Elderly And Burn Injuries: A Ten-Year Analysis of 612 Patients

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Abstract

Background: With all the progress made in geriatric medicine, we expect to have a growing population of elderly soon. With burn injuries, as one of the most common unpredictable injuries to the elderly, it is essential to clarify the epidemiological pattern and factors related to worse outcomes in geriatric burn patients. We aimed to investigate burn characteristics in the elderly in Guilan province, IRAN, in ten years.

Methods: This study conducted a retrospective analysis of burn patients aging 60yrs and over in Velayat Burn Center between 2010 and 2020. The data collected from the hospital information system included age, sex, marital state, occupation, residency, season and month of the incident, place of incident, total body surface area (TBSA), burn degree, cause of the burn, anatomical site of the injury, pre-injury morbidities, surgical managements, length of hospital stay and mortality.

Results: Among 612 patients, the mean age was 72.20±8.94 years. The female to male ratio was 1.14:1 with a total of 53.3% female burn patients. 94.90% of patients lived with family members. 59.3% lived in urban areas. Most of the burn injuries happened during winter and summer. 82.5% happened indoors. The mean was 19.70±22.13%. The most common causes were flames (50.0%) and scalds (44.3%). The mean length of hospital stay (LOS) was 6.14±6.27 days. The overall mortality rate was 15%.

Conclusion: We concluded that most burn injuries among the geriatric population happen indoors, during the first hours of the day, and on the first day of the week, making it essential to establish special prevention programs suiting these situations. On the other hand, with the increased life expectancy and the unpredictable nature of burn injuries, it is essential to identify risk factors and establish prevention programs for the elderly.

Introduction

The geriatric population _individuals aged 60 years and more_ are high-risk for burn injuries due to their age-related complications such as decreased physical strength, an impaired protective mechanism, poor vision, longer reaction time, abuse, and neglect (1, 2). As life expectancy increases, the incidence of burn injuries raises in the elderly as well (3). Burn injuries can have worse outcomes in the elderly since wound healing in this population is delayed, leading to morbidities, prolonged hospital stays, and mortalities (4). Previous studies showed that 23.7% of the elderly collapse when caught in a fire scene, and their protective mechanisms weaken because of decreased sensitivity and atrophic skin (5, 6). Age is a direct contributor to increased burn mortality, and dealing with burn injury in the setting of multiple medical conditions is challenging (7). Lifelong disabilities and disfigurements caused by burn injuries, economic difficulties brought to patients by burn traumas, and the inability to integrate burn patients back into their daily life, make burn injuries an enormous social and economic burden for burn victims (8, 9).

Guilan _a province located in the north of Iran_ has the oldest population in Iran over the past 15 years (10). As few studies have evaluated trauma injuries in the elderly, there is a knowledge gap in our

understanding of the burn trends in the elderly in Iran. We believe that Guilan province provides an adequate sample of the elderly population, and we can have a better overview of injuries in the elderly.

Knowing the epidemiological pattern of burn injuries in the elderly can help better understand the risk factors related to worse outcomes, suggest preventive programs, and improve the overall management of this delicate age group in burn injuries.

This study aimed to identify and analyze the epidemiologic characteristics of burn among the geriatric population in Guilan province for the past ten years.

Method

Study design:

We performed a retrospective analysis of burn characteristics amongst the elderly. Researchers at the burn and regenerative medicine research center enrolled this study in Velayat Hospital burn center, Guilan province. With nearly 335,000 people older than 60 years old, this province has had the oldest population in the country over the past 15 years. Our burn center _with 55 beds in the burn ward and ten beds in the burn ICU_ has approximately 700 admissions per year, covering most of the burn patients in the area. We managed burn injuries either outpatient or inpatient. Admission criteria were based on the American Burn Association (ABA) guidelines. Burn patients took the following treatment plan: adequate fluid resuscitation, wound assessment and management, control of infection, nutritional support, pain control, and other palliative efforts. Before data collection, the ethics committee of Guilan University of Medical Sciences approved this study (Approval ID: IR.GUMS.REC.1398.37), fulfilling Helsinki's World Medical Association Declaration recommendation.

Data Collection:

We collected data from the Hospital Information System (HIS) of Velayat Burn Center from January 2010 to January 2020. Inclusion criteria were all patients 60 years and more admitted to the hospital complaining of burn injuries regardless of burn characteristics. Exclusion criteria were outpatients and incomplete medical records. Our team gathered data using a form inconsistent with available data designed by the research team. Following parameters were gathered: **1)** demographic characteristics: age, sex, marital state, occupation, residency (rural vs. urban), pre-injury medical condition (Metabolic diseases, Neurological diseases, Cardiovascular diseases), **2)** burn characteristics: burn agent (scald, flame, chemicals, electrical, contact), presence of inhalation injury, Total Body Surface Area (TBSA), place of the incidence (indoors vs. outdoors), burn degree (first, superficial second, deep second, third), anatomical site (head and neck, trunk, upper limb, lower limb, whole-body), season, month, and day of the week of the injury, the hour of the incident (divided into four time-lines from midnight to 5:59 am, six to 11:59 am, 12 to 5:59 pm, six to 11:59 pm), **3)** in-hospital events: Length of Hospital Stay (LOS), surgical

management (debridement only, skin grafting, and amniotic membrane dressings), patients' outcome (death vs. survived).

Statistical analysis:

We recorded the group statistics values as mean ± standard deviation. Categorical variables were recorded as frequency and percentages. We used Fisher's exact test for dichotomous variables for the tests between the groups, and the Chi-squared test was used for ordered categorical variables. Continuous measures were analyzed using the Mann-Whitney U-test test. We performed an additional analysis to detect the risk factors of LOS. In this case, we used multivariate linear regression. We tested all potential predictors first. We selected a set of independent statistically significant covariates in a multivariable model by performing the stepwise multivariate linear regression. All statistical analyses were two-tailed. A p-value < 0.05 was considered statistically significant for purposes of this discussion. All analyses were performed with the statistical package using SPSS® V24.0.

Results

Out of 6,300 burn patients admitted to Velayat Burn Center, from January 2010 to January 2020, 701 were above 60 years old. We excluded 89 cases because of incomplete medical records.

Demographic characteristics: Different variables are shown in table-1. Older age was related to a higher mortality rate (P-value <0.001). The distribution of age groups is available in Fig. 1. Most of the patients were women (F: M ratio of 1.14:1) with no correlation to higher mortality (P-value =0.256). In our survey, 94.9% of patients were married (n=581), 5.1% were either single or had lost their partners and lived alone (n=31). Our data showed that 48.9% of cases were housewives (n=299), 17.0% were retired (n=104), and 7.2% were unemployed (n=44), all of which spent most of their time indoors (73.1% of the population in our study). 21.1% were freelancers (n=129), 4.7% were farmers (n=29), 0.7% were cook (n=5) and one patient was a herdsman. 59.3% of our cases lived in urban areas (n=363), while 40.7% lived in rural areas (n=249).

Burn characteristics: Analyzing the chronological pattern of burn injuries, we found out that most burn injuries happened in winter (31.2%), and the minimal proportion of injuries was during summer (21.6%). March was the most common (11.3%) month for burn injuries, while May had the minimum incidence (6.5%). During weeks, most injuries occurred Saturdays (17%), which is the beginning of the week in our country, and 12.6% happened during the weekend. According to our data, 40.4% of burn injuries occurred from 6 to 11:59 am, while the mere proportion of burn injuries (7.4%) happened from midnight to 5:59 am. 82.5 % of burn injuries happened indoors, while 17.5 % happened outdoors. Other variables are available in Table-1. The Mann-Whitney U test showed a significant difference between TBSA in survivors and patients who died (p<0.001). Whole-body burn injury caused the most death among other anatomical sites of injury. In our study, no 1st-degree burn injury resulted in admission. Although burn injuries in survivors mostly happened due to scalding, flames were related to more deaths among patients. As demonstrated in Fig. 2, the flame was more common in men while scald was common in women. 18.1%

of patients had inhalation injury as well, 20.7% of whom did not survive. Nonetheless, inhalation injury was more probable in the elderly between 90-99 years.

In-hospital events

73.4% of our patients had a history of an age-related pre-injury medical condition (n=449). 36.8% suffered from cardiovascular diseases, 27.3% had a history of metabolic diseases, and 9.3% had neurological diseases. Management of the cases consisted of fluid resuscitation, nutritional support, and surgical procedures. More data is available in Table-1. The amniotic graft was the most successful surgical management with the least mortality rate. A considerable proportion of death was in patients with debridement only. The Mann-Whitney test showed a significant difference between LOS in survivors and non-survivors (p<0.001). Based on obtained results, the mean LOS was 5.73±5.96 days for survivors and 8.43±7.44 days for non-survivors. Unfortunately, 15.03% of all cases died during in-hospital stay (n=92). Different parameters in non-survivors are available in Table-2. They were primarily men with higher TBSA, and more extended hospital stays. The incidence of cardiovascular diseases and flame injuries were higher among non-survivors in comparison to the survivors group. Results related to the comparison of the mean of age, TBSA, and LOS based on patient's outcome are shown in Table-3

Risk factors for LOS

The median LOS was six days. We performed a multiple linear regression model using age, gender, etiology, and TBSA variables to detect the factors associated with LOS. Results presented in Table 4 show that TBSA (p = 0.000) and female gender (p=0.049) were the only factors to be significant in mortality. In addition, according to standardized beta coefficients, we can conclude that the TBSA has more importance on LOS.

Table 1
Cross-tabulation of variables.

Variable		outcome			
		Total (%)	Died (N=92)	Survived(N=520)	P-value
Age range (yrs) Mean:	60-69	43.5	30	236	P (value[a]) = <0.001 (12.13)
	70-79	32.2	27	170	
	80-89	21.1	29	100	
	90-99	3.3	6	14	
Gender	Female	53.3	44	282	P (value[a]) =0.256 (1.28)
	Male	46.7	48	238	
Etiology	Scald	44.3	11	260	P (value[b]) = 0.000 (51.75)
	Flame	50.0	77	229	
	Contact	3.8	2	21	
	Chemical	1.5	1	8	
	Electric	0.5	1	2	
TBSA range (%) Mean: 19.70±22.13	1-20	75.0	10	449	P (value[b]) = <0.001 (313.92)
	21-40	14.1	28	58	
	41-60	3.9	16	8	
	61-80	2.6	16	0	
	81-100	4.4	22	5	P (value[b]) = <0.001 (8.85)
Burn Degree	Superficial 2nd	25.5%	12	144	
	Deep 2nd	37.7%	40	191	
	3rd	36.8%	40	185	
LOS (days) Mean: 6.14±6.27	1-10	85.1	69	453	P (value[b]) = <0.001 (12.59
	11-20	11.1	18	50	
	21-30	2.6	2	14	
	>=30	1.1	3	4	
Surgery	Debridement only	38.4	70	165	P (value[b]) = <0.001 (65.86)

Variable		outcome			
	Skin grafting	52.5	21	300	
	Amniotic membrane	9.2%	1	55	
Anatomical site	Head and Neck	8.8%	5	49	P (value[b]) = <0.001 (141.33)
	Trunk	19.1%	15	102	
	Upper extremities	10.0%	3	58	
	Lower extremities	41.8%	9	247	
	Whole-body	20.3%	60	64	
	a. Pearson Chi-Square; b. Fisher's Exact Test				

Table 2
Different parameters in patients who died.

Parameter		Percentage
Mean age (yrs)	75.16±9.58	
Gender	Female	47.8%
	Male	52.2%
Mean TBSA (%)	55.48±28.79	
Mean LOS (days)	8.43±7.44	
Etiology	Flame	83.7%
	Scald	12%
	Contact	2.2%
	Chemical	1.1%
	Electric	1.1%
Surgery	Debridement only	76.1%
	Early skin grafting	22.8%
	Amniotic membrane	1.1%
Pre-injury medical condition	Negative	19.6%
	Cardiovascular diseases	39.1%
	Metabolic diseases	22.8%
	Neurologic diseases	18.5%
Burn degree	Superficial second	13%
	Deep second	43.5%
	Third	43.5%
The anatomic site of injury	Head and neck	5.4%
	Trunk	16.3%
	Upper limb	3.3%
	Lower limb	9.8%
	Whole-body	65.2%

Table 3
Results related to comparing the mean of age, TBSA, and LOS based on patient's outcome.

	Died (N=92)	Discharged (N=520)	p-Value
Age, mean ± SD (yrs)	75.16 ± 9.58	71.68 ± 8.72	0.001
TBSA, mean ± SD (%)	55.48 ± 28.79	12.63 ± 12.43	0.000
LOS, mean ± SD (days)	8.43 ± 7.44	5.73 ± 5.96	0.000

Table 4
multiple linear regression model of factors related to the length of hospital stay.

Variable	Unstandardized beta coefficients	Standardized beta coefficients	95 % CI Lower Upper	t	p-value
Intercept	5.787		4.938 6.635	13.392	0.000
TBSA	0.047	0.166	0.025 0.039	4.160	0.000
Sex	-1.020	-0.081	-2.04 -0.036	-2.036	0.042

Discussion

With Improvements in geriatric medicine, the elderly live longer. The present study mainly discussed the epidemiological features of burn among the geriatric population at Velayat Burn Center in the north of Iran, from January 2010 to January 2020. Guilan is one of the northern provinces in Iran, with 335,000 elderlies, respectively. The proportion of the elderly in our population is 13%. According to the National Population and Housing Census results in 2016, 2011, and 2006, Guilan has had the oldest population in Iran for the past 15 years (10). This study is different from previous studies because of the following facts: [1]No previous studies have ever discussed the epidemiological features of burn injuries in the elderly in Guilan; [2]With the most population of the elderly in the whole country, Guilan province is a good target for epidemiological investigations of burn injuries in the geriatric population. [3]In this study, we discussed parameters that are more likely to give better views of the pattern of burn in the elderly.

The proportion of the elderly in burn patients was 11%, while in Australia (11), 21.8% of burn patients were above 60, implying that these patients are more referred to ER in developed countries, while in developing countries like Iran, due to neglect, fewer old patients present to the ER. The mean age was higher in our study (72 years vs. 64 and 69 years) (4, 12), and the most common age group was 60-69 years which was similar to another study (13). Along with the increased life expectancy, the geriatrics work long after retirement because of financial issues, which increases the chances of work-related burn accidents.

While similar to other studies (14–17), women had more burn accidents, most incidents occurred indoors (82.5%). Most burn injuries happened to the married couples who lived with family members and were either housewife, retired, or unemployed. All of the above show the risk of household activities in burn accidents among the elderly. While many parents work long hours, grandparents play an important role in taking care of their grandchildren _ grandmothers prepare meals for the children, and grandfathers take them outside for a walk or to the park_ and the whole scenario increases the chances of burn accidents in the household. With this information, prevention programs can focus on [1]educating family members, nurses, maids, and nannies, [2]standardizing houses, installing fire alarms, and identifying danger zones like bath, and kitchen, and [3]focusing on the awareness of the elderly about fire-related dangers. Similarly, Aboderin et al. (18) discussed that despite the aging population in developing countries, less attention is paid to the elderly, and preventive programs focus more on children.

Our data showed that burn accidents happen more in urban areas, inconsistent with a study in china (19). Cultural changes are a simple explanation; while in the past three decades, many rural young adults have forced their parents to move to urban areas to be close to the city. As they can not afford to live in big apartments, they buy old apartments without the essential standards. This phenomenon has caused devastating changes in the lives of the elderly. As a result, we see more indoor burn accidents in urban areas.

In our study, the dominant burn agent was flames _inconsistent with some studies (4, 20, 21) and similar to some others (12, 22)_ but in survivors, the most common agent was scald that results from the slight dominancy of women, indoor accidents, and age-related medical conditions of the elderly like reduced reaction time, visual impairments, and a limited range of motions. Similar to previous studies (23–25), inhalation injury was a risk factor for poor prognosis in the elderly.

The elderly suffer from comorbidities, and even mild burn injuries can cause complications resulting in hospitalization. This can explain the mean TBSA of 19.70±22.13 %, most of which were between 1-20%, which is inconsistent with similar studies (4, 26, 27).

In our study, the average length of hospital stay was 6.14±6.27 days. This parameter was much shorter than other similar research: 23 days in Egypt (4) and 19.6±25.3 days in the USA (28). As previously mentioned in Table-4, the two most essential factors on LOS were higher TBSA and the female sex. Patients with minor injuries left the hospital during the early days of admission, and patients with severe injuries expired during their early days of admission.

One of the most important things that makes the geriatric different from other age groups is medical conditions. In our study, the most common pre-injury medical condition was cardiovascular diseases, and the second was metabolic diseases. Similar to our study, Wang et al. (22) found that the most common morbidity was hypertension. According to previous studies (29), pre-injury morbidities can cause longer hospital days, more surgeries, and worse outcomes. Prolonged reaction time due to heart malfunction and a reduced sense of touch because of neuropathies in diabetic patients can result in severe burn

injuries. Educating diabetics and cardiovascular patients, and explaining their vulnerability to simple burn injuries, can help reduce the incidence.

According to the results of previous studies (8, 11, 30–32), the average mortality rate of geriatric burn patients is 15-20%, respectively which is near to the reported mortality rate in our study (15.03%). The mortality rate was related to the age range of the patients (p<0.001), and it raised with age, as reported in previous studies (32, 33). In common with another study (24), there was no significant difference between male and female patients regarding the mortality rate (p=0.256). The least mortality rate was in patients who had amniotic graft as a surgical treatment for their burn injuries. The mortality rate was affected by the anatomical site of the burn injury (p<0.001), and it was the highest in patients with burns in the whole body and trunk, reported as 65.2% and 16.3%, respectively. According to the statistics, age, TBSA, and LOS varied significantly between survivors and non-survivors.

The limitations in our study are: Considering the retrospective nature of this study, we could not collect the information of all the geriatric burn patients because of the lack of data and paper-based records. The elderly who died from a burn injury before reaching the hospital, those treated in private medical centers, and the ones who left our burn center against medical advice were excluded from the study. This study was the first epidemiological investigation of burn among the elderly in Guilan, a northern province in Iran with the oldest population in the whole country. The more we know about the pattern of burn among the geriatric population, the more we can manage prevention programs and reduce the number of burn patients among the delicate group of the elderly.

Conclusion

Our study showed that burn injuries of the elderly happen mostly (82.5%) indoors, during the first hours of the day (40.4% of burn injuries occurred from 6 to 11:59 am), and mainly on the first day of the week in Iran. Also, longer TBSA and female sex seem to have the most effect on the length of hospital stay. Along with the rise in life expectancy, geriatric medicine has developed during the past years. As we expect to have more elderly soon, it is essential to assess the risk factors related to poor outcomes and manage prevention programs for high-risk groups and situations.

With lowering the movement of rural inhabitants to urban areas, improving the safety of apartments and nursing homes, educating nurses and parents about the dangers of children spending time alone with their grandparents, and warning the health care system about the threats for diabetic patients and patients with heart conditions, it would be possible to lower the incidence and overall mortality of burn injuries in the elderly.

Abbreviations

TBSA: Total Body Surface Area

 LOS: Length Of hospital Stay

HIS: Hospital Information System

Declarations

Ethics Approval and consent to participate

The Ethics Committee of Guilan University of Medical Sciences approved this study (Approval ID: IR.GUMS.REC.1398.37), according to the principles of the Helsinki Declaration of 1983. Informed written consent was not applicable in this study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

No competing interests to declare.

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Authors' contributions

MM and ZHD designed the work and study method and have drafted the work.
RZ and SH performed analysis and interpretation of the data.
ZHD and SH performed an interpretation of the data and substantially revised the drafted work.
All authors were involved in structuring and writing the manuscript. All authors read and approved the final manuscript.
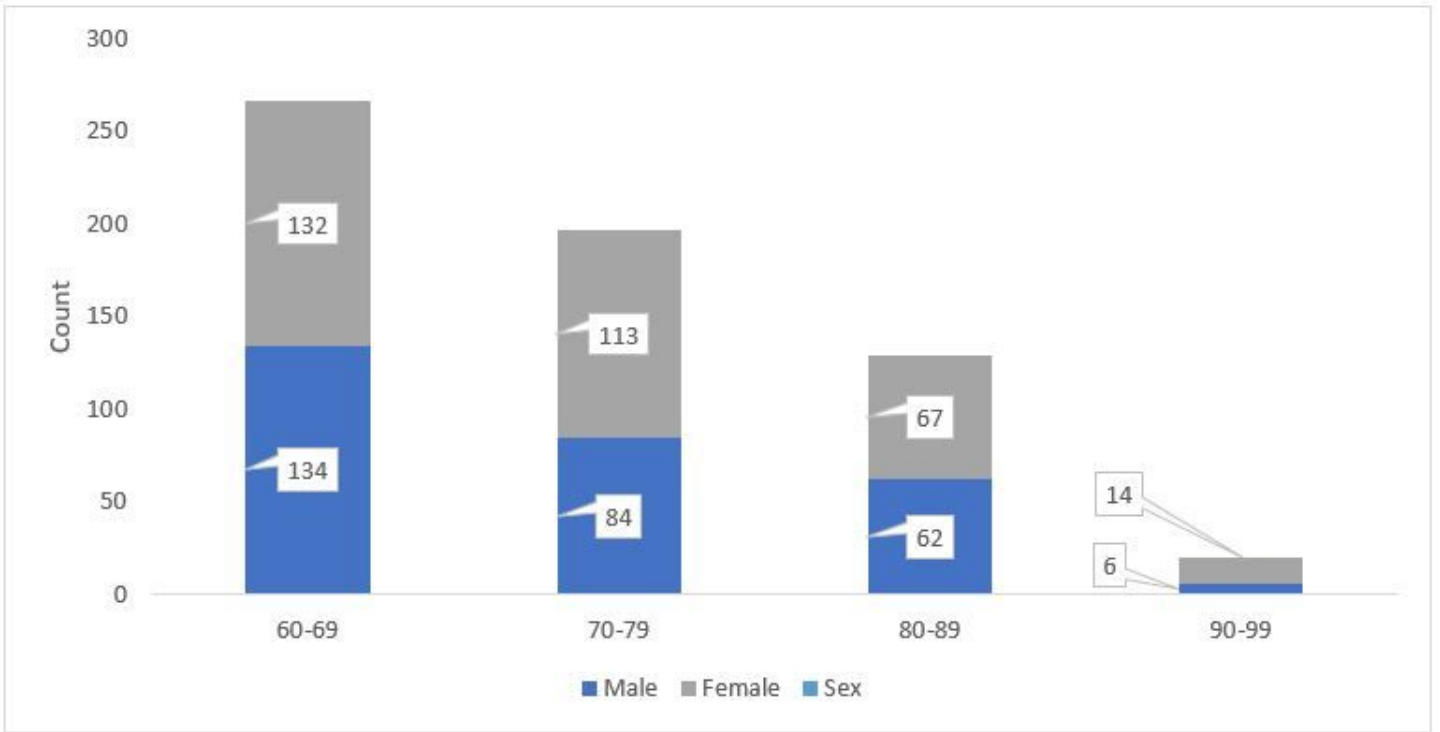
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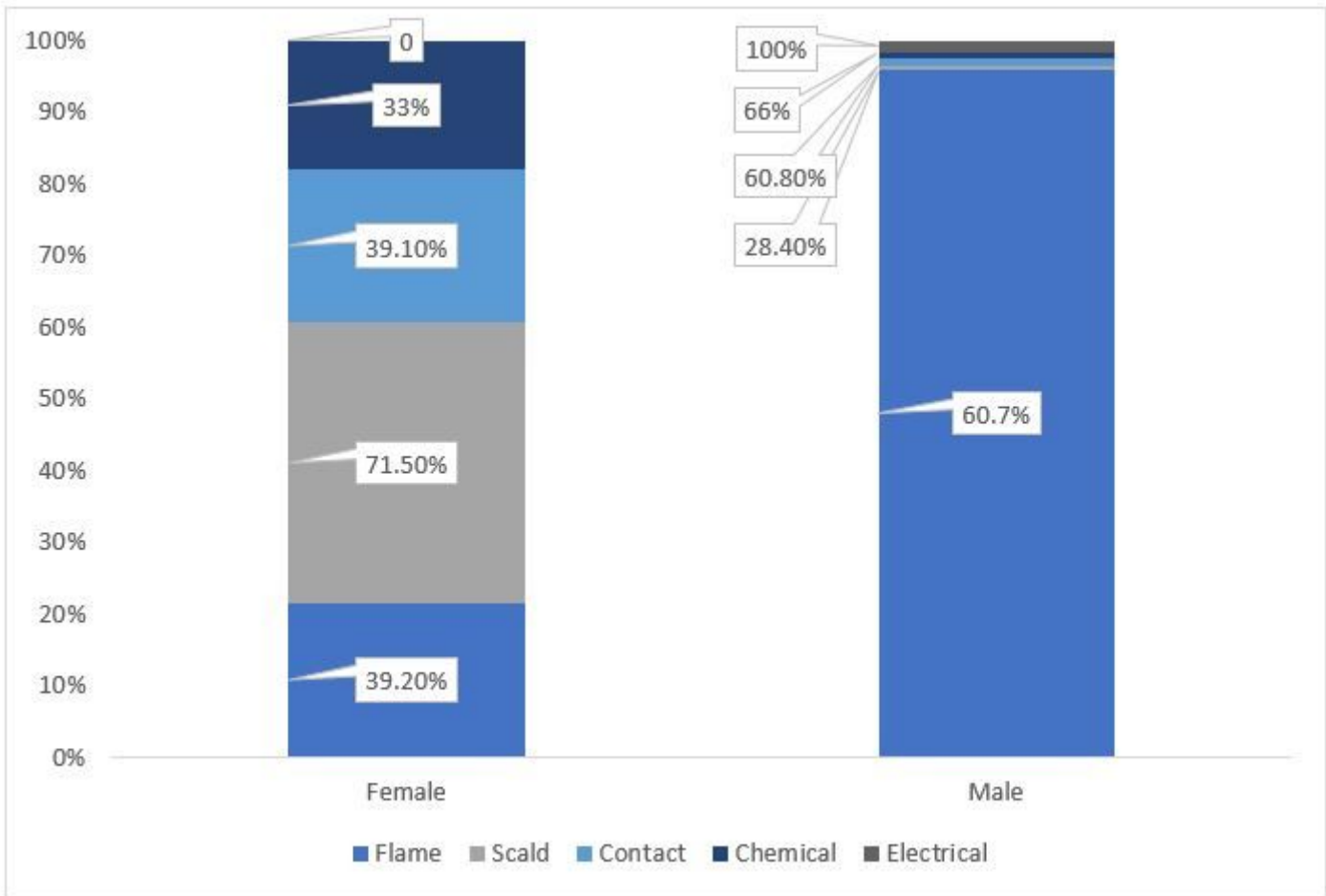
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Figures

Figure 1

Distribution of age groups.

Figure 2

Gender distribution among the cause of burn injury.