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# Demographic characteristics and prognostic indicators of childhood burn in a developing country☆

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ABSTRACT

Children constitute a significant proportion of burn victims in most studies from the developing countries. While there has been a progressive improvement in the outcome from childhood burn in many developed nations, the morbidity and mortality remains high in many low and middle income countries. The aim of our study is to evaluate the demographic characteristics and prognostic indicators of childhood burn in a major referral teaching hospital in a developing country. A review of the records of 638 patients with acute burns managed over a 10-year period from January 2001 to December 2010 at the University College Hospital, Ibadan Nigeria was done. The clinical and epidemiological data were retrieved from computerized data base using the ISBI proforma. Information obtained includes Biodata, Etiology, location, TBSA, presence of Inhalation injury and the treatment outcome. Data of patients aged 16 years and below were analyzed using the SPSS version 16. The main outcome measure was the patient's survival. 289 children representing 45.3% of the total number of burn patients were managed over the period. The M:F ratio was 1.1:1. The median age of the cohort was 4.0 years while the median TBSA was 21.0%. Non-intentional causes were responsible for 89.6% cases. Most of the injuries (88.6%) occurred at home. Eighty-three patients had inhalation injury out of which 57 (68.7%) deaths were recorded. The overall mortality rate in the cohort was 39.5% with an LA50 of burn size of 45%. The TBSA was also found to be a determinant of outcome.

Majority of childhood burns are from preventable causes with attendant dismal mortality figures. Effective burn prevention strategies and improved quality of care remain pivotal in reducing childhood burn morbidity and mortality in the developing countries.





## 1. Introduction

Burns have been reported to be among the most devastating of all types of trauma and one of the most expensive catastrophic injuries to treat. Burns have reached epidemic proportions in recent years in many developing countries and the pediatric age group is particularly vulnerable [1,2]. Burns continue to be a major source of mortality and morbidity from trauma in many parts of the world, particularly in the low and middle

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income countries (LMIC) [3,4]. The global incidence of burn involving all age groups has been quoted to be 1.1 per 100,000 [5]. The incidence varies by geographical location, socioeconomic status, ethnic group, age and sex [6], and even within the same geographical area, the incidence varies greatly by race and ethnicity. In South Africa, children of African descent have a burn rate of 4.5 per 100.000 compared to 0.3 for white children [7]. 90% of burn occur in LMIC with the highest incidence is in South East Asia [6,8].

The incidence is increasing among the pediatric age group. Over 96,000 children are hospitalized per year from burns with children five years and below at greatest risk in Africa [6,8]. A prevalence rate of 6.1% has been quoted for children 0–5 years in Ghana while children 0–5 years account for 50% of all burns in children in India [4].

Preventable burn that leaves a child permanently disfigured has been described as the most tragic event that could befall a child [9]. Despite this growing problem, not much attention has been given to the burden of burns amongst African children [10].

There has been an improvement in the management of burn worldwide over the past decades as a result of better understanding and treatment of burn shock [11–13], advances in intensive care and metabolic support as well as aggressive wound management [14,15]. The presence of inhalation injury, size of the burn wound and patients' age have been cited as independent risk factors for mortality in pediatric burn [16,17].

Our objective is to determine the demographic characteristics of childhood burn and identify the determinants of outcome in our institution, a major referral teaching hospital in Nigeria. This should further add to the ISBI and WHO initiatives of developing an international database on burns.

## 2. Patients and methods

A review of the records of six hundred and thirty-eight (638) patients with acute burns managed over a 10-year period from January 2001 to December 2010 at our burn unit was done. The data of patients aged 16 years and below were extracted and analyzed.

The patients' management followed the standard protocol of burn resuscitation, however wound care had to be tailored to meet the patients' financial capabilities. Most of the patients had no form of health insurance and had to make out of pocket payment for their care. This impacted adversely on the services that the patients were able to access. For instance most of the patients who required early wound excision and skin grafting could not afford the cost of surgery and eventually had conservative wound care. Other adjunctive cares which were also affected to varying degrees by dismal financial situation of some of the patients included but was not limited to physiotherapy, nutritional rehabilitation and therapeutic antibiotic use when indicated. The diagnosis of inhalation injury was made using clinical criteria.

Relevant clinical and epidemiological data were retrieved from the departmental computerized data base compiled using the International Society for Burn Injury (ISBI) pro forma [18].

Information obtained included the patients' age, sex, etiology of burn, location of the burn, the TBSA, presence or absence of Inhalation injury and the outcome of care. The Helsinki declaration was strictly adhered to in this study.

Statistical analysis was performed using SPSS software, version 16.0 (SPSS, Inc., Chicago, IL.)

## 3. Results

Two hundred and eighty-nine (289) pediatric patients representing 45.3% of the total number of burn patients were managed over the 10-year period. The M:F ratio was 1:1.1. The median age of the patients was 4.0 years while the median percentage burn (TBSA) was 21.0% (Fig. 1). The 25th, 50th and 75th percentiles for the TBSA were 9.0%, 21.0%, and 38.8% respectively.

Children aged between 0 and 5 years constituted the largest proportion (63.7%) followed by those between 6 and 10 years (21.1%) while those between 11 and 16 years constituted 15.2% of the childhood population (Fig. 2).

Flame injury was the commonest etiology (48%) followed closely by Scald injury (41%). Of all the burns sustained by flame, 68.8% resulted from petrol related fire accidents while 25% was as a result of fires from kerosene operated devices. Other causes of open flame injuries were responsible for the remaining 6.2%. In effect a significant proportion (93.8%) of burns from flame resulted from petrochemical products (Fig. 3). However, when the burn etiology was determined separately for the three age groups, scald was found to be the commonest cause of burn in the 0–5 year age group (54.3%) compared to flame (33.2%). Other causes were responsible for

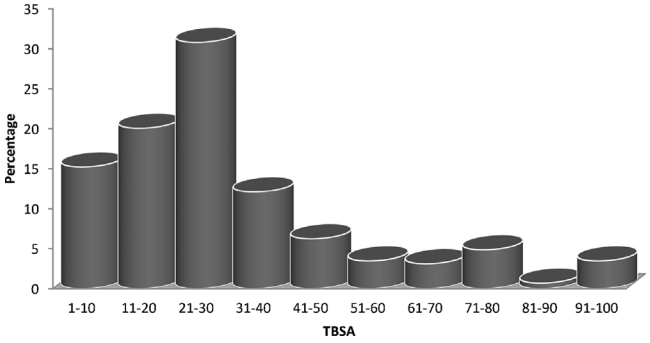


**Fig. 1 – TBSA distribution.**

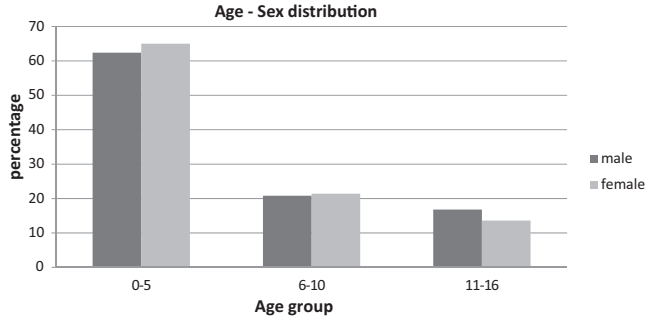


**Fig. 2 – Age–sex distribution.**

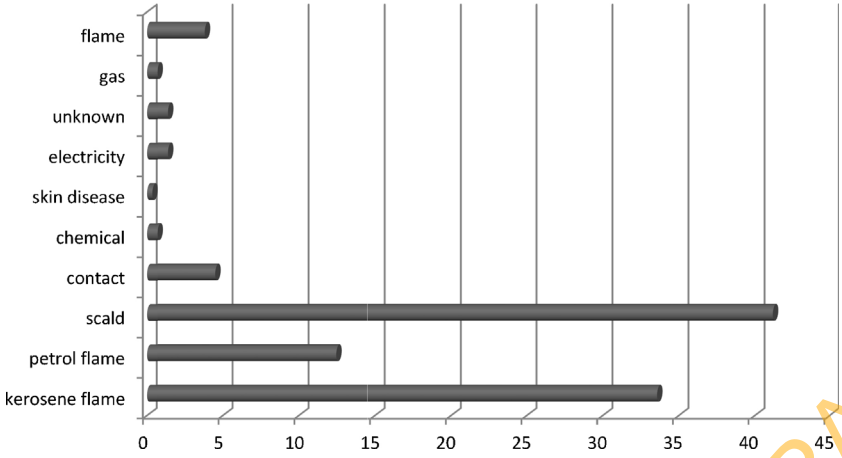


**Fig. 3 – Etiology of burn.**

the remaining 12.5%. In the 6–10 year age group, scald accounted for 21.3% of the injuries while 67.2% resulted from flame. As expected, flame injury was by far the commonest etiology of burn (70.5%) in the 11–16 year age group (Fig. 4).

In all, 88.6% of the injuries occurred at home and non-intentional causes were responsible for most (89.6%) of the cases. Eighty-three (28.7%) of the patients had inhalation injury out of which 57 (68.7%) deaths were recorded.

The size of the burn (TBSA) was also found to correlate with outcome. While about 70.5% of the children who sustained burn of 50% TBSA and below survived, only 6.7% of those who had injury of above 50% TBSA survived. This was found to be statistically significant with a $P$ value $< 0.01$. When stratified by the percentage burn, the mortality figures were 10% for burn size 1–20%, 37.1% for burn size 21–40%, 89.3% for burn size 41–60%, 87.0% for burn size 61–80% and 100% for burn size above 81%.

Another significant finding in this study is the higher mortality figures in patients with associated inhalation injury suggesting that presence of inhalation injury is an important determinant of outcome in childhood burn ($P$-value $< 0.01$, odds ratio 5.9 and 95% confidence interval of 3.4–10.4).

The other outcome measure was the age of the patients. The age group that had the worst outcome was the 0–5 years age group with 64.9% mortality as compared to 15.8% and 19.3% mortality in the 6–10 years age group and 11–16 years age group respectively, although this was not found to be statistically significant ($P$ value 0.74).

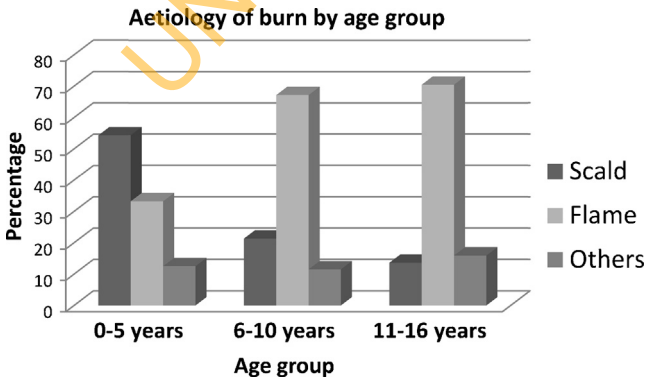


**Fig. 4 – Etiology of burn by age group.**

Worthy of note is our finding that petrochemical agents is assuming greater importance (45%) in the causation of burn, 33% from petrol related fires and 12% from kerosene devices.

Regarding etiology of the burn, while 71.4% of the patients who sustained scald injury survived, only 47.4% of those who had flame burn survived. Closely related to flame burn is the association with inhalation injury. Our study found that 83 (28.7%) patients had inhalation injury out of which 57 (68.7%) deaths were recorded.

Multivariate regression modeling was conducted to determine the significant correlations in the cohort. Only the TBSA remained significantly predictive of mortality (OR 0.20; 95% CI 0.005–0.086; $P < 0.01$; Pearson chi sq 66.67).

In all, 114 (39.5%) deaths were recorded in the cohort with an LA50 of 45%.

## 4. Discussion

Childhood burn continues to pose significant public health challenge especially in the low and middle income countries (LMIC) because majority of the burns are from preventable causes. Of equal importance are its attendant high mortality, morbidity and long term disability in many of these countries. 95% of burn deaths occur in LMIC. The mortality rate among the low income countries is 11 times higher than in High income countries (HIC). Fire related mortality rate in Africa for children under 5 is 32.9 per 100,000 [19,20]. Various studies have reported relatively higher mortality and morbidity figures for childhood burns in many developing countries [21–26].

Although Vilasco and Bondurand [22] reported almost two decades ago that burn mortality in Africa was higher than expected, more recent studies [21,24,26,27] including this one have not shown any significant improvement in the survival figures. This calls for concerted efforts to intensify burn prevention campaigns and improvement in the quality of burn care. This will require increased funding for health,

improvement in the societal infrastructure especially the energy sector and appropriate legislation to promote the use of fire retardants, alarms and sprinklers in homes and public places.

This study, like many others [21,23,28,29] found the less than 5 year olds to be the most vulnerable age group in the childhood period. We found a significantly higher mortality figure of 64.9% in the 0–5 year age group compared to 15.8% and 19.3% in the 6–10 and 11–16 years age groups respectively. This is in consonance with a previous study by Morrow et al. [17] which reported that age was a1 independent risk factor for mortality in pediatric burns.

It is also interesting to note that while an earlier study from our institution [21] found a preponderance of female patients (M:F = 1:2.1) among the pediatric burn age group, the current study found an almost equal sex ratio (M:F = 1:1.1). A possible explanation for this could be because of the increasing contribution of petrochemical products to the etiology of burns and the more explorative nature of the male child which makes them more exposed to petro or kerosene operated devices. This is more evident with increasing age of the children with a M:F ratio of 1:1.04 in the 0–5 years compared with a M:F ratio of 1.2: 1 in the 11–16 years.

Flame was found to be the commonest etiological factor of childhood burn in this study (48%) compared to scald (41%). This is in consonance with what was earlier reported from our hospital [21] and in some other studies [23] but in contra distinction to a higher incidence of scald as reported by many more authors [30–35].

It is significant to note that petrochemical agents are assuming increasing importance in the etiology of burn in many developing countries. This is probably as a result of in effective electricity supply which has made the use of alternative devices necessary for cooking and lighting purposes. This finding should be useful for governmental public health policy formulation and for planning appropriate burn prevention programs.

There has been an increase in the incidence of inhalation injury in the patients presenting to our center over the years. While Adigun et al. [36] reported an incidence of 16% among both the pediatric and adult burn patients from our hospital over a decade ago the current study reports an incidence of 28.7% although in the pediatric population alone.

Improved outcome in the management of burn in the low and middle income countries is predicated upon a tripod of improved hospital infrastructure, affordability of care and availability of requisite trained man power, some or all of which may be in short supply in these countries. The appropriate facilities for diagnostic and therapeutic care of patients with inhalation injury cannot be compromised if the poor mortality figures are to reduce. Improved quality of life and easy access to effective health insurance will ensure prompt resuscitation, treatment and early wound cover with skin grafts when indicated thereby reducing the risks of wound infection, chronicity and other wound morbidities. Lastly, the constant training and re-training of burn care practitioners will keep them up to date on best practices for burn care and ensure the appropriate standard of care at all times.

Ultimately the key to reducing morbidity and mortality associated with burn in the developing countries is prevention which could be along the global public health initiatives of the WHO and ISBI. There should be effective educational campaigns in schools and through the print and electronic media in languages understood by the people. Environmental modification and hazard reduction in terms of provision of safer and affordable cooking environment, safer storage of flammable liquids in child-proof containers and legislative changes that will make it mandatory for the use of fire-retardant building materials and the installation of fire alarms and water sprinklers in homes.

## 5. Conclusion

The outcome of childhood burn in many low and middle income (LMIC) countries remains dismal despite advances in burn management techniques in many parts of the world. The significant predictors of outcome were found to include the size of the burn, presence of inhalation injury and the age of the patient. Concerted efforts must be made to reduce the incidence of burning, and the high mortality, morbidity and other long term disabilities through effective burn prevention campaigns and improvements in the care of the injured.

## Conflict of interest

The authors declare that there are no conflicts of interest in this work.

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