Original Article

Pediatric burns mortality risk factors in a developing country's tertiary burns intensive care unit

Pius Agbenorku1,2,3,4,5, Manolo Agbenorku1,2,3, Papa Kwesi Fiifi-Yankson1,2,3

1Reconstructive Plastic Surgery and Burns Unit; 2Department of Surgery; 3Komfo Anokye Teaching Hospital; 4School of Medical Sciences; 5Kwame Nkrumah University of Science & Technology, Kumasi, Ghana

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Abstract: Aim: This study aimed at identifying risk factors related to pediatric burns mortality in a middle income country such as Ghana. Methods: The data for the three years retrospective study (May 2009 – April 2012) was obtained from the pediatric burn admissions records and patients’ folders of the Reconstructive Plastic Surgery & Burns Unit (RPSBU), Komfo Anokye Teaching Hospital (KATH), Ghana. Data retrieved included: Demographic features, Total Burned Surface Area (TBSA) incurred; Aetiology of burns; Duration of the admission; Outcome of admission; Part of the body affected and Cost incurred. Ethical approval for this study was obtained from the KNUST-SMS/KATH Committee on Human Research, Publications and Ethics. Data analyses were performed with SPSS 17.0 version. Results: Information on 197 patients was completely retrieved for the study. Burns mortality rate for the study was identified to be 21.3% (N=42). The mean age of the 42 dead patients was 3.7±0.3 years, ranging from 0-13 years, while, males (54.8%, N= 23) outnumbered females (45.2%, N=19). The TBSA burned interquartile range was 48%. In terms of etiology of burns Scald (73.8%, N=31) was the commonest cause of injury. Mortality risk factors identified were Age <6 years (P=0.028); Scald especially hot water and soup (P=0.016); TBSA >36% (P=0.028) and Inhalation injury (P=0.040). Conclusion: Age, scald, TBSA and Inhalation Injury were identified as pediatric burns mortality risk factors in a developing country such as Ghana’s RPSBU. These identified factors will serve as a guideline for plastic surgeons and other health professionals practicing in countries such as Ghana.

Keywords: Pediatric burns, mortality risk factors, burns mortality, developing inhalation injury, scald

Introduction

Childhood burns place enormous socio-economic burden on individuals, their families and health services [1]. Significant physical and psychological sequelae are associated with non-fatal burns, with survivors requiring ongoing treatment, rehabilitation and regular surgical intervention [2, 3]. Burn injuries lead to multiple short and long term costs to families, communities and the nation. The obvious consequences of burns are well known and include pain, infections, extensive scarring, wound and scar contractures, amputations and death as well as psychological trauma [2, 4, 5].

Burns are the fourth most common type of trauma worldwide, following traffic accidents, falls and interpersonal violence [6]. Death by burn injury in low and middle income countries (LMICs) is estimated to be eleven times higher than in high-income countries. Over 95% of fire related burns occur in LMICs [7, 8] and are among the leading causes of disability-adjusted life years (DALYs) lost in LMICs [9]. World Health Organization (WHO) estimated that 43,000 people die of burns in Africa every year with a rate of 6.1 per 100,000 [7]. Flames, scalds (including steam) and contact burns are the top three causes of severe burns in most studies [10]. Albertyn, Bickler and Rode [11] stated that burn injury is on the increase throughout Africa citing poverty, illiteracy and movement to urban slums and shanty towns as some of the reasons. These occur in regions that generally lack the necessary infrastructure to reduce the incidence and severity of burns [8, 12].

Children account for almost half of the population with severe burn injury [13-17] and children under 5 years account for 50% to 80% of all childhood burns [13, 17-20]. In pediatric popu-
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Scalds clearly dominate, accounting for 60% to 75% of all hospitalized burn patients, followed by flame and contact burns [10]. Globally, the majority of children burned are boys with a ratio of around 2:1 to girls [11, 21-25] and the mortality rate of males is greater than females [25]. Some studies have also reported a higher female mortality [18, 26-29] but in other studies, no significant difference was found [19, 30-33]. The commonest causes of injury death among children less than five years were burns, transport accidents and drowning – each which was estimated to occur at 7 per 100,000 populations per year in 1992-1998, for girls [34]. Most childhood burns occur in the home environment and in a domestic setting, with cooking as the most common activity [35-41]. In the cases of childhood accidents, burn injuries constituted 25% and most were due to accidental falls into fires and scalds from boiling water [35, 42, 43].

Generally, gender, age, burn surface area, presence of inhalation injury, co-morbid disease, co-existing trauma, and pneumonia are considered mortality risk factors of burn patients [44, 45] but there are some variations between adult patients and pediatric patients. Burn patients die for three main reasons; burn shock during the first few hours after injury, respiratory failure in the following days, and septic complications and organ failures during the subsequent weeks [46] which have been measured as length of time to intravenous access. Patients receiving resuscitation within the first hour have significantly higher chance of survival [54]. Respiratory failure and sepsis are the leading causes of death in severely burned children, with acute lung injury and respiratory distress syndrome (ARDS) accounting for 40-50% of all deaths [53]. Multi-drug resistant organisms also increase death rates from patients with burn-related sepsis from 42% to 86% [53]. The reason for the higher mortality rate of burns in children may involve a lesser physiologic reserve, thinner skin, technical difficulties with vascular access, lesser margin for error in fluid management, or a greater reluctance to subject young children to stressful excisional burn operations [50, 55]. This study is aimed at identifying risk factors related to pediatric burn mortality in a middle income country, to provide plastic surgeons and other health professionals adequate information on factors to consider in the management of pediatric burns.

Patients and methods

Study setting

The Accident and Emergency (A&E) Center established in 2009, is located at Komfo Anokye Teaching Hospital (KATH) in Kumasi - the second-largest hospital in Ghana and the only tertiary health institution in the middle belt of the country, affiliated to the School of Medical Sciences (SMS) of the Kwame Nkrumah University of Science and Technology (KNUST) with a current 1000 beds capacity, with an annual hospital attendance of about 679,050 patients made up of both out- and in-patients (Biostatistics Unit, 2012). The A&E Center which houses the Reconstructive Plastic Surgery & Burns Unit (RPSBU), among other units, is made up of a total of 160 ventilated bed capacities. These units are well equipped with all necessary tools to attend to any A&E case. Severe burn injury patients are initially attended to by the Emergency Physician team-on-duty before being referred to the Plastic Surgery team-on-duty. The surgeon or his resident/registrar gets to the patient within the shortest possible time and makes the decision to admit the patient to a specific burns ward for management. The 6 unit room in the Burns Intensive Care Unit (BICU), as an ultramodern...
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KATH accident & emergency center protocol for burns management

The Emergency Physician team-on-duty receives the burns patients first after having been assessed by the triage nurses; they follow a protocol provided by the Plastic Surgery team (pain management procedures and antibiotics application). Details of the procedures had been described by Agbenorku in his study entitled: Modernized standards in burns management: A comparative study in Komfo Anokye Teaching Hospital, Kumasi, Ghana [56].

Data collection

The data for the three years retrospective study (May 2009 – April 2012) was obtained from the pediatric burn admissions records and patients’ folders of the RPSBU of the A&E Center’s BICU of KATH. Data retrieved included: Demographic features which includes: age, sex, Total Burned Surface Area (TBSA) incurred, and aetiology of burns; Duration of the admission; outcome of admission; part of the body affected and cost incurred.

Ethical clearance

Ethical approval for this study was obtained from the Kwame Nkrumah University of Science and Technology School of Medical Sciences/ KATH Committee on Human Research, Publications and Ethics.

Data presentation and analyses

This information was displayed in tables and graphs and analyzed with Multiple Regression, SPSS version 18.0 (SPSS, Inc., Chicago, IL, USA).

Results

Demographic characteristics of pediatric burns patients

A total of 246 pediatric (0-14 years) patients' were admitted for the three years period at the study center. However, information of 197 patients was completely retrieved for the study, since the information of the others (N=49) was statistically incomplete for the study.

Burns mortality rate for the study was identified to be 21.3% (N=42). The mean age of the 42 dead patients was 3.7±0.3 years, ranging from 0-13 years (Figure 1), while, males (54.8%, N=23) outnumbered females (45.2%, N=19). The TBSA burned incurred by patients ranged from...
15% - 98%, with an interquartile range of 48% (Figure 2). In terms of etiology of burns Scald (73.8%, N=31) was the commonest cause of injury followed by flames (16.7%, N=7), while,
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According to the studies of Morrow et al. [47] and Sheridan [48], children aged 48 months and younger do not tolerate large thermal injuries as well as adults. Therefore children younger than 48 months with burns more than 30% of the body surface have a higher rate of mortality than adults with identical injuries [47, 55]. In this present study which buttresses the former ones, children with age less than 6 years and TBSA more than 36% had been proved to be essential factors to consider so as to alleviate effectively, burns mortality in children in countries such as Ghana. The childhood age and TBSA as a risk factor in burn-related mortality in this study is also in line with that of Fordjuoh et al. [37]. Therefore, in addition to educating families about augmenting the level of supervision of children, especially in the kitchen where most burns occur, serious efforts at identifying other burn-causing environmental factors in future studies may be important. The establishment of community programmes is one way of ensuring adequate child supervision and general child wellbeing, particularly for children in burns prone areas.

Furthermore, the present study again identified hot water, soup and inhalation injury as mortality risk factors for pediatrics burns. The study of Brusselaers et al. revealed that, in pediatric populations, scalds clearly dominate, accounting for 60% to 75% of all hospitalized burn patients, followed by flame and contact burns [10]. Similar trend was demonstrated in this study, with scald leading the chart of burns etiology followed by flames. The presence of inhalation injury also double the mortality rate predicted by burn size alone [37, 38]. Globally, the majority of children burnt are boys with a ratio of around 2:1 to girls [11, 21-25] and the mortality rate of males is greater than female [25]. Studies have also reported a higher female mortality [18, 26-29] but in other studies, no significant difference was found [19, 30-33]. In terms of gender, this current study supports the theory of no significant difference and no risk factor for mortality so far as burns mortality is taken into consideration. Thus, being female or male is not something important to predict burns mortality in children in Ghana. Although survival rate has improved for children with burns in recent years [36], those with all four risk factors for mortality thus young age, hot water and soup, inhalation injury and large burns are still very difficult clinical problems for

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<td>8</td>
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<td>Upper Limbs</td>
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<td>Lower Limbs</td>
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<td>Buttocks and genitalia</td>
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<td>Multiple</td>
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Table 1. Anatomical body parts affected in the study (N=42)

Anatomical body parts affected by burns

The study revealed that, patients with multiple body parts burnt constitute the majority (45.2%, N=19) in terms of part of the body affected by burns, while, those with only the buttock and genitalia were few (4.8%, N=2), as shown in Table 1.

Mortality risk factors

Multiple regression analysis was used to determine socio-demographic features which are mortality predisposing factors influencing pediatric burns in the study center. Using the “outcome of admission ie. death” as the dependent factor, all the demographic features of the participants were involved in the analysis. A probability value (P-value) of less than 0.05 was considered to be statistically significant at 95% confidence interval (Table 2).

Discussion

Generally, gender, age, burn surface area, presence of inhalation injury, co-morbid disease, co-existing trauma and pneumonia are considered mortality risk factors of burn patients [57, 58] but there are some variations between adult patients and pediatric patients. The analysis of this study however, identified four (Age <6 years; Scald; TBSA >36 and Inhalation injury) risk factors so far as burns pediatric mortality is concerned. The other features were irrelevant in this study as opposed to that of the others [57, 58].
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Table 2. Pediatric burns mortality risk factors in the study

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig (P-value)</th>
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<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
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<tr>
<td>Age (&lt;6 years)</td>
<td>0.098</td>
<td>0.042</td>
<td>0.407</td>
<td>2.305</td>
</tr>
<tr>
<td>Sex</td>
<td>0.128</td>
<td>0.076</td>
<td>0.267</td>
<td>1.679</td>
</tr>
<tr>
<td>Duration</td>
<td>-0.090</td>
<td>0.048</td>
<td>-0.315</td>
<td>-1.869</td>
</tr>
<tr>
<td>Aetiology (hot water &amp; soup)</td>
<td>-0.083</td>
<td>0.033</td>
<td>-0.464</td>
<td>-2.549</td>
</tr>
<tr>
<td>TBSA (&gt;36%)</td>
<td>-0.063</td>
<td>0.027</td>
<td>-0.389</td>
<td>-2.298</td>
</tr>
<tr>
<td>Inhalation injury</td>
<td>0.054</td>
<td>0.047</td>
<td>-0.0148</td>
<td>1.065</td>
</tr>
<tr>
<td>Sepsis</td>
<td>-0.126</td>
<td>0.061</td>
<td>-0.762</td>
<td>2.650</td>
</tr>
<tr>
<td>Body Part Affected</td>
<td>-0.007</td>
<td>0.013</td>
<td>-0.094</td>
<td>-0.570</td>
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</table>

**Denote significant value (P<0.05).

Pediatric mortality resulting from burns is very disturbing and appropriate care systems and treatments have been exercised throughout the years to help reduce the mortality risk factors of children and patients of burns. Clinical measures includes: The prevention of complication of sepsis by early burn wound excision and grafting. Other methods include prophylactic antibiotics, topical antimicrobial agents, infection control practices and early and effective closure of deep burns is important in infection prevention. Moreover, the development and refinement of techniques of positive-pressure ventilation have sharply reduced the prevalence of respiratory death [51, 52]. Carefully monitoring ventilator settings to insure low peak inspiratory pressures, allowing relative hypercapnia and avoiding hyperoxia has also achieved a 53% decrease in mortality within a period of two years [48]. Application of fluid resuscitation formula has markedly reduced the prevalence of death due to resuscitation failure [50]. The need to educate people about fire-safety in the home environment has been suggested for many years [17, 18]. The study of Hyder et al. recommended the implementation of Legislation to increased use of smoke detectors, flame-retardant clothing for children and water heater modifications [5]. In developing countries such as Ghana, prevention strategies need to be tailored to the specific environment taking into account local risk factors and available resources [9]. Other preventive measures that had been classified are improving of socio-economic status, community programmes, the design of standards and educational awareness [7, 31].

Conclusion

Age less than 6 years; scald especially hot water and soup; TBSA greater than 36%; and inhalation injury were identified as pediatric burns mortality risk factors in a developing country such as Ghana’s Reconstructive Plastic Surgery & Burns Unit (RPSBU). These identified factors will serve as a guideline for burn surgeons and other health professionals in the management of pediatric burn cases. Child health policy makers and other infant wellbeing related organizations could educate parents especially mothers in the prevention of pediatric burns at home (especially in the kitchen) emphasizing on burns involving hot water and soup, which is a major burns mortality factor.

Acknowledgement

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Disclosure of conflict of interest

The authors declared no conflict of interest.

Address correspondence to: Dr. Pius Agbenorku, University P O Box 448, Kwame Nkrumah University of Science & Technology, Kumasi, Ghana. Phone: +233 24 459 9448; E-mail: pimagben@yahoo.com

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