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Pre-burn malnutrition increases operative mortality in burn patients who undergo early excision and grafting in a sub-Saharan African burn unit

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ABSTRACT

Introduction: In the developed world, pre-existing malnutrition in the burn population influences operative outcomes. However, studies on pre-existing malnutrition and operative outcomes of burn patients in the developing world are lacking. We therefore sought to characterize the burn injury outcomes following operative intervention based on nutritional status.
Methods: This is a retrospective review of operative patients admitted to our burn unit from July 2011 to May 2016. Age-adjusted Z scores were calculated for height, weight, weight for height, and mid-upper arm circumference (MUAC). Following bivariate analysis, we constructed a fully adjusted logistic regression model of significant predictors of post-operative mortality, both overall and for specific age categories.
Results: Of the 1356 admitted patients, 393 received operative intervention (29%). Of those, 205 (52.2%) were male, and the median age was 6 years (3, 25), with 265 patients (67%) aged ≤16 years. The median TBSA was 15.4% (10%–25%) and open flames caused the majority of burns (64%), though in children under 5, scalds were the predominant cause of burn (52.2%). Overall mortality was 14.5% (57 patients) and ranged from 9.09% for patients aged 6–16, to 33.3% for adults ≥50 years. Increased time from injury to operative intervention was protective (OR: 0.90, 95% CI: 0.83, 0.99). In post-operative patients with z-scores, increasing %TBSA burned (OR: 1.11, 95% CI: 1.05, 1.17) and increasing malnutrition (OR: 1.46, 95% CI: 1.03, 1.91) predicted death in the adjusted model.
Conclusion: Poor nutrition is an important risk factor for post-operative mortality in burned patients in resource-poor settings. Screening for malnutrition and designing effective interventions to optimize nutritional status may improve surgical outcomes in LMIC burn patients.

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1. Introduction

Burn patients in low- and middle-income countries (LMICs) suffer a disproportional burden of global burn mortality, with over 90% of burn deaths [1]. In sub-Saharan Africa (SSA), burn mortality affects mainly children. The region accounts for 64% of the world's burn mortality in the 0–4 year old group, and 78% of burn mortality in the 5–14 year age group [1–5]. In high-income country burn centers, interventions that improve burn injury outcomes include: adequate fluid resuscitation, early excision and grafting, early enteral nutrition, and admission to a burn unit [6,7]. We have previously shown that in a resource-poor setting there is an increased mortality associated with early excision and grafting [6]. However, the causal relationship between early excision and grafting and increased mortality could not be clearly delineated.

Despite the low incidence of preexisting malnutrition in high-income countries (HICs), the hypermetabolic effect of burn injury on nutritional status is well characterized [7–15] and early enteral nutrition plays a vital role in burn management. Despite adequate baseline nutritional status and optimal nutritional supplementation, patients with severe burns can lose up to 25% of their lean body mass after an acute burn injury [10,12]. This effect is especially pronounced in children because of their lower metabolic reserve and increased caloric and protein estimates in relation to body size [13,14]. The prevalence of pre-existing malnutrition in children living in SSA is high, yet there is a paucity of data regarding the effect of pre-existing malnutrition on post-operative mortality [16–18].

The World Health Organization (WHO) uses three indicators to denote poor nutritional status: malnutrition, wasting and stunting. It defines moderate pediatric malnutrition as a weight-for-age between −2 and −3 z-scores below the median of the WHO growth standards. Moderate wasting and stunting are described as weight-for-height and height-for-age falling between −2 and −3 z-scores [19]. The Academy of Nutrition and Dietetics (AND) and the American Society for Parenteral and Enteral Nutrition (ASPEN) use the same pediatric parameters, but include also a mid-upper-arm-circumference (MUAC)-for-age z-score [20,21]. Weight-for-age changes are thought to represent acute changes to nutritional status or overall health, whereas decreased height-for-age (stunting) tends to represent exposure to a chronic state of either malnutrition or disease [19].

Adult nutritional status indicators are less well accepted. ASPEN recommends 2 or more of the following for documentation of adult malnutrition: energy intake <75% of ideal, weight loss, loss of muscle mass, loss of subcutaneous fat, localized edema, and diminished hand grip strength. These indicators are based on expert opinion and recommended for the United States population; no such consensus exists for adults in resource-poor settings. The WHO uses Body Mass Index (BMI) in women of childbearing age as an indicator of malnutrition, and both the Centers for Disease Control (CDC) and the WHO define a BMI < 18.5 kg/m^2 as underweight [22].

Malawi, a landlocked country in southeastern Africa, has a 2016 population of over 17 million people, and a life expectancy of 57 and 60 years for males and females, respectively. In 2011, 50% of the population lived below the poverty line [23]. In 2016, the per capita gross domestic product (GDP) was US $300, representing a 41% decline from a high of US$512 in 2011 [24]. In 2014, 20.7% of the population could not achieve the minimum dietary energy consumption [23]. Healthcare in Malawi is free and universal with a per capita healthcare spending of US $29 [25].

The prevalence of underweight in children 0–5 years living in Malawi increased from 12.1 to 16.7% between 2009 and 2014. In 2010, 48% of children ≤ 5 years were stunted. In 2004–2005, the most recent data available, 9.2% of women of childbearing age had a BMI under 18.5 kg/m^2 [23]. Given the high prevalence of burn and under nutrition, we hypothesize that the presence of pre-existing nutritional stress in burn patients who undergo operative intervention in our SSA burn unit is associated with increased mortality.

2. Methods

We performed a retrospective review of prospective data entered into the Kamuzu Central Hospital (KCH) burn unit database. KCH, located in Malawi's capital of Lilongwe, is a public, 600-bed, tertiary care hospital with a catchment population of approximately 6 million people. All patients receive treatment free of charge. The KCH burn unit was commissioned in 2011 in partnership with the North Carolina Jaycee Burn Center. It has 31 beds, 8 nurses, 2 nursing assistants, and 1–2 clinical officers who oversee clinical management and perform surgeries with attending surgeon oversight [5]. Burn patients receive the standard hospital meal allotment of three servings of corn-meal porridge or cake served with peanut butter for breakfast, a vegetable or protein stew for lunch and again with peanut butter for dinner. They also receive two boiled eggs per day from the burn unit funds. Enteral feeding is almost always achieved per os and nasogastric tubes are occasionally utilized. The amount of nutrition delivered to each patient does not vary with burn severity. Children who are breast fed prior to burn injury continue breast milk during their admission. There is no dedicated nutritionist or separate nutritional support,

All patients admitted to the burn unit between 1 July 2011 and 1 May 2016, who received operative intervention were included in this study. Operative intervention consisted mainly of debridement, burn wound excision, escharotomies and skin grafting. The primary aim was to determine the relationship between pre-existing malnutrition, defined using any of the WHO and/or AND/ASPEN indicators or BMI for adults, and post-operative mortality. The primary outcome was in-hospital mortality among patients undergoing surgery in the burn unit during the period under study. We analyzed mortality for all patients, as well as for a priori determined age categories of 0–5, 6–16, 17–49, and ≥50 years.

We first compared the demographic and clinical characteristics of operative and non-operative patients. Non-operative patients were then excluded from the remainder of the study. Bivariate analysis of each independent variable was performed based on mortality, using Pearson's correlation, two tailed Fisher's exact test, 2-sample T-test, or Kruskal-Wallis testing, as appropriate. Means are presented with standard