

## Medico-legal Evaluation of Burn Deaths in Southern Odisha

Bhakta Narayan Munda<sup>1</sup>, Sindhu Sudha Sahu<sup>2</sup>, Manoj Kumar Jena<sup>3</sup>

### Abstract

Thermal burns and related injuries are a major cause of death and disability affecting the entire world and more so to the developing countries like India. All the cases were analysed to find out different epidemiological factors, precipitating factors, circumstances, manner and cause of such deaths in southern region of the state. Majority of the victims (66.89%) were females and belonged to the *age group of 11-40 years (77%)*. Majority of the victims (67.54%) were married, among which 57.36% deaths occurred within 7 years of marriage. 78.81% victims were from rural area. Maximum (82.11%) incidents took place in indoor between 6 PM and 9 PM (25.16%). Most of the cases were due to flame (91.39%) and bursting of kerosene pressure stove (19.21%) which was the most common source of fire. Extremities were involved in 98.57% cases. In 36.42% cases > 90% total body surface area is involved. Most of the victim (65.56%) died within 1 week when > 50% of TBSA is involved. Septicaemia was the leading cause of death (35.76%). Septicemia (27.15%) and Neurogenic shock (27.8%) were major contributors when > 50% TBSA involved. Maximum numbers of deaths (67.54%) were accidental in nature. > 90% of TBSA is burnt found in 48.18% of suicide cases and in 68.18% of homicide cases. Nearly one-fourth (24.44%) of dowry death cases were due to burns.

**Keywords:** Thermal burns; Flame; Kerosene; Septicaemia; Accidental; Dowry deaths.

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### Introduction

Thermal burns and related injuries are a major cause of death and disability affecting the entire world and more so to the developing countries like India. Annually about 2 million people suffer

from various modes of burn injuries worldwide, of whom more than 1 lakh die. In India about 60,000 people suffer from burns annually, more than 50,000 are treated in hospitals and about 10,000 succumb to thermal injury.

Because of its frequent occurrence, burn was classified amongst the fifteen leading causes of death in India in 1998. Although the causative agents vary, burn by dry heat appears to be the most common cause of all burns. Many established factors decide the fate of burn affected patients, but still some hidden factors are there which decide the mortality of the burn victims.

Keeping in view of its importance, the present study has been taken up to know more in detail about the different factors responsible for mortality of the burn patients which in turn will help in reducing the mortality due to burns.

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## Materials and Methods

A prospective study was conducted in which 151 cases of burn deaths were taken as study material out of a total 1870 autopsies done in a Medical College and Hospital, in Southern Odisha over a period of two years. All the cases were analyzed with respect to the age-sex distribution, religion, marital status, educational status, occupation, time and place of occurrence, geographical distribution, source of the fire, total body surface area involved, survival period, cause of death and manner of death. Information was obtained by perusal of police papers, hospital records, history from the accompanying persons/relatives and autopsy findings; the data so obtained was tabulated, analyzed and compared with findings of other authors.

## Results

A total of 151 cases (8.07%) of burns have been reported out of 1870 cases of all types of autopsies during this period of 2 years. Female victims (66.89%) outnumbered male victims (33.11%) with a female to male ratio approximately 2:1. **Figure 1** shows almost 77% of the total cases belonged to adolescent and young adult (11-40 years) age group. The peak incidence is observed in the age group 21-30 years (35.76%). Higher incidence in males was found in 21-30 years age group (36%). But in females mostly the sufferers were encountered from 11 to 20 years (38.61%) age group.

**Table 1** depicts most of the victims (67.54%) were married and among them 67.32% were females. In married females, 57.36% deaths occurred within 7 years of marriage. Majority of the victims were

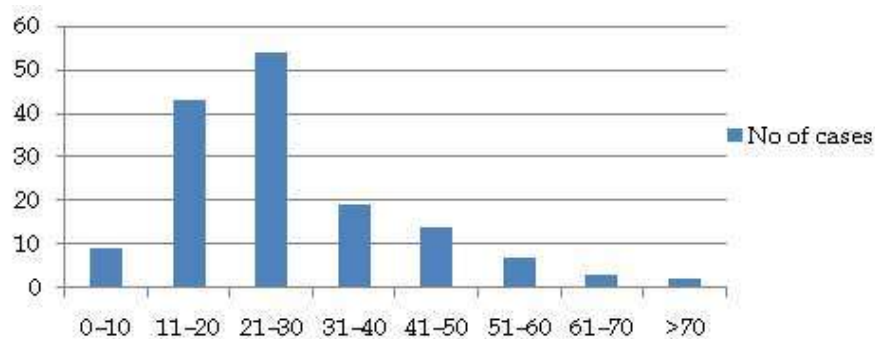


Fig. 1: Age distribution of Burn victims

Table 1: Distribution of Burn cases among married females

Duration of marriage	No of cases	Percentage (%)
< 1 Year	11	16.18%
1-2 Years	7	10.29%
2-3 Years	6	8.83%
3-4 Years	5	7.35%
4-5 Years	3	4.41%
5-6 Years	2	2.95%
6-7 Years	5	7.35%
> 7 Years	29	42.64%
Total	68	100%

Table 2: Geographical distribution

Area	Male	Female	Total
Rural	41	78	119
Urban	9	23	32
Total	50	101	151

$$\chi^2 = 0.21, df = 1, p = 0.62$$

from rural community (78.81%) (Table 2). Fig. 2 reveals maximum (82.11%) incidents took place in indoor. In Table 3 the highest incidence took place during 6.01 PM-9 PM (25.16%) followed by 3.01 PM-6PM (21.85%), 6.01 AM-9 AM (15.89%) and least during 9.01 PM-12 Midnight (1.98%).

Maximum numbers of cases were due to flame burns (91.39%). Only 1.32% cases were scalds. Among flame burns maximum numbers of burn injuries were due to alleged burst of kerosene pressure stove (19.21%), followed by suicidal burn using kerosene (15.23%), clothes caught fire from

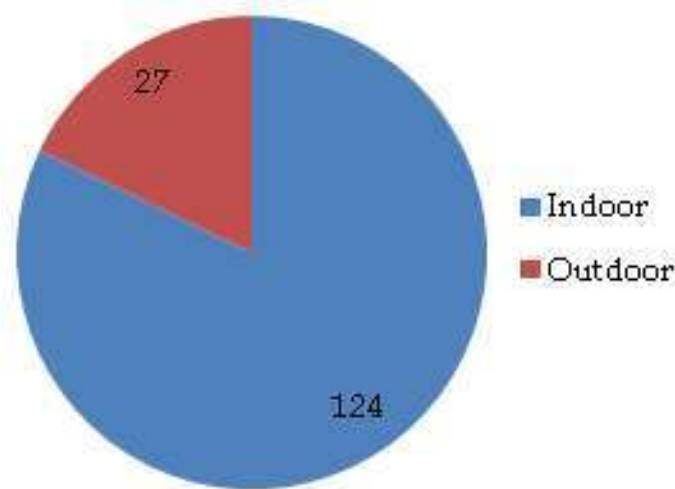


Fig. 2: Place of incidence

Table 3: Time of incidence

Time of incidence	Cases	Percentage (%)
12.01 AM-3 AM	11	7.28
3.01 AM-6 AM	7	6.63
6.01 AM-9 AM	24	15.89
9.01 AM-12 Noon	16	10.59
12.01 PM-3 PM	14	9.28
3.01 PM-6 PM	33	21.85
6.01 PM-9 PM	38	25.16
9.01 PM-12 Midnight	3	1.98
Unknown	5	3.34

Table 4: Sources of Burn

Sources of Burn	Total	Percentage (%)
Flame/dry heat	138	91.39
Kerosene Stove burst	29	19.21
Clothes caught fire from Gas-stove	5	3.31
Clothes caught fire from Kerosene-stove	8	5.29
Clothes caught fire from Open-chullha	17	11.25
Gas leakage	4	2.65
While saving a victim	1	0.66
Fall into Fire	3	1.98
House fire	17	11.25
Accidental Burn from Kerosene lamp, dibiri etc	14	9.27
Clothes caught fire from Religious-candle while worshipping	5	3.31
Suicidal Burn using kerosene	23	15.23
Homicidal Burn using kerosene	12	7.95
Scald from Hot water/Liquid	2	1.32
Lightning	4	2.65
Electricity	7	4.63

open chulha ( domestic stove) (11.25%), house fire (11.25%), accidental burns from kerosene lamp (9.27%), homicidal burn using kerosene (7.95%), clothes caught fire from kerosene stove (5.29%) shown in (Table 4). In (Table 5) majority of the cases (52.32%) wearing synthetic dress at the time of incident.

Most of the victims (74.84%) died within 1 week of the incidence, among which (50.33%) cases died within 24 hours. Only 25.16% victims survived for > 1 week. Most of the victim died within 1 week when > 50% of TBSA is involved. 13 cases died at the spot where > 90% of TBSA is involved. One case is recorded where < 30% of TBSA is involved and survived for > 2 weeks. It was observed that in 36.42% cases, more than 90% of the total body surface area (TBSA) is involved. In 93.38% cases, percentage of burn is > 40% TBSA whereas, 10 (6.62%) cases were found with percentage of burn < 40% TBSA (Table 6). Major cause of death

in burn was septicaemia (35.76%) followed by neurogenic shock (28.47). In majority of shock > 80% of TBSA is involved where as septicaemia is caused when wide range of body surface area involved i.e., 30%–100% (Table 7).

Maximum numbers of deaths (67.54%) were accidental in nature. In accidental burn there is wide range of involvement of TBSA i.e., 31–100%. But it involves > 70% of TBSA in majority of the burn cases of suicide and homicide. Among suicides, > 90% of TBSA is burnt in 13 (48.18%) cases and among homicides it is found in 15 (68.18%) cases (Table 8). Commonest sites burnt were the extremities (98.57%) followed by chest (97.85%). Genitals are involved in 42.85% of the cases. Least common sites affected are soles (28.57%) (Table 9). Taking dowry death in to consideration, out of the total 45 alleged cases of dowry Deaths, 11 (24.44%) were due to burns and 24 (75.56%) were due to others causes (Fig. 3).

**Table 5:** Nature of wearing apparel

Nature of wearing Apparel	Cases	Percentage (%)
Cotton	59	39.07
Synthetic	79	52.32
Unknown	13	8.61

**Table 6:** Distribution of survival period according to TBSA involved

Duration of survival	TBSA involved								Total	Percentage (%)
	≤ 30%	31–40%	41–50%	51–60%	61–70%	71–80%	81–90%	91–100%		
Spot death	1	0	1	0	3	0	1	13	19	12.58
< 12 hrs	0	0	1	2	2	2	4	22	33	21.86
12–24 hrs	0	0	4	2	1	2	8	7	24	15.89
2–3 days	0	1	2	4	0	5	2	4	18	11.93
4–7 days	0	1	2	1	4	3	4	4	19	12.58
1–2 weeks	0	2	2	1	3	2	4	5	19	12.58
> 2 weeks	1	4	4	4	4	1	1	0	19	12.58
Total	2	8	16	14	17	15	24	55	151	100

**Table 7:** TBSA involved and cause of death

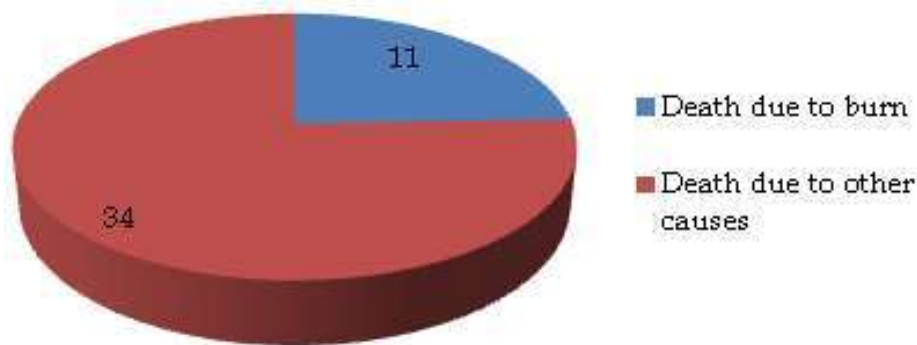
Period of survival	TBSA involved								Total
	≤ 30%	31–40%	41–50%	51–60%	61–70%	71–80%	81–90%	91–100%	
Neurogenic shock	0	0	1	2	3	2	4	31	43
Hypovolemic shock	0	2	5	4	1	7	10	11	40
Septicemia	1	6	9	6	11	6	9	9	57
Others	1	0	1	2	2	0	1	4	11
Total	2	8	16	14	17	15	24	55	151
Percentage %	1.32	5.30	10.60	9.27	11.26	9.93	15.90	36.42	100

**Table 8:** Distribution of manner of death according to TBSA involved

Manner of death	TBSA involved								Total	Percentage (%)
	≤ 30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%		
Accident	2	8	12	11	12	13	17	27	102	67.54
Suicide	0	0	2	3	3	2	4	13	27	17.89
Homicide	0	0	2	0	2	0	3	15	22	14.57
Total	2	8	16	14	17	15	24	55	151	100

**Table 9:** Anatomical site involved

Anatomical site	Cases	Percentage (%)
Head and Neck	128	91.43
Chest	137	97.85
Back	130	92.85
Abdomen	120	85.71
Extremities	138	98.57
Genitals	60	42.85
Palms	90	64.28
Soles	40	28.57
Scalp hairs	81	57.85



**Fig. 3:** Dowry death cases

**Discussion**

Our study revealed that 8.07% of the total medico-legal deaths were due to burn. In contrast, studies conducted in Turkey<sup>7</sup>, Imphal<sup>12</sup> revealed a lower percentage of incidences whereas, studies in other parts of India<sup>1,2,4,9,11</sup> reported higher percentage of deaths due to burns.

The female victims (66.89%) outnumbered male victims (33.11%). These findings almost tallies with the studies done in India<sup>1,2,4,8</sup> and in contrast to studies in Turkey<sup>7</sup>, Imphal<sup>12</sup> where male outnumbered female. Female preponderance may be due to their involvement in kitchen work and fire sources and traditional clothing pattern in Indian women, illiteracy, poverty, lack of awareness, mental stress, torture by in-laws etc.

The peak incidence is observed in the age group 21-30 years involving 35.76% victims, followed

by 11-20 years comprising of 28.47% victims. In females mostly the sufferers were encountered from 11 to 20 years (38.61%) age group followed by 21 to 30 years age group accounting 35.64% of the cases. This observation almost tallies with the studies in India<sup>2,9,10,11</sup> Imphal<sup>12</sup>, differed from studies in Turkey<sup>7</sup>, India<sup>1,3,4,5</sup> attributed to early age of marriage and subjection to dowry torture and dressing style.

It was found that most of the sufferers (67.54%) were married which was almost equal in both sex comprising 67.32% females and 66% males. Among unmarried, males constitute 17 (34%) cases and females constitute 33 (32.68%) cases. Studies in India<sup>1,2,5,7</sup> reported a higher percentage of married victims as compared to our study. The factors attributed to burns among married males could be unemployment, depression and stressful situations. Likewise, the triggering factors for burns in married females could be young age at the time

of marriage combined with inability to cope with the physical and psychological stress of marriage, harassment from in-laws, inadequate precautions during cooking and wearing of the loose clothes like sari.

On analyzing the data further, and concentrating on the duration of marriage of the married females. It was observed that 57.36% deaths occurred within 7 years of marriage where as 42.64% deaths occurred after 7 years of marriage out of which 16.18% deaths occurred within 1 year marriage. This finding almost tallies with a study in India.<sup>8</sup> The reason for such deaths in married females within 3 years of married-life could be due to nervousness, stress, mal-adjustment, torture, demand of dowry and lack of awareness in kitchen etc.

Incidences of burn death cases were most common in rural areas (78.81%) tallies with studies in India.<sup>2,4,5</sup> The high incidence of thermal burns in the rural areas can be explained by use of kerosene oil lamps for light in the villages, use of substandard kerosene and gas stoves, use of open coal and wood fires for warmth and cooking and lack of safety measures etc.

It was observed that maximum cases (82.11%) had taken place in indoor similar to studies in India.<sup>1,5</sup> Maximum number of burn death cases were found in indoor like kitchen followed by living room in either sex, because female spent most of the time in kitchen, it also serves as a secluded place for suicidal purpose and can be used to escape from homicide allegation.

On analyzing the incidences of burn in different hours of a day, it was observed that highest incidence of burn injury took place during 6.01 PM–9 PM (25.16%) followed by 3.01 PM–6 PM (21.85%). Our study is quite consistent with the study in India.<sup>4</sup> Females were more affected in evening because of poor lighting condition and traditional method of cooking, carelessness in kitchen.

It was found that most burn cases occurred during summer 51 (37.08%). This is quite consistent with the study in India<sup>4</sup>, dry and hot atmosphere increasing chances of pressure overload in the pressure stoves which may lead to bursting. There is highest availability of hay, husk, dry leaves and woods etc. during this time.

Majority of the cases were due to flame burns (91.39%), followed by electric burns (4.64%) almost tallies with the studies in India.<sup>11</sup> The high incidence of flame burn is explained by use of oil for lamps in villages, candle for lighting, substandard kerosene and gas stoves, use of open coal and wood fires.

Maximum numbers of burn injuries were due to alleged burst of kerosene pressure stove (19.21%), followed by suicidal burn using kerosene (15.23%), clothes caught fire from open chullha (11.25%), house fire (11.25%), accidental burn from kerosene lamp, dibiri etc. (9.27%), homicidal burn using kerosene 12 (7.95%), clothes caught fire from kerosene stove 8 (5.29%). Thus kerosene was the main offending agent in majority of the cases. The above finding almost tallies with studies in India.<sup>1,3,5</sup>

We observed that majority of the victims (52.32%) wearing synthetic clothes whereas (39.07%) victims with cotton dress. On sex wise analysis, it revealed that majority of the females 67 (66.33%) wearing synthetic dress which is at par with studies in India.<sup>6,10</sup> Synthetic clothes catch fire easily, flare upward and stick to the body surface resulting in difficulty for the victim to save oneself from the burn injury.

On analysing the duration of survival of the burn victims after the incidence, it is observed that most of the victims (74.84%) died within 1 week of the incidence, among which 50.33% cases died within 24 hours and (25.16%) cases survived > 1 week. Studies in India<sup>9,11</sup> found quite similar result as of our study. However, our findings did not tally with the studies in India.<sup>4,8</sup>

On further analysis we tried to find the relation between total body surface areas burnt and burn deaths. Majority of cases (36.42%) had > 90% TBSA involved; followed by 16.43% death when 81–90% TBSA is involved. In 82.85% cases, percentage of burn is > 50% TBSA. In 17.25% cases were found with percentage of burn < 50% TBSA. The above findings are quite similar with the studies in India.<sup>9,11</sup> From the above findings, it is clear that most of the fatality occurred when > 50% of TBSA is involved.

It was observed that maximum number of victims (35.76%) died as a result of septicemia followed by neurogenic shock (28.47%) and hypovolemic shock (26.49%). Our finding almost tallies with the studies in India.<sup>5</sup> Septicaemia as the most important factor for the cause of death appears when the period of survival is more than 5 days. This is because most of the victims who survived the initial 24 hours after burns, succumb to infection of the burnt area and its complications. Burns cause devitalisation of tissue leaving extensive raw areas, which usually remain moist due to the outflow of serous exudates. The exposed moist area along with the dead and devitalized tissue provides the optimum environment favoring colonisation and proliferation of numerous micro-organisms,

which is further enhanced by the depression of the immune response.

Our study revealed that maximum numbers of deaths (67.54%) were accidental, (17.89%) deaths were suicidal and (14.57%) deaths were homicidal in nature. > 90% of TBSA of burn was found in 48.18% suicide and 68.18% of homicide cases. The above findings almost tallies with the studies in India.<sup>1,3,11</sup> Turkey<sup>7</sup> detected a quite higher percentage of accidental burn deaths as compared to our study. However, a study in India<sup>2</sup> reported 47.8% were suicidal burns which is quite high in comparison to our study. Highly selective factors, such as socio-economic conditions, domestic quarrels, disturbed domestic life, chronic disease, mental disorder, disappointment in love or failure in examination etc. may determine the number of suicide cases.

Our study revealed that common sites of involvement are the extremities (98.57%) followed by chest (97.85%), back (92.85%), head and neck (91.43%), and abdomen (85.71%). Genitals are involved in 42.85% of the cases. Least common site affected is soles (28.57%). The above finding almost tallies with the study in India.<sup>10</sup> In our study extremities and trunk (chest and abdomen) are frequently involved because fire was lighted from below in most cases as source of fire is in lower level *i.e.*, at the level of floor. This study also shows that fatality is more when trunk is involved more than extremities. This is because more loss of fluid and electrolytes from the body.

## Conclusion

The distribution, causes of burns and the different factors responsible for mortality of the burn patients are more or less similar to the pattern found in other Indian studies, even similarity in all the parameters used in this study.

In our study we observed that most of the victims were married females of younger age group, educated up to primary level, from rural back ground and belonging to lower socio-economic strata. Domestic fire was the most common cause and cooking was the common activity when incident took place. Kerosene was found to be the most common offending agent and stove burst, being the main cause. Synthetic clothes/sarees are the important cofactors having a preponderance of accidental manner followed by suicidal. Most of the cases were accidental in nature followed by suicidal. Majority of the victims died due to

septicemia within 1 week of hospitalization with burns involving more than 50% of the total body surface area.

The factors like female gender, younger age group, cheap kerosene cooking stoves, loose fitting synthetic garments, wearing dress material and most importantly the percentage of burn are the prime factors which are mainly responsible for mortality in the burn victims. Development of burn wound infections indicating the decrease of natural defences responsible for counteracting them is another major factor influencing the mortality of patients. Dowry death still prevalent in our society shows the social angle and apathy towards society.

As this problem of thermal deaths persists in our country, active awareness and sensitisation mandatory not only by the government but also by different non-government organization to come together with SOP to minimise burn mortality and also to prevent and reduce the incidence.

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