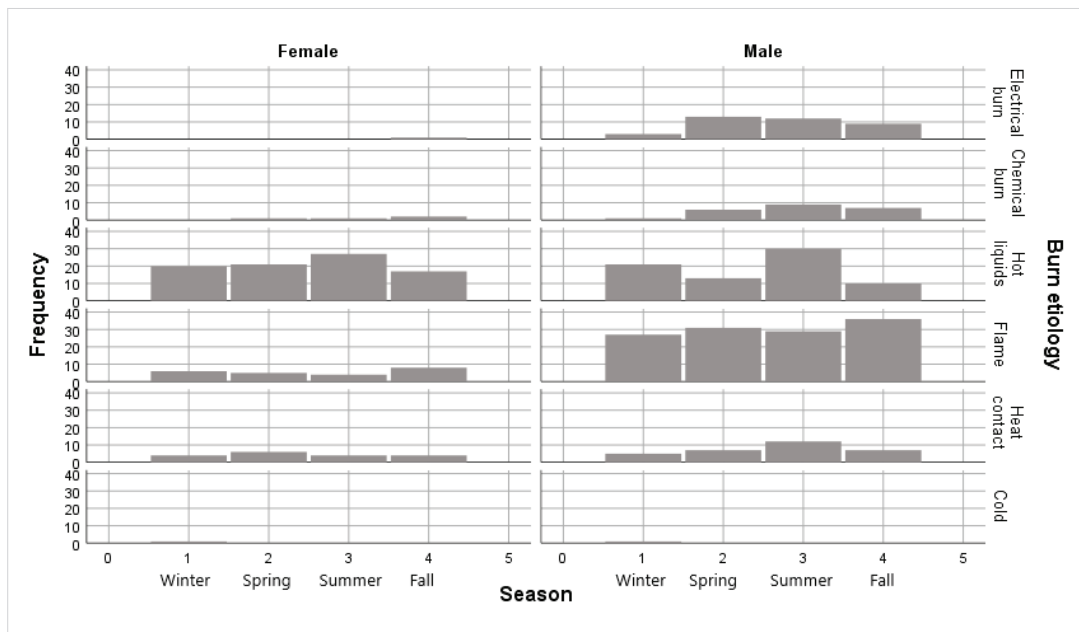


Figure 2. Fall=Autumn.

terminated between the groups ($p=0.790$). There was seen to be a statistically significant increase in the exposure of individuals aged >65 years to boiling liquid burns in winter and summer months ($p=0.014$) (Figure 1). Despite the lack of seasonal difference in respect of sex, there was a significant difference between the groups when they were evaluated in respect of sex, seasonal change, and cause of burn ($p<0.001$) (Figure 2).

The percentage of burned body surface area was seen to be greater in summer and autumn months on presentation at hospital ($p=0.006$), and seasonal comparison of the total burn area values was found to have a moderate clinical effect (effect size= 0.325) (Table 2).

Table 2. Comparison of burn area percentages by seasons

	Seasons				p	Effect Size
	Winter	Spring	Summer	Autumn		
Total burn area (%)	5 (1-97)	5 (1-60)	7 (1-85)	8 (1-95)	p= 0.006	0.325

* Kruskal Wallis test $p < 0.05$ was considered statistically significant.

DISCUSSION

There are studies in the literature which have reported that seasonal effects can have an impact on surgical outcomes, may increase hospital presentations, and could have positive or negative effects on the use of resources. It has been shown that seasonal status does not only affect burns patients, but can also affect breast cancer recurrence (8), high HbA1c levels (9), cardiopulmonary arrest (10), and admission to intensive care units (ICU) (11). Knowledge of these types of conditions can allow planning of resources and personnel in hospitals, ICUs, and burns centers, and even the provision of information to the community on this subject using mass communication tools.

Although the current study results showed no difference in patient sex according to the seasons, it has been reported in the literature that there is a higher rate of hospital presentation and admission of males than females, irrespective of season. For example, a large patient series in Germany has reported that males constituted approximately 70% of all burn injury patients (12). Studies from other countries have shown similar results. In a study by Schiefer et al. it has been shown that the presentation rate of male patients was higher in all months, and in summer months, this rate was further increased. The same study has reported that the rates of female patients were relatively increased in the months of December, January, February, and March (13). Consistent with these findings in the literature, the rate of male patients in the current study was 68.7%.

When the patients were evaluated in respect of age and season, there was no difference between the groups ($p = 0.790$), but in winter and summer months, individuals aged >65 years were seen to be more exposed to boiling liquid burn injuries. Similar to the findings of Williams et al. (14), the main reason for this was thought to be that these patients spent more time at home in these periods and probably were exposed to accidents in the house.

There are different opinions on the subject of the seasonal relationship with the development of burns. While there are studies from developed countries showing no difference between the seasons of the year in respect of burns injuries (12,13) studies from developing countries have reported seasonal differences (14,15). One of the noticeable points in the studies published in developing countries is that the causes of burns are directly affected by conditions such as the geographic features of the

region, seasonal condition, and the level of development. For example, in a study published by the Tampa General Regional Burns Centre, burns patient admissions reached a peak immediately after the end of the hurricane season related to accelerants used for the destruction of rubble (16). In a large-scale ($n = 3515$) pediatric study in Australia, winter has been reported to be the season of most boiling liquid and flame injuries, but this has not been observed for contact burns (17). Hultman et al. have evaluated 740 patients and reported that spring was the season with the highest rate of hospitalizations (15). In another study of 1600 patients in the Dominican Republic, it has been reported that the demographic profile was seen to have an effect on electrical burns, but there was not seen to be any statistically significant difference in the mechanisms of burn injury according to season (7). Tyler et al. have shown that the frequency of boiling liquid and flame burns was greater and although the seasons had no effect on mortality, the incidence of burns was higher in the winter months (5). In the current study, summer was seen to be the season of most hospitalizations.

Although patient hospitalizations have been reported in the literature to be higher in autumn and winter, the seasonal shift to summer seen in the current study was thought to be due to the conversion from apartment block central heating systems to individual home heating in the last 15 years in this region where our center is located, as it is a region which is highly developed. Williams et al. have similarly evaluated a 10-year period of hospital admissions, and despite an increase in winter, in the last two years there was an increase in presentations at the burns center in the summer similar to in winter (14). No reasons for this were given by Williams et al. but in the current study, this was thought to be due to an increase in workplace accidents in summer and the fact that in the rural areas of our region, it is traditional at the end of summer to prepare sauces, molasses and cheese over an open fire, and that chemical and electric burns could contribute to these results in the warmer months of spring, summer and autumn.

The most important limitation of this study is its retrospective design. However, our clinic is the most important reference burns center in the region, and records have been kept electronically for more than ten years in addition to the written records system still being maintained, and therefore, data loss can be considered to be at a minimum level.

CONCLUSION

The results of this study clearly showed that there was a seasonal effect on the mechanisms of burn injuries. It was also seen from literature review that seasonal predominance and the mechanisms of burn injuries could show differences. The results of the current study demonstrated an increase in electrical and chemical burns in warmer months. In this context, it can be seen to be necessary for burns units to investigate seasonal incidences of the region and to be prepared for potential accidents.

Ethics Committee Approval: The study was approved by the Local Ethics Committee (Decision no: E-16-912, Date: 21.02.2019)

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**ORJİNAL ÇALIŞMA-ÖZET**

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Mevsimlerin yanık mekanizmaları üzerine etkileriBülent Çomçalı¹, Cengiz Ceylan², Buket Altun Özdemir¹, Serhat Ocaklı¹, Hikmet Pehlevan Özel³, Ahmet Çınar Yastı¹¹ Ankara Şehir Hastanesi, Genel Cerrahi Kliniği, Ankara, Türkiye² Bingöl Devlet Hastanesi, Genel Cerrahi Kliniği, Bingöl, Türkiye³ Beypazarı Devlet Hastanesi, Genel Cerrahi Kliniği, Ankara, Türkiye**ÖZET****Giriş ve Amaç:** Bu çalışmanın amacı yatış gerektiren yanıklarda mevsimlerin yanık mekanizmaları üzerinde etkisini ortaya koymaktır.**Gereç ve Yöntem:** Çalışmada yatış gerektiren 419 yanık hastasının demografik verileri, yanık derece ve yüzdelerine, yanık yaralanma mekanizmaları, yanık nedenleri ve mortalite, morbidite bilgileri retrospektif olarak elde edildi. Yanık mekanizmaları termal yanıklar (alev yanığı, haşlanma yanığı, temas yanığı), kimyasal ve elektrik yanıkları olarak gruplandırıldılar. Yanık yüzdeleri hesap edilirken yüzey alanına göre dokuzlar kuralı kullanılarak hesaplandı. Mevsimsel ayırım kuzey yarım küreye göre yapıldı.**Bulgular:** Mevsimlere göre en fazla yanık 130 hasta (%31,0) ile ilkbaharda olduğu görüldü. Yanık mekanizmalarından en fazla yanık türü 159 hasta ile haşlanma yanığı ve bunu takiben 146 hasta ile alev yanığı izlenmekteydi. Elektrik ve kimyasal yanıkların daha çok ilkbahar ve yaz aylarında sıklığının arttığı görüldü. Yanık türleri ile mevsimler arasında istatistiksel olarak anlamlı farklılık olduğu görüldü ($p=0,024$). Vakaların 82'si iş kazası olmakla birlikte çoğunluğu sırası ile sonbahar ve yaz mevsimlerinde olduğu görüldü ve iş kazaları ile mevsimler arasında istatistiksel olarak anlamlı farklılık görüldü ($p=0,045$). Kış ve yaz mevsiminde 65 yaş üzeri bireylerin haşlanma ve nedenli yanık yaralanmasına anlamlı oranda daha fazla maruz kaldıkları görüldü ($p=0,014$).**Sonuç:** Mevsim değişikliklerinin yanık türlerindeki etkisi görülmekle birlikte, kış mevsimlerinde özellikle termal yanıkların daha sık olması beklenirken, yatış endikasyonu olan hastalarda bunun beklendiği gibi olmadığı görüldü ve özellikle iş kazalarında daha sık görülen kimyasal, elektrik yanıklarının yaz ve ilkbahar gibi sıcak mevsimlerde olduğu görüldü. Bu anlamda, yanık birimleri mevsimlere göre değişen hasta profillerine hazırlıklı olmalıdır.**Anahtar Kelimeler:** Yanık yaralanmaları, yanıkların nedenleri, mevsimsel etki**DOI:** 10.47717/turkjsurg.2022.5377