Original Article

A Demographic and Forensic Analysis of Thermal Burn Fatalities: An Autopsy-Based Study in Kolhapur District

N.S. Jagtap[1], M.M. Ghatage[2], Y.S. Thorat[3]

[1]Assistant Professor, Department of Forensic Medicine & Toxicology, R.C.S.M. Government Medical College & CPR Hospital Kolhapur, [2]Assistant Professor, Department of Forensic Medicine & Toxicology, R.C.S.M. Government Medical College & CPR Hospital Kolhapur, [3]Assistant Professor, Department of Forensic Medicine & Toxicology, Government Medical College Miraj.

How to cite this article: N.S. Jagtap, M.M. Ghatage, Y.S. Thorat. A Demographic and Forensic Analysis of Thermal Burn Fatalities: An Autopsy-Based Study in Kolhapur District. Indian Journal of Forensic Medicine and Toxicology/Volume 19 No. 4, October-December 2025.

Abstract

Background: Thermal burns remain a major public health concern in developing countries, with significant mortality and medico-legal implications. Regional studies are essential for understanding the unique demographic and forensic patterns that influence outcomes.

Objective: To analyze the demographic profile, manner of death, extent of burns, and survival patterns among thermal burn victims subjected to medicolegal autopsy in Kolhapur district.

Methods: A retrospective observational study was conducted over a defined period, examining 475 autopsy cases of thermal burn deaths at a tertiary healthcare center in Kolhapur district. Data were analyzed for age, sex, total body surface area (TBSA) involved, manner of death, survival duration, seasonal trends, and urban-rural distribution.

Results: Out of 475 cases, females accounted for 63.7% of burn deaths. The most affected age group was 21–30 years (31.7%). Accidental burns were the predominant manner of death (73.9%). TBSA involvement >80% was observed in 48% of cases. A majority of deaths occurred within 1–3 days post-injury. Rural areas and winter season showed a higher incidence.

Conclusion: The study highlights a high prevalence of thermal burn deaths among young rural females in Kolhapur, often with extensive TBSA involvement and limited survival duration. These findings underscore the urgent need for improved burn prevention strategies, timely medical care, and region-specific public health interventions.

Keywords: Thermal burns, Burn mortality, Autopsy study, Forensic pathology, Kolhapur district, Demographic profile, TBSA, Accidental burns, India, Medicolegal autopsy

Corresponding Author: N.S.Jagtap, Assistant Professor, Department of Forensic Medicine & Toxicology, R.C.S.M. Government Medical College & CPR Hospital Kolhapur.

E-mail: nikhiljagtap13.nj@gmail.com

Submission date: July 31, 2025 **Acceptance date:** Sept 3, 2025 **Published date: October 13,2025**

Introduction

Burn injuries represent one of the most devastating forms of trauma, often resulting in significant morbidity and mortality worldwide. They remain a major public health issue, especially in low- and middle-income countries where access to specialized burn care is often limited[1,2]. Globally, an estimated 180,000 deaths annually are attributed to burns, with the vast majority occurring in developing nations[3]. India, in particular, accounts for a substantial proportion of global burn mortality, with studies indicating over 700,000 burn injuries annually and an estimated 1,40,000 deaths[4,5].

Thermal burns can result from various sources such as flame, scalds, contact with hot objects, and explosions. Among these, flame burns are most commonly associated with fatal outcomes[6,7]. Burn injuries in India have unique epidemiological and socio-cultural patterns, with young women being disproportionately affected, often in the context of domestic accidents, suicides, or dowry-related violence[8-10]. The age group of 21–30 years is consistently reported as the most vulnerable demographic, likely due to increased domestic exposure and social pressures[11,12].

Autopsy-based studies play a crucial role in understanding the pattern, cause, and manner of burn-related deaths. These studies help determine whether the death was accidental, suicidal, or homicidal, and are essential for medico-legal investigations and prevention strategies[13.14]. The integration of forensic findings with epidemiological data can guide public health interventions aimed at reducing burn mortality and improving outcomes for burn victims[15].

Despite the high burden, literature on the demographic profiling and forensic autopsy findings of burn deaths remains limited in many regions. Available studies have pointed toward significant gender disparities, seasonal variations, and urban-rural differences in incidence[16-18]. Furthermore, social determinants such as education, occupation, and housing conditions influence both the occurrence and outcome of burn injuries.[19-21].

This study aims to fill the knowledge gap by analyzing the demographic characteristics and autopsy findings of thermal burn fatalities over a defined period. It seeks to identify key risk groups and patterns, and to propose evidence-based preventive measures. Through this, the study contributes to the larger goal of reducing avoidable deaths from thermal injuries and improving forensic understanding in burn-related fatalities.[22,23].

Methodology

Study Design: The study was conducted in the Department of Forensic Medicine and Toxicology, Rajarashi Chhatrapati Shahu Maharaj Government Medical College Kolhapur District, MaharashtraThe study included all autopsy cases of thermal burn fatalities brought for medico-legal examination during this time.

Study Period: January 1, 2021 to December 31, 2023.

Inclusion Criteria:

- All deceased individuals subjected to medico-legal autopsy with a cause of death determined to be thermal burns.
- Cases with complete autopsy records, including police inquest reports, hospital treatment records (if available), and postmortem findings.

Exclusion Criteria:

- Cases of electrical burns, chemical burns, or scalds without flame burns.
- Decomposed bodies where the cause of death could not be reliably ascertained.
- Incomplete documentation or missing case files.

Assessment of Burn Extent: The extent of burn injury was calculated using the Wallace Rule of Nines. Where available, hospital-based TBSA estimations were cross-checked with autopsy documentation.

Results

A total of 475 autopsy cases of thermal burn fatalities were included in the study conducted over the specified period.

1. Gender Distribution

Out of 475 cases, 303 (63.7%) were females and 172 (36.3%) were males, showing a marked female predominance.

Table 1: Gender-wise Distribution of Burn Cases

Gender	Number of Cases	Percentage (%)
Male	172	36.2%
Female	303	63.7%
Total	475	100%

2. Age-wise Distribution

Burn deaths were most common in the 21–30 years age group (151 cases, 31.7%), followed by:

- 0–10 years: 26 cases (5.4%)
- 11–20 years: 102 cases (21.4%)
- 31–40 years: 89 cases (18.7%)
- 41–50 years: 60 cases (12.6%)
- 51–60 years: 29 cases (6.1%)
- 60 years: 18 cases (3.7%)

Table 2: Age-wise Distribution of Burn Cases

Age Group (Years)	Number of Cases	Percentage (%)
0–10	26	5.4%
11–20	102	21.4%
21–30	151	31.7%
31–40	89	18.7%
41–50	60	12.6%
51–60	29	6.1%
>60	18	3.7%
Total	475	100%

3. Manner of Death

The majority of deaths were accidental in nature (205 cases, 73.9%), followed by:

- Suicidal burns: 56 cases (20.2%)
- Homicidal burns: 16 cases (5.7%)

Table 3: Manner of Death in Burn Cases

Manner of Death	Number of Cases	Percentage (%)
Accidental	205	73.9%
Suicidal	56	20.2%
Homicidal	16	5.7%
Total	277	100%

4. Extent of Burns (Total Body Surface Area - TBSA)

- 80% TBSA: 228 cases (48%)
- 51–80% TBSA: 162 cases (34.1%)
- 31–50% TBSA: 53 cases (11.2%)
- ≤30% TBSA: 32 cases (6.7%)

4: Extent of Burns (Total Body Surface Area – TBSA)

TBSA (%)	Number of Cases	Percentage (%)
≤30%	32	6.7%
31–50%	53	11.2%
51–80%	162	34.1%
>80%	228	48.0%
Total	475	100%

5. Duration of Survival Post-Burn

- Died within 24 hours: 141 cases (29.6%)
- Survived 1–3 days: 169 cases (35.5%)
- Survived >3 days: 165 cases (34.7%)

Table 5: Survival Time Post-Burn

Survival Duration	Number of Cases	Percentage (%)
<1 day	141	29.6%
1–3 days	169	35.5%
>3 days	165	34.7%
Total	475	100%

6. Urban vs Rural Distribution

- Rural cases: 287 (60.4%)
- Urban cases: 188 (39.6%)

Table 6: Seasonal Distribution of Burn Cases

Season	Number of Cases	Percentage (%)
Winter	183	38.5%
Summer	147	30.9%
Monsoon	145	30.5%
Total	475	100%

7. Seasonal Variation

The highest incidence was observed during the winter season (November–January) with 183 cases (38.5%), followed by:

- Summer (March–June): 147 cases (30.9%)
- Monsoon (July–October): 145 cases (30.5%)

Table 7: Urban vs Rural Distribution

Area Type	Number of Cases	Percentage (%)
Urban	188	39.6%
Rural	287	60.4%
Total	475	100%

8. Autopsy Findings

Common autopsy findings included:

- Pugilistic attitude: 411 cases (86.5%)
- Singeing of scalp hair: 398 cases (83.8%)
- Soot in trachea/bronchi: 264 cases (55.5%)
- Congestion of lungs: 379 cases (79.8%)
- Visceral congestion (liver, spleen, kidneys): Present in 401 cases (84.4%)
- Subendocardial hemorrhage: Observed in 139 cases (29.2%)

Table 8: Autopsy Findings in Thermal Burn Fatalities (n = 475)

Autopsy Findings	Number of Cases	Percentage (%)
Pugilistic attitude (boxing posture)	411	86.5%
Singeing of scalp hair	398	83.8%
Soot particles in trachea/bronchi	264	55.5%
Congestion of lungs	379	79.8%
Visceral congestion (liver, spleen, kidneys)	401	84.4%
Subendocardial haemorrhage	139	29.2%

Discussion

Burn injuries remain a significant public health concern, particularly in low- and middle-income countries like India, where they constitute a major share of medico-legal autopsy cases. The present study analyzed 475 cases of thermal burn deaths to evaluate demographic trends, patterns of injury, and associated autopsy findings.

In our study, females accounted for 63.7% of the total burn fatalities, which is consistent with findings from Sharma et al. (2002), who reported a female predominance of 65% in burn deaths in North India[4]. Similarly, Kumar et al. (2007) observed that 60.2% of burn deaths were among females, attributing it to domestic exposure, traditional cooking practices, and sociocultural factors like dowry harassment and marital disputes[12]. This gender disparity underscores the vulnerability of women, particularly in the domestic setting.

The 21–30 years age group was the most affected (31.7%) in our series, similar to the observations of Subrahmanyam (1996), who found that young adults in the second and third decades of life were at the highest risk[6]. This age group corresponds with increased domestic responsibilities and exposure to open flames, kerosene stoves, and cooking fires, especially among females.

The majority of the cases (73.9%) were accidental, which aligns with findings from studies by Singh et al. (1996) and Behera et al. (2008), where accidental burns were reported in 70–75% of cases[9,17]. However, 20.2% of deaths were suicidal, and 5.7% were homicidal, reflecting the continued relevance of burn injuries in self-harm and criminal acts. Mohanty and Panigrahi (2004) also highlighted the growing incidence of suicidal burns among young married women, often related to dowry or domestic abuse[20].

Burn extent analysis revealed that 48% of victims had >80% TBSA involvement. Similar findings were reported by Pal et al. (1997), where more than half of the burn fatalities had TBSA >70%[10]. High TBSA is strongly associated with poor prognosis due to fluid loss, infection, and systemic organ failure. Singh et al. (2003) noted that patients with burns exceeding 60% TBSA rarely survive without prompt and intensive care[16].

In terms of survival period, 34.7% of the victims survived more than 3 days, suggesting possible opportunities for medical intervention in some cases. Ganesan et al. (2020) reported similar findings, emphasizing that early hospitalization and resuscitation could reduce mortality, especially in patients with 40–60% TBSA burns[23].

Seasonal variation showed a peak during the winter season (38.5%), which is likely due to the increased use of heating appliances, open fires, and indoor cooking during colder months. This is in concordance with studies by Lal and Chavan (2013), who also reported a winter predominance in burn incidents[7].

Autopsy findings in this study provide valuable insight into the pathophysiology of burn-related deaths. The pugilistic attitude (seen in 86.5% of cases) is a common feature of thermal burns due to muscle contraction from intense heat[14]. Singeing of hair and soot in the tracheobronchial tree were seen in 83.8% and 55.5% of cases, respectively, indicating exposure to flame and inhalation of smoke prior to death. Similar findings were highlighted in studies by Dogra and Rudra (2000), where soot in airways was considered a reliable marker of antemortem burning[8].

Visceral congestion and subendocardial hemorrhages were also frequently observed, supporting the systemic inflammatory response and hypoxia as contributing factors in burn mortality[13]. These pathological findings are in agreement with the observations of Reddy (2017) and Hemalatha & Kumar (2014), who emphasized the importance of internal examination in ascertaining the vitality of burns[15,21].

Our study also noted a higher number of cases from rural areas (60.4%), likely reflecting poor access to safe cooking practices, emergency care, and health education. This rural predominance has also been reported in studies by Chawla et al. (2013) and Ahuja & Bhattacharya (2004), stressing the need for targeted community-based prevention strategies[18,19].

Overall, this study reinforces the role of forensic autopsy in identifying patterns and potential preventive strategies for burn fatalities. The demographic trends, especially among young females, highlight urgent social and public health priorities.

Uniqueness of the Study in Kolhapur District

This study is one of the few comprehensive forensic analyses of thermal burn fatalities specifically conducted in the Kolhapur district of Maharashtra, a region with distinct sociocultural and geographic characteristics. Unlike larger metropolitan studies, this research provides valuable insight into the rural-urban divide, with a majority of cases originating from rural backgrounds where traditional cooking methods, poor housing conditions, and limited access to emergency care are prevalent. Kolhapur's cold winters, reliance on open flames, and high prevalence of kerosene-based cooking further contribute to burn incidents, which are contextually different from other regions. The study also highlights local trends in dowry-relatedsuicides and domestic accidents, which remain underreported elsewhere. By correlating demographic patterns with autopsy findings over a defined period, the study offers a region-specific evidence base that can inform targeted public health interventions and legal reforms in the Kolhapur district.

Conclusion

Thermal burns continue to be a significant cause of mortality, especially in developing regions like ours. This study revealed that burn fatalities predominantly affect young females in the reproductive age group, reflecting the social and domestic vulnerabilities they face. Accidental burns were the most common manner of death, with high total body surface area (TBSA) involvement contributing to poor prognosis and high mortality. A significant number of victims survived for more than 24 hours, highlighting the need for timely and advanced medical care.

Seasonal peaks during the winter and a higher incidence in rural areas emphasize the influence of environmental and socioeconomic factors. The autopsy findings not only confirmed the cause and manner of death but also helped in differentiating between antemortem and postmortem burns, contributing to the medico-legal understanding of these cases.

This study underscores the need for improved public education, safe cooking practices, and better access to burn care facilities, and stronger enforcement of domestic safety laws. Multisectoral intervention—combining medical, legal, and social approaches—is essential to reduce the burden of burn-related mortality in the population.

Future Research Recommendations

1. **Prospective multicentric studies** – Conducting prospective studies across multiple districts or states to compare regional variations in burn epidemiology and autopsy findings.
2. **Integration of forensic and clinical data** – Combining autopsy results with hospital admission records to assess the role of pre-hospital care, resuscitation, and treatment outcomes in survival rates.
3. **Socioeconomic and cultural factors** – Investigating the influence of literacy levels, occupational hazards, domestic fuel use, and cultural practices on burn incidence.
4. **Burn injury prevention programs** – Evaluating the effectiveness of community-based burn awareness campaigns, safety regulations, and public health interventions.
5. **Histopathological correlation studies** – Expanding microscopic examination of burn tissue to better determine vitality, duration of survival, and possible inhalation injury effects.
6. **Toxicological analysis** – Including routine screening for carbon monoxide, cyanide, and alcohol to assess their contribution to mortality in burn victims.
7. **Longitudinal follow-up studies** – Tracking survivors of severe burns to understand long-term morbidity, psychological effects, and socio-economic impact.

Limitations of the Study

1. **Hospital-based autopsy data** – The study is based solely on medicolegal autopsy cases, which may not represent all burn-related deaths in the community, particularly those not reported for postmortem examination.
2. **Retrospective design** – Being retrospective, the study relied on available records, which may have incomplete or missing details regarding scene findings or pre-hospital treatment.
3. **Limited clinical correlation** – Information on pre-burn medical conditions, hospital course, and treatment interventions was not uniformly available, limiting clinicopathological correlation.
4. **Geographic restriction** – Findings are specific to the Kolhapur district and may not be generalizable to other regions with different sociocultural and healthcare contexts.
5. **Potential bias in cause classification** – Manner of death (accidental, suicidal, homicidal) was determined based on police inquest and case history, which may be influenced by reporting bias.

Declarations

Ethics approval and consent to participate and consent: Not Applicable since the study did not include any intervention of live subjects

Funding and conflicts of interest: None to declare

References

1. Peck MD. Epidemiology of burns throughout the world. Part I: Distribution and risk factors. *Burns*. 2011;37(7):1087–100.
2. Forjuoh SN. Burns in low- and middle-income countries: a review of available literature on descriptive epidemiology, risk factors, treatment, and prevention. *Burns*. 2006;32(5):529–37.
3. World Health Organization. Burns Fact Sheet. Geneva: WHO; 2018.
4. Sharma BR, Harish D, Sharma A, Sharma S. Kitchen accidents vis-à-vis dowry deaths. *Burns*. 2002;28(3):250–3.
5. Gupta M, Gupta OK, Goil P. Burn epidemiology: the Pink City scene. *Burns*. 1993;19(1):47–51.
6. Subrahmanyam M. Epidemiology of burn injuries—A study of 1239 patients. *Burns*. 1996;22(6):433–7.
7. Lal S, Chavan KD. Pattern of fatal burns in Aurangabad, Maharashtra: a postmortem study. *J Forensic Med Toxicol*. 2013;30(1):45–8.
8. Dogra TD, Rudra A. Fire deaths in Delhi: a study of 200 cases. *Forensic Sci Int*. 2000;110(2):149–57.
9. Singh D, Jit I, Tyagi S. Burn deaths in Chandigarh zone: an autopsy study. *Am J Forensic Med Pathol*. 1996;17(4):312–5.
10. Pal J, Bhatnagar A, Agarwal P. Epidemiological and socio-cultural study of burn patients in M.Y. Hospital, Indore, India. *Burns*. 1997;23(6):420–3.
11. Patetta MJ. Fire-related deaths and injuries in residential structures. *JAMA*. 1990;263(2):214–6.

12. Kumar A, Lalwani S, Sharma A, Rautji R, Dogra TD. Fatal burns in Delhi, India: a retrospective epidemiological study. *J Burn Care Res*. 2007;28(1):115–9.
13. Gautham K, Agnihotri AK. Pattern and distribution of fatal burn injuries: a medico-legal study. *J Indian Acad Forensic Med*. 2011;33(4):312–6.
14. Reddy KSN. *The Essentials of Forensic Medicine and Toxicology*. 34th ed. Hyderabad: K Suguna Devi; 2017.
15. Hemalatha V, Kumar A. Forensic evaluation of burn deaths—A study of 100 cases. *Indian J Forensic Med Pathol*. 2014;7(3):117–20.
16. Singh H, Singh A, Gorea RK, Aggarwal AD. Burns mortality in Chandigarh zone. *J Indian Acad Forensic Med*. 2003;25(3):133–9.
17. Behera C, Rautji R, Dogra TD. Burn injuries: An analysis of 500 patients. *Medico-Legal Update*. 2008;8(2):33–6.
18. Chawla R, Chanana A, Rai H. Burn injury profile: a study from a tertiary care hospital in northern India. *J Clin Diagn Res*. 2013;7(2):250–3.
19. Ahuja RB, Bhattacharya S. ABC of burns: Burns in the developing world and burn disasters. *BMJ*. 2004;329(7463):447–9.
20. Mohanty S, Panigrahi MK. Deaths due to burns in a developing country: are women still the victims? *J Clin Forensic Med*. 2004;11(4):250–2.
21. Mehta M, Shahane S. Burn mortality in India: a study of 1000 cases. *Int J Burns Trauma*. 2012;2(3):112–6.
22. Sharma S, Gupta A, Singh S. Epidemiology and outcomes of burn injuries in a tertiary care center: a 5-year study. *Indian J Plast Surg*. 2020;53(1):38–44.
23. Ganesan M, Jha AK, Subbiah M. Mortality predictors in flame burns: a prospective analysis. *Indian J Crit Care Med*. 2020;24(4):256–61.