Original Article

An Autopsy Based Study on Death due to Burn Injuries

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Abstract

Background: Burn injuries remain a major health concern nowadays and one of the leading cause of accidental death in Bangladesh. Death due to burn injuries is common in forensic practice but many a time it is very difficult to investigate the burn incident as the important evidences are destroyed. During autopsy evaluation of each victim who died due to burn injuries, the autopsy surgeon faces various challenges which include identification of the victim, determination the cause and manner of death, interpretation of temperature related arte fact like heat ruptures, heat haematoma etc.

Objective: To determine the frequency and various types of burn injuries causing death of the victims along with analyzing the post-mortem findings and identify emerging trends in burn injury related tragic death.

Methods: This cross-sectional descriptive study was conducted on 112 burn injured cases autopsied at Dhaka Medical College Hospital, Dhaka, Bangladesh from September 2024 to February 2025. During autopsy, deceased bodies were meticulously examined both externally and after dissection internally. Data were collected from inquest reports, chalan, death certificates (if the victim died at hospital) which included information on victim's demographics along with the statement of the eye witness of the scene of incident and the autopsy findings of the autopsy surgeon. A standardized protocol was followed to ensure data accuracy and consistency.

Results: Results revealed a predominance of female victims 59(52.7%) compared to 53(47.3%) of male burn injured victims. The common sources of burn injuries were accidental fire from house hold gas/kerosene stove (34.8%), mosquito coil (19.6%) etc. Apart from these others factors responsible for burn injuries were accidental burst of gas cylinders (36.6%), electric short circuit (26.6%), and accident in industrial chemical factories or warehouses (16.1%). Common post-mortem findings included organ congestion in 112(100%) cases, erosions/carbon particles in respiratory tract/lungs specially in inhalation burn in 99(88.4%) cases, escharotomy present in 48(42.85%) cases and involment of the epidermis/ dermis of the skin in 112(100%) cases.

Conclusion: This study reveals different causes of death due to burn injuries along with the postmortem findings. Even early intervention in the clinical management of severe burn cases, still give a grave prognosis and many a times complete recovery is a great challenge. Necessary steps and precaution are needed to be taken in order to prevent these various types of accidental burn incidences.

Keywords: Burn injuries, Septic shock, Post-mortem examination.

Introduction

Burn is an injury or lesions caused due to application of heat or chemical substances to the external or internal surface of the body which causes tissue damage. Radiation causes tissue damage by converting infrared frequencies into thermal heat or by absorbing it within the layers of skin. Chemical burn occurred when corrosive substance like acid or alkali comes in contact with body surface area or by accidental ingestion. Scald is an injury caused by application of liquid above 60ºC or from steam.[1]

In this subcontinent thousands of deaths occurred due to burns injuries and majority of those incidents occurred at home & are due to defective electric wiring, defective cooking devices and industrial accidents etc. Sources of burn are fire , radiation, contact with highly heated substances like metal or liquid, short circuit of ill fitting electric wires, lightning, chemicals (corrosives), X-ray, UV- ray, radium, laser etc. Incident of burn occured due to catching fire in houses or worn clothes, inflammable liquid, fire explosions, industrial furnace etc.

Based upon the depth of burn injuries in the skin, the two different types of classifications are- Dupuytren's classification and Wilson classification (Modern classification). Dupuytren classified various types of burn injuries into six degrees, on the other hand Wilson merges these into three degrees which are - a) Epidermal: Blister is formed and these burns are very painful and repaired completely without forming scar. b) Dermo-epidermal: There is complete damage to the whole thickness of skin. Eschar formed and due to contraction of scar tissue there might be disfigurement at the burn injured affected part of the body. c) Deep: There is complete damage to all layers of skin, muscles, nerve endings and even sometimes underlying bone. With the help of a high frequency ultrasound machine depth of the burn injuries could be measured.[1]

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Minimum temperatures required to produce burn are 44º C for about 5 to 6 hours, 65º C for about 2 seconds and 70º C for about < 1 second. Estimation body surface area calculating burn injuries is done according to Rule of Nine and as per the rule, each upper limb 9%, anterior and posterior part of each lower limb 18%, head and neck region 9% , anterior part of chest and abdomen 18% and posterior part of chest and abdomen 18% and external genitalia 1%.[2]

Effects or complications of burn injuries are septicemia, hypovolemic shock, asphyxia occurred due to inhalation of irrespirable gases, formation of burn scar and in some patients keloid formation which causes deformity or disability or both to the burn affected site of the body of the victim.

Factors modifying the effect of burns are intensity of applied heat, duration of exposure, extent of body surface area and site of the body like burn in the trunk, lower abdomen & genitalia are fatal. Causes of death in burn injuries are (within 24 hours) Primary or neurogenic shock[3], secondary or vascular or hypovolemic shock[4] (death within 24-48 hours). Beside these other important cause related deaths due to burn injuries are asphyxia due to suffocation as a result of inhaling smoke. Deaths occurring after 48 hours as a result of burn injuries are due to internal organs failure, septicemia, hypovolemic shock, fluid and electrolytes imbalance, Hepatorenal Syndrome etc. Correlation of the ante mortem clinical data with the postmortem findings at morgue including external examination of victim's dead body, after dissection internal examination of the organs, histopathological examinations report of the organs, in necessary cases chemical analysis report of the viscera and DNA profiling report (if the victim is unknown/identity of the victim need to confirm) were much helpful to explain the cause of death in much more precise way.[5] However, there remains a need for further research to address the underlying causes of death due to burn incidences and thereby reduce the death due to burn injuries.

Materials and Methods

This cross-sectional descriptive study was conducted at the Department of Forensic Medicine and Toxicology at Dhaka Medical College Hospital, Dhaka, Bangladesh, from September 2024 to February 2025. A total of 112 autopsies were performed during this time on individuals who died due to burn injuries.

The study was conducted after taking the approval of the research protocol and the ethical clearance from the institutional review board. Data were collected from inquest reports and chalan provided by police and in case of hospital death, death certificate provided by the hospital authority. Relevant history of the burn incident was also obtain from next-of-kin (if present) of the deceased, who was interviewed prior to autopsy regarding details about the burn incident and also about victim´s clinical history. The confidentiality of victim´s information was maintained throughout the study.

A thorough autopsy was performed on each case, including external examination, internal examination, and collection of relevant samples. The relevant demographic information of the victims, causes of death due to burn injuries, percentage of body area of burn injuries and incidences of death, and associated post mortem findings in burn injuries were recorded in a standardized data collection form.

The collected data were analyzed using descriptive statistics to summarize in tables and figures. Frequency, distributions, percentages, and means were calculated to summarize the data. All questionnaires were checked very carefully to identify and prevent any error in data collection. After collection of all the required data, these were checked, verified for consistency and tabulated using the SPSS/PC v26.0 software. Where appropriate, mean values are expressed as mean ± standard error.

Results

The autopsy findings of the 112 poisoning victims were enrolled in this study with 59(52.7%) of them being females and the rest 53 (47.3%) males. The data for all 112 victims were available for analysis from their enrollment in this study.

The age of the burn injured victims ranged from 6-70 years where the majority of the burn injured affected i.e. 28(25.0%) were from the age group 31-40 years 46(41.1%) of them were different works of life like service holders, businessmen, day laborer. A large number of victims i.e. 52(46.4%) resided in urban areas (Table-I).

Table-I: Socio-demographic profile of the patients (n=112)

Attributes		n (%)
Sex	Female	59 (52.7)
	Male	53 (47.3)
Age	6-10	2 (1.8)
	11-20	18 (16.1)
	21-30	20 (17.9)
	31-40	28 (25.0)
	41-50	12 (10.7)
	51-60	25 (22.3)
	61-70	7 (6.3)
Area of residence	Urban	52 (46.4)
	Semi-urban	42 (37.5)
	Rural	18 (16.1)
Occupation	Students	17 (15.2)
	Homemakers	26 (23.2)
	Service holders/ Businessmen/Day laborers	46 (41.1)
	Industrial /garments workers	18 (16.1)
	Others	5 (4.5)

Among the 112 cases, most common reasons of burn injuries were due to house hold gas/kerosene cylinder/stove explosion or accidental use 39(34.8%), followed by commercially used gas cylinder explosion 22(19.6%) and other causes of the burn injuries are accidental explosion in industries or warehouses 17(15.2%), electric short circuit 15(13.4%), Chemical burn 13(11.6%), household inadvertence use of mosquito coil/electric heater unit 4(3.6%) and Boiling water spill 2(1.8%) mostly in case of children, as described in Figure-1.

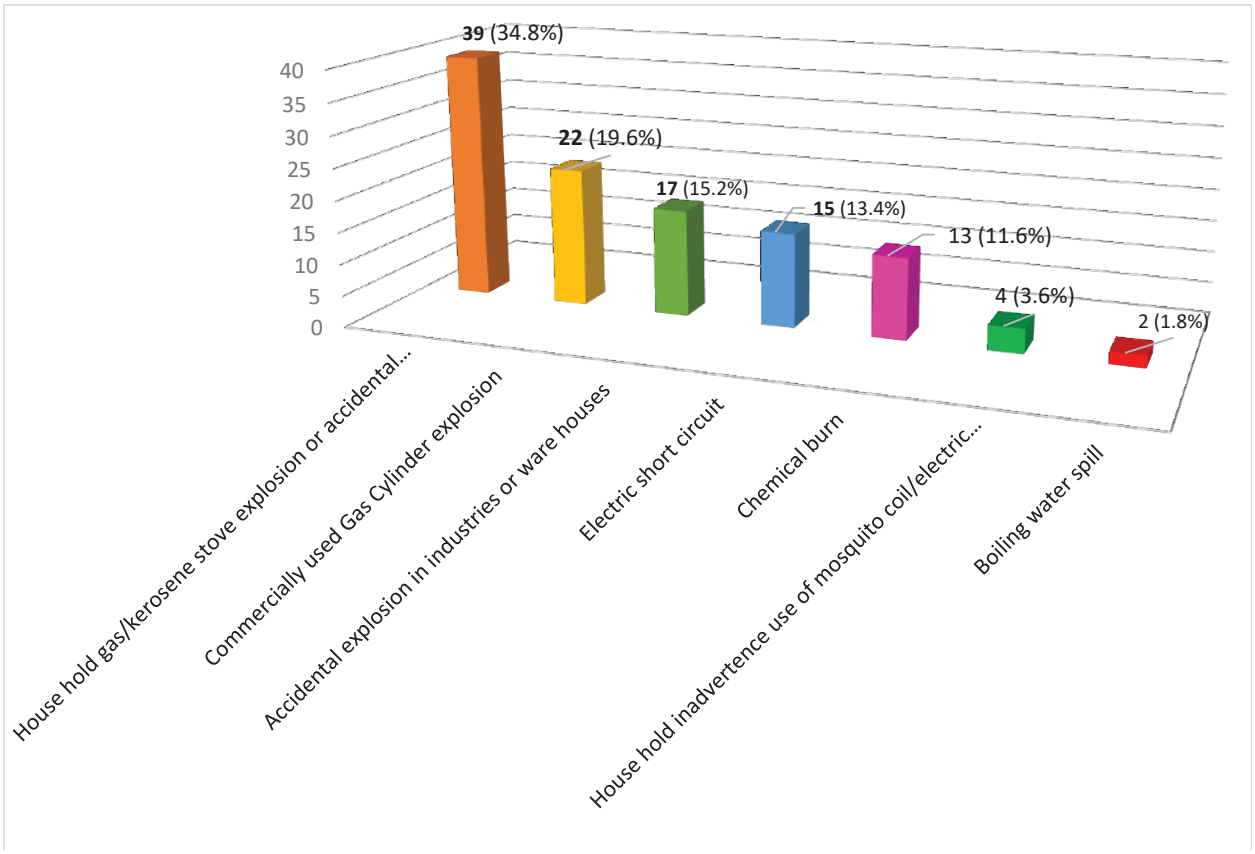

Figure-1: Different causes of burn injuries

Among the 112 victims burn injuries who underwent postmortem examination among them, causes of death were due to infection/ septicemia/disseminated intravascular coagulation/multiorgan failure 41(36.6%), primary neurogenic shock 30(26.6%), pneumonia/ Adult Respiratory Distress Syndrome 18(16.1%),hypovolemic shock/circulatory collapse 8(6.7%), electrolytes Imbalance 7(6.3%), acute kidney injury and acid-base disorder 5(4.5%), others 3(2.5%) as described in (Figure-2).

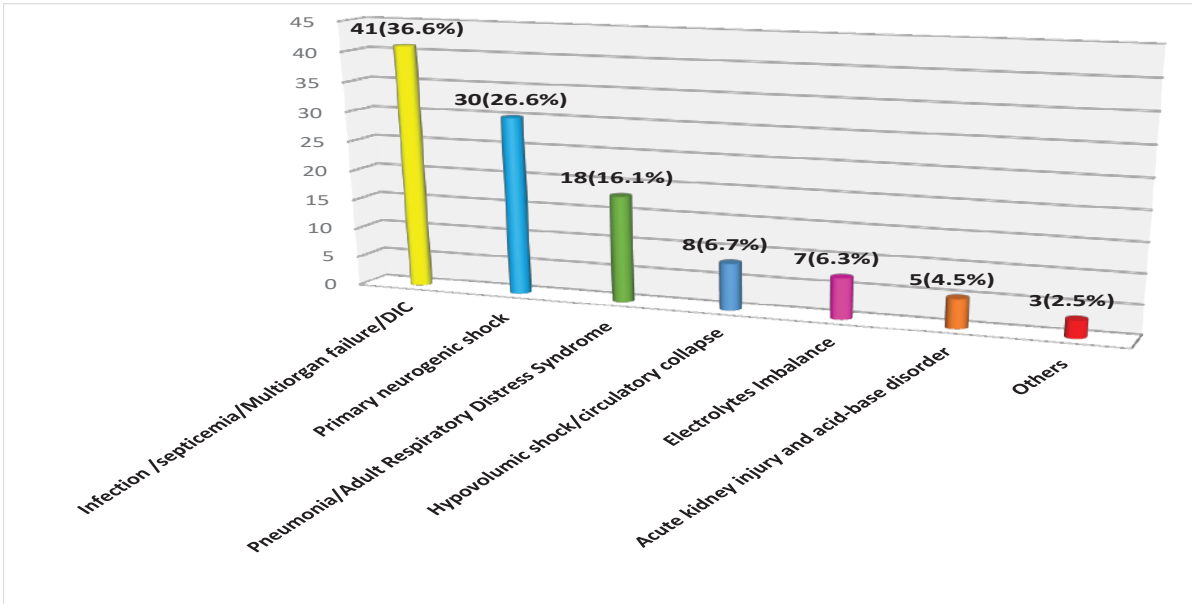

Figure-2: Various causes of death due to Burn Injuries

Among the 112 victims of burn injuried cases, >50% body area involved by burn injuries causes death in 83(74.1%) cases . More than 40% /30%/20% body area involved by burn injuries causes death in 16(14.28%)/ 9(8.03%)/4(3.57%) cases respectively (Figure-3).

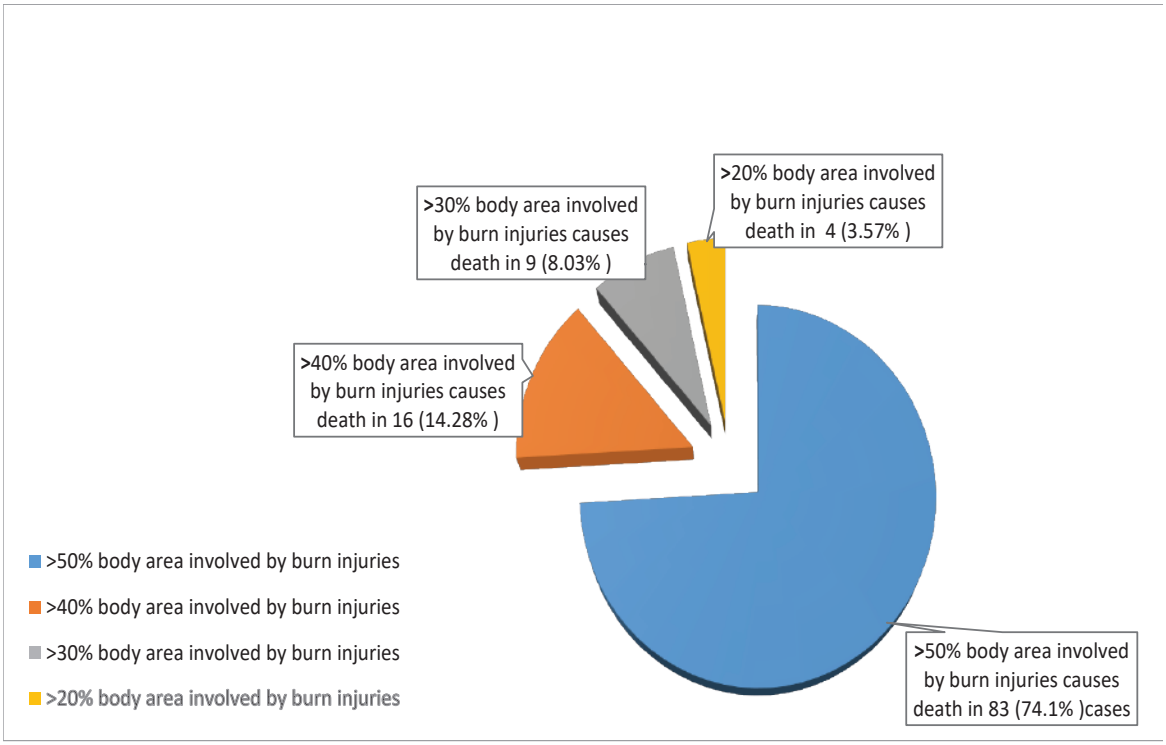

Figure-3: Percentage of body area of Burn Injuries and Incidences of death

Among the 112 victims of burn injuries , the most common post-mortem findings were congestion of internal organs 112(100%), involvement of the epidermis/dermis of the skin 112(100%), brain shrunken and soft 75(66.96%), congestion / edema/ consolidation in the lungs 88(78.6%), erosions/carbon particles in respiratory tract/lungs 99(88.4%), heart filled with blood 106(94.64%), petechial hemorrhages in pleura and pericardium 110(98.21%), erosions in alimentary tract 107(95.5%), escharotomy 48(42.85%), heat ruptures 45(40.17%) and heat haematoma 39(34.82%) which described in (Table-II).

Table-II: Post-mortem findings in burn injured victims (n=112)

Post-mortem findings	Frequency	Percentage
Congestion of the internal organs	112	100
Involvement of the epidermis/dermis of the skin	112	100
Brain shrunken and soft	75	66.96
Congestion / edema/ consolidation in the lungs	88	78.6
Erosions/carbon particles in respiratory tract/lungs	99	88.4
Heart filled with blood	106	94.64
Petechial hemorrhages in pleura and pericardium	110	98.21
Erosions in alimentary tract	107	95.5
Escharotomy	48	42.85
Heat ruptures	45	40.17
Heat haematoma	39	34.82

Discussion

Burn injuries are mostly accidental types and the victims could be from any age group and profession. Considering the socio-demographic profile of the burn injured victims of this study it was found that most of the victims were female 59(52.7%) whereas common age group were 31-40 years (28/25%), most of the victims were service holders/businessmen/day laborers (46 /41.1%) and earlier study showed mortality rate of burn injuries found higher in female though the death rate due to burn injuries were higher in rural area as that study conducted based on all over country but as this study was conducted at Dhaka Medical College Hospital morgue, so mortality rate found higher in urban area (52/46.4%) compare to rural (18/16.1%) part of the country.[6] In this study, among the different causes of burn incidences, the commonest was due to accidental explosion of household gas stove/cylinder (39/34.8%) followed by commercially used gas cylinder explosion (22/19.6%) and accidental explosion in chemical industry (17/15.2%) or electric short circuit (15/13.4%) and the previous study showed 90% of burn incidences were at home with the kitchen where 89% of the deaths were caused by flame burn and cooking fire, heating fire and fire from kerosene lamps were the major sources of flames.[7]

As there is severe pain that occurs in second degree burn followed by first degree, the victim cannot sustain or very difficult to sustain with this severe pain which is also a cause of death due to burn injuries if the area of burn injuries are more than 50%. In this study apart from death due to neurogenic pain (30/26.6%) other important cause of death were due to septicaemia/disseminated intravascular coagulation /multi organs failure (41/36.6%), pneumonia or Adult Respiratory Distress Syndrome (18/16.1%), hypovolemic shock (8/6.7%) etc and the earlier study showed that most frequent cause of death were multisystem organ failure in 64.9% of cases; 93% of these had systemic inflammatory response syndrome at time of death and in infection was causing death in 45.9% cases.[8]

Circulatory collapse due to fluid loss might occur if >15% of body surface area is affected by burn injuries. Haemoglobinuria might found if >30% of body surface area is burnt and if >50% of body surface area is involve by burn injuries, it is fatal. If the burn injuries involve the vital organs even the percentage of burn affect the body is less than 50%, the outcome is usually fatal. Burn injured victims in extreme of ages, fatality is more. In this study it was found that most of the victims (83/74.1%) died who had burn injuries in more than 50% of body surface area followed by more than 40% of body surface area were involve in burn injuries (16/14.28%) and these findings correlate with the other previous study that showed that victims mostly died (23.91%) with 51–60% total body surface area burns.[9]

All three body cavities namely- cranial, thoracic and abdominal, were examined during autopsy and samples were taken from deceased body and sent for relevant investigation like chemical analysis of the viscera along with blood and urine in suspected cases of ante mortem poisoning, histopathological examination of the organs in order to see the changes in viscera due to burn injuries or its complications, DNA profiling was done if the identity of the burn injured victim was not known or need to be confirmed.

Sometimes victims died as they are trapped in a place where fire is spread everywhere and there is no way to escape and in these cases most of the victims died due to inhalation of carbonmonoxide gases.[10] In these cases if the victims are not rescued and resuscitated immediately they died on the spot of burn incident. In these case during postmortem, carbon particles are found in the respiratory tract as well as in the lungs. Inhalation burn is one of the worst prognosis where most of the victims died even after getting full intensive care unit support.[11] Important autopsy findings of the burn injured victims in this study were congestion of the internal organs (112/100%), congestion/ oedema/consolidation in the lungs (88/78.6%), presence of carbon particles/erosions due to burn in the respiratory tract (99/88.4%), heart filled with clotted blood and presence of interstitial edema (106/94.64%), petechial hemorrhages in pleura and pericardium (110/98.21%), erosions in alimentary tract (107/95.5%), escharotomy (48/42.85%), heat ruptures (45/40.17%). heat haematoma (39/34.82%) and autopsy findings in other study shows signs of vitality (soot in airways and/or digestive tract) were found at autopsy in large majority (67%) of victims who died from burns on the contrary in our country we don't have facility to measure post mortem carboxyhemoglobin in blood whereas their study showed the majority of victims with elevated COHb levels had aspirated soot also (50.9%), while five had elevated COHb levels without signs of soot inhalation (4.7%).[12]

It was sometimes difficult to distinguish between ante-motem and post-mortem burn injuries whereas their characteristics on autopsy might indicate if a significant burn injuries occurred before the onset of death.[13] On various occasions during post mortem, there were various challenges faced by the autopsy surgeon like, unable to identify the victim and also difficult to find the cause of death due to severe burn injuries followed by decomposition of the body or burnt body into charred or if the burnt body exhumed. In these cases mostly the second molar tooth had taken as a sample for DNA profiling in order to identify the deceased body or confirm the identity of the deceased person.[14]

On the basis of clinical examination and various investigations, the treatment provided to the burn injured patients are many a times do not respond well or up to the level of expectation due to various reasons. So by doing the post mortem examination the sequences of the complications as well as other features or changes in the organs due to burn injuries would be understood in a much more precise way.

Appropriate precaution should be taken to prevent the burn incidences. Other than the persons who died due to burn injuries, many survivors are living with a lot of disabilities and deformities of the limbs or any part of the body due to permanent scar of burn injuries. Control of infection as well as hydration status of the burn injured victims remain a great challenge of the concerned clinicians. For forensic investigation to find out the underlying cause of the burn incident, the scene of occurrence should be visited by a team of forensic experts in order to make conclusive opinion.

Conclusion

With the expansion of modern civilization as well as invention of various electronic devices, chances of injuries due to accidental explosion of these devices are also increased. Mass awareness should be created among the people of all works of life to prevent such tragic incidences in the society. Proper fire safety measures should be ensured in the industries. Emergency treatment facilities should be available at all tertiary care hospitals or all government medical college hospitals in order to provide immediate necessary resuscitation and further intensive care level treatment of burn injured victims. On this aspect proper recommendation could come out by further research on this subject so that many lives could be saved from permanent disabilities as well as deaths. The demographic profile reveals vulnerability among working-age adults, particularly in urban areas,

suggesting a potential link between socioeconomic factors and burn incidents. Comprehensive health education programs can empower communities to identify and avoid potential risks. Further research remains vital to stay ahead of emerging trends in poisoning and develop targeted interventions that can save lives.

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