Original Article

Forensic analysis of accidental burn: Study of a catastrophic death in tertiary care Medical College and hospital.

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ABSTRACT:

Accidental burn is an alarming but preventable cause of mortality in Bangladesh. Over the year, thousands of individuals are affected by burn incidents due to many underlying risk factors. Unsafe cooking process, poor electrical wiring, inadequate hospital management and accessibility to proper care, lack of knowledge etc plays a crucial role for burn. Over the recent years, some major burn incidents has made burn a major public health concern in Bangladesh.

This study was conducted to evaluate the demographical profile of the victims, the cause and source of burn, total body surface area in relation with burn, causes of death due to burn and their preventions. Results reveal that females suffer mostly from burn from their kitchen ignited materials or during cooking. On the other hand, males who suffer from burn, are affected mostly from their occupational source. Mortality increases proportionally to the total body surface area involved in burn. Also death rates are high due to inadequate first aid support, delay in hospital admission, infection etc. The study highlights the causes, preventive measures and sort out the importance of strengthening burn management facilities across the country.

Key Words:
Accidental burn, Fatal burn, Explosion burn, Chemical burn, Total body surface area burn, Septicaemia, Prevention of burn.

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Introduction

Among all the trauma, burn injuries are most complex and severe injuries as they often result in disfigurement, disability and even death. A severe burn injury is the most devastating injury a person can sustain and yet hope to survive 1. It is a common catastrophe today as burn injury cases are one of the common emergencies admitted to any hospital 1. Thousands of people suffer severe burn injuries each year and hundreds more lose their lives 2. Burn injuries occur on the job, at home, and on the roads as a result of faulty equipment, negligence, and uncontrollable circumstances 2. Burn injuries are costly, result in permanent scars as well as lifelong damages and death as usual 2. There are a variety of types of lethal and nonlethal thermal injury, including flame burns which char skin and singe hair, scalding from hot fluids and contact burns those results from touching hot objects 3. Burn injuries are the global public health problem, the incidence is estimated to be around 2,65,000 deaths per year 3. Huge preponderance is observed in low and middle income countries 5. The death rate due to burns is 11 times higher in low and middle income countries compared to high income countries 5. In addition to

causing large numbers of deaths, millions of non-fatal cases often leave people disabled and disfigured for life 7. In 2013, the average disability-adjusted life year per capita caused by such injuries was 12.3 years 7. The general belief that burn usually occur at the two extremes of age 8. Fire and burn injuries are second only to motor vehicle accident as the leading cause of death in children of ages 1-4 years in US 8. The psychological and physiological

effects of a severe burn injury, whether from exposure to harmful substances or just a lack of social support, may have a profound impact on a person's ability to function in

their daily lives and at work 12. Due to the recent deformities, functional losses and trauma experienced by patients seen in an adult burn clinic, in addition to the psychological components that go into maintaining compliance with the lengthy treatment and recovery process, the mental health of these patients grows a crucial factor 12.

Burns are defined as tissue reaction to injury due to heat, chemicals or radiation 4. It causes disruption of the metabolic processes of cells that ultimately ends in tissue death 4. Medically, a burn is when heat, radiation, electricity, friction, or chemicals destroy organic tissues like skin 11. Classifying burn severity by depth (first, second, third or fourth degree), total body surface area and damage source is typical 11. The main cellular manifestation is coagulation necrosis 4. Burn injuries mostly occur due to heat transfer from hot liquids (scalding), cooking flames and sometimes due to exposure to chemicals, electricity and ionizing radiation 5. Low socio-economic status, young mothers, poor parental education, overcrowding, lack of water supply, children under five years of age and female gender are factors related to increased risk of burns in the pediatric population 9. In addition, hot water burn is the most common etiology, followed by fire, hot surfaces and electricity 9.

Socio-economic and environmental factors in Bangladesh like use of open fires for cooking, kerosene stoves, unstable gas supply, faulty electrical systems, flammable clothing and overcrowded housing, all these factors contribute to the high incidence of accidental burns. Moreover, many of the victims get inadequate and improper first aid treatments leading to worsening the outcomes. This study aims to assess the accidental fatal burn injuries in Bangladesh to identify the underlying causative agents and their preventions.

Methodology

A retrospective cross-sectional study was conducted using data from the Forensic Medicine department of Shaheed Suhrawardy Medical College Hospital (ShSMC). The study covered a period of one calendar year (July 01, 2023 - June 30, 2024). 100 accidental burn cases data was collected and analyzed according to their demographic characteristics, total burnt body surface area, causes and sources of burn and probable cause of death due to burn. Simple random sampling technique was applied to conduct this study. Extremes of ages, homicidal and suicidal cases and who died of long term delayed complication of burn were excluded. Data were obtained from hospital records, forensic post-mortem findings and reports. Information included :

- Gender
- Age
- Causes and sources of accidental burn
- Total body surface area involved in accidental fatal burn
- Causes of death due to burn

During the whole study procedure, ethical principles were strictly maintained.

Observation

Statistical methods were applied to the data to determine their frequencies and percentages. The correlation between burn and demographic characteristics, causes and sources of burn, total body surface area burnt and death, causes of death due to burn were assessed. The analyzed data were summarized in tables and figures for clarity.

Table 01. Gender wise distribution of fatal accidental burn incidents.

Traits		Percentage (%)
Gender	Male	41%
	Female	59%

During 01 year study it is noted that most of the burn victims were female in gender. Among them majority of

the victims suffered burn from kitchen. 59% cases were female victims while only 41% were male victims. There were also some common incidents where male and female and even their whole family was burnt to death.

So as for kitchen origin, it can be concluded that this statistics indicates their unsafe process of cooking, their lack of knowledge of safely handling the ignited materials and awareness.

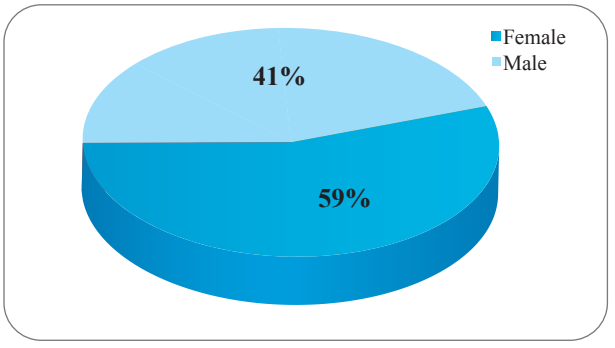

Fig I : Gender wise distribution of fatal accidental burn incidents

Table 02. Age wise distribution of fatal accidental burn incidents.

Age	Number of patient	Percentage
11 - 20 years	18	18 %
21 - 30 years	33	33 %
31 - 40 years	27	27 %
41 - 50 years	15	15 %
51 - 60 years	05	05 %
61 - 70 years	02	02 %

For age wise distribution of fatal accidental burn incidents, it is observed that, all age groups of individuals suffer equally from explosion / firework burn. For the deceased between 11 and 20 years age, 18 cases was found.

Within 21 - 30 years, 33 deceased was found. Between 31 and 40 years, 27 dead bodies were accounted for. For 41 to 50 years, 15 bodies were found to be affected by burn.

And for 51 - 60 years and 61 - 70 years, only 05 and 02 bodies were found accordingly.

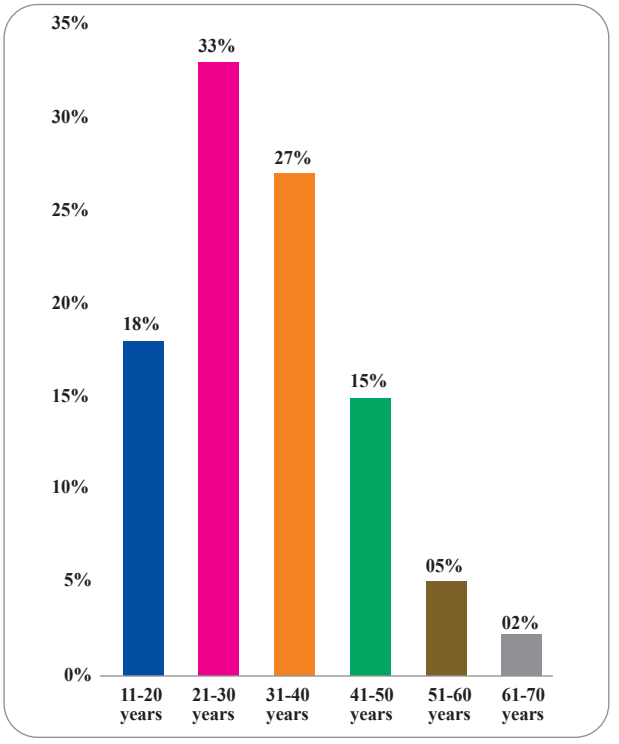

Fig II : Age wise distribution of fatal accidental burn incidents

Table 03. Causes and sources of accidental burns.

Causes of burn	Number of Victim	Percentage %	Remarks
Explosion / firework burn	33	33 %	Gas cylinder, festival fireworks
Flame burn	25	25%	Cooking fires, overturned stoves, gas leak etc.
Scald burn	19	19 %	Hot water, oil, soups, milk
Electrical burn	12	12 %	Faulty wiring, open connections, storm damage
Chemical burn	11	11 %	Industrial corrosive acids, Accidental splashes

Commonest accidental burn is due to explosion / firework burn which amount to almost 33% of total burn victims.

Second most responsible for death is Flame burn amounting to 25% of total cases and females are the main victims of kitchen accidental flame burn due to poor handling of ignited materials, lack of awareness and knowledge. These burns occur mainly due to poor ventilation.

Scald burn has the alarming rate of 19% and the majority of scald burns victims are children below 10 years due to accidental spillage of hot liquids.

Apart from these, there are also Electrical burn involving 12% cases and Chemical burn which amounts to 11% cases.

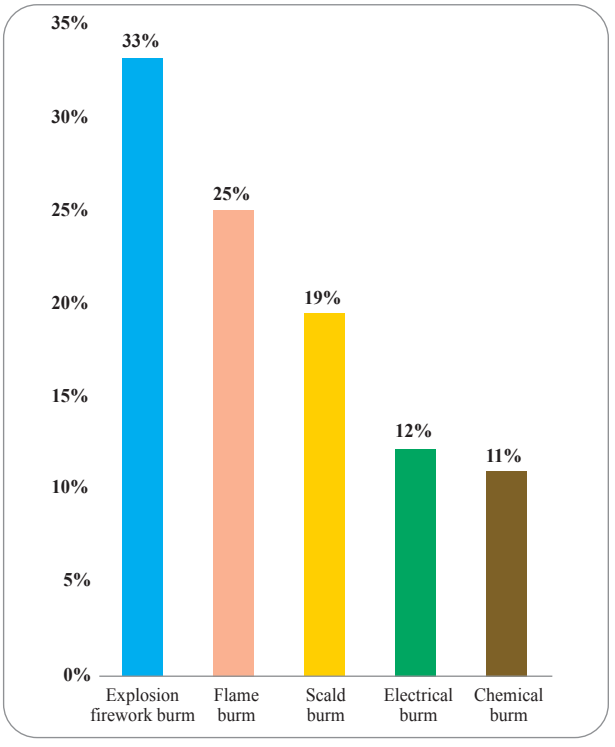

Fig III : Causes and sources of accidental burn

Table 04. Total body surface area involved in accidental fatal burn.

Total body surface area (%)	Number of death observed
21 - 40 %	06
41 - 60 %	27
61 - 80 %	55
> 80 %	12

Among total 100 dead bodies around 70% bodies had more than 50% burn in total body surface area. Although death due to lesser percentage of burn were also noted. Frequency of dead bodies directly proportional to the total body surface area involved. Only 06 dead bodies had 21-40% burn in total body surface area.

41-60% burn in total body surface area was observed in 27 dead bodies. 61-80% burn was seen in 55 dead bodies. More than 80% burn was seen in 12 bodies.

It is found that burn in more than 50% of total body surface area increases the risk of death. For 70% burn, it is almost known that the victim will die.

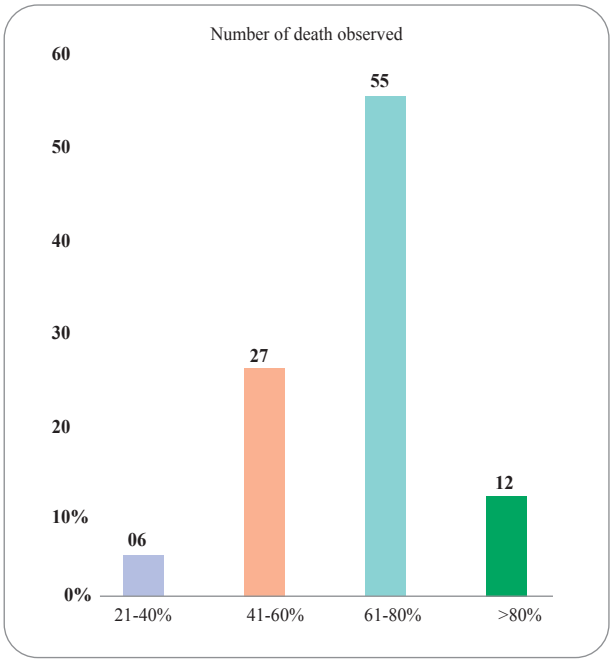

Fig IV : Total body surface area involved in accidental fatal burn

Table 05. Causes of death due to burn.

Cause	Frequency (%)
Hypovolumic shock	43 %
Septicaemia	29 %
Respiratory complication	16 %
Acute renal failure	07 %
Cardiac arrest	05 %

Among the all 100 cases, most of the victims suffered death due to hypovolumic shock accounting up to 43%.

Septicaemia is also found to be a serious complication of burn, affecting 29% of victims leading to death.

Respiratory complication isn't uncommon in burn victims. A lot of cases were found with carbon soot particles deposition in the airway due to burn. Respiratory complication caused death in 16% victims. Acute renal failure played some degree of role to cause death amounting up to 07%.

Cardiac arrest was found to cause death in 05% of victims.

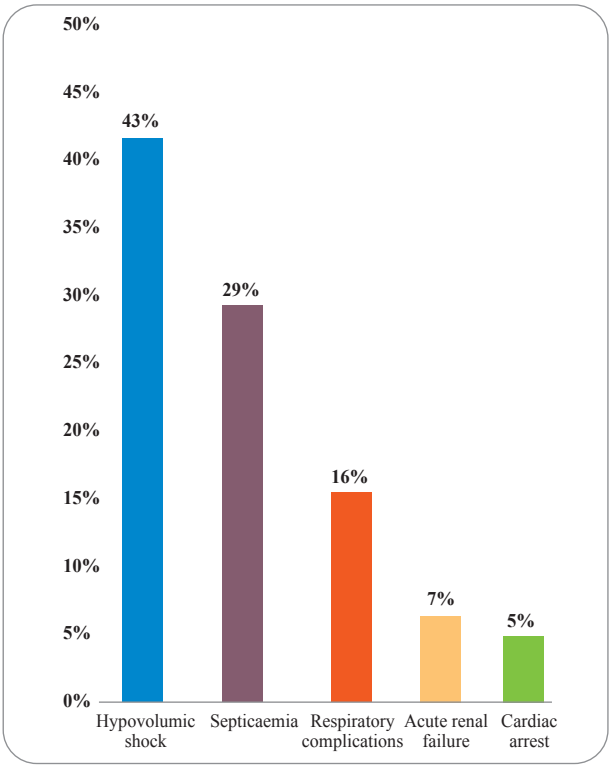

Fig V : Causes of death due to burn

Discussion

The findings of this study strongly correlates with the epidemiological pattern of the burn cases in the developing countries. In Bangladesh, accidental burns are most commonly found in among young children and females, establishing a strong link among socio-economic status, domestic environment, lack of awareness and knowledge, cultural practices etc.

Gender vulnerability

Females, mainly housewives, who are exposed to open fires and kerosene stoves in poorly ventilated kitchens. The use of synthetic sharees further increases the risk several fold as being highly flammable. This study reveals their unsafe process of cooking, lack of knowledge of safely handling the ignited materials and also awareness.

On the other hand, deceased males who died of electric burn, mainly electricians employed in power development. Some also came up with explosion burn, chemical burn. Males had sustained these injuries mainly in their workplaces or while providing their services.

There were also some explosive incidents where whole family including children were burnt to death.

Age and burn

For age related aspects in burn, Explosion / firework burn affect all age group of people. At early adulthood, aged from 21 - 30 years, most cases were observed from work-place or kitchen, mainly due to lack of experience. Some corrosive chemical burns were also found.

Between early to mid-adulthood of 31 - 40 years, all type of burn were found including corrosive chemical burn.

Cases start to decrease from middle age (41 - 50 years). Their experiences is believed to play a crucial role in avoiding the accidents. However, some inevitable incidents occurred involving 15 % of total cases. But the ratio is very low comparing to the young age groups. The middle aged groups that belong to 51 - 60 years, has more lower ratios of cases.

Lastly for 61 - 70 years of senior citizens, very few cases were noted. These groups of people mainly suffered household tragedies which includes members of the house like gas cylinder explosion.

Causes and sources of accidental burn

Among all the causes of accidental burn, most common causes involving a wide number of cases were explosion / firework burn. These burn involves all age groups of people.

Flame burn is mainly caused due to cooking fires, overturned stoves, gas leak etc. Scald burn is mainly due to hot water, milk, oil splashing etc. Electrical burn can occur due to faulty wire, open connections, storm damaging the electrical units etc.

Chemical burn affects mainly to the factory workers due to accidental splashes. Young females may also be the victims of chemical burn due to vitriolage. Although the incidents of vitriolage are decreasing significantly day by day.

Total body surface area involved in accidental burn

Causes of death due to burn is directly proportional to the depth and total body surface area. It is known and also

observed that involvement of over 50% of total body surface area in a victim is likely to cause death and more than 70% burn is sure to cause death. However, fatality is noted even with lower degree and body surface area of burn in extremes of ages but few in numbers proportionally. So, mortality is directly proportional to the total body surface area involved in burn.

Among 100 studied dead bodies, 55 bodies were found with 61-80% total body surface area burnt, which amounts to the highest ratio in this study.

Only 06 bodies were found with 21-40% burn in total body surface area.

Causes of death due to burn

Variety of methods and mechanisms are known to cause death in burn victims. Among them most common is Hypovolumic shock. In this study, hypovolumic shock was found to be the cause of death among 43% of total victims, which holds the highest ratio.

Burn is also known to be usually complicated by Septicaemia, a severe and fatal complication of burn almost with 100% mortality rate. In this study, Septicaemia or septic shock caused death in 29% of the victims.

Respiratory complications also summed up to 16% of cases. Bodies had carbon soot particles in their airway due to inhalation of the fumes.

Acute renal failure and cardiac arrest also had somewhat involvement in death in burn victims.

Preventive Strategies For Bangladesh

1. Community education

I. Promote safe cooking practice.
II. Discourage open flaming sources in indoors.
III. Discourage using synthetic dresses while cooking.
IV. Teach basic first aid for burn.
V. Teach to properly turn off the ignited materials.
VI. Educate adults on kitchen safety & child supervision.

2. Infrastructure and environmental safety

I. Replace kerosene stoves with electric stoves to reduce usage of easily ignited flammable materials.
II. Properly maintain kitchen ventilation to maintain optimum air flow.
III. Installing Gas leakage detector above stove in kitchen.
IV. Improve and properly maintain wiring of the households switch boards to prevent short circuit related incidents.
V. Establishment of well equipped, capacious fire exit from the buildings in case of emergency situations.
VI. Maintaining a separate ABC Dry powder or CO2 or Foam or Mini and auto fire extinguisher for each apartment or floor.
VII. Install fire alarm system to alert the neighbors about the fire incidents.

3. Institutional measures and policies

I. Establishment of burn prevention committee at the national and district levels.
II. Fire safety training and activities in school and other community programs to raise public aware ness and skills.
III. Boost up hospital care and ambulance services, specially equipped for burn victims.
IV. Establishing burn unit in all hospitals to support the victims for early management, treatment and rehabilitation.

4. Clinical improvements

I. Establishment of dedicated burn unit in all the hospital to ensure early treatment.
II. Sufficient supportive drugs like IV fluids, Antibi otics, Analgesics and Sterile dressing equipments.
III. Train health worker to act in urgent in case of burn victims, fluid and wound management.
IV. Maintain sterile environment to control infection and regular wound check up.
V. Train health workers for rehabilitation, physio therapy and psychotherapy for burn victims.

Limitations

1. Study limited to one institution.

2. Some records lacked detailed data on hospital care and first aid.

3. Data was taken only from the bodies where autopsy was performed.

4. Extremes of age were excluded.

Conclusion

Accidental burns are a major but preventable one of the public health concerns globally, not to mention also in Bangladesh. These death mainly affect children and females from domestic environment like kitchen and males from occupational environment. The mortality rate increases proportionally with the burnt body surface area. Mortality at over 50% of burnt body surface area was observed.

To reduce these accidental burn related incidents, multi-secretarial approach is necessary involving all groups of people from government personnel to community leaders.

Proper education on burn safety, infrastructure establishment and sufficient burn care can significantly reduce mortality from accidental burn injury in Bangladesh.

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