

## **Burn Injuries Prevalence, Causes, Complications and Improvement in Northern Saudi Arabia**

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### **Abstract**

**Background:** Burn is a major public health problem worldwide associated with significant morbidity and mortality. It occurs in any age group with majority among children and old age and may range in severity from very minor requiring no treatment to extremely severe requiring highest level of intensive treatment.

**Objective:** This study was designed to investigate burn injuries prevalence, causes, complications and improvement in Northern Saudi Arabia.

**Methods:** A cross-sectional study was conducted in Northern Saudi Arabia during the period from 10 October to 30 November 2018. Data collected using by a pre-designed online questionnaire. Collected data was coded and analyzed using statistical package for the social sciences (SPSS, version 22). P-value of less than 0.05 considered statistically significant.

**Results:** Our study reported that there were 66.4% of the participants had history of burns. Hot water as the most common cause by 58.5% followed by flaming fire by 32.1%, sun rays 3.6%, electric shock and chemicals 2.7% and only 0.3% for severe cold. Hands were the most common site by 56.9% followed by arm 12.45, leg 9.6% and foot 6.6%. First degree found in 71.1%, second degree in 25%, third degree in 2.2% and only 0.5% were fourth degree. Skin disfigurements the most common complications by 17% followed by secondary bacterial infection of the burn site 9.3% and 2.7% for wide scare. Burns was more prevalent among females 79.4% than males 20.6% ( $p = 0.04$ ).

**Conclusion:** Our study reported that there were 66.4% of the participants in Northern Saudi Arabia had history of burns. Hot water as the most common cause followed by flaming fire. Health education to the public about the importance of the problem and first aid management is mandatory.

**Keywords:** Burn Injuries; Prevalence; Causes; Complications; Northern Saudi Arabia

### **Introduction**

A burn is a thermal injury caused by biological, chemical, electrical and physical agents [1]. These kinds of injuries are frequent and have a larger prevalence among economically and culturally marginalized countries. Emergency services in the United States treat 500,000 patients with burns each year. 46% of them are caused via flame and cause about 3,500 deaths/ year [2].

Thermal burns involve the skin. Scalds caused by hot fluid or steam. Contact burns caused by hot solids or objects such as much hot pressing irons or cooking utensils, as like nicely as lighted cigarettes. Flame burns caused by flames or incandescent fires, such as like those started by lighted cigarettes, candles, lamps or stoves. Chemical burns caused by exposure to a chemical substance such as strong

acids or alkalis. Electrical burns caused by an electrical current through the body. Inhalational burns are the result over respiration in heated gases, steam, hot liquids and unhealthy merchandise of incomplete combustion causing thermal or chemical injury to the airways and lungs [3]. And accompany a skin burn in approximately 20% to 35% of cases. Inhalational burns are the most common cause of death among people suffering fire related burn [4].

Classification by the degree and depth of a burn, first-degree or superficial burns, second-degree or partial-thickness burns, third-degree or full-thickness burns. In adults, a full-thickness burn will occur within 60 seconds if the skin is exposed to hot water at a temperature of 53°C [5]. Classification by extent of burn the extent of burn, clinically referred to as the total body surface area burned is defined as the proportion of the body burned [6].

First aid for referral dissipating the heat is the advance objective as tissue temperatures over 45C continue to cause local injury [5]. Cooling with running tap water for 10 minutes is essential as this removes as much heat as possible, helps reducing the initial pain [7,8] and decreases edema in the wound [9]. Wounds should be cleaned with a bland soap. Chlorhexidine gluconate soap is preferred by some because of its activity against regular skin flora [10]. Tar and asphalt burns should be cooled first. The causing agents will stick to the skin. Peeling of these materials may do further harm to the skin thus it is better to use a solvent [11]. Many chemical lesions may benefit from rinsing with water as well as this at least dilutes the agent. However, in many cases, more specific measures are necessary [12,13]. In larger burns, administration of IV fluids may be indicated prior to transporting the patient to a burn center if transportation may take long time. Ringers lactate should be infused at 2 - 4 ml/kg/percentage TBSA [14]. There is overwhelming evidence that childhood burns are generally naturally molded and preventable [15].

A study carried out in Shiraz, Iran. A total number of 713 patients, 510 (71.5%) male and 203 (28.5%) female, 304 (42.6%) patients were evaluated with second and more degree of burn. 200 (65.8%) were male and 104 (34.2%) were female. The range age of patients was from 1 to 91 years old with the mean age of 32.03 ± 12 years. According to the sex ratio of patients in different years of study it has been shown that the ratio of male to female in year 2014 had a higher proportion in comparison with the two other years of study. Comparing the results in pediatric ward during the time of study showed that the number of patients has been declining by 31 percent and the deterioration of patients is significantly decreased as well.

This study was designed to investigate burn injuries prevalence, causes, complications and improvement in Northern Saudi Arabia.

## Methods

**Study design:** A cross-sectional study was conducted in Arar and Tabuk cities, Northern Saudi Arabia during the period from 1 October to 30 November 2018.

**Participants:** This study included 584 randomly selected participants aging between 0- 60 years old (General female population of Arar and Tabuk cities, KSA).

**Data collection:** by a pre-designed online questionnaire. It was filled by participants after a brief introduction or explanation of the idea of the research to the public. Sampled cases filled out the predesigned questionnaire to collect demographic and socioeconomic data including:

- Socio-demographic characteristics of the participants including age and sex of child.
- If the participant had burn injury.
- Questions to detect site, cause, complication and improvement of burn.

**Statistical analysis**

Collected data was coded and analyzed using statistical package for the social sciences (SPSS, version 22). Descriptive statistics for the prevalence and quantitative variables was used. Relation between burn injury and other variables was determined using the chi-square test. P-value of less than 0.05 considered statistically significant.

**Ethical considerations**

Participants were informed that participation is completely voluntary and data collectors introduced and explained the research to participants. No names were recorded on the questionnaires. All questionnaires were kept safe.

**Results**

Table 1 show the socio-demographic characteristics of the studied population and BMI group and prevalence of history of burn among the studied cases. The study included 548 cases, the majority of cases aged 20 - 30 years old 40.3% followed by 34.3% for cases aged less than 20 years. Females represent 77%, male 23%. Among studied cases there were 60.4% single and 37.2% married. 65.7% not working and 34.3% working. There were 81.6% had university education or more, 17% secondary educated and only 1.4% illiterate and basic education. Normal weigh group represent 53.8% of cases followed by overweight 24.6%, obese 16.8% and 4.7% were underweight. History of burns was reported in 66.4% of studied population.

Age group	Frequency	Percent
< 20	188	34.3
20 - 30	221	40.3
31 - 40	83	15.1
> 40	56	10.2
Sex		
Female	422	77.0
Male	126	23.0
Marital status		
Widow/divorced	13	2.3
Single	331	60.4
Married	204	37.2
Working status		
Not working	360	65.7
Working	188	34.3
Educational level		
Illiterate and basic	8	1.4
Secondary	93	17.0
University or more	447	81.6
BMI group		
Underweight	26	4.7
Normal	295	53.8
Overweight	135	24.6
Obese	92	16.8
History of burn		
Yes	364	66.4
No	184	33.6

**Table 1:** Socio-demographic characteristics of the studied population and BMI group and prevalence of history of burn among the studied cases, Arar, 2018 (N = 548).

Table 2 show relationship between History of burn and socio-demographic characteristics of the studied population. There was a statistical significant among history of burns and sex (p = 0.04), it was more prevalent among females 79.4% than males 20.6%. However, there was no significant correlations with age group and working status (p = 0.122), (p = 0.324) respectively.

Variable	Responses	History of burn		Total (N = 548)	P value
		Yes (N = 364)	No (N = 184)		
Age group	< 20	130	58	188	0.122
		35.7%	31.5%	34.3%	
	20 - 30	148	73	221	
		40.7%	39.7%	40.3%	
	31 - 40	46	37	83	
		12.6%	20.1%	15.1%	
> 40	40	16	56		
	11.0%	8.7%	10.2%		
Sex	Female	289	133	422	0.040
		79.4%	72.3%	77.0%	
	Male	75	51	126	
		20.6%	27.7%	23.0%	
Working status	No work	242	118	360	0.324
		66.5%	64.1%	65.7%	
	Work	122	66	188	
		33.5%	35.9%	34.3%	

**Table 2:** Relationship between History of burn and socio-demographic characteristics of the studied population among the studied cases, Arar, 2018 (N = 548).

Table 3 show burn related variables among the studied cases. Hand was the most common site of burns by 56.9% followed by arm 12.4%, leg 9.6%, foot 6.6%, back and buttocks 4.8% and chest 2.5%. A regards causes of burns we reported hot the most common causes by 58.5%, flaming fire 32.1%, sun rays 3.6%, 2.7% for chemicals and electrical shock and only 0.3% for severe cold. Size of burns was 5 - 10 cm in 47.3% of cases, 29.9% less than 5, 10.75% more than 10 and 12.1% was unknown. First degree burns was the most common type by 71.7%, second 25%, third 2.2% and fourth degree represent only 0.5%. Skin disfigurements was the most common complications reported by 17%, secondary bacterial infection of the burn site 9.3% wide scare by 2.7%, negative psychic impact due to disfigurements 2.2%, abscess formation 1.4% and the least one was bone and joints problem 0.3%. There were 37.1% seeking for medical care. Regarding to treatment creams and ointments used by 59.6% of cases, herbal treatment 39% bandages 9.6% and only 2.5% for surgical treatment. Improvement of burns occurred in 79.95 of cases.

Site of burn	Frequency	Percent
Hand	207	56.9
Arm	45	12.4
Leg	35	9.6
Foot	24	6.6
Back and buttocks	17	4.8
Chest	9	2.5
Thighs	8	2.3
Face	5	1.4
Abdomen	4	1.1
Head	4	1.1
Supra pubic area	1	.3
Neck and shoulders	1	.3

<b>Cause of burn</b>		
Hot water	213	58.5
Flaming fire	117	32.1
Sun rays	13	3.6
Electric shock	10	2.7
Chemicals	10	2.7
Sever cold	1	.3
<b>Burn size</b>		
< 5	109	29.9
5 - 10	172	47.3
> 10	39	10.7
Unknown	44	12.1
<b>Season</b>		
Summer	222	61.0
Winter	101	27.7
Spring	28	7.7
Autumn	13	3.6
<b>Degree of burn</b>		
1st	261	71.7
2rd	91	25
3nd	8	2.2
4th	2	.5
<b>Complications</b>	102	28.0
<b>Type of complications</b>		
Skin disfigurements	62	17.0
Secondary bacterial infection of the burn site	34	9.3
Wide scare	10	2.7
Negative psychic impact due to disfigurements	8	2.2
not justified symptoms are not justified	5	1.4
Abscess formation	5	1.4
Bone and joint problems	1	.3
<b>Seeking medical care</b>		
No	229	62.9
Yes	135	37.1
<b>Type of treatment</b>		
Creams and ointments	217	59.6
bandages	35	9.6
Surgical treatment	9	2.5
Herbal treatment	103	39.0
<b>Improvement of burn</b>		
No	73	20.1
Yes	291	79.9

**Table 3:** Burn related variables among the studied cases, Arar, 2018 (N = 364).

Table 4 show the relationship between improvement of burn and age, sex and burn related variables among the studied cases. We found that there was significant relations between improvement of burn and age (p = 0.001), burns size (p = 0.04) and diagnosis and treatment (p = 0.000).However, there were no relation with sex (p = 0.124), degree of burns (p = 0.559), cause of burns (p = 0.557), complications (p = 0.273), season (p = 0.705) and BMI group (p = 0.129).

Variables	Responses	Improvement of burn		Total (N = 364)	P value
		Yes (n = 291)	No (n = 73)		
Age group	< 20	98	32	130	0.001
		33.7%	43.8%	35.7%	
	20 - 30	111	37	148	
		38.1%	50.7%	40.7%	
	31 - 40	44	2	46	
		15.1%	2.7%	12.6%	
> 40	38	2	40		
	13.1%	2.7%	11.0%		
Sex	Female	227	62	289	0.124
		78.0%	84.9%	79.4%	
	Male	64	11	75	
		22.0%	15.1%	20.6%	
Degree of burn	1 <sup>st</sup>	207	54	261	0.559
		71.1%	74.0%	71.7%	
	3 <sup>rd</sup>	7	1	8	
		2.4%	1.4%	2.2%	
	2 <sup>nd</sup>	75	16	91	
		25.8%	21.9%	25.0%	
4 <sup>th</sup>	1	1	2		
	.3%	1.4%	.5%		
Burn size (in cm)	< 5	78	31	109	0.044
		26.8%	42.5%	29.9%	
	5 - 10	146	26	172	
		50.2%	35.6%	47.3%	
	> 10	30	9	39	
		10.3%	12.3%	10.7%	
Don't know	37	7	44		
	12.7%	9.6%	12.1%		
Cause of burn	Sun rays	9	4	13	0.557
		3.1%	5.5%	3.6%	
	Sever cold	1	0	1	
		.3%	.0%	.3%	
	Electric shock	9	1	10	
		3.1%	1.4%	2.7%	
	Chemicals	9	1	10	
		3.1%	1.4%	2.7%	
	Hot water	174	39	213	
		59.8%	53.4%	58.5%	
Flaming fire	89	28	117		
	30.6%	38.4%	32.1%		

Diagnosis and treatment	No	165	60	225	0.000	
		56.7%	82.2%	61.8%		
Yes	126	13	139	0.273		
		43.3%	17.8%			38.2%
Complications	No	212	50			262
		72.9%	68.5%			72.0%
Yes	79	23	102		0.708	
		27.1%	31.5%			28.0%
Season	Autumn	9	4	13		
		3.1%	5.5%	3.6%		
	Spring	23	5	28		
		7.9%	6.8%	7.7%		
	Winter	83	18	101		
		28.5%	24.7%	27.7%		
Summer	176	46	222			
	60.5%	63.0%	61.0%			
BMI group	Underweight	12	3	15		
		4.1%	4.1%	4.1%		
	Normal	148	48	196		
		50.9%	65.8%	53.8%		
	Overweight	76	14	90		
		26.1%	19.2%	24.7%		
Obese	55	8	63			
	18.9%	11.0%	17.3%			

**Table 5:** Relationship between Improvement of burn and age, sex and burn related variables among the studied cases, Arar, 2018 (N = 364).

### Discussion

Burn is a major public health problem worldwide associated with significant morbidity and mortality. It occurs in any age group with majority among children and old age and may range in severity from very minor requiring no treatment to extremely severe requiring highest level of intensive treatment. There are various causes for burn injuries as flame, hot water, chemicals, electricity and radiation. As per the World Health Organization, burns account for an estimated 300,000 deaths annually, majority (> 95%) of which occur in developing countries, with the Southeast Asia region contributing to 57% of the deaths [17].

This across sectional study was conducted among 548 of studied cases Arar, KSA. The study aim to investigate burn injuries prevalence, causes, complications and improvement in Northern Saudi Arabia.

Our study reported that there were 66.4% of cases had history of burns. Another cross sectional study was done among the Saudi population in medina city among 281 participants, the majority of them had burned 69.4% [18]. Another study reported high prevalence of burns, there were 88.5% of cases had burns [19]. The annual incidence of burns has been reported by several studies. All age incidence of burns ranges from 112 to 518 per 100,000 per year [20,21]. A higher incidence of 1,388 per 100,000 per year is reported amongst children below 5 years by a study from Pakistan [22]. Another population-based study reported, the overall incidence of burns was 27.9/1000 person-years [23].

As regards the causes of burns this study reported hot water as the most common causes by 58.5% followed by flaming fire by 32.1%, sun rays 3.6%, electric shock and chemicals 2.7% and only 0.3% for severe cold. Similar to our result another study found that the majority of cases 42.6% burned by hot liquid, 24.6% flame, 20% hot surface, 9.7% electrical and 2.6% chemicals [18]. A retrospective study of all burn injury cases (277) admitted to King Fahd Hospital Al-Baha, burns (mostly from hot water and tea) were the main injuries sustained (49.1%), followed by flame burns (37.5%), electrical 7.6% and chemicals 3.6% [25]. In Bangladesh, another study reported that contact with hot liquids causing burns (57%), such as cooking oil appeared to cause the greatest number of burn injuries, other sources were flame (25%), contact with hot objects (16%), explosives and chemical [28]. However, in Iran another study found that fire was the most common cause of burns followed by hot liquid [29]. This was confirmed by several studies [30-32].

As regards site of burns our study reported, hand the most common site by 56.9% followed by arm 12.45, leg 9.6% and foot 6.6%. Another study reported, 90.3% of participants were burned on Periphery (arms, limbs, foot, hands), 6.7% on their face and 2.1% on abdomen and back [18]. Another study reported, the upper limbs were involved in 66.8%, followed by lower limbs (49.1%), head and neck regions (48.4%) and trunk (44%), genital and perineal areas were the least affected (9%) [8]. Another study reported, head was the most frequent area affected (53.3%) followed by lower limb 40% [37]. Another study reported, thorax and abdomen (67.9%) were the most common areas involved in all types of burns, while the head and neck, upper extremity and lower extremity were involved in 34.9%, 55.1% and 44.9% respectively [40].

Regarding to degree of burn our results showed that the majority was first degree 71.1%, second degree 25%, third degree 2.2% and only 0.5% for fourth degree. Another study reported that the degree of burning was superficial burning sensation with redness (first degree) on 69.2%, second degree 29.7% and only 1% for third degree [18]. However, another study found that 45.5% of cases had second degree followed by mixed degree 38.6%, deep second 9%, third 4.8% and only 1.6% for first degree [35]. Another study reported that the majority of our patients were admitted with second-degree burns (48.7%) [36]. In Egypt another study reported most cases were either mixed second and third degree burns or isolated second degree (49.2% and 44.3% respectively) [39]. In India another study reported that the majority of the cases belonged to third-degree burns (64.6%), while the rest (35.4%) were first and second degree [40].

Our study reported that the majority of burns occurred during summer 61%, 27.7% during the winter, 7.7% during the spring and 3.6% during autumn. In contrast to our result another study found a slight insignificant seasonal variation in the frequency of burns was observed, with high incidence in spring (28.5%) and winter (27.8%) and fewer occurrences in summer (23.8%) and autumn (19.9%) [25]. Another study was conducted in Jeddah, reported the highest occurrence of burns was in autumn (35.7%) and the lowest was in spring (10.7%) [27]. In Egypt another study found that a higher percentage of burns was occurred in winter months compared to other seasons of the year which is maybe probably due kerosene stoves (which is still in use in many low socioeconomic areas of Egypt) for boiling water and producing warmth [37]. That was also reported in other studies in Ain Shams University Burns Unit done by Hemada, *et al* [38].

Regarding to relation between burns and gender our study found that it was more prevalent among females 79.4% than males 20.6% and there was a significant correlation between burns and gender ( $p = 0.04$ ). In agreement with our result another study reported, female were more affected than male by 74% to 26% female to male [18]. Similar study in south Asian found that female also was more affected than male. In some culture, females are responsible for daily household activities more than male. This is the reason that more females sustain flame burn compared to males [23]. Another study reported that female burn victims were significantly higher in number than males without obvious reasons [25]. In contrast to our result another study was conducted among 407 patients with acute burn injuries, the prevalence was higher among males (67.3%) than females (32.1%) [34].



Our study reported that there was no significant correlations between burns and age ( $p = 0.122$ ) and it was more prevalent among age group 20 - 30 years by 40.7%. However another study found that children up to 10 years of age were the main victims (59.2%), which agrees with other reports [26,27]. Such high incidence of burns among children is probably due to large families in the community, and the fact that a lot of time is spent at home.

According to complications of burns our study reported skin disfigurements the most common one by 17% followed by secondary bacterial infection of the burn site 9.3% and 2.7% for wide scare. Another study reported, the commonest complication was burn wound sepsis most frequently by a gram-negative bacilli (65.63%) of which *Pseudomonas aeruginosa* were that commonest organisms [33]. In India another study found that septicemia and disseminated intravascular coagulation were the major complications in the post-resuscitation phase (51.4%) while aspiration pneumonia, hematemesis and gastric dilation were seen in 16.9%, 10.1% and 2.7% patients respectively, as far as late outcome is concerned hypertrophic scar (62.3%) is the most common outcome, rest are alopecia (22.1%), contractures (18.2%) and amputation (2.4%) [40].

## Conclusion

Our study reported that there were 66.4% of the participants in Northern Saudi Arabia had history of burns. Hot water as the most common cause followed by flaming fire. Health education to the public about the importance of the problem and first aid management is mandatory.

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