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Characteristics of paediatric burns seen at a tertiary centre in a low income country: A five year (2004–2008) study

I.O. Fadeyibi [a,*], I.A. Mustapha [b], N.A. Ibrahim [c], F.I. Faduyile [d], M.O. Faboya [a], P.I. Jewo [e], S.A. Ademiluyi [a]

[a] Burns & Plastic Unit, Department of Surgery, Lagos State University Teaching Hospital (LASUTH)/College of Medicine, Lagos State University (LASUCOM), Ikeja-Lagos, Nigeria
[b] Trauma Unit, Department of Surgery, LASUTH, Ikeja-Lagos, Nigeria
[c] General Surgery Unit, Department of Surgery, LASUTH/LASUCOM, Ikeja-Lagos, Nigeria
[d] Morbid Anatomy and Forensic Pathology Department, LASUTH/LASUCOM, Ikeja-Lagos, Nigeria
[e] Anatomy Deptartment, LASUCOM, Ikeja-Lagos, Nigeria

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ABSTRACT

Background: Children are the most risk prone in cases of burns. The previous epidemiologic study of paediatric burns in Lagos-Nigeria was carried four decades ago. A new study becomes necessary in view of the increasing incidences of petroleum related fire disasters in Nigeria.
Patients and methods: : Children up to the age of 14 years admitted for major burns at the Lagos State University Teaching Hospital (LASUTH), Ikeja-Lagos, Nigeria between January 1, 2004 and December 31, 2008 were studied. Information about the demographics, mechanism/circumstances of burns, associated injuries, surface extent (TBSA) and depth, modes of management and outcome, length of admission, and post mortem findings in cases of death were collected.
Results: : A total of 298 children with major burns were seen; 198 were males and 100 females. The ages ranged from 1 day to 14 years with mean of 4.56 ± 3.95 years. Forty percent of the cases occurred among the toddlers and 25.5% in the 2–5 years age group. Fire was the leading cause of burns, occurring in 198 (66.4%) cases. The TBSA ranged from 1% to 100% with mean of 29.67 ± 21.98. The mortality rate was 29.9%. Autopsy showed asphyxia as the primary cause of death in 14 (48.27%) cases, multiple organ dysfunctions in 27.59% and septicaemia in 13.79%.
Conclusion: This study identifies the main causes of paediatric burns and the major factors responsible for morbidity and mortality at the present time in a low income country. The level of awareness about burns prevention among the populace and health care facilities should be improved.

1. Introduction

Burns are among the most devastating injuries with long term physical, physiological, psychological and economic ramifications. The injury occurs with high frequency in the developing countries [1–4].

Factors that have been associated with the high incidence of burns in the developing countries include; high population

* *Corresponding author at*: Burns & Plastic Unit, Department of Surgery, Lagos State University Teaching Hospital (LASUTH), Ikeja-Lagos, Nigeria. Tel.: +234 8023213551.
E-mail address: idfad@yahoo.com (I.O. Fadeyibi).
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density, poverty, socio-cultural factors, illiteracy, inconsistent supply with high prices of petroleum products, erratic electricity supply and local religious/traditional practices [5–7].

In Nigeria, petroleum products related fire disasters have been on the increase in recent years. The causes include petroleum pipeline ruptures and vandalizations, exploding petroleum motor tankers, household fires from illegally stored premium motor spirit (PMS), use of PMS contaminated kerosene in lanterns and cooking stoves and exploding cheap PMS-using electricity generating machines [2,8]. The fire disasters were associated with burns.

Surveys by the World Health Organization showed that low and medium income countries accounted for up to a total of 95% of the 238,000 annual global deaths from thermal burns [9]. Children represent the most risk prone age group in cases of burn [10]. Burns accounted for 38.7% of all paediatric admissions in the Gambia [11].

The consequences of burn on the children are many. The resulting morbidity has high psychological consequences on the children that survive [12,13]. The mortality rate of paediatric burn varies with different countries. While it may be low in some, it is high in others [6,7,10,13–16]. Paediatric burns also have psychological, social and economic effects on the families of the victims [14].

The epidemiology of burn varies from one part of the world to another and even in the same environment over time. Civilizations, industrialization, changing socio-cultural practices, societal stabilities and the dynamics of changing world macro and micro economies all affect the epidemiology [10]. Previous epidemiologic studies of paediatric burns in Lagos, Nigeria were carried out by Sowemimo [7] nearly four decades ago. In view of the increasing incidence of fire disasters in Nigeria, there is the need to study the epidemiology of burns in this age group.

The purpose of the study was to determine the characteristics of paediatric burns in Ikeja-Lagos, Nigeria, identify the risk factors, note the outcome of the various methods of management and recommend burn preventive measures. The outcome of the study may also enable rational decision in the distribution of resources in the health care system.

2. Patients and methods

The study subjects were the children up to the age of 14 years with major burns that were admitted into the Burn Wards of the Lagos State University Teaching Hospital (LASUTH), Ikeja-Lagos, Nigeria between January 1, 2004 and December 31, 2008. LASUTH is affiliated to the College of Medicine of the Lagos State University, Ojo-Lagos, Nigeria. It is one of the four tertiary health institutions in Lagos but the only one with dedicated Burn Wards. It also has higher patient turnover as a result of the liberal health policy being operated by the management of the hospital. It is the referral center for all major burns in Lagos and neighboring states. Lagos is a densely populated city with a population of over 10 million people [16] and was the former administrative capital of Nigeria.

The case notes of all the children that were admitted for major burns in the Burn Wards during the study period were coded for data download and the hospital admission numbers recorded. The data were recorded into the proforma designed for the study, and subsequently stored in a computer. The information included; the biographic data, mechanism/circumstances of the injury, other associated injuries, surface extent (TBSA) and depth of burns, modes of management, length of hospital stay (LOS), outcome of management and post mortem findings in cases of death.

Major burns were categorized as burns with total body surface area (TBSA) involved that are equal to or greater than 10%. The assessment of the TBSA was based on the Lund and Browder's chart [17]. The depth of the injury was clinically assessed by the most senior member of the management team, often a Consultant Burns and Plastic Surgeon. The depths were categorized into first degree (Superficial epidermal burn), second degree (Partial/superficial dermal burn) and third degree (Full thickness burn). First degree burn presents as painful skin lesion with erythematous changes. Second degree burns are more painful with skin blisters and areas with wet, exudating raw wounds. When patents present late, the raw areas may be dry with reddish-grey appearance. Third degree burns present with much less pain than is expected for the extent of the burns. The wounds are relatively dry with plastic-like appearance and dull coloured.

Inhalation injuries were diagnosed based on the history of injury; burns that were sustained in closed environment, from electricity generator engine explosion, premium motor spirit (PMS) and domestic cooking gas (butane) explosions, polypropylene foam mattress fire, and from lighted kerosene lantern and cooking stoves. Clinically, patients presented with any of the following; stridor, hoarseness, facial burns, carbonaceous deposits in the nostrils, tachypnoea, drowsiness and irritability. Arterial Blood Gas (ABG) analyses were performed in these patients to assess the need for critical care management and respiratory support. The length of hospital stay (LOS) was calculated from the day that the patient was seen and admitted at the Emergency Room (ER) to the day of discharge from the ward.

2.1. *Patient management*

On admission, all the patients were assessed and the standard management protocol of the unit for all major burns commenced.

Fluid replacement was based on Parkland formula (4 ml/kg/% burn). Ringer's lactate was the crystalloid used in all the patients. Half of the entire quantity of fluid required for the resuscitation was given in the initial 8 h and the rest in the next 16 h. When patients presented late, the rate of fluid replacement was adjusted based on regular clinical review and the response of patients. In all the cases, the rate of fluid administration was aimed at achieving an hourly urinary output of 1.2 ml/kg/h.

Antitetanus immunoprophylaxis was administered on all the patients. Routine prophylactic antibiotics were administered on all patients based on the burn wards and hospital staff microbial surveillance results. Wound biopsies were taken and microbial culture with antibiotic sensitivity tests carried out. The patients' antibiotics therapies were then modified based on the results. Intravenous analgesia was administered to control pain.

Closed wound management was carried out in all the patients. Wounds were generally cleansed with disinfectant fluids on admission and normal saline on subsequent days. Blisters were punctured but the overlying skin was left intact to serve as biological dressing in second degree burns. Very dirty wounds were cleansed routinely with the disinfectant fluids until when these become cleaner and normal saline was then used. Wounds were covered with silver salt based antimicrobial ointments and dressings applied in layers. Escharotommies were done as required and escharectomies were done from 72 h after admission when the patients were haemodynamically stable. Tangential excisions were carried out in only very few patients from 72 h post admission. Wound coverage with split-skin grafting was done after these excisions. Meshed skin grafting were done and often repeated in patients with extensive burns.

Patients with inhalational injuries were managed in the Critical Care Ward. Prophylactic oxygen therapy was administered on all the patients with either intranasal catheter or face mask. Regular arterial blood gases assessments were done to check the effectiveness of the respiratory support. Enteral feeding was commenced after 24–48 h in all patients except when there was abdominal distention or paralytic ileus. Oral feeding was supplemented with parenteral feeds whenever there were anthropometric and or biochemical evidences of inadequate nutritional intake.

The patients were discharged home when the wounds were completely healed or at the request of the relatives. Patients that died were taken to the mortuary for postmortem examinations. Only few postmortem examinations were carried out on the patients due to religious and socio-cultural reasons.

2.2. Data analysis

Statistical analyses were performed using SPSS™ 15.0 software. The children were compared by gender groups (males versus females) and classified into age groups. Test of significance were conducted using chi-square for discrete variables and *T*-test for continuous variables. Level of significance was determined at $p < 0.05$.

This study was approved by the Research and Ethics Board of Lagos State University Teaching Hospital, Ikeja-Lagos, Nigeria.

3. Results

3.1. Demographic data

A total of 746 patients (113 in 2004, 120 in 2005, 157 in 2006, 178 in 2007 and 178 in 2008) with major burns were seen and hospitalized at the Burn Wards of LASUTH, Ikeja-Lagos, Nigeria during the study period. Out of these, 298 (39.95%) were children not more than the age of 14 years. There were 198 males and 100 females giving a male:female (M:F) ratio of 1.98:1. The ages ranged from 1 day to 14 years with median and mean values of 3.0 and 4.56 ± 3.95, respectively. The mean age for the males was 4.42 ± 3.69 and 4.95 ± 4.41 for the females. The day old baby sustained flame burn with inhalation injury from a lighted kerosene lantern that exploded while it was being refilled with kerosene. The lantern was used to keep her warm. The difference in the mean of the ages of both genders was not statistically significant ($p = 0.263$). Forty percent (120) of the cases occurred among the toddlers (1–2 year age group) and 25.5% among the pre-school age group (2–5 years). The distribution of all patients according to age and gender is shown in Fig. 1.

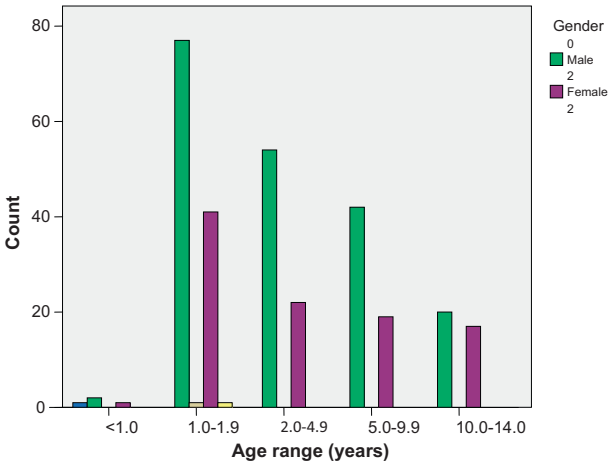

Fig. 1 – Distribution of cases of paediatric burns according to age and gender.

3.2. Aetiology and mechanisms of burns

Fire was the leading cause of burns, occurring in 198 (66.4%) cases. Out of these, 117 (59.09%) sustained the injury from fire explosions from kerosene lanterns, cooking stoves, and electricity generating machines. One (0.3%) patient sustained burns from fire explosion in the toilet. The explosion occurred when the patient carried a locally fabricated lamp in the night to a pit latrine and the gases from the pit that were produced as a result of microbial decomposition of faecal materials caught fire. Three cases (1.01%) sustained burns when the mattresses

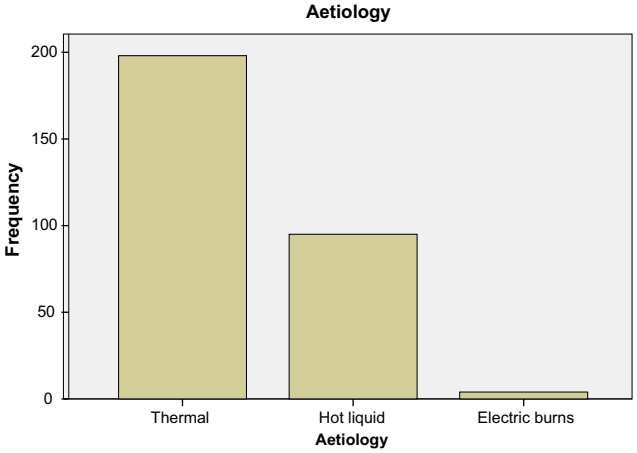

Fig. 2 – Aetiology of burns and the number of cases involved.

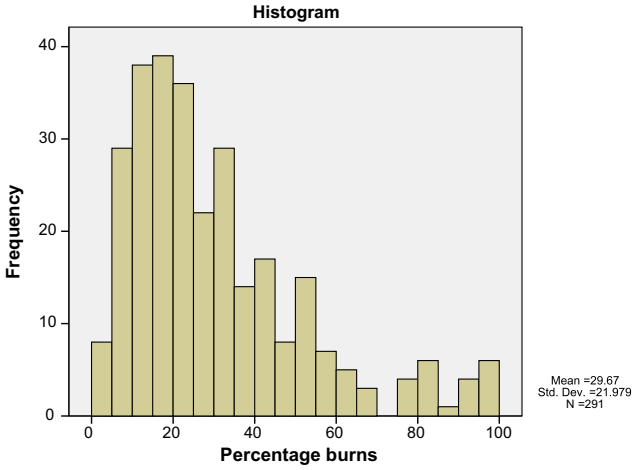

Fig. 3 – The distribution pattern of TBSA involved in burns among the cases that were studied.

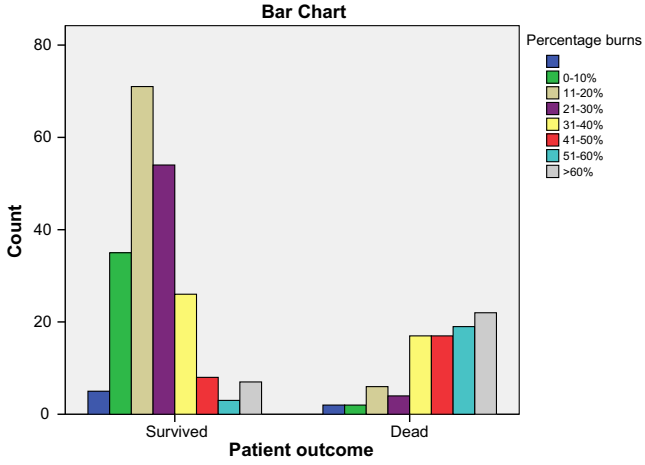

Fig. 4 – The TBSA that were involved in burns and the survival pattern of the patients.

on which they were laid caught fire from lighted candles and one (0.3%) toddler sustained burns when he crawled into an open fire. Other cases sustained flame burns from domestic fire accidents, exploding petrol tankers and road traffic accidents. Scald (due to boiling water, hot soup, hot vegetable oil and hot herbal concoctions) was responsible for burns in 31.9% (Fig. 2).

There was no statistically significant difference between the gender of the patients and the aetiologic agents ($p = 0.893$).

3.3. *Extent of burns*

The total body surface area (TBSA) involved in burns in the cases ranged from 1% to 100% with median and mean value of 24 and 29.67 ± 21.98, respectively. The mean TBSA for the males was 31.11 ± 24.00 and 27.02 ± 17.31 for the females. There was no statistically significant difference between the mean TBSA ($p = 0.45$) of the genders. A total of 261 (87.6%) cases sustained burns greater than 10% TBSA out of which 19.5% were greater than 50% (Fig. 3). There was positive correlation between the age groups and the extent of burns ($p = 0.014$). Only about 20% of the cases in the age range 0–2 years sustained burns that were greater than 40% while more than 30% of the older children sustained burns that were greater than 40%. All the cases sustained mixed thickness burns.

Inhalation injury was diagnosed in 46 cases (15.44%).

3.4. *Anatomic distribution of burns in the cases*

The burn involved more than one anatomical part in 97.33% (290) cases. All the anatomical parts were involved in 30% of the cases. The upper limbs were the most involved in 90.42% of the cases followed by the lower limbs in 80.85%.

3.5. *Length of hospital stays (LOS)*

The number of days spent on admission in the hospital by the patients ranged from one day to 211 days; with median and mean value of 12 and 18.61 ± 24.18, respectively. Five (1.68%) cases with burns greater than 95% TBSA died within 24 h of admission. Cases with extensive skin loss stayed longer for the wounds to heal.

3.6. *Outcome*

A total of 209 (70.1%) cases were successfully managed and discharged while 29.9% died. One hundred and five (35.23%) patients required surgical management. These included 27 fasciotomies, 29 escharotomies, 48 escharectomies, 15 tangential excisions and 58 split/meshed skin grafting procedures. Some of the patients underwent multiple surgical procedures. The mean TBSA of the cases that survived was 21.40 ± 5.64 and 49.06 ± 22.57 for those that died. The difference is statistically significant. Increasing TBSA involved in burns showed strong positive correlation with the mortality rate in the study ($p = 0.000$) (Fig. 4). The gender of the patients did not affect the outcome of management in the study ($p = 0.893$). There was correlation between the aetiologic agents and the mortality rate ($p = 0.006$). The mortality rate from fire explosions was 35.68%, 18.95% for scald and none in burns from electricity (Table 1).

The mortality rate was highest (75%) among the 0–1 year age group. Though clinically important, age was however found not to be statistically significant in the outcome of management in the study ($p = 0.118$). This may be due to the relatively small number of cases in the 0–1 year age group (Fig. 5).

3.7. *Postmortem findings*

A total of 29 autopsy examinations were carried out on paediatric cases that had burns as secondary cause of death

Table 1 – Aetiology of burns, number of cases involved and the mortality (%).

Aetiology	Number of cases	Mortality	(%)
Fire	199	71	35.68
Hot liquids	95	18	18.95
Electricity	4	–	0.0
Total	298	89	29.87

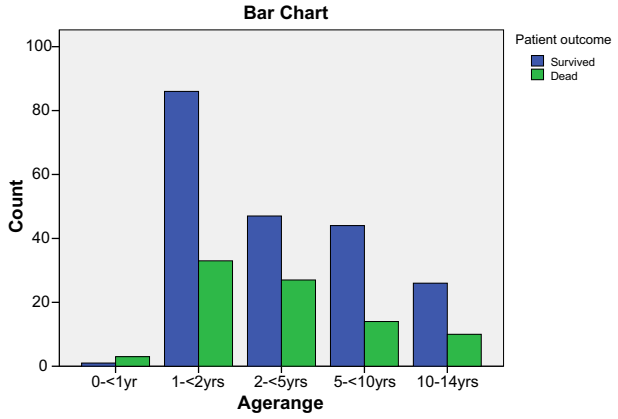

Fig. 5 – Ages of patients and the survival pattern in cases of paediatric burns that were studied.

during the study period. The results of the examination showed that asphyxia was the primary cause of death in 14 (48.27%) cases, multiple organ dysfunctions (MODS) in 27.59%, septicaemia in 13.79%, anaemic heart failure in 6.90% and biventricular heart failure in 3.45%. The patients that died from anaemic heart failure refused blood transfusion based on their religious believe. The patient with biventricular heart failure had ventricular septal defect that was discovered at autopsy.

4. Discussion

The trend of hospital admission in this study showed yearly increase during the period of the study. This could be a reflection of overall increase in the incidence of burns in the population and public awareness about the facilities that are available at the burn centre.

Children between the ages of 1–2 years (toddlers) were shown to be at the greatest risk of sustaining burns in the study making them the most important group at risk and the prime target for prevention. This is similar to findings from previous studies in other regions of Nigeria, South Africa, Japan and Hong Kong [15,18–21]. Children in this age group are inquisitive and very active. They tend to either explore or play with most things that they come by. At the same time, they could not appreciate the dangers in the environment [15]. Children require more attention during this period. Access should be strictly controlled and parental surveillance improved especially in environments with dangerous objects. The lay-out of the living environment may also need to be redesigned. Dangerous objects including highly inflammable materials, electricity generating machines and cooking areas should be restricted to areas that must be made inaccessible to children.

The males were more affected in this study. This is similar to the findings in most studies [18,21–24].

In the current study, fire was found to be the predominant cause of burns. This is similar to the findings from previous studies from Turkey [19], Bangladesh [20], Angola [25], and Ghana [26]. Scald as the cause of Burns also came second in these studies. Previous studies in Nigeria by Sowemimo [7] Onuba [27] and Iregbulem et al. [28] recorded scald as the leading cause of burns. There were infrastructural problems in Nigeria during the period of the present study. Petroleum products were in short supply and electric power outages common. The safety regulations in the handling of the available petroleum products were sometimes breached [2,8]. Thus on some occasions, fire disasters occur and may be associated with burns. Due to the frequent power outages, portable PMS using electricity generating machines were often used to generate electricity. The machines are affordable for most people and are sometimes placed in unusual places including the sitting rooms and the common passages of the houses. While the engines were on, the tanks are sometimes refilled with PMS. Some of these machines in such circumstances caught fire and exploded. Such incidences were responsible for some of the burns recorded in the study. In others, kerosene lanterns that were already lighted were refilled with kerosene. The fumes from the kerosene were ignited by fire from the lantern and explosions occurred. In such instances the kerosene was already contaminated with PMS. The contaminant lowered the flash point of the mixture making them highly inflammable [8]. Some of the cases that were seen in this study sustained burns in such circumstances. It is important that infrastructural development and maintenance programme should be carried out by the government. This will contribute in improving the standard of living of the people and make the living environment safer. Efforts should also be made by the appropriate authorities to ensure regular supply of petroleum products. This will discourage the populace from storing them in places that are not safe.

The mean TBSA of the injuries reported in this study (29.67%; ±21.98) is high. Most of the previous studies that were carried out in children had mean TBSA of 12.3%, 10.0%, and 16.36%, respectively [15,21,22]. This may be due to the aetiologic agents that were involved in considerable number of cases in this study. More than 40% of the cases sustained flame burns from petroleum products. Petroleum products catch fire in explosive manner [2]. The fire spreads very quickly engulfing the patients. The injury has the characteristics of flame burns sustained in closed environment. There could be associated inhalational injury [2,8]. Health education programme highlighting the risks that are involved when the safety profiles in the handling of petroleum products are breached should be carried on a regular basis. The information should be disseminated using the media with proven impact on the target populace and large coverage.

The mean length of hospital stay (LOS) in this study was more than those of similar studies [18,23,24,29]. The LOS is directly related to the types and extent of wounds as well as the mode of management [15,18,24,29]. The wounds in the present study were more extensive and of mixed thickness. In extensive wounds, surgeries including skin grafting are required. The healing of both donor and recipient sites require time. In extensive wounds, repeated skin grafting procedures, cropping the skin from the same donor sites after healing will require more time. In some of the cases with very extensive wounds that were seen in this study, wound healing was by secondary intention due to non availability of donor skin.

The mortality rate in this study was higher than was seen in most other studies reviewed [18,19,22]. However studies in similar environment recorded high mortalities [6,7]. Factors that influence the outcome of burns management in all age groups are well documented [2]. Aetiologic agent was found to be significant in this study. Flame was responsible for burns in 66.3% of the cases. Flame as the cause of burns was found to be more fatal than other causes of burn by Tarabian et al. [22] in their studies in Hamadan, Iran. In Israel [18] and Kuwait [30], flame caused 53% and 82% of all burn deaths. The mechanism of the injury is also important. Flame burns from petroleum products are associated with high mortality rates. This is due to the explosive nature of the flame and the associated inhalation injury [2]. TBSA was found to correlate with mortality in this study. Critical analyses of this study revealed that the proportion of wounds with extensive TBSA was more than that of previous studies [15,18,22]. With increasing TBSA, Tarabian et al. [22] noted higher mortality rate in his study. Pulmonary complications and multiple organ failures were responsible for many of the deaths in this study. Pulmonary pathology and dysfunction of various other organs may develop from the pathophysiologic responses to burns [4]. Management of these responses is challenging. Up to date knowledge and sophisticated medical facilities are required. In the Low and Middle Income countries, inadequate funding may make these difficult.

A major limitation in this study is that as a referral hospital based study, it may not accurately quantify the incidence and risk factors for paediatric burns in the study environment. The medical personnel at the different points of referrals would have triage some of the patients and transfer only those that were considered as having little chance of survival at their hospitals to the tertiary center. This may also contribute to the mortality rate that was observed in this study.

In conclusion, the study provides information about the main sources of burn in children and major factors responsible for morbidity and mortality in paediatric burns were identified.

A lot is still required to improve the level of awareness in the populace with regard to the agents that could cause burn. There is also need to educate the parents and guardians on proper surveillance of children and the need to improve the health care facilities by the necessary authorities. Further studies would be required on the best approach to manage these categories of patients so as to reduce the morbidity and mortality figures.

Conflict of interest statement

We wish to state that there is no conflict of interest in this study.

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