Original Article

Decadorial of a burn center in Central India

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Abstract

Introduction: Burn injuries are a serious public health problem. In our study we have identified different epidemiological factors based on 10 years of our experience at a burn unit in central India and recommend some strategies to prevent burn injuries. **Materials and Methods:** This is a retrospective analysis (2001-2010) of database from burn unit of S.S. Medical College, Rewa, India. **Results:** 2499 patients with burn injury were analysed. 66.8% and 38.2% patients were females and males respectively, with a median age of 25 years. Flame (80.1%) was most common cause, home (96%) was most common place, traditional Indian stove (28.8%), kerosene lamp (26.7%), hot liquid (12.2%) and kerosene stove (10.4%) were common causes. Median Total Body Surface Area (TBSA) burn was 40.0%; females had significantly greater ($P < 0.001$) burn than males (median 50% vs 26.0%). High mortality (40.3%) seen; female sex (OR 3.22, 95% CI 2.65-3.92); young age (15-29 year) (OR 3.48, 95% CI 2.45-4.94); flame burn (OR 12.9, 95% CI 1.69-98.32); suicidal burn OR 6.82 95%CI 4.44-10.48) and TBSA > 76% (OR 3099, 95%CI 1302-7380) were significant risk factors for death. Median hospital stays was 8 days; shorter hospital stays seen among TBSA burn > 76% (2 days), suicidal intent (4 days), and those who expired (4 days). Septicemia (45.8%) and burn shock (41%) were the major cause for death. **Conclusions:** Cooking and lighting equipments are major cause of burn injury among females and young age group. Equipment modification to improve safety features and public awareness programs are necessary to reduce burn incidents.

Key words: Burns, epidemiology, female, flame, kitchen, mortality, septicemia, suicidal

INTRODUCTION

Incidence of burn injuries are common in India[1] and is the sixth leading cause of accidental death.[2] Youths and females constitute a significant part of the affected population. A large number of patients suffer from severe burns resulting in increased mortality and morbidity. Despite India's recent socio-economic growth, management of burn patients and their prognosis remains poor due to the lack of trained professionals and specialized burn centers and enormous cost of medical and surgical management, which is not affordable by most patients.[3,4]

The epidemiological factors of burn injuries vary considerably in different communities and region of the world including India. As very few epidemiological studies are reported from India, the present study was designed to identify the various factors responsible for burn injury treated over a decade in our burn treatment unit and to compare its outcome with various other studies from India and other countries. Further, an effort was made to recommend various preventive measures at the community level to decrease the incident of burn injury.

Access this article online	
Quick Response Code:	Website: www.jnsbm.org
	DOI: 10.4103/0976-9668.127303

MATERIALS AND METHODS

This is a retrospective study of burn patients admitted from 1st January 2001 to 31st December 2010 in our hospital. Data was obtained from the medical record section,

regarding, (i) Registration: age, sex, residence, occupation, marital status, socio-economic status, (ii) Chronological: dates of admission and discharge, (iii) Circumstantial: place, intent, cause and source of heat, (iv) Clinical assessment: by using Wallace's "Rule of Nine" in adult and "Lund and Browder" chart in the pediatric age groups and (v) Cause of death: The interrelationships between clinical and epidemiological variables with burn injury were studied. Statistical analyses were performed using the SPSS (Version 16.1) software and following tests were applied: Binominal test, Mann-Whitney U test, Kruskal-Wallis test, Pearson's Chi-squared test (χ^2) and *P* value.

RESULTS

Seasonal variation

Most burn cases were observed in summer (35.5%) and winter (23.9%) with the lowest incidence in the rainy season (19%) [Graph 1].

Age and sex

Out of total 2,499 burn patients, 1670 (66.8%) are females and 829 (38.2%) are males. Above 6 years of age, significantly ($P < 0.001$) more females than males reported burn injuries. The median age of patients suffering burn injuries was 25 (mean 26) years, indicating incidence being predominant in young population [Graph 2].

Residence and place of incident

Most (71.3%) burn patients were from rural areas. Most burns were of domestic origin (96.0%) and kitchen (54.8%) was the most common place of injuries, followed by the living room (41.2%) with very few burn injuries encountered outdoors (4.0%). Females most commonly encountered burn injuries in kitchen (M:F = 1: 2.2) and living room (M:F = 1:1.9) while males predominantly suffered from burn injuries outdoors (M:F =1:0.7).

Cause of burn and equipment

Flame (80.1%) was the most common cause of burn, followed by scald (12.4%), electrical (6.9%) and few cases of chemical burn (0.6%) [Graph 3]. Equipments responsible for flame burns were: floor level cooking arrangements using wood as fuel in Chulha (traditional Indian stove) (28.8%), homemade kerosene bottle lamp chimney (26.7%) and pressurized kerosene stove (10.4%). Scalds (12.4%) were due to contact with hot liquids such as milk, water, oil, vegetable, etc., [Table 1].

Intent of burn

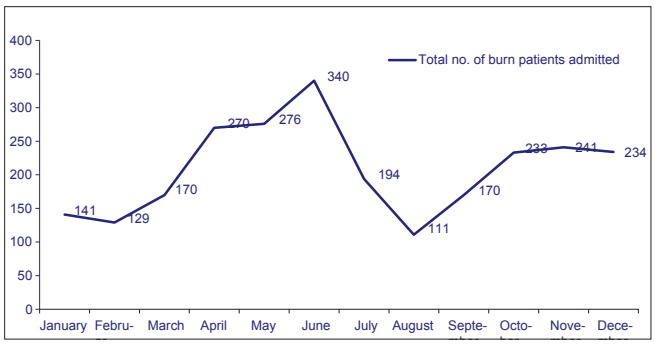
Accident (93.3%) was the most common intent, followed by suicide (5.8%) and homicide (0.9%). Although females were the majority among all intents, the data did not reach statistical significant ($Z = 0.664$, 2df, $P = 0.718$).

Cause of burn according to age and sex

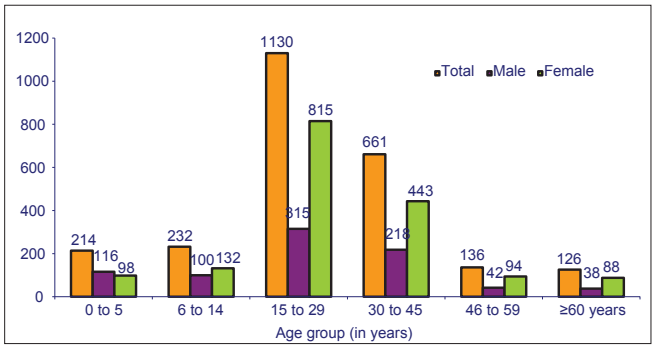
Amongst children aged 0-5 years, scalds (55.6%) were most common with no significant sex differences ($P = 0.064$). Contrary to this, flame injuries were most common ($P < 0.001$) among the age group over 15 years. Among adults significantly ($P < 0.001$) more females than males patients suffered flame burn, only electrical burns were significantly more common among males ($P < 0.001$) [Table 2].

Clinical assessment of the burn wound

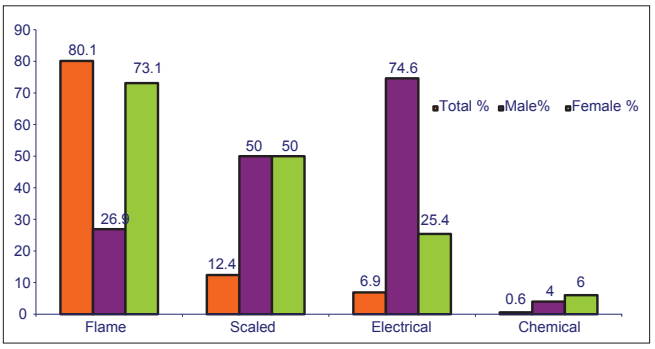
In our study, total body surface area (TBSA) burn ranged from 1% to 100% (median 40%, mean 47.5%). 1319 (52.7%) patients had < 40% TBSA burn while 1180 (47.3%) patients had > 41% TBSA burn. Significantly ($Z = 250.6$, 9df, $P < 0.001$) more female cases than males were observed with TBSA > 10% [Graph 4].



Graph 1 : Incidents of burns according to month



Graph 2 : Burns according to age and sex



Graph 3 : Cause of burn and sex

Table 1: Causes of burn and equipments responsible

Cause No.(%)	Equipment	Total		Child<14 year		Adult>15 year		Sex
		No.	%	No.	%	No.	%	M: F
Flame	Chulha	710	26.7	30	4.3	680	95.7	1:3.93
2001 (80.1)	Chimney	666	26.7	139	20.9	527	79.1	1:3.32
	Stoveburst	259	10.4	21	8.1	238	91.9	1:2.54
	Kerosene	200	8.0	18	9.0	182	91.0	1:1.72
	LPG	90	3.6	01	1.1	89	98.9	1:1.09
	Openfire	57	2.3	22	38.6	35	61.4	1:0.58
	Firecracker	19	0.8	05	26.3	14	73.7	1:0.26
Scald	Hotliquid	306	12.2	168	54.9	138	45.1	1:0.97
310 (12.4)	Cookerburst	04	0.2	0	-	04	100.0	Allfemale
Electrical 173 (6.9)	Electricwire	166	6.6	27	16.3	139	83.7	1:0.28
	Lightening	07	0.3	03	42.9	04	57.1	Allfemale
Chemical	Chemical	15	0.6	04	26.7	11	73.3	1:1.5
15 (0.6)								

LPG: Liquefied petroleum gas

Table 2: Cause of burn and age

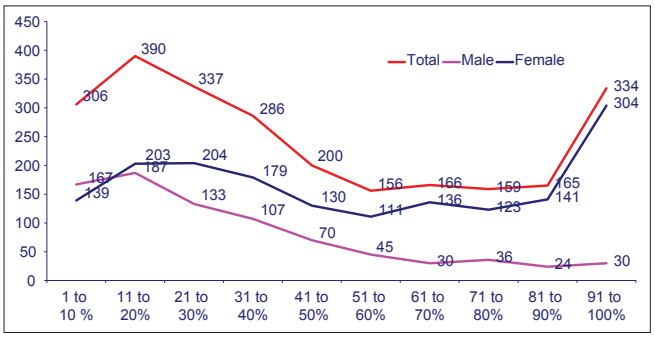
Age (Year)	Cause	Male		Female		Binominaltest	Chi-square test
		N	%	*N*	%		
0-5	Flame	42	47.2	47	52.8	*P*=0.672	χ^2=7.247
	Scald	68	57.1	51	42.9	*P*=0.142	3 df
	Electrical	05	100.0	-	-	-	*P*=0.064
	Chemical	01	100.0	-	-	-	
6-14	Flame	61	39.9	92	60.1	*P*=0.015	χ^2=5.322
	Scald	24	49.0	25	51.0	*P*=1	3 df
	Electrical	15	55.6	12	44.4	*P*=0.701	*P*=0.150
	Chemical	-	-	03	100.0	-	
15-29	Flame	233	23.6	754	92.5	*P*<0.001	χ^2=96.96
	Scald	38	43.2	50	56.8	*P*=0.241	3 df
	Electrical	43	82.7	09	17.3	*P*<0.001	*P*<0.001
	Chemical	01	33.3	02	66.7	*P*=1	
30-45	Flame	150	27	406	73	*P*<0.001	χ^2=77.24
	Scald	18	40.9	26	59.1	*P*=0.291	3 df
	Electrical	46	83.6	09	16.4	*P*<0.001	*P*<0.001
	Chemical	04	66.7	02	33.3	*P*=0.688	
46-59	Flame	26	23.6	84	76.4	*P*<0.001	χ^2=8.60
	Scald	5	71.4	2	28.6	*P*=0.453	3df
	Electrical	11	61.1	7	38.9	*P*=0.481	*P*=0.035
	Chemical	-	-	1	100.0	-	
≥60	Flame	27	25.5	79	74.5	*P*<0.001	χ^2=8.60
	Scald	02	66.7	01	33.3	*P*=1	3df
	Electrical	09	56.2	07	43.8	*P*=0.804	*P*=0.035
	Chemical	-	-	01	100.0	-	
Total	Flame	539	26.9	1462	73.1	*P*<0.001	χ^2=208
	Scald	155	50	155	50	*P*=1	3df
	Electrical	129	74.6	44	25.4	*P*<0.001	*P*<0.001
	Chemical	06	40	09	60	*P*=0.607	

Distribution of burn patients based on TBSA

Significant statistical differences in median TBSA burn between different characteristics were observed. Females (median 50%, SD ± 31.45); age 15-29 year (median 55%, SD ± 31.56); flame burn (median 50%, SD ± 30.46%), suicidal intent (median 90%, SD ± 27.25%) and among who succumbed to burn injury (median 82%, SD ± 21.78%) had severe burn injury [Table 3].

Hospital stays

Hospital stay ranged from few hours to 182 days (median 8 days). Significantly, shorter ($P < 0.001$) hospital stay was observed among TBSA burn > 76% (2 days), suicidal intent (4 days) and those who succumbed to burn injury (4 days). Longer hospital stay was observed among TBSA burn 26-50% (16 days), but no significant difference in median hospital stay was observed between male and female patients ($P = 0.747$) [Table 4].



Graph 4 : Total body surface area (TBSA) burn and sex

Mortality

Females had significantly higher (48.8% vs. 22.9%, $P < 0.005$) mortality than males and they are also more likely succumbed to burn injury than males (odds ratio [OR] 3.22, 95% confidence interval [CI] 2.65-3.92). 15-29-year-old patients had highest mortality (52.3%) and were more likely to succumb to burn injury (OR 3.48, 95% CI 2.45-4.94). Suicidal burn cases had the highest mortality (80.4%) and most often resulted in patient death (OR 6.82, 95% CI 4.44-10.48). Flame burn had highest mortality (48.0%) and was most likely to result in death (OR 12.9, 95% CI 1.69-98.32). Increase in TBSA significantly ($Z = 1859.79$, 3df, $P < 0.001$) increased mortality; thus, highest mortality (98.8%) was observed in patients with 76-100% TBSA burn [Table 5]. Septicemia was most common cause of death (45.8%), followed by burn shock (41.0%), pneumonia (11.8%) and other factors (1.4%).

DISCUSSION

Seasonal variance in burn injuries are previously reported from Western (Ahmedabad)[5] and Central India (Nagpur).[6] Very high temperature and low humidity during the summer in these regions are responsible for burn injuries. However, in winter, people in rural regions use "open wood fire" and "Gorsy" (burning coal on an earthen container) as a source of heat, which also increase the incidence of accidental burns. The incidence is also considerable in the month of November, attributed to firecracker accidents during customary celebration of "Diwali" (the festival of lights).

In our study, large number burns were due to the domestic activities (96%) and the majority of the incidences occurred in kitchen (54.8%). It is essential to note that in rural Rewa region people don't have a separate kitchen area and rather cook inside or beside their living room/cottage. Most of the studies from India[7,8] and other low income countries such as Egypt,[9] Pakistan[10] also report similar trend. Flame (80.1%) was most common cause of burn, which is consistent with other studies reported in India[5-8] and other developing countries,[9-11] although equipments responsible vary widely.

Table 3: Burn characteristics according to TBSA

Characteristics	TBSA		SD	Chi-square test
	Median	Mean		
Sex				
Male	26	33.66	±25.17	P<0.001
Female	50	44.40	±31.45	Z=(−) 1566
Age (Years)				
0-5	25	31.49	±21.89	χ^2=206.14
6-14	25	33.54	±25.48	5df
15-29	55	56.06	±31.56	P<0.001
30-45	40	46.18	±30.82	
46-59	30	35.95	±26.4	
≥60	36	43.41	±29.9	
Cause				
Flame	50	53.86	±30.46	χ^2=472.77
Scald	20	23.92	±16.42	3df
Electrical	10	18.72	±19.68	P<0.001
Chemical	20	21.27	±9.80	
Intent				
Accidental	40	45.65	±30.37	χ^2=121.67
Suicidal	90	76.68	±27.25	2df
Homicidal	50	54.96	±34.61	P<0.001
Outcome				
Discharge	25	27.28	±16.63	χ^2=1389
Expired	82	78.35	±21.78	2df
Absconded	37	42.87	±26.68	P<0.001

TBSA: Total body surface area, SD: Standard deviation

Table 4: Burn characteristics according to hospital stay (days)

Characteristic	Days		Chi-square test
	Median	Mean	
Sex			
Male	8	11.16	P = 0.747
Female	8	11.98	Z=−0.323
Age (Years)			
0-5	7	10.09	χ^2 = 4.98
6-14	8.5	12.04	5df
15-29	8	12.07	P = 0.417
30-45	9	12.68	
46-59	9	11.96	
≥60	6	12.56	
Cause			
Flame	9	9.26	χ^2 = 19.51
Scald	6	8.6	3df
Electrical	5	8.4	P < 0.001
Chemical	8.22	12.1	
Intent			
Accidental	8	8.54	χ^2 = 38.65
Suicidal	4	7.82	2df
Homicidal	5	14.52	P < 0.001
TBSA			
1-25	6	9.23	χ^2 = 625.71
26-50	16	17.46	3df
51-75	14.5	18.39	P < 0.001
76-100	2	5.07	
Outcome			
Discharge	11	8.07	χ^2 = 359.8
Expired	4	10.94	2df
Absconded	6	13	P < 0.001

TBSA: Total body surface area

Table 5: Burn mortality (*n*=2327)

Characteristics	Total	Expired		Mortality	Oddsratio (95%CI)	*P*value
		No.	%			
Sex						
Male	761	174	18.6	22.9	Ref. group	χ^2=144
Female	1566	764	81.4	48.8	3.22 (2.65-3.92)	1df
						P<0.001
Age						
0-5	196	47	5.0	24.0	Ref. group	χ^2=144.44
6-14	214	42	4.4	19.6	0.74 (0.48-1.23)	5df
15-29	1052	551	58.8	52.3	3.48 (2.45-4.94)	*P*<0.001
30-45	622	222	23.7	35.7	1.75 (1.21-2.53)	
46-59	124	30	3.1	24.1	1.01 (0.59-1.71)	
>60	119	46	5.0	38.7	1.99 (1.21-3.27)	
Cause						
Chemical	15	1	0.1	6.7	Ref. group	χ^2=267.72
Electrical	161	19	2.0	11.8	1.87 (0.23-15.06)	3df
Flame	1864	984	95.3	48.0	12.9 (1.69-98.32)	*P*<0.001
Scaled	287	24	2.6	8.3	1.27 (0.16-10.13	
Intent						
Accidental	2168	815	86.9	37.6	Ref. group	χ^2=102.25
Suicidal	138	111	11.9	80.4	6.82 (4.44-10.48)	2df
Homicidal	21	12	1.2	57.1	2.21 (0.92-5.27)	*P*<0.001
TBSA						
1-25%	772	20	2.1	2.6	Ref. group	χ^2=1859.79
26-50%	635	113	12.0	17.8	8.13 (4.99-13.26)	3df
51-75%	336	228	24.3	67.9	79.37 (48.16-130.81)	*P*<0.001
76-100%	584	577	61.6	98.8	3099 (1302-7380)	

TBSA: Total body surface area, CI: Confidence interval

Earthen Chulha in the present study was the most common (28.8%) equipment responsible for burn accidents. Rural Indian housewives cook food on this traditional floor level earthen using charcoal/wood as fuel, which is very dangerous and lack fire safety features. This has increased susceptibility to burn injuries among rural Indian housewives and children playing around her. Hence, it is essential to make the cooking space safe by separating it from the living room and adopting necessary safety precautions while cooking. Government projects providing brick made house for rural people must be enforced to create fire safe cooking environment to reduce the incidence of burn injuries.

Chimney (26.7%) was the second most common source of accident identified in our study and is consistent with many other reports from India[6,8] and Sri Lanka.[11] Chimney is indigenously made and is used as a source of light in rural areas. A hole is made over the cap of a glass bottle or tin jar and a piece of cloth is passed through this hole and dipped in bottle/jar containing kerosene. This bottle lamp is very unstable because of its shape, where center of gravity remains at a higher level and easily tilts down. When this chimney falls down, kerosene and fire spreads all over and burn accidents occurs. Product modification for this kerosene lamp is needed; a conical shaped lamp with a wide base may give better gravitational stability so that it will not tilt/fall down easily. Kerosene lamp related accidents could be reduced more effectively by providing an alternate source of light. Hence, electrification or installing solar system in all villages and providing lighting from 5 pm to 10 pm will certainly decrease the use of chimney and hence the incidence of burns.

Kerosene pressure stoves was the third common (10.4%) cause of burn injury in our study and it is the most common source of accident in the urban India[6,12,13] and Sub-Saharan countries,[9] where kerosene is easily available and affordable. The mechanism of stove injury is very unique, sometimes the burner hole is choked by carbon deposits or by any particulate impurities in kerosene; when the whole is pinned for cleaning, a large volume of aerosol comes jets out under high pressure as a fire ball and accidents occurs. A land mark study by Ahuja and Bhattacharya[12] from Delhi showed that banning of kerosene pressure stove decreased burn admission by 25%. Consequently, Delhi has become the first kerosene free city in India.[14] However, without providing an alternative, banning of kerosene stoves all over India may not be practical, because kerosene is affordable and stoves are very handy to use. Hence, promotion of non-pressurized kerosene stove are recommended along with strictly regulating the quality of pressure stoves, purity of kerosene and providing community based training for correct and safe use of kerosene stoves. Scalds were responsible for 12.4% of total burn accidents and children (54.19%) were the most commonly affected. Similar incidence of scalds among children are also reported from both high[15] and low income countries.[16,17]

Gender wise distribution of burn patients greatly differ in high and low income countries. With male predominance in high-income countries such as Norway[18] and Australia[19] and female predominance in the middle and low income countries such as Egypt,[9] Pakistan[10] Sri Lanka[11] and India.[12,20] Such gender differences observed are multi factorial and related to varying socio-cultural behaviors. People of all ages are susceptible to burn, although the household circumstances, work place and physical activity may increase or decrease the susceptibility rate. Mean age of burn injuries in our study was 25 years (median 26 years), which is comparable to reports from developed countries[18,19] and other studies from India.[5,6,8] Children are also at a higher risk of burn injuries, both in high-income and low/middle-income countries.[9,10,18,19] We found a significant number (17.9%) of patients in the pediatric age group (0-14 years). Similar pattern (20.28%) of pediatric burns are also reported by Ganesamoni *et al.*[13] in south India. Among the pediatric burn patients, a considerable proportion (8.6%) of children was found to be young (0-5 year). This is because pre-school children crawl into danger areas accidentally.

The median TBSA burn in our study was 40%. Most importantly, 47.3% cases had > 40% TBSA burn. Such higher TBSA burns are also reported in many Indian studies.[3-5,12] However, in high-income countries[18,21] mean TBSA was 11.5-19.5% and only 4-8.2% cases had 30% or more TBSA burn. Significantly, ($Z = 250.6$, 9df, $P < 0.001$) more females than male cases had TBSA exceeding 10% in our study and above 70% TBSA burn, 86.3% cases were females. Hence in addition to traditional causes, we should also focus on the intent, which may bring some light into this gender difference. Indeed burn injuries may be intentional or non-intentional, but sometimes it is very difficult to determine it. Memchoubi *and* Nabachandra.[22] has reported a high rate of suicidal (24.61%) and homicidal (29.23%) burn in autopsy cases. Other studies from India[6,13,23,24] have also reported a high rate of homicidal and suicidal burns among females. However, in our study, no significant association between female sexes with homicidal/suicidal burn was observed, this may be probably due to under reporting of the exact intent by the attendants to avoid litigation.

Severity of burns determines hospital stay. Our data is consistent with the previous report by Attia *et al.*[9] who reported mean hospital stay of 21.5 and 5.3 days by surviving and patients succumbing to burn injuries respectively. Comparing and interpreting burn mortality data's are very difficult, because, study population, management protocol and statistical analysis differ widely among different studies. High mortality (40.3%) was observed in our study and is consistent with other studies from India and other low income countries.[9,12,13,16,20] In contrast to these results, very low mortality is reported from high-income countries, for example, in Norway[18] only 4% mortality was reported in a 20 year study with median 15% TBSA burn. A study from Israel[25] also reported low (4.4%) mortality rate, but amongst severe burns (TBSA > 90%) mortality was 96.6%, which is consistent with our study (98.8% mortality rate in TBSA > 76%). These data are also consistent with Dastgiri *et al.*[26] where higher risk of death was observed with higher TBSA > 75%. Indeed every 1% increase in TBSA is significantly associated with 6% increase in risk of death.[27] Hence, we can conclude that among severe burns mortality is comparable between low and high-income countries and management of severe burn is challenging in all set up. Age and gender are also a very important independent factor to predict mortality,[28] young age (15-29 year) and females[29,30] being the most vulnerable group, which is consistent with observations in our study. Septicemia was identified the most common cause of death (45.8%) in our study, followed by burn shock (41.0%). Our results are consistent with other reports.[4,22,24] Severely, burnt patients suffer from burn shock and delay in resuscitation increases mortality.[12] The pitfall of conservative management is delayed wound excision because the burnt tissue serves good media for bacterial colonization, which is subsequently followed by bacteremia and septicemia. Thus, significant numbers of patients succumb due to septicemia in our country. This treatment protocol needs to be improved.

CONCLUSION

Causes of burn in the Rewa region of central India are very "primitive" in nature and are related to cooking (Chulha) and lightening (Chimney) equipments, which are very basic needs of life. Hence, to decrease burn accidents, local administrations must enforce Government housing programs optimally and lighting through conventional and unconventional ways should be provided to all houses. As young people are most affected, educating through community interaction programs to emphasize on safe cooking practices, fire safety precautions, first-aid training must be implemented. Finally, home violence on females in India is a shameful reality; just drafting strict laws will not decrease this crime; education seems to be the answer to this socio-cultural problem.

To conclude, in our study we have tried to describe the epidemiology of burn injury and proposed some primary prevention strategies for prevention of burn injuries. Nevertheless, further research and resources are required for secondary and tertiary prevention of burn injuries.

ACKNOWLEDGMENTS

We acknowledge Prof. Dr. G. P. Shrivastava, (M.S., Fellow, Interplast Australia), Professor and Head, Department of

Surgery, S.S. Medical College, Rewa, (M.P.) India, for his constant encouragement, guidance and supervision throughout this project. We also thank Dr. Deepak Shukla, M.Sc., Ph.D., for his assistance in statistical analysis and to Dr. Udhav Agrawal, M.Sc., Ph.D., for his excellent computer works and technical assistance.

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How to cite this article: Bain J, Lal S, Baghel VS, Yedalwar V, Gupta R, Singh AK. Decadorial of a burn center in Central India. J Nat Sc Biol Med 2014;5:116-22.

Source of Support: Nil. **Conflict of Interest:** None declared.