



AUTOPSY BASED PROFILE OF FLAME BURN DEATHS: A ONE - YEAR PROSPECTIVE STUDY

Forensic Medicine

Dr. Ujjal Chutia	Post Graduate Trainee, Department of Forensic Medicine, Gauhati Medical College & Hospital, Guwahati
Dr. Kanak Chandra Das	Professor & HOD, Department of Forensic Medicine, Gauhati Medical College & Hospital, Guwahati
Dr. Kan Babu Choudhury	Associate Professor, Department of Forensic Medicine, Gauhati Medical College & Hospital, Guwahati

ABSTRACT

Background: Burn is one of the most common and the most catastrophic forms of trauma among people, leading to severe mortality and morbidity. The incidence of burn injury varies greatly between cultures. The majority of these occur in low and middle-income countries and almost two-thirds occur in the African and South-East Asia regions. **Materials and Methods:** The study is an autopsy based prospective study on flame burn cases carried out at Gauhati Medical College and Hospital, Guwahati, Assam, during a particular period of a calendar year i.e., 1st May, 2021 to 30th April 2022 in a specified population. The purpose of the study is to evaluate the various socio-demographic factors related to flame burn deaths. **Results:** Among 245 cases studied, majority of the victims were females (63.27%). Most of the incidents took place at home (53.87%). Majority of incidents took place in winter season (53.06%) and toxemia (56.33%) was the most common cause of death. **Conclusion:** Thermal burns and related injuries are major cause of death and disability all over the world. Hence, detailed study of flame burn injuries and its associated factors is essential to plan future strategies for burn prevention.

KEYWORDS

Burn, Catastrophic, Trauma, Toxaemia, Burn prevention.

INTRODUCTION

'Fire' is an important tool of human life¹². The discovery of fire was one of the greatest achievements of the early humans of the old stone age. In the initial period of existence, humans used or saw naturally caused fires as bush fires, forest fires and lightning. The early man used uncooked food, bore cold and fought the wild beasts and other foes without fire. Later, accidentally, it was noticed by them that two dry stones when rubbed together tend to produce fire as well. From thenceforth, humans began to produce fire through the use of flint stones. Fire was then used to roast meat, to keep warm during cold and to frightened wild animals by keeping a fire burning at cave entrances. In addition to many other benefits that fire provided to early humans, it also had a major impact on the innovation of tool and weapon manufacture. Subsequently with the advancement of civilization, fire was also being used in religion, magic and superstition^{7,13}.

At present day, burn is one of the most common and the most catastrophic forms of trauma among people, leading to severe mortality and morbidity. The incidence of burn injury varies greatly between cultures. In the United Kingdom (with its population of 65 million), each year around 175 000 people visit accident and emergency (A&E) departments suffering from burns, of whom about 13000 need to be admitted. About 1000 have severe burns requiring fluid resuscitation, and half of the victims are under 16 years of age. According to WHO, an estimated 180 000 deaths every year are caused by burns and vast majority occur in low and middle income countries. The majority of these occur in low and middle-income countries and almost two-thirds occur in the African and South-East Asia regions. South-East Asia alone accounts for more than half of these fire-related deaths. In South East Asian region, death due to burns in girls and women is more than that of Tuberculosis, HIV/AIDS and malaria combined¹⁶.

The risk factors for burns vary between regions, age groups, sexes and country GDP. Young girls, particularly in low and middle income countries are at risks of burns at home, particularly in the kitchen. The use of potentially unsafe kerosene cooking appliances and open fires at floor level, and traditionally loose clothing and wraps are seen as significant risk factors for flame related burns in younger women aged 16-35 years. Adult males are typically most at risks for burns in the workplace, second to exposure to flames, scalds and faulty electricity wiring. Hence, it is important to know the exact epidemiological features and actual cause of burns in each area as they vary with geography, demography, culture, customs and several other unknown factors.

The aims and objective of this research work is to find out the various

socio-demographic characteristics related to burn deaths and causes of death in burn in Kamrup district with special emphasis on preventive aspects of burns in rural areas of our region.

AIMS AND OBJECTIVES

The study "AUTOPSY BASED PROFILE OF FLAME BURN DEATHS – A ONE YEAR PROSPECTIVE STUDY" was undertaken with the following aims and objectives.

AIMS

1. To know the incidence of burn deaths in Kamrup districts of Assam and factors related to it.
2. To find out preventive strategies in high risk groups.

OBJECTIVES

1. To study the various socio-demographic pattern of death due to burn injury.
2. To find out the causes (mode) of death due to burn injury.

MATERIALS AND METHODS

The study is an autopsy based prospective study to find out the various epidemiological factors related to flame burn deaths during a particular period of a calendar year i.e., 1st May, 2021 to 30th April, 2022, in a specified population irrespective of age and sex. Burn due to chemical/electrocution/radiation/scald are excluded from the study. The study area was two numbers of districts namely Kamrup (Metro) and Kamrup (Rural) and adjoining areas in the state of Assam from where the cases are brought to Gauhati Medical College and Hospital, Guwahati for medico-legal autopsy.

All the data were collected in a specially designed proforma, conveniently made to record the different data in detail as needed for this analysis, which was then processed, tabulated, analyzed and documented as observations and results.

Ethical approval was received from the institutional Ethical committee prior to carrying out the research and a detailed proforma was planned and conveniently made to document the different information in detail about every case studied in the department and embodied in this thesis work.

RESULTS AND OBSERVATION

During the period of study, i.e. from 1st May 2021 to 30th April 2022, a total of 3386 medico-legal autopsies were performed in the Mortuary of Department of Forensic Medicine & Toxicology, Gauhati Medical College and Hospital, Guwahati, Assam. Out of these, 245 cases were

of flame burns constituting 7% of the total autopsies performed. Detailed results and observations have been charted out based on study of data collected. These have been represented in the form of tables.

Gender Wise Distribution Of Burn Victims

Table- 1.1 Gender Wise Distribution Of Burn Victims

Gender of the burn victims	Number of cases (N = 245)	Percentage (%)
Male	90	36.73
Female	155	63.27
Total	245	100

Among the total flame burn cases studied, it has been observed that the majority of the burn victims were females with 155 cases (63.27%). Males contributed to 90 cases, the percentage being 36.73%. The male : female ratio being 1:1.72.

Place Of Burn Incident

Table- 1.2 Place Of Burn Incident

Place of incidence	No. of cases (N = 245)	Percentage (%)
At home		
Kitchen	113	46.12
Living room	4	1.63
bathroom	15	6.12
Work place	23	9.39
Front / back yard	80	32.65
Others(open space/roadside)	10	4.08
Total	245	100

From the table 1.2, it has been observed that most of the burn incidents occurred at home with 132 (53.87%) cases of which 113cases (46.12%) occurred at kitchen. This is followed by front/back yards with 80(32.65%) cases, work place with 23 (9.38%) cases and others with 10 (4.08%) cases.

Time Of Burn Incident

Table- 1.3 Time Of Burn Incident

Time of burn incident	Number of cases	Percentage (%)
5 A.M. to 11 A.M.	93	37.96
11A.M. to 4P.M.	56	22.85
4P.M. to 11P.M.	67	27.35
11P.M. to 5A.M.	29	11.84
Total	245	100

From the table 1.3, it has been observed that majority of the incidents took place between 5 a.m. to 11 a.m. with 93 cases (37.96%). This is followed by 4 p.m. to 11 p.m. with 67 cases (27.35%), 11a.m. to 4 p.m. with 56 cases (22.85%) and least incident occurred between 11p.m. to 5 a.m. with 29 cases (11.84%).

Month Wise Distribution Of Burn Incidents

Table – 1.4 Month Wise Distribution Of Burn Incidents

Month of burn	Number of cases	Percentage (%)
January	47	19.18
February	41	16.73
March	29	11.84
April	19	7.76
May	8	3.27
June	7	2.86
July	4	1.63
August	5	2.04
September	9	3.67
October	11	4.49
November	23	9.39
December	42	17.14
Total	245	100

Calculation of month wise distribution of burn incidents was carried out on all the burn victims irrespective of age and sex and it has been found that the most common month in which most of the burn incidents took place was the month of January with 47 cases or 19.18% of the total cases studies. This is followed by December with 42cases(17.14%), February with 41 cases(16.73%), March with 29 cases(11.84%), November with 23 cases(9.39%), April with 19 cases(7.76%), October with 11 cases(4.49%), September with 9 cases(3.67%), May with 8 cases(3.27%) and June with 7 cases(2.86%) . The incidence of burn cases were low in the months of July and August with 4(1.63%) and 5(2.04%) cases respectively.

Season Wise Distribution Of Burn Incidents

Table- 1.5 Seasonal Variation Of Burn Incidents

Season of the year	Number of cases	Percentage (%)
Winter	130	53.06
Autumn	43	17.55
Spring	56	22.86
Summer	16	6.53
Total	245	100

From the table 1.5, it has been observed that most of the burn incident occurred during winter season with 130 cases or 53.06% of the total cases studied. This is followed by spring with 56 cases (22.86%), autumn with 43cases (17.55%) and lastly summer with 16 cases (6.53%). There was no significant difference between males and females regarding the season of injury and are mostly accidental.

Manner Of Burn Injuries

Table - 1.6 Manner Of Burn Injuries.

Manner of burn injuries	Number of cases (N = 245)	Percentage (%)
Accidental	233	95.10
Suicidal	12	4.90
Homicidal	0	0
Total	245	100

From the table 1.6, it has been found that the most common manner of burn injury was accidental with 233 cases or 95.10% of the total cases studied. This is followed by suicidal with 12 cases (4.90%). No homicidal cases were found. Majority of accidental burn cases occurred at home and females were the most common victims.

Causes Of Suicidal Burn

Table- 1.7 Causes Of Suicidal Burns

Causes	Number of cases (N=12)	Percentage (%)
Poverty	1	8.33
Quarrel with husband or family members	3	25
Psychiatric illness	5	41.67
Incurable disease	1	8.33
Undetermined	2	16.67
Total	12	100

From the table 1.7 it has been observed that majority of the victims had a history of psychiatric illness (5cases or 41.67%) and had a recent history of quarrel with family members (3 cases or 25%). Other causes include poverty and incurable disease; and some were undetermined.

Causes Of Death In Burn Victims

Table - 1.8 Cause Of Death Of Burn Victims

Cause of death	Number of cases (N = 245)	Percentage (%)
Toxaemia	138	56.33
Shock	74	30.20
Others(exhaustion, suffocation, syncope)	33	13.47
Total	245	100

From the table 1.8, it has been observed that a majority of the cases numbering 138 (56.33%) died due to toxaemia followed by 74 cases (30.20%) due to shock and others included 33 cases (13.47%).

DISCUSSION

Gender Wise Distribution Of Burn Victims: In the present study, highest incidence of burns is seen in females (63.27%) and this is because household and kitchen responsibilities are mostly carried out by females in our society. The nature of clothing worn by woman of our region is also an important factor in causation of burns. The majority of females were loose synthetic clothing during cooking which increases the likelihood of accidental flame burns both in number and severity. Man commonly encountered burn injury outdoors. Lack of appropriate safety measures, negligence in certain working environment are common causes for male predominance. The observations are similar to the studies by H. M. Mangal et al (2007), R Chawla et al (2011), S. Lal et al (2012), M. M. Afify et al (2012), Harish D et al (2013) and Rashid Rehal Khan et al (2019).

According to studies conducted by Nele Brusselaers et al (2010) in Europe, and Zeynep Sener Bache (2020) and Bulent Comcali et al

(2022) in Turkey, male predominates female. This can be justified by the higher proportion of industrial and recreational burn injuries among males. In addition the occupational hazards associated with burn injuries affect the male population more than females. On the other hand, the decrease incidence of female in burns could be due to use of standard cooking appliances like induction cooktop, microwave etc for cooking where the possibility of accidental burn injuries are less.

Place Of Incidence: In my study, it has been found that the home was the most common place of burns, with remaining occurring outdoors. Other places where burn incident took place were work place (industrial burn/burn at petrol pump) and open space (agricultural field). At home, it was found that kitchen was the most common place of burn as compared to living rooms and bathroom. According to Ambade V. N. et al (2006), Harish D et al (2013), Dr Amit Ranjan (2020), M.E. Bansude et al (2021) and Talla Srinivas et al (2021), the largest number of burn incidents took place in kitchen which is comparable with my study. The factors that contribute to the kitchen being the commonest place of accidental flame burn are small kitchen area, cooking at floor level, use of low-quality cooking appliances like kerosene stoves, stockpiling of kerosene gallons in kitchen and lastly due to lack of safety measures while cooking in kitchen.

Time Of Incident: Maximum number of burns incidents occurred between 5 A.M. to 11 A.M. followed by 4 P.M. to 10 P.M. while minimum cases (4%) occurred during 11 P.M. to 5 A.M. when most of the people are sleeping. The observations in my study is similar to the study S. Lal (2012). As female homemakers are in a rush to prepare the two meals (breakfast and lunch) along with the work load of other household activities, this time period in the morning hours is extremely prone to accidental burn injuries. Again the next phase where burn injuries occurred is between 4 P.M. to 10 P.M. The period again coincides with the time to prepare meal (dinner) at home. Moreover, 4 P.M. to 10 P.M. is the time period when people sit near a fire place during winters for warmth.

Seasonal Variation Of Burn Incidents: In the present study, it was found that maximum number of cases occurred during winter season (53.06%) followed by spring (22.86%). Winter is the coldest season in Assam. During winters, people like to stay near a fire place for warmth and due to uneven conditions end up in a fire incident. Moreover, during the winters people of Assam celebrate New Year 's Eve and Magh Bihu, during this time people gather and sit near the bonfire, where they cook and eat outdoors near the fire. The findings in my study is consistent with the studies conducted by M. M. Afify et al (2012) and inconsistent with the study conducted by Pandey S.K. and Chaurasia N (2014) and Dr Awdhesh Kumar (2015) who found most cases during summer season. This could be due to difference in geographical features of the region, seasonal condition, and level of development and social lifestyle of the people.

Month Wise Distribution Of Burn Incidents: In the present study, it is found that maximum number of burn incidents occurred in January (19.18%) followed by December (17.14%). The observations are in accordance with Dr. Rajani V. Bhagora (2011). This could be due to the fact that in our region of this country people at those periods are busy celebrating the New Year's Eve and bihu festival (Magh Bihu) by use of open wood fires for warmth and cooking. In addition, during December and January i.e., during the winters, people commonly arrange an open wood fire for warmth.

Manner Of Burns: Maximum number of burns was accidental (95.10%) followed by suicidal (4.90%). No homicidal burn cases were found. Alleged accidental burns are common, may be because of ignorance, poor standards of safety measures, cooking at floor level and wearing of sarees and dupattas while cooking. Similar findings have been observed by C.B. Tripathi (1999), Dr. H. Nabachandra and Memchoubi Ph. (2007), S Lal et al (2012), Mostafa M. Afify et al (2012), Arpan Mazumder and Amarjyoti Patowary (2013), Harish D et al (2013), Shinde A.B. and Keoliya A.N.(2013), Dr Kamal Singla (2014), Farhana Shahid et al (2018), M. E. Bansude et al (2021) and Talla Srinivas et al (2021).

Alleged suicidal burns are mostly seen in victims with history of psychiatric illness and domestic quarrel. In those with history of psychiatric illness, victims were mostly seen aged 50 years and above and in those with history of family quarrel, victims were mostly below

20 years of age.

According to Dr Anamika Nath et al (2015) and, Manigandaraj G and Selvakumar R (2021), suicidal burn was the most common manner of death. This could be due to deep-rooted customs of dowry, marital disharmony, stress and poverty which could have compelled the married females to commit suicide.

Causes Of Suicidal Burns: In the present study, the most common cause of suicidal burn is found to be due to psychiatric illness followed by domestic quarrel. In those with psychiatric illness, victims were mostly females aged 50 years and above, and in those with history of quarrel/argument with family members, victims were mostly below 20 years of age. In young, the reason behind could be due to illiteracy and addiction which leads to domestic quarrels, while in elderly mild cognitive impairment, dementia and depression are the commonest causes. As per history from relatives, victims poured kerosene oil and burned themselves with a matchstick. The findings are inconsistent with the study conducted by Shinde A.B. and Keoliya A. N. (2013) in this context. According to Shinde A.B. and Keoliya A.N. the most common cause associated with suicidal burns is domestic quarrel and in my study it comes to be the second cause of suicidal burns.

Cause Of Death: In my study, majority of burn victims died due to toxemia (56%) followed by shock (30%). Majority of the patients who survived for a period of more than 5 days died due to complications of septicaemia (toxaemia) and that was well evident from the gross morphological and microscopic findings from the tissues sent. Victims who survived for a period of less than 24 hours died mostly due to shock (hypovolaemic or neurogenic). Other causes attributed to are exhaustion, suffocation and syncope.

In the studies conducted by Dalbir Singh et al (1998), Tripathi CB et al (2000), Jyosthna Devi Ande et al (2011), S.Lal et al (2012) and Rashid Nehal Khan et al (2019) observed that majority of the burn victims died due to Septicemia which is similar to my study. Thus, infection leading to secondary complications and ultimately multiorgan failure was the major cause of death seen in burn victims, which could be tackled with the use of better burn facility care. In cases of shock, the high mortality rate can be attributed to the fact that majority of the victims were from the rural areas where initial care was not proper and there was a delay in getting admitted to a higher centre, ultimately leading to shock and death. So, the health care system needs to be strengthened at periphery.

CONCLUSION

Burn injuries are common in India, majority are accidental and occurs at home, and are preventable. High mortality is found to be associated with female sex and flame burns. The epidemiological factors of the burn injuries vary in different countries. Despite many advances in medical science, management to burns remains a challenging task in developing countries due to lack of infrastructure, trained persons and cost of treatment. Health care delivery system has to be upgraded at its various levels to decrease mortality and long term disability of burn patients. Public education and environmental modification is also essential to bring about a decrease in incidences of burn injuries. So, for planning and implementing prevention programmes, the approach has to be multidisciplinary and co-ordinated and this can be largely accomplished by measures like

- Mass education: Providing sufficient amount of education so as to build awareness in the mindset of the general population through school education and communication channels about burnt-related safety practices and more importantly about immediate first-aid management of burns before arrival in hospital.
- Transition of cooking appliances: People should abolish the use of chullhas and kerosene stoves and make a transition to use LPG and induction cooktops for cooking which are comparatively safer.
- Child burn prevention: Parents and caretakers should always keep an eye on infants and children when a fire is on. Kids should be educated never to put anything into the fireplace when it is lit. Moreover, scald burns is commonly seen in children and can be prevented by keeping hot liquids out of reach of children in locked containers that cannot be reached or opened by them.
- Prevention at work place: Burn incidences can be reduced at work place by taking occupational safety measures, providing occupational safety training (fire drills), and using protective equipments. Moreover, authorities concerned should ensure that there is a fire exit and escape route clearly marked and

unobstructed at all times. They should also review and update their risk assessments regularly.

- Upgradation of Health Care Delivery System: Health care delivery system should be upgraded at its various levels. The following recommendations are structured in accordance with WHO and NPPBI documents on burn injury prevention^{4,11}.
- a) At primary level: At primary level, staffs such as ANMs, nurses, dressers, Anganwadi workers etc should be trained in respect to first-aid treatment of burn patients.
- b) At district level: At district level, proper and periodic training of doctors and other staffs on recent advancement of treatment of burn patients should be undertaken. Number of beds in burn units should be increased and other facilities related to burn injury management should be upgraded so as to provide excellent medical care.
- c) At tertiary level: At tertiary level, training of doctors and staffs, structural modifications in hospital building, introduction of new services, development of treatment protocols and coordination between different health facilities should be undertaken. The existing operation theatre and ICUs should be upgraded. The existing operation theatres should be augmented by providing basic equipments such as ventilators, vital parameter monitors, skin graft mesher, Humby's knife, portable lights, dermatome etc. At this level, every possible facility and information related to complete burn rehabilitation should be available.

The present study is concluded with the hope that the given suggestions will help in reducing the number of burn incidences.

REFERENCES

1. Afify MM, Mahmoud NF, Abd El Azzim GM, El Desouky NA. Fatal burn injuries: A five year retrospective autopsy study in Cairo city, Egypt. *Egyptian Journal of Forensic Sciences*. 2012 Dec;2(4):117–22.
2. Arpan Mazumder, Amariyoti Patowary. (PDF) A study of pattern of burn injury cases [Internet]. [cited 2022 Sep 10]. Available from: https://www.researchgate.net/publication/298487045_A_study_of_pattern_of_burn_injury_cases
3. Bahçe ZŞ, Öztaş T. Epidemiological analysis of patients with burns in third-line hospitals in Turkey. *Int Wound J*. 2020 Jun 9;17(5):1439–43.
4. Burns [Internet]. [cited 2023 Mar 16]. Available from: <https://www.who.int/news-room/fact-sheets/detail/burns>
5. Coşcalı B, Ceylan C, Altun Özdemir B, Ocaklı S, Pehlevan Özel H, Çınar Yastı A. Seasonal effects on the mechanisms of burn injuries. *Turk J Surg*. 2022 Mar 1;38(1):5–10.
6. Fire and It's Value to Early Man [Internet]. [cited 2023 Mar 16]. Available from: <http://fubini.swarthmore.edu/~ENV52/S2007/rmckenn1/FirstEssay.htm>
7. Gowlett JAJ. The discovery of fire by humans: a long and convoluted process. *Phil Trans R Soc B*. 2016 Jun 5;371(1696):20150164.
8. Harish D, Kaur C, Singh A, Kumar A. A comprehensive analysis of deaths due to burns in a tertiary care centre. *Journal of Punjab Academy of Forensic Medicine and Toxicology*. 2013 Jan;13:68–73.
9. Kumar DA, Pandey DS. Socioeconomic Characteristics of Unnatural Death Due to Dry Burn in Varanasi ;Uttar Pradesh ;India. In 2015.
10. Lal S, Shrivastava G, Singh S, Yadav G, Bain J, Gupta R. Mortality pattern of burn patients admitted in S. G. M. Hospital Rewa: A teaching institute of central India. *J Sci Soc*. 2012;39(3):130.
11. Makhija L, Bajaj S, Gupta J. National programme for prevention of burn injuries. *Indian J Plast Surg*. 2010;43(3):6.
12. Mckenna R. Fire and It's Value to Early Man [Internet]. [cited 2022 Oct 8]. Available from: <http://fubini.swarthmore.edu/~ENV52/S2007/rmckenn1/FirstEssay.htm>
13. Nath PDA, Chakraborty PN. Burnt Wives of Agartala: A Retrospective Study From Medico Legal Autopsies of A Tertiary Hospital of Tripura, Northeast India. *International journal of emerging trends in science and technology*. 2015;2.
14. Pandey S, Chaurasia N, Kumar A. Thermal Burn: An Epidemiological Retrospective Study. *Indian Journal of Forensic Medicine & Toxicology*. 2014 Jul;8:34.
15. Patil V. The Beginning of Fire Worship and its Veneration in Indian Culture [Internet]. 2016 [cited 2022 Oct 5]. Available from: <https://www.esamskriti.com/essay-chapters.aspx?sectionname=Culture&subsectionname=Indian-Culture&topicname=The-Beginning-of-Fire-Worship-and-its-Veneration-in-Indian-Culture&chapter=1>
16. Ph M, Nabachandra H. A study of burn deaths in Imphal. *Journal of Indian Academy of Forensic Medicine*. 2007;29:131–4.
17. Sm D, Cb T. Burnt wife syndrome. *Annals Academy of Medicine Singapore*. 1984;13:37–42.
18. Stokes M a. R, Johnson WD. Burns in the Third World: an unmet need. *Ann Burns Fire Disasters*. 2017 Dec 31;30(4):243–6.
19. Stokes M a. R, Johnson WD. Burns in the Third World: an unmet need. *Ann Burns Fire Disasters*. 2017 Dec 31;30(4):243–6.