NUTRITIONAL STATUS OF PEDIATRIC BURN PATIENTS HOSPITALISED AT KENYATTA NATIONAL HOSPITAL USING ANTHROPOMETRIC MEASUREMENTS

Dissertation submitted in partial fulfillment for the degree of Masters of Medicine (Pediatrics and Child Health) of the University of Nairobi

Researcher: Dr. Doreen Karimi Mutua

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Supervisors: Dr. Dalton Wamalwa
Senior Lecturer, Dept. of Pediatrics & Child health
University of Nairobi

Dr. Bashir Admani
Lecturer, Dept. of Pediatrics & Child health
University of Nairobi

Dr. Kimani Wanjeri
Consultant Plastic surgeon, Dept. of Surgery
University of Nairobi

Mrs Lina Njoroge
Nutritionist
Kenyatta National Hospital

DECLARATION

This dissertation is my original work and has not been presented for a degree in any other university.

Signed…….

Dr. Doreen Karimi Mutua

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Dr. Dalton Wamalwa Sign……..

Dr. Bashir Admani Sign……..

Dr. Kimani Wanjeri Sign……..

Mrs Lina Njoroge Sign……..

DEDICATION

I would like to dedicate this work to the following people:

- To my parents, **Mr and Mrs Robert Mutua** who taught me to believe and work towards anything that I set out to do. It is my hope that I always make them proud.

- To my sister, **Mrs Caroline Nkirote Njau** who has been my number one supporter, friend, critique and source of strength.

- To the world's greatest children, **Ryan Rikie Njau** and **Janelle Wangari Njau** who have shown me what it is to be a child. The joy and privilege of being their number one doctor has helped me push to being the best clinician I can be.

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LIST OF ABBREVIATIONS

KNH	Kenyatta National Hospital
TBSA	Total Body Surface Area
NRI	Nutritional Risk Index
WHO	World Health Organization
WHZ	Weight for Height z scores
WAZ	Weight for Age z scores
HAZ	Height for Age z scores
PEM	Protein Energy Malnutrition
MUAC	Mid Upper Arm Circumference
KDHS	Kenya Demographic Health Survey
IQR	Interquartertile range

ABSTRACT

Background: Pediatric burn patients are prone to under nutrition due to the hyper metabolic response that increases their metabolic demands and it can go on for prolonged periods. Children have limited energy stores and this makes them vulnerable to deficiencies if appropriate nutritional support and monitoring is not offered.

Objectives: To define the nutritional status of pediatric burn patients admitted to Kenyatta National Hospital (KNH) at admission and after two weeks, to describe the patterns of change and the factors associated with deterioration in nutritional status.

Methodology: A prospective cohort study of patients below 13 years admitted to the Plastic Surgical Unit. Patients were recruited at admission by consecutive sampling over a period of 6 months with their details collected using a questionnaire. Their anthropometric measurements were taken on the 3rd and 14th day after admission.

Results: The proportion of patients with normal nutritional status changed from 83% to 63% using the Weight for Height Z scores (WHZ) and from 63% to 57% using the Mid Upper Arm Circumference (MUAC). Thirty two percent of the patients lost >10% of their baseline weight between the two measurements. Age and pre burn nutritional status were found to be significantly associated with deterioration in nutritional status.

Conclusion: One in five of the pediatric burn patients had deterioration in nutritional status with those having an abnormal MUAC being at highest risk of losing >10% of their weight within the two weeks post admission.

1.0 LITERATURE REVIEW

Burns are traumatic injuries to the tissues caused by heat, friction, electricity, radiation or chemicals. They are common injuries seen in emergency departments, with approximately 30-40 % of these occurring in children below the age of 15 years.[1] Burns are a leading cause of unintentional death in children, second only to motor vehicle accidents in the developed countries.[1] Similarly, in the developing countries, burns are significant injuries occurring in children and a major cause of morbidity and mortality in them. Factors such as poverty, illiteracy, urban migration and the development of slums and shanty towns contribute to the high incidence of burn injuries in African children .[2]

Burn injuries evoke a systemic metabolic response with profound effects on organ function, susceptibility to infection, wound healing, growth, development and mortality. Children are especially vulnerable to nutritional deficiencies owing to their limited energy reserves. [3] A burned patient's metabolism is greatly accelerated with increased requirements for energy, carbohydrates, proteins, fats, vitamins, minerals and antioxidants. Early nutrition through enteral and/ or parenteral routes is vital in averting a deterioration of their nutritional status. A careful assessment of the nutritional state of the burn patient is important in reducing infection, recovery time, and long-term sequelae.

Nutritional status has been shown to have important effects in recovery from illness or injury, for example an experimental semi starvation of normal volunteers that caused a 25% loss of body weight was associated with apathy, depression, fatigue and a loss of will to recover.[4] Consequent loss of muscle power affects respiratory function thus increasing susceptibility to chest infections [5] and causes a decrease in cardiac function.[6] Poor nutritional status impairs immune function and thus increases the risk of infection. These complications result in increased morbidity, mortality and lengthened stay in hospital at a substantial extra cost in health care. [7]

The problem of malnutrition in hospitalized patients remains largely unrecognized. Nutritional screening of patients at risk of depletion is not routine in our health care facilities. Nyandiko et al (2000) found that 75% of the patients admitted to the general pediatric wards at Kenyatta National Hospital (KNH) were malnourished and subsequently, 58% of the patients had a deterioration in nutritional status using the Nutritional Risk Index(N.R.I.) and 34% when

percentage weight loss was used to assess nutritional status.[8] McWhirter and Pennington (1994) found that, of 500 admissions(both adults and children) to Dundee hospital, 40% were malnourished at the point of entry and by the time of discharge, 75% were affected by a deterioration in nutrition status during hospitalization.[9] Roldan Avina et al in 1995 at a University Hospital in Spain found a prevalence of malnutrition at admission of 53% with an incidence of Protein Energy Malnutrition (PEM) in 66% of patients admitted for more than 7 days.[10]

This indicates that most of our patients are likely to be malnourished at the time of admission and hospitalization tends to worsen their nutritional status. Burns increase the nutritional needs of patients and are likely to further compromise their nutritional status if appropriate measures are not taken. Monitoring of the nutritional status of burn patients identifies those who are malnourished or those at risk of malnutrition so that aggressive surveillance systems on their nutritional requirements and intake can be maintained.

Burns in pediatric patients may be an indicator of child abuse (18% of pediatric burn injuries[1]), therefore it is important to assess the pattern and site of injury and their consistency with the patient's history.[1] Child abuse and neglect are common in the lower socioeconomic groups and this forms the majority of the patients seen at KNH. This is likely to influence the pre burn nutritional status of these children and thus put them at a risk of developing PEM.

1.1 Epidemiology of burns

Accurate records of the prevalence of burns in pediatric patients are not available. However extrapolation from population- based studies suggest that the incidence of hospitalized pediatric burn patients is highest in Africa and lowest in America, Europe, Middle East and Asia.[11] This has resulted in an increased focus on burn treatment and prevention, increased fire and burn prevention education, greater availability of regional treatment centers, widespread use of smoke detectors and occupational safety measures in the latter countries.[1]

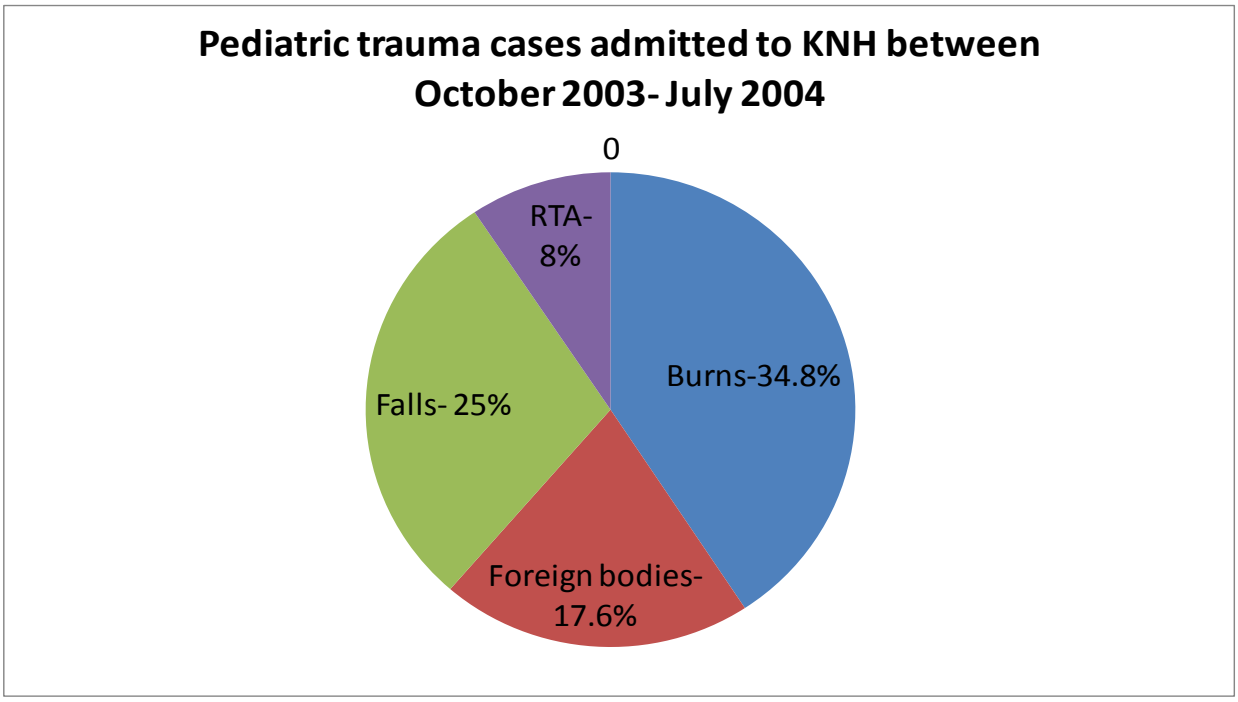
Children below five years of age are at greatest risk of burns with those < 2 years having a mortality rate twice that of older children and adults with equivalent injuries.[11]

The South Africa Medical Research Council indicates that 3.2% of the South African population is burned annually with 50% of the individuals below 20 years of age.[12] In Ghana, a community based multi-site survey done in 1988 using presence of scar as evidence of previous burn found

a prevalence of 6% with the highest incidence being between 18-23months of age and the highest prevalence in rural areas.[13] A retrospective study done in Zaria, Nigeria found that 60% of the patients were below 16 years with two thirds of these being below 4 years of age.[14]

In Kenya, Nthumba (2005) et al did a study on the outcome of moderate and severe thermal burns admitted to the plastic surgical unit at KNH. In the demographic profile, children between the ages of 1-5 years comprised of 49.1% of the patients.[15] Gome (2005) et al conducted a descriptive prospective study on pediatric trauma patients hospitalized at KNH and revealed that burns were the commonest cause of trauma in children admitted to the surgical wards.[16]

Figure 1: Pediatric trauma cases admitted to KNH between October 2003- July 2004



Source: Data derived from a prospective study at KNH by Gome et al in 2003/4[16]

1.2 Overview of burns

1.21Causes of burns

The main causes of burns include: thermal injury, chemicals and electric current.

Thermal burns are sustained from hot liquids (scalds), open flames or contact with hot surfaces and form more than 70% of all burn injuries. In most studies, scalds are the commonest cause of burns in children (50-85%). [1, 17- 19] Some of the fluids involved include hot water, beverages like hot tea and porridge. Flame burns occur when there is contact with an open flame that causes direct injury to the tissues. Flames may come from explosions of flammable substances like cooking gas or petroleum products. Contact burns occur when a child touches a hot surface like a hot cooking pot, iron box, utensils etc.

Electrical burns are sustained when an electric current passes through the tissues with significant injury occurring with voltages between 200- 1000v. Ignition of clothing may produce some flame burns, but most of the injury occurs to the deeper tissues like the heart. These burns are severe and have a high morbidity and mortality.

Chemical burns are caused by acidic or alkaline substances. Alkali burns produce liquefactive necrosis and are considered higher risk burns due to the likelihood of penetrating deeper into the tissues. Acid burns cause a coagulative necrosis thus limiting the depth and penetration of the burn.

Inhalational injury occurs when burns are sustained in enclosed places and are associated with serious morbidity and mortality. They should be suspected when there is severe respiratory distress, carbon monoxide poisoning or signs of airway trauma like burnt hair in the nostrils.

1.22 Burn depth

This is classified according to the layer(s) of the skin and underlying tissues that are involved by the burn. The partial thickness burns involve mainly the epidermis and the dermis and can either be superficial or deep dermal burns. Full thickness burns extend completely through the skin to the subcutaneous tissues and may involve underlying structures like tendons, nerves, muscle or bone.

1.23 Burn surface area

This describes the extent of the burns on the body's surface and is expressed as a percentage. It can be estimated using various techniques like the palm method, the rule of nines or the Lund and Browder charts (see Appendix 7). The latter method has been shown to have the highest accuracy in estimating burn surface area and will be used for the purposes of this study.

1.24 General management of burns

The management of burns begins from the time of injury with first aid measures which if done appropriately can have significant effects on the extent and depth of the burns. In the hospital setting, initial resuscitative measures are instituted with airway management, fluid replacement, pain control, tetanus prophylaxis and initial wound management.[1] Minor burns like superficial 1st and 2nd degree thermal burns of less than 10% TBSA and those that do not involve special areas are managed on an outpatient basis. Patients with burns involving more than 10 % of the body surface area for children, inhalational injury, high tension electrical and chemical burns are admitted for inpatient care. Burns involving special areas like the hands, face, joints, perineum and those where child abuse / neglect are suspected are also managed as inpatients because they carry a high risk of morbidity and mortality.

Patients admitted to wards are managed by a multidisciplinary team that includes: pain management specialists/ anesthetists, dieticians/ nutritionists, intensivists, pediatricians, nurses, occupational therapists, parents/caregivers, patient, pharmacists, physiotherapists, psychiatrists, and social workers. [20]

1.3 Nutrition in burns patients

The aim of nutritional support in burns patients is to provide appropriate intervention that allows for optimal wound healing and maintains normal growth. Improved nutritional status in burns patients reduces the likelihood of complications like infection, poor wound healing and reduces the length of hospital stay.[7]

1.31 Metabolic response to burn injury

Burns produces a hyper metabolic response characterized by both protein and fat catabolism. Depending on the time since the burn, children with burns of 40% TBSA require approximately 50-100% more than the predicted basal energy expenditure for their age.[1]

Immediately following injury, the patient will enter into the “ebb” phase for approximately 72 hours in which they are likely to experience hypovolemia, shock, tissue hypoxia, a decrease in cardiac output and oxygen usage, a reduction in body temperature and a decrease in insulin levels. The ebb phase is characterized by hyperglycemia and hypo metabolism.

Following the ebb phase, a patient enters into a “flow” phase, occurring 3-5 days following the injury that is characterized by hyper metabolism which increases cardiac output, oxygen consumption, body temperature and energy usage. Subsequently the patient undergoes protein and skeletal muscle catabolism that is mediated by an increase in insulin, epinephrine, norepinephrine, glucagon and cortisol levels. This is a compensatory mechanism for the increased energy demands that aims to mobilize glucose and free fatty acid release but their usage is poor. Energy production is dependent on protein following a traumatic injury and this leads to an extreme loss of lean body mass and a negative nitrogen balance until the cause of the physiological stress is sorted out. The breakdown of protein also leads to an increase in urinary losses of potassium, phosphorous and magnesium. Serum iron and zinc levels decrease following burn injury as a result of tissue destruction.

This response occurs in all trauma or critically ill patients but the severity, duration and magnitude is uniquely severe for burn patients. [21] It has been shown to persist for up to 12months post burn injury thus predisposing these patients to under nutrition if appropriate nutritional support is not given.[11, 21] The intensity of the response is dependent on the Total Body Surface Area (TBSA) burnt, body weight at admission and the time from injury to tissue/eschar excision and wound coverage. [21] Early enteral feeding (within 6hours) may help modulate this hyper metabolic response.

1.32 Nutritional requirements

Adequate provision of energy is mandatory to prevent the breakdown of proteins and fats to bridge the energy gap with carbohydrates providing up to 65% of the energy in the diet. Several

formulae have been used to determine energy requirements in pediatric burn patients and include: the Galveston formula, Cureri formula, Hindred formula and Harris Benedict equation.

The use of these formulae will be dependent on the protocols of the plastic surgical unit. In KNH, the protocol for nutritional support for the pediatric burn patient uses the following formula[22]:

Kcal/24 hours= (60kcal x kg pre burn weight) + (35 kcal x TBSA (%)) [22]

Protein (gram/24 hours) = (3gram x kg pre burn weight) + (1 gram x TBSA (%)) [22]

Proteins should provide 20-25% of total calories with an estimated intake of 2- 3 gm of protein/ kg/ day for children. Current evidence suggests that supplementation of some amino acids such as arginine and glutamine improve immune functioning and wound healing, decrease protein breakdown, increase nitrogen retention and muscle mass and help to preserve gut integrity. [20]

Vitamins and minerals need to be supplemented as their physiological demand is increased in patients with burns. Vitamin A has been shown to play a role in the prevention of stress ulcers [23] while the intake of B group vitamins should be increased proportional to energy intake[23] as they are required for various metabolic processes. Zinc and copper promote wound healing[24] and should be supplemented in burn patients. However low levels of serum iron in most cases are not diet related and may have a protective effect against infection. [25]

1.33 Nutritional assessment

The assessment of the nutritional status of burn patients can be done by anthropometry, biochemical factors or a combination of both.

Anthropometry involves measuring the patient's weight, height and mid upper arm circumference. These are simple, safe, quick, sensitive and inexpensive measurements that can be used in clinical practice to determine nutritional status. They are also used to calculate indices that reflect the nutritional status of the patient as follows: Weight for Age (W/A) as a marker for being underweight, Weight for Height (W/H) for acute malnutrition and Height for Age (H/A) for chronic malnutrition. The body mass index which is calculated as weight/ height $(m)^2$ is also used to assess nutritional status with a cut off of less than 19 indicating under nutrition, 19-

25, normal nutritional status and > 25 being overweight/ obese. The MUAC provides a simple method for estimating body composition.

Biochemical factors such as albumin, transferrin, thyroxin binding pre albumin, and retinol binding protein can also be used. Albumin concentration responds slowly to protein restriction and is more often a reflection of the illness in a patient than nutritional intake. [9]Transferrin on the other hand is more sensitive, has a shorter half life but may be elevated during infection, stress and with concurrent iron deficiency.[9] Thyroxin binding pre albumin and retinol binding protein both respond to nutritional intake but are also affected by disease process.[9] These limitations usually affect the interpretation of these markers hence should be used in combination with anthropometric measurements in determining the nutritional status of these patients.

This study used anthropometry as the method to determine the nutritional status of pediatric burn patients.

1.34 Malnutrition in burns patients

Malnutrition is a common complication seen in patients with burns and this is made worse if the patient's nutritional status was compromised the time of admission. A study on the complications of pediatric burn patients managed at a teaching hospital in North Western Nigeria between April 1998 and March 2003 found that up to 32% of the patients became malnourished. The other complications were infections (64.9%), anemia (40.5%) and contractures (29.8%). [26] At the Shrinner's Children's hospital in Boston, a retrospective study conducted between January 2003 and January 2009 on pediatric burn patients admitted at least 3 weeks after burn injury and with an initial TBSA of > 20% revealed that 61% of the patients were diagnosed to be malnourished.[27]

Children with burns are susceptible to under nutrition due to the hyper metabolic response that increases their energy demands and can go on for protracted periods. The pain of the injury and the procedures in the wards may cause anxiety that increases metabolic demands and hence adequate pain control reduces the energy requirement of burn patients. The skin forms a protective barrier against infective organisms and with its damage in burn patients their susceptibility to infection increases and this further elevates their metabolic rates and energy requirements. Certain sites of burn injury for example around the face and hands may interfere with food intake and thus compromise the nutritional status of the patient. With regard to these

factors, appropriate nutritional support measures need to be implemented to prevent deterioration in nutritional status once burn injuries are sustained.

1.35 Case definition of malnutrition

Acute severe malnutrition was defined as a WHZ below -3SD and moderate malnutrition as WHZ between -2 to -3 SD. This was obtained from charts in the WHO's pocket guidebook of Hospital care for children.

A change in nutritional status by percentage weight loss was regarded as mild (5%), moderate (5-10%) and severe (>10%). This was calculated as follows:

$$\%\textbf{Weight loss} = (\textbf{W1} - \textbf{W2})/\textbf{W1} \times 100$$

W1 = WEIGHT AT ADMISSION

W2 =WEIGHT AFTER TWO WEEKS POST BURN INJURY

2.0 STUDY JUSTIFICATION AND UTILITY

Burns are a major cause of morbidity and mortality in our patients. Children with burns are at risk of malnutrition both in the acute and recovery phases. Malnutrition in pediatric burn patients puts them at risk for infections, poor wound healing, prolonged hospital stay and ultimately death. There are no studies or nutritional surveillance mechanisms for this vulnerable group in our setting.

This study may form a basis for the establishment of nutritional surveillance and support strategies which will ultimately improve outcome and reduce morbidity and mortality of our pediatric burn patients.

3.0 RESEARCH QUESTION

1. What is the effect of burns on the nutritional status of pediatric patients admitted to KNH?
2. What are the factors associated with a deterioration in the nutritional status of these patients?

3.1 OBJECTIVES

Primary objective

- To describe the nutritional status at admission and at two weeks following burn injury of children admitted at KNH using anthropometric measurements.

Secondary objectives

- To describe the pattern of change in nutritional status of pediatric burn patients admitted at KNH.
- To identify factors associated with developing malnutrition in these patients (age, gender, TBSA, site of the burn, caregiver characteristics, pre burn nutritional status).
- To describe the feeding practice in the unit.

4.0 STUDY METHODOLOGY

4.1 STUDY DESIGN

A prospective cohort study

4.2 STUDY AREA

The study was carried out at the Plastic Surgical Unit in KNH which is a national, tertiary and referral hospital in Kenya. The Plastic Surgical Unit is a specialized centre where patients with burn injury are admitted for care. It consists of a critical care unit where patients with severe burns are admitted for initial stabilization and a ward setting where the more stable patients are managed. The unit admits both pediatric and adult patients.

This study was carried out at the Plastic surgical ward (Ward 4D) where the patients who have been stabilized are admitted.

4.3 STUDY POPULATION

The patients were children drawn from Nairobi County and the surrounding districts. This being a national and referral hospital, some patients may have been referred from peripheral areas of the country for specialized burn care.

INCLUSION CRITERIA

- Children with burns admitted to the Plastic Surgical Unit aged below 13years (which is cut off for the definition of pediatrics patients at the KNH)
- Patients whose guardians gave informed consent.

EXCLUSION CRITERIA

- Patients whose clinical status was not suitable to allow for anthropometric measurements to be taken. These included the following: critically ill, those on ventilator support and those with extensive burns (>80% TBSA).
- Patients with co-morbidities such as renal, cardiac or liver disease.

4.4 SAMPLING PROCEDURE

Patients were recruited after admission into the ward by consecutive sampling.

4.5 SAMPLE SIZE

The sample size was determined by using the Fischer's formula.

$$N = \left(\frac{z}{m} \right) \times p(1 - p)$$

N= 86 patients (sample size)

Z= 1.96 (standard deviation around the mean corresponding to a 95% confidence level)

m =0.1 (margin of error around the mean)

p= 0.34 (prevalence quoted from Nyandiko's study[8])

4.6 STUDY DURATION

Patients were recruited over a period of six months.

4.7 STUDY PROCEDURE

The patients were identified and selected using the inclusion and exclusion criteria by consecutively sampling. Informed consent was sought from the guardians at the time of admission (see Appendix 6).

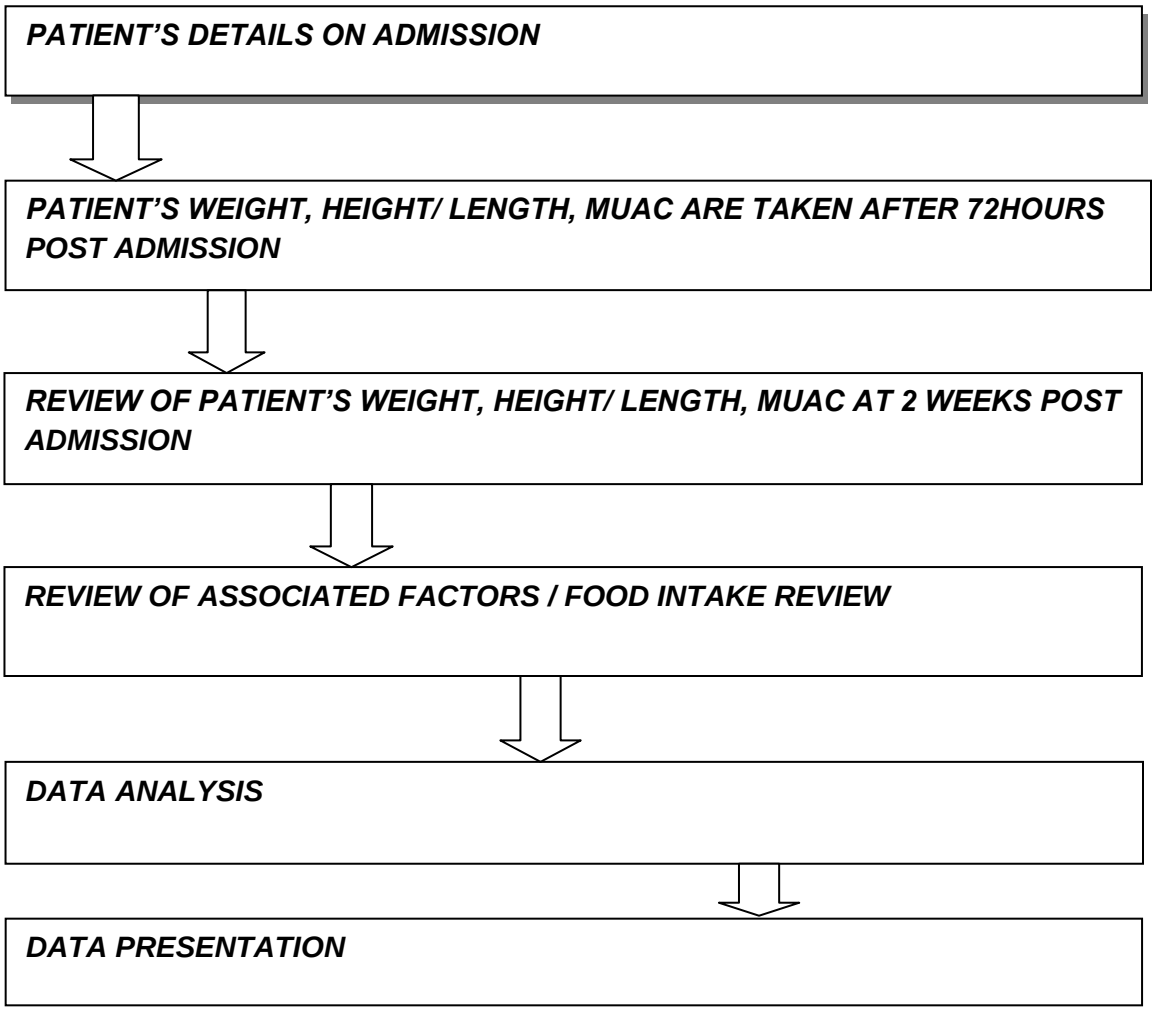
The patient's and caregiver's demographic profiles and burn details were recorded using a questionnaire at admission (see Appendix 1). The patients were weighed at 72hours after admission to avoid interference of the weight measurement with the fluids that are administered and also to allow for pain control and wound management to be initiated. The patient's height/ length, weight and MUAC were taken as described in Appendix 3, 4 and 5. These measurements were repeated on the 14th day post admission and the anthropometric indices calculated and a comparison of the change in nutritional status made. The percentage weight loss of each patient was calculated by dividing the change in weight with baseline weight measurement. A weight loss of <5%, 5-10% and >10% was described as mild, moderate and

severe in describing the patterns of change in nutritional status. The factors that were proposed to be associated with a weight loss of 10% were analyzed to test for association.

A 24 hour observation of the feeding practice in the unit was done by the researcher. The following information was collected: the feeding routes (parenteral/ enteral), supervision during feeding, any adjustments made to children with burns around the face and hands.

A random sample (n= 22) within the study sample size (N= 86) were given a food intake questionnaire (see Appendix 7). The expected intake of energy and proteins were calculated using the formulae in the nutrition protocol for burn patients in KNH. A comparison of the expected and estimated intakes was done to determine the adequacy of the diets.

Figure2: FLOW CHART OF THE STUDY METHODOLOGY



4.8 DATA MANAGEMENT

Data collected using the study instruments was entered into a customized MS Access data base with inbuilt range and consistency checks to minimize data entry errors. The database was stored on the researcher's computer (PC) and data access was restricted using a password. At the end of the data entry, it was transferred to SPSS version 17. All data cleaning, verification and analysis was conducted in SPSS. Anthropometric indices were calculated using the software, Epi Info Version 3.3.2.

Statistical analysis

The initial stage of statistical analysis aimed to describe the sample characteristics including demographic and social characteristics. These descriptive analyses was conducted using SPSS procedures for calculating means (SD) and medians (range) for continuous variables, and frequency tables or graphs for categorical variables.

Weight- for- height *z*-scores (WHZ), weight-for -age *z*-scores (WAZ), and height-for-age *z*-scores (HAZ) were calculated for each participant using WHO reference standards in Epi Info. These anthropometric indices were summarized in SPSS and used to describe the nutritional status of the sample at day 3 and day 14 after burn injury. The factors associated with development of malnutrition in burn patients were analyzed by conducting bi-variate tests of association i.e. chi-square statistics and the corresponding *p*-values for categorical variables and *t*-tests or Mann- Whitney *U*– test for continuous variables. The odds ratios for factors found to have a significant association were calculated.

5.0 ETHICAL CONSIDERATIONS

- The study was approved by the KNH/ UON Ethics Committee (see appendix 8).
- An informed consent was obtained for each patient recruited in to the study. The caregivers were explained to the details of the study in English and Kiswahili depending on their preference and level of understanding. They were allowed to make a decision of whether to have their children participate in the study. The caregivers who did not agree to participate in the study were informed that their children would be given standard of care as per the protocols in the unit.
- Caregivers and patients were informed that there would be no discomfort experienced with the anthropometric measurements and they would not incur any additional costs for participating in this study.
- Patients who were found to be malnourished were offered treatment as per the WHO guidelines for managing severe malnutrition.
- Patient's confidentiality was maintained by ensuring that the study material used codes and not the patient's names. The information gathered in the study was protected by entering it into a database that is coded and data access restricted by use of a password. The parents/ caregivers of children found to be malnourished were informed by the researcher directly.
- Data obtained would be used for the purposes of this study only and any publications made will not directly link the patient to any outcome.

6.0 RESULTS

The study recruited 86 pediatric burns patients admitted to the plastic surgical ward at KNH. The characteristics of these patients are presented below.

6.1 Socio-demographic characteristics

The characteristics of children admitted with burns at KNH are shown in Table 1. The patients comprised 44 (51.2%) males yielding a male-to-female ratio of approximately 1: 1. The median age was 22 months (IQR 13 to 36 months) with a range from 3 months to 13 years. As shown in table 1, most of the patients were found in the age groups between 3 months and 3 years. Infants accounted for 19.8% of the patients, 31.4% were aged 1 to 2 years and 22.1% of patients were between 2 to 3 years.

Table 1: Age and sex distribution of children admitted with burn injury at KNH

	Frequency	**Percent**
Sex		
Male	44	51.2
Age		
3 to 11 months	17	19.8
12 to 23 months	27	31.4
24 to 35 months	19	22.1
36 to 59 months	7	8.1
>60 months	16	18.6

Most of the primary caregivers in the study were parents of the patients (n = 84, 97%). Approximately three-quarters (73%) of all children were accompanied by both parents while only 2 children were accompanied by a relative to the hospital (either the grandparent or an aunt).

Fathers were more likely to be in employment compared to mothers accompanying the burn patients ($p < 0.001$). The fathers were also more highly educated compared to mothers ($p = 0.004$) and had significantly higher monthly incomes ($p < 0.001$) compared to the mothers of patients admitted with burn injuries. The characteristics of caregivers of the patients in this study are presented in table 2 below.

Table 2: Characteristics of caregivers of children admitted with burns at KNH

	Fathers' details	Mothers' details	P value*
Caregiver characteristics	N=65 (73%)	N=84 (97%)	
Occupation			
Unemployed	1(1.6)	35(41.7)	< 0.001*
Casual	25(40.3)	17(20.2)	-
Formal employment	28(45.2)	10(11.9)	0.18
Professional	8(12.9)	22(26.2)	0.006
Education			
Primary	22(35.5)	52(61.9)	-
Secondary/ Tertiary	40(64.5)	32(38.1)	0.002
Income			
< Ksh 10000	52(83.9)	78(92.9)	0.11*
Ksh 10001- 50000	10(16.1)	6(7.1)	

* Fischer's exact test

6.2 Clinical information

Table 3 shows that most burn patients did not have chronic illness and the three with chronic illnesses had epilepsy or cerebral palsy. 19.8% had been weighed recently and none of the patients admitted with burns were on treatment with steroids or diuretics (drugs that can alter weight).

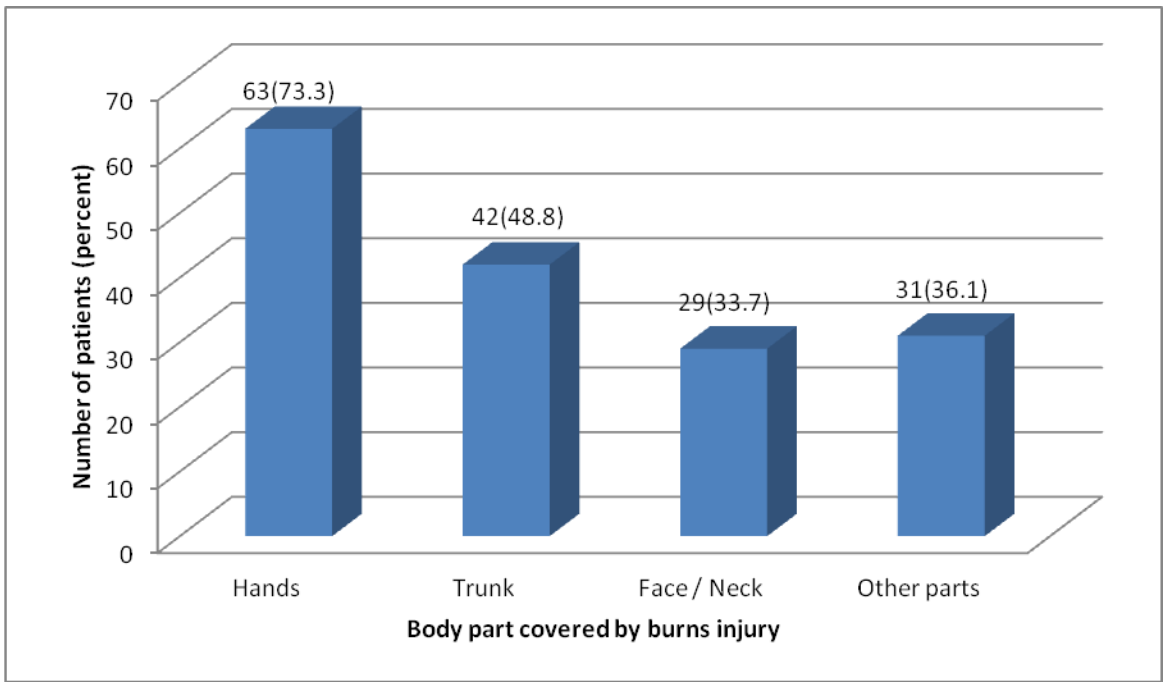
Table 3: Selected clinical information of children admitted to KNH with burn injury

Chronic illness	**Frequency (N)**	**Percent (%)**
None	83	96.5
Epilepsy	2	2.3
Rickets and mild cerebral palsy	1	1.2
Child weighed in the previous 2 weeks		
Yes	17	19.8
No	69	80.2

6.3 Burns information

Figure 3 below shows the distribution of burns according to involved body parts among children at KNH. The most commonly involved body part was the hand which was affected by burns in 73.3% of cases, followed by the trunk in 48.8% of cases and face or neck in 29 (33.7%) cases. Other parts (36.1%) included areas like the gluteal region and the lower limbs.

Figure 3: Body parts involved in burn injury among children at KNH



Further details including the etiology of burns, their severity and setting in which burn injuries occurred are presented in Table 4. The majority (95.4%) of burns injuries were caused by exposure to high temperatures (thermal). In addition, the leading burn agent was hot fluids causing 91.9% of all burns. The children who had electrical burns had touched live wires in the home and sustained relatively minor injuries. The child with chemical burns had swallowed battery acid stored in the house with injuries to the oral mucosa. Majority of the children (75.6%) had TBSA of less than 20%. Full thickness burns occurred in 33 (38.4%) of patients while the remaining 53 (61.6%) had partial thickness burns. Eighty seven percent of burns occurred in the home and 46.5% of all burns occurred within the kitchen. Other places in the home where burns occurred included the bedroom, bathroom, sitting rooms and within the home compound. The burns that were outside the home occurred near roadside food kiosks and at neighbors' houses.

Table 4: Etiology and severity of burn injuries among admissions at KNH

	Frequency (N)	Percent (%)
Cause of burns		
Thermal	82	95.4
Chemical	1	1.2
Electrical	2	2.3
Inhalational	1	1.2
Burn agent		
Hot fluids	79	91.9
Open flame/ hot object	3	3.5
Electrical	2	2.3
Inflammable agents	2	2.3
Total burn surface area		
<20%	65	75.6
>20%	21	24.4
Depth of burns		
Superficial	53	61.6
Full thickness	33	38.4
Settings of burn accidents		
Home	75	87.2
Others	11	12.8
Places in home where burns occur		
Bedroom	17	19.8
Kitchen	40	46.5
Bathroom	2	2.3
Sitting room	16	18.6
Others	2	2.3

6.4 Nutritional status of pediatric burn patients admitted at KNH

6.41 Nutritional status using anthropometric indices and MUAC

Table 5 presents the Weight-for- height Z scores of 81 pediatric burn patients in the study. The remaining 5 children were aged between 12 and 13 years and were therefore outside the WHO reference range for calculating their WHZ. The nutritional status for these five patients was assessed using MUAC presented in table 5.

The medians for WAZ and WHZ on the 3rd day were higher than those on the 14th day as shown in table 5 meaning that over the two weeks the patients lost weight but the HAZ remained the same on the two measurement occasions.

The median MUAC for all patients at day 3 was 14cm (interquartile range (IQR) of 13-15cm) while on day 14 the median MUAC was 13.5cm (IQR of 12.5-14.5cm) which was slightly lower than that of the former.

Table 5: Nutritional status of pediatric burn patients using anthropometric indices and MUAC for day 3 and day 14

	Median (day 3)	**IQR**	**Median (day 14)**	**IQR**	***P value**
WAZ	-0.07	-2.01 to -0.07	-1.72	-2.84 to -0.84	<0.001
HAZ	-0.92	-2.15 to 0.01	-0.92	-2.15 to 0.01	-
WHZ	-0.39	-1.36 to 0.38	-1.5	-2.75 to -0.17	<0.001
MUAC	14	13-15	13.5	12.5-14.5	<0.001

*wilcoxon test

Figure 4: Nutritional status of pediatric burn patients admitted at KNH using WHZ

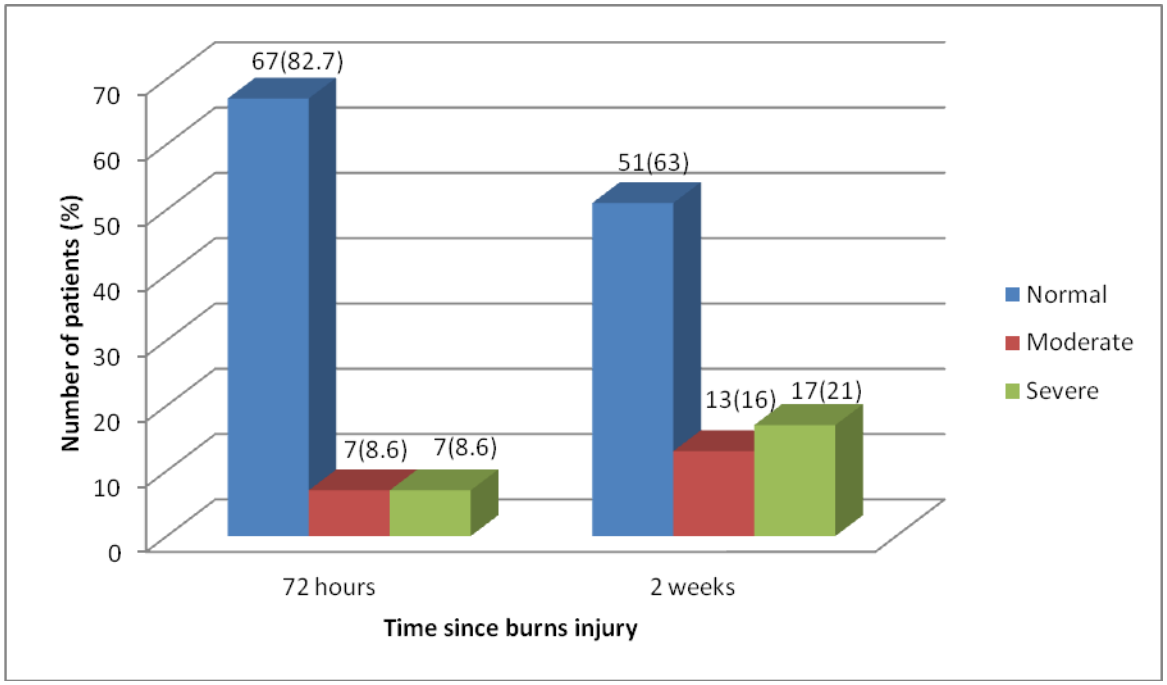
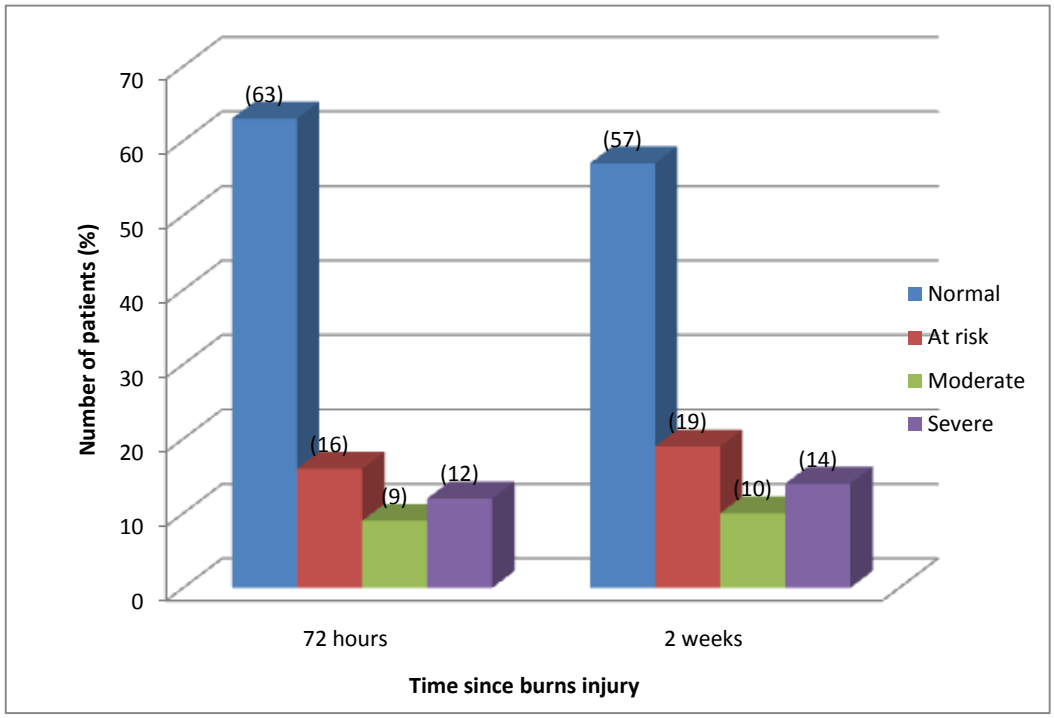


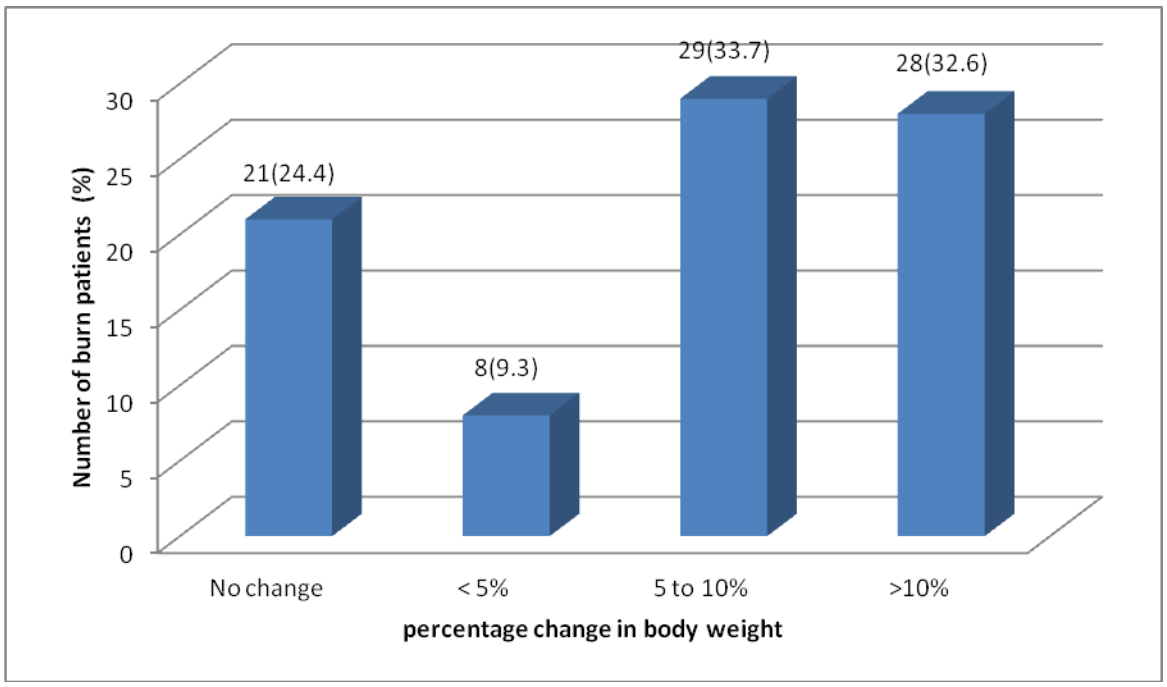
Figure 5: Nutritional status of pediatric burn patients admitted at KNH using MUAC



6.5 Patterns of weight change

A total of 65 (75.6%) patients lost weight between the two measurements. As shown in figure 6 one-third of the patients lost between 5% and 10% of total body weight between 72 hours and day 14 while 32.6% lost over 10% of body weight during the same period.

Figure 6: Distribution of weight change between day 3 and day 14 among pediatric burns patients



6.6 Factors associated with body weight change among burns patients

The factors that were tested for association with weight loss in the patients in this study are described below. The cut of 10% change in body weight was used because this is the amount of weight that burn patients can lose in the first 3 weeks without significant effect on their nutritional status[11].

6.61 Patients' demographic factors and weight loss

The age of patients was found to have a significant association with a weight loss of more than 10% (p = 0.001). The odds of losing greater than 10% of body weight following burns reduced significantly from 1.00 among children 3 to 11 months to 0.12 in children aged 24 months and above. However, gender was not associated with weight loss (p = 0.441)

Table 6: Associations between patient demographics and weight loss following burns

	Percent change in body weight			
	Less than 10%	**Greater than 10%**	**Odds ratio (95% CI)**	**P value**
Age category	N=58, (%)	N=28, (%)		
3 to 11 months	7(41.2)	10(58.8)	1.00	-
12 to 23 months	15(55.6)	12(44.4)	0.56(0.14-2.25)	0.54
>24 months	36(85.7)	6(14.3)	0.12(0.03-0.51)	0.001
Sex				
Male	28(63.6)	16(36.4)	1.00	0.441
Female	30(71.4)	12(28.6)	0.7(0.25-1.91)	

6.62 Caregiver (maternal) factors and weight loss

Maternal caregiver characteristics including income, education were not significantly associated with changes in body weight as shown in Table 7.

Table 7: Associations between maternal attributes and weight loss following burns

	Percent change in body weight			
	less than 10% N = 58	**greater than 10% N = 28**	**Total**	**P value**
Maternal education				
Primary	34(64.2)	19(35.9)	53(100)	0.59
Secondary/ Tertiary	24(72.7)	9(27.3)	33(100)	
Maternal income				
< Ksh 5000	24(72.7)	9(27.3)	33(100)	-
> Ksh 5000	14(80)	2(20)	10(100)	0.3
No income	20(57.1)	15(42.9)	35(100)	0.18

6.63 Types of burns and weight loss

As shown in Table 8 below, burn characteristics including the TBSA burnt, the depth of the burn and the part of the body part involved, showed no statistical association with changes in body weight.

Table 8: Associations between burn characteristics and weight loss following burns

	Percent change in body weight		P value
Body part involved	**less than 10% N = 58**	**greater than 10% N = 28**	
Trunk			
No	32(72.7)	12(27.3)	0.28
Yes	26(61.9)	16(38.1)	
Hands			
No	17(73.9)	6(26.1)	0.44
Yes	41(65.1)	22(34.9)	
Face/ neck			
No	38(66.7)	19(33.3)	0.83
Yes	20(69)	9(31)	
TBSA			
< 20 %	45(69.2)	20(30.8)	1.00
20% and above	18(69.2)	8(30.8)	
Depth			
Superficial	37(69.8)	16(30.2)	0.55
Full thickness	21(63.6)	12(36.4)	

6.64 Preadmission nutritional status and weight loss

As shown in Table 9, WAZ and WHZ scores at 72 hours were not significantly associated with changes in body weight on day 14. The MUAC measure at 72 hours was significantly associated with day 14 changes in body weight ($p = 0.038$). Only 22.2% of patients with normal MUAC lost >10% of body weight compared to 42.9%, 62.5% and 50% of patients with classifications of “at risk”, moderate and severe malnutrition.

Table 9: Associations between pre burn nutritional status and weight loss following burns

	Percent change in body weight			**P value**
	less than 10%	**greater than 10%**	**Odds ratio (95%CI)**	
MUAC				
Normal (>13.5 cm)	42(77.8)	12(22.2)	1.00	-
At risk (12.5-13.4 cm)	8(57.1)	6(42.9)	2.6(0.6-10.6)	0.12
Moderately malnourished (11.5-12.4 cm)	3(37.5)	5(62.5)	5.8(0.9-41.6)	0.03
Severely malnourished (<11.5 cm)	5(50)	5(50)	3.5(0.7-17.7)	0.07
WAZ				
Normal (Z > -2)	46(71.9)	18(28.1)	1.00	-
Moderate (Z = -3 to -2)	8(53.3)	7(46.7)	2.2(0.6-8.2)	0.17
Severe (Z ≤ -3)	4(57.1)	3(42.9)	1.9(0.3-12.5)	0.42
WHZ				
Normal (Z > -2)	44(65.7)	23(34.3)	1.00	-
Moderate (Z = -3 to -2)	4(57.1)	3(42.9)	1.4(0.2-9.2)	0.69
Severe (Z ≤ -3)	5(71.4)	2(28.6)	0.8(0.1-5.1)	1.00

6.7 FEEDING PRACTICE IN THE UNIT

Most of the patients in the study were fed within the first 24 hours after admission with the enteral route used in 95% of the cases. All the patients did not have nutritional prescriptions and only 9.3% of them had micronutrients supplemented. 73% of the patients had caregivers in the ward and would assist in feeding of the children.

Table 10: General characteristics about the feeding practice in the unit

	Frequency (N)	Percent (%)
Duration before first feeding		
<24hrs	67	77.9
24-72hr	16	18.6
>72hr	3	3.5
Routes used for feeding		
Enteral	82	95.4
Parenteral	2	2.3
Both	2	2.3
Nutritional prescription available		
No	86	100.0
Micronutrients prescribed		
Yes	8	9.3
No	78	90.7
Caregiver available to feed child		
Yes	63	73.3
No	23	26.7

A subsample of 22 pediatric burn patients was included in a survey to determine feeding practices in the unit and to determine the adequacy of the diets in the unit. Food intake questionnaires were used to get the number of meals and snacks given to the children and then they were used to calculate the estimated food intakes in terms of calories and proteins. Nine (40.9%) of these patients were breastfeeding. Majority of the patients (96%) had at least 3 meals per day, but only 23% had at least 2 snacks in a day. Majority of the patients had their diets mainly from hospital food as shown in table 11. The calorie intakes of most patients were below 70% of the expected intake and the protein intake was below 70% of intake in 91% patients as shown on table 12.

Table 11: Dietary intake of pediatric burns patients based on 24 hour food intake recall

	Frequency	**Percent**
Children below 3 years		
Breast feeding	9	40.9
Breast feeding frequency		
• 4 to 7 times daily	8	88.9
• At least 4 hourly	1	11.1
Complementary feeding	9	40.9
All children		
At least 3 meals a day	21	95.5
At least 2 snacks a day	5	22.7
Main source of food		
• Hospital food	16	72.7
• Home food	3	13.6
• Both	3	13.6

Table 12: Summary of calorie and protein intakes of pediatric burn patients from the 24 hour food intake recall

% Expected daily intake	**Calorie intake**	**Protein intake**
< 20%	0	1(4.6)
20-50%	10(50)	14(63.6)
50-70%	4(20)	5(22.7)
>70%	6(30)	2(9.1)

As shown in Table 13 below, the average daily intake of calories and proteins (863.7kcal and 23.8gm respectively) were significantly lower that the daily requirements of 1579.8kcal and 64.1gm respectively.

Table 13: Comparison of estimated daily requirements and daily intake of pediatric burn patients at KNH

	Daily requirement	Estimated daily intake	Deficit	P value*
Energy(kcal)	1579.8	863.7	716.1	< 0.001
Protein(grams)	64.1	23.8	40.3	< 0.001

*Paired t-test

6.61 Feeding complications

Feeding complications were rarely reported. None of the patients had known food allergies. Caretakers reported that 4 (18.2%) patients vomited after feeding while only two children had at least one episode of diarrhea during the current hospitalization.

6.62 Caregivers' views on the feeding practice

Out of the 22 respondents, 21 reported that the quantities of food offered in the ward were adequate. Nine caretakers described the appetite of their child's as good, 11 as fair and 2 as poor. Approximately two-thirds (68.2%) of caretakers reported that food in the ward was well prepared. 15 (68.2%) caretakers supervised their children during feeding time.

7.0 DISCUSSION

The nutritional status of burn patients affects their outcome in terms of wound recovery, morbidity and mortality. In this study, we found that approximately one out five pediatric burn patients had a deterioration of their nutritional status when assessed using the WHZ over the two weeks following burn injury.

Patients recruited into the study were between the ages of 3months and 13years and of these, 81% were children below the age of 5years. Asha et al conducted a study on the profile of pediatric burn patients admitted to the Red Cross Children's' hospital (South Africa) and found that their commonest age groups for pediatric burns were the infants and toddlers[30]. In other literature, the peak age for burns in children has been between 1-4 years and this susceptibility is explained by their explorative nature, inability to comprehend the dangers of their actions and their acquired motor skills[1,13,14]. The male to female ratio of the patients recruited was 1:1 which differs from the South African profile where the boys were more affected than girls with a ratio of 1.5: 1[30]. In other African literature, more boys than girls are burned with a ratio of about 2:1 and this is because they are thought to be more explorative and thus puts them at risk for burns. The clinical information obtained revealed that, majority of the patients did not have any chronic illnesses and thus were likely to have been fairly healthy before the burns. This was relevant to this study because chronic illnesses or certain drugs used to treat them may influence the nutritional status of these patients. Only about 20% of the children had had a pre morbid assessment of their nutritional status and thus to overcome this limitation the anthropometric measurements on day 3 post admission were used to estimate the pre burn nutritional status.

In South Africa, the commonest cause of pediatric burns were hot fluids (83%) followed by flame burns (15%) and then electric burns (1.7%). A similar pattern was seen in our study where most of the burns were thermal with those by hot fluids being about 92%, open flames (3.5%) and electrical (2.3%). Majority of the burns occurred within the home around the kitchen area. This may imply that parental or caregiver education programs should prioritize safety in the home. Hands are usually common sites of burns in children and this was also demonstrated in this study where 73% of all burn sites were the hands; and the trunk and face/neck being 49% and 34% respectively. Burns around the face and neck and hands were of particular interest to the researcher because of their potential to interfere with food intake. Asha et al also in their profile of patients found a fairly similar pattern with burns around the hands and upper limbs being the commonest, followed by the face and trunk[30]. Majority of the patients in this study (75%) had

TBSA burnt of < 20% and about 60% had partial thickness burns which mean that their injuries were of moderate severity.

The nutritional status of pediatric burn patients on the 3rd day post admission using the WHZ and MUAC showed that about 83% and 63% had normal nutritional status respectively while with a follow up assessment on day 14 post admission, the number of children with normal nutritional status using the WHZ and MUAC decreased to 63% and 57% respectively. These results show that there was a significant deterioration in the nutritional status of the patients admitted to the unit. About 33% of these patients lost more than 10% of their pre morbid weight which is an indicator of very rapid weight loss. There are limited studies on the nutritional status of pediatric burn patients but a study by Bell et al examined weight change in 42 adult and pediatric burn patients and found that 83% of the patients had weight loss within 10% of their pre morbid weight[31]. Our findings suggest that pediatric burn patients are at risk of under nutrition and this poses a challenge to their requirements for growth, wound healing and increases their susceptibility to infection.

The factors that were analyzed to test for their association with weight loss in this study included: age, gender, pre burn nutritional status, TBSA burnt, depth and site of the burns. Of these, only age and pre burn nutritional status assessed using MUAC showed a significant association. Bell et al also made an observation that age, percent initial burn size and pre burn weight were the factors associated with the weight change[31]. In this study, younger age predisposed children to increased risk of weight loss and this may have been because, smaller children have limited nutritional reserves which when coupled with the high energy demands of the burns result in deficiency earlier. MUAC is a quick, cheap, safe, and easy to interpret anthropometric measurement and in this study, it showed the ability to predict children to be at risk of rapid weight loss. It would therefore be recommended by the researcher as a basic screening and follow up tool for the nutritional status of pediatric burn patients in our unit.

A study by Jescheke et al found that female burned patients exert an attenuated inflammatory and hyper metabolic response compared with males and this decrease was reflected in improved muscle protein net balance and preservation of lean body mass[28]. However in this study there was no significant association between gender and weight loss. This is probably because the former used indirect calorimetry to measure energy requirements and dual x-ray absorptiometry to estimate body composition and these are more direct techniques of nutritional assessment than anthropometry. Maternal characteristics especially education level (KDHS

2008-09)[29] has been shown to have a positive influence on the nutritional status of children but in this study, maternal education level and income showed no significant association with the patients' weight loss. This could be explained by the short duration in which the study was conducted and that the patients were in a relatively controlled environment in the ward. The TBSA burnt is directly proportional to the severity of the hyper metabolic response which would mean that the bigger the surface area the higher the weight loss. In this study, the TBSA burnt showed no significant association with weight decline and this was probably due to the fact that majority of the patients had TBSA burnt of less than 20% which were of mild to moderate severity. Similarly, most of the patients had partial burns and therefore showed no significant association with weight loss. Interestingly, the site of the burn also did not alter the pattern of weight loss. About 73 % of the children had caregivers present with them in the ward and they may have assisted with the feeding of the patients.

We made direct observations and a 24 hour food intake recall to determine the feeding practice in the unit. Majority of the children had been fed with in the first 24 hours post admission and enteral feeding was the commonest route used. These are both positive factors since early enteral feeding within six hours of injury has been shown to help modulate the hyper metabolic response[21]. However gaps were noted in that none of the patients admitted to the unit had a nutritional prescription and only about 9% had micronutrients supplemented. Nutritional prescriptions are important in estimating the energy and protein needs of patients and ensuring a plan of how to administer them is made. In this study, using the 24 hour food intake recall, estimates of the daily intake of energy and proteins were calculated. It revealed that average daily intakes of energy and protein for these patients were significantly lower than the expected requirements ($p < 0.001$). This indicates that the diets provided to our pediatric burn patients are grossly inadequate.

The strengths of this study include the use of simple and relatively easy techniques to monitor the nutritional status of pediatric burn patients which can therefore be applicable in plastic surgical units or burn wards even in low resource settings (that is settings with few staff and minimal equipment). We also used objective measurements of weight and height which were well calibrated.

The major weaknesses of this study were mainly the short duration in which it was conducted and that it would have been interesting to compare anthropometry with other direct techniques for measuring energy and protein requirement like indirect calorimetry and dual x-ray

absorptiometry. However these techniques are not widely available in our setting and therefore would only be ideal for research purposes.

CONCLUSION

- Burn injury was associated with deterioration in nutritional status of patients admitted to the plastic surgical unit with an incidence of moderate and severe malnutrition being at 20% within the two weeks following burn injury using WHZ scores.

- About a third of the patients lost more than 10% of their weight in two weeks which reflects a very rapid weight loss compared to what is expected in pediatric burn injury.

- Age and pre burn nutritional status using MUAC are the factors that were shown to have a significant association with deterioration in nutritional status in pediatric burn patients.

RECOMMENDATIONS

- Pediatric burn patients should have their anthropometric measurements followed up while in the ward so that deterioration in nutritional status is detected early and appropriate nutritional support offered.

- Infants and children with abnormal MUAC at admission should be monitored closely for deterioration in nutritional status.

- Nutrition prescriptions for all patients indicating the expected caloric and protein intakes for each individual child should be done at admission and reviewed regularly with the changes in anthropometric indices.

STUDY LIMITATIONS

- There may be influence on the other sources of food other than hospital diet.
- The feeding pattern in the unit was not standardized for the study population.
- The validity of the study may be affected by non random sampling at recruitment.
- The sample size was modest.

REFERENCES

1. Kliegman R, Behrman R, Jenson H et al. Nelson's textbook of Pediatrics. 18th ed. India: Saunders: An imprint of Elsevier; 2007

2. Abatanga FA, Mock CN. Pediatric Surgery: A Compressive text for Africa. Chapter 25, Epidemiology, Prevention and Control; p157- 63

3. Sanne V, Manon V, Luise M et al. An evaluation of nutritional practice in a pediatric burns unit. S Afr Med J 2010; 100: p383- 88

4. Keys AJ, Brozek J, Henschel O et al. The biology of human starvation. Minneapolis, MN: University of Minnesota Press, 1950:p140- 60

5. Arora NS, Rochesner DF. Respiratory muscle strength and maximal voluntary ventilation in undernourished patients. Am Rev Respir Dis 1982;126;p5-8

6. Heynsfield SB, Bethel RA, Ansley JD et al. Cardiac abnormalities in cachetic patients before and during nutritional repletion. Am Heart J 1978; 95: p584-94

7. Reilly JJ, Hull SF, Albert N et al. Economic impact of malnutrition: A model system for hospitalised patients. J Parenter Enteral Nutr 1988;12: p372-6

8. Nyandiko M. Deteriorating nutritional status of patients admitted to Kenyatta National Hospital: magnitude and consequences [MMED thesis]. University of Nairobi: 2000

9. Pennington C, McWhriter R. Incidence and recognition of malnutrition in hospital. BMJ (England). 1994 Apr; 308: p945-48

10. Roldan Avina, Perez CP. Malnutrition in hospitalized patients: A Randomized, prospective study. Hospital Nutrition, July- Aug 1995 10(4) p192-8

11. Nthumba PM, Fabia R. Pediatric Surgery: A Compressive text for Africa. Chapter 33, Burns; p 214- 21

12. Review of Nutritional management of burn patient. S Afr J Clin Nutrition; 2009; 22(1): 09-15

13. Forjuoh SN, Keyl PM, Diener- West M et al. Prevalence and age specific incidence of burns in Ghanian children. J Trop Pediatr; 1995;p41

14. Kalayi GD. Burn injuries in Zaria: 1 year retrospective study; East Afr Med J; 1997; 71: p317- 21

15. Nthumba PM, Oliech JS. Outcome of moderate and severe thermal burns at Kenyatta National Hospital. East and Central African journal of surgery; 2005; 10(2): p37-42

16. Gome DL, Mutiso VM, Kimende K. Pediatric trauma cases at Kenyatta National hospital; East and Central African journal of surgery; 2005; 10(2): p33-6

17. Allorto NL, Oosthuizen GV, Carke DL et al. Spectrum and outcome of burns at a regional hospital in South Africa. Burns; 2009; 35(7): p1004-8

18. Justin- Temu, Rimoy G, Premji Z et al. Causes, magnitude and management of burns in under-fives in district hospitals in Dar es Salaam, Tanzania. East Afr J Public Health; 2008; 5(1): p39- 42

19. Parbhoo A, Louw QA, Grimmer- Somers K. A profile of hospital- admitted pediatric burns patients in South Africa. BMC Res Notes; 2010; 11(3): p165

20. Baytieh L, Carr- Thompson A, Maclennan P et al. Nutrition and dietetics- Principles and guidelines for Adult and Pediatric burn patient management; review date: Dec 2004: p40-56

21. Mark DJ. Emergency care of moderate and severe thermal burns in children; In Up to date for Clinicians.17.3; 2009

22. Nutritional management guidelines: A manual by Kenyatta National Hospital Nutrition and Dietetics Department 2002. Section IX, Nutritional support for burn patients: p89

23. Helen McCarthy, Gurry C. A pocket guide to Clinical nutrition. Chapter 25, Burns: p496- 03

24. Cunningham JJ, Lydon MK, Emerson R et al. Low ceruloplasmin levels during recovery from major burn injury: influence of open wound size and copper supplementation. Nutrition; 1996; 12(2):p83-8

25. Ward CG, Bullen JJ, Rogers HJ. Iron and infective: New developments and their implications. J Trauma; 1996; 41(2): p356-64

26. Uba AF, Edino ST, Yakubu AA. Pediatric burns: management problems in a teaching hospital in North Western Nigeria. Trop Doct; 2007; 37(2):p114-5

27. Dylewski ML, Prelack K, Weber JM et al. Malnutrition among pediatric burn patients: A consequence of delayed admissions. Burns; 2010; 36(8): p1185-9

28. Jeschke MG, Mlcak RP, Finnerty CC et al. Gender differences in pediatric burn patients: Does it make a difference? Annals of Surgery: July 2008-Vol 248- Issue 1: p126-36

29. Kenya Demographic and Health Survey (2008-09). Chapter 11, Nutrition of women and children: p141-60

30. Asha P, Quinette AL, Karen GS. A profile of hospital – admitted pediatric burns patients in South Africa. BMC Research Notes 2010, 3:165

31. Bell SJ, Molnar JA, Krasker WS, et al. Weight maintenance in pediatric burned patients. Am Diet Assoc.1986 Feb; 86(2): 207-11

APPENDICES

Appendix 1: QUESTIONAIRE

TITLE: ASSESSMENT OF THE NUTRITIONAL STATUS OF PAEDIATRIC BURN PATIENTS ADMITTED AT KNH

RESEARCHER: DR DOREEN K MUTUA

SERIAL NO…… **DATE OF ADMISION ……../……../……..**

PART 1: PATIENT'S DETAILS

1. Age (year(s) / month(s): ……../……..

2. Gender: 1.male 2.female ☐

3. Where do you live?.....

4. Who is/ are your primary caregiver(s) ☐

1. Father (Go to Q5) 2.Mother (go to Q6)

3. Both mother and father (go to Q5 &6) 4.Other (go to Q7)

PART 2: PARENTS/ CAREGIVER'S DETAILS

5. Father:

a) **What is your occupation?** ☐
   1.Unemployed 2.Casual 3.Formal employment 4.Professional
b) **What is your educational level?** ☐
   1.None 2.Primary 3.Secondary 4.Tertiary
c) **What is your average income per month (in Ksh)** ☐
   1.< Ksh 5000 2.Ksh 5001-10000 3. Ksh 10001- 50000 4. Ksh > 50000

6. Mother:

a) **What is your occupation?** ☐
   1.Unemployed 2.Casual 3.Formal employment 4.Professional
b) **What is your educational level?** ☐
   1.None 2.Primary 3.Secondary 4.Tertiary
c) **What is your average income per month (in Ksh)** ☐
   1.< Ksh 5000 2.Ksh 5001-10000 3. Ksh 10001- 50000 4. Ksh > 50000

7. Other:

a) **What is your relation with the patient?**
1. Aunt 2. Uncle 3. Grandparent 4. Adopted ☐

b) **What is your occupation?**
1. Unemployed 2.Casual 3.Formal employment 4.Professional ☐

c) **What is your educational level?**
1. None 2.Primary 3.Secondary 4.Tertiary ☐

d) **What is your average income per month (in Ksh**)
1. < Ksh 5000 2.Ksh 5001-10000 3. Ksh 10001- 50000 4. Ksh > 50000 ☐

PART 3: CLINICAL STATUS AT ADMISSION

8. Does your child have any chronic illness? 1. Yes 2. No ☐

If yes, specify

……

9. Has your child been weighed within the last 2 weeks? 1. Yes 2. No ☐

If yes, please indicate the weight in kg: ……..

10. Please indicate if the child is on the following medication(s)? (Also look in to treatment sheet)

1. Steroids 2. Diuretics ☐

PART 4: BURN DETAILS

11. What was the cause of the burn? 1. Thermal 2. Chemical 3. Electrical 4. Inhalational ☐

12. What was the agent of the burn? …….

13. What is the depth of the burn? 1. Superficial 2.Full thickness ☐

14. What is the total burn surface area (%, use Lund and Browder chart)?

1. <10% 2. 10- 20 % 3. 20- 40 % 4. > 40% ☐

15. What parts of the body are involved in the burn? :

Face/ neck ☐ Hands ☐ Trunk ☐ Others ☐

16. Where did the burns occur?

1. Home (go to Q17) 2. School 3. Others ☐

17. If at home, in which room did the burn occur? ☐

1. Bedroom 2. Kitchen 3. Bathroom 3. Sitting room 4. Others

PART 5: NUTRITION DETAILS

18. When was the first feed given after admission? :

1. <24hrs 2. 24-72hr 3. >72hr ☐

19. What are the route(s) of feeding used?

1. Enteral 2. Parenteral 3. Both ☐

20. Is there a nutrition prescription? 1. Yes 2. No ☐

21. Are micronutrients supplemented? 1. Yes 2. No ☐

22. Is there a caregiver helping to feed the child? 1. Yes 2. No ☐

23. Is there bilateral pedal edema?

a) At 72hrs 1. Yes 2. No ☐

b) At 14 days 1. Yes 2. No ☐

MEASUREMENT	**AT 72 HRS**			**AT 14 DAYS**		
WEIGHT (KG)	W1	W2	AVERAGE	W1	W2	AVERAGE
HEIGHT (CM)	HT1	HT2	AVERAGE	HT1	HT2	AVERAGE
MUAC (CM)						

Appendix 2: Food intake questionnaire

To be answered by parent or guardian (for children below 5years) or a child above 6years

SERIAL NO……. **Age (years/months)** ……/…….

PART A: FOR CHILDREN BELOW 3YEARS

1. Is your child still breastfeeding? 1. Yes 2. No ☐

2. If yes, how often did your child breastfeed yesterday? ……

3. Is your child on complementary feeds? 1. Yes 2. No ☐

4. If yes, at what age was your child weaned? .....

PART B: FOR ALL CHILDREN

5. How many meals did your child eat yesterday? ……

6. How many snacks did your child eat yesterday? .....

7. What is the main source of your child's diet in the ward? 1. Hospital 2. Home 3. Other ☐

8. Describe the foods and quantities eaten by your child yesterday (indicate method of preparation)?

- Breakfast……
- Lunch ……
- Supper ……..
- Snacks: mid morning……..mid afternoon……

9. Are the quantities of food offered in the ward adequate? 1. Yes 2. No ☐

10. How would you currently describe the appetite of your child at most times? ☐

1. Good 2. Fair 3. Poor

11. Is the food in the ward well prepared? 1. Yes 2. No ☐

12. If no, what improvements would you like to see?.....

.....

13. **How much milk did your child take yesterday (estimate in mls))**? .....

14. Is there anyone who supervises your child's feeding? 1. Yes 2. No ☐

15. If yes, specify who? .....

PART C: COMPLICATIONS OF FEEDING

16. How many episodes of diarrhea has your child had while in the ward?.....

17. Does your child vomit after feeding? 1. Yes 2. No ☐

18. If yes, specify number of times.....

19. Does your child have any food allergies? 1. Yes 2. No ☐

20. If yes, specify .....

PART D: TO BE FILLED BY RESEARCHER

21. Estimated energy intake (in Kcal) for that day (to be calculated from Q8).....

.....

22. Record required energy intake for this patient using the KNH protocol.....

23. Assess protein intake (to be calculated using Q8).....

24. Record protein intake (KNH protocol)

25. Is the intake of these macronutrients adequate? 1. Yes 2. No ☐

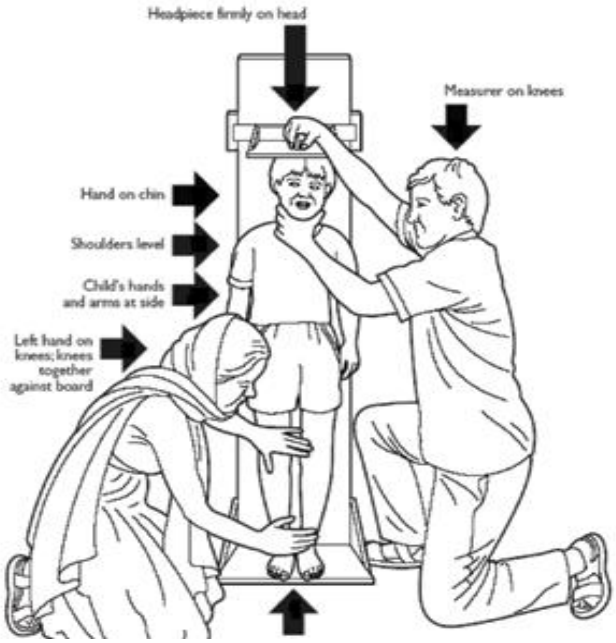
Appendix 3: Height measurement

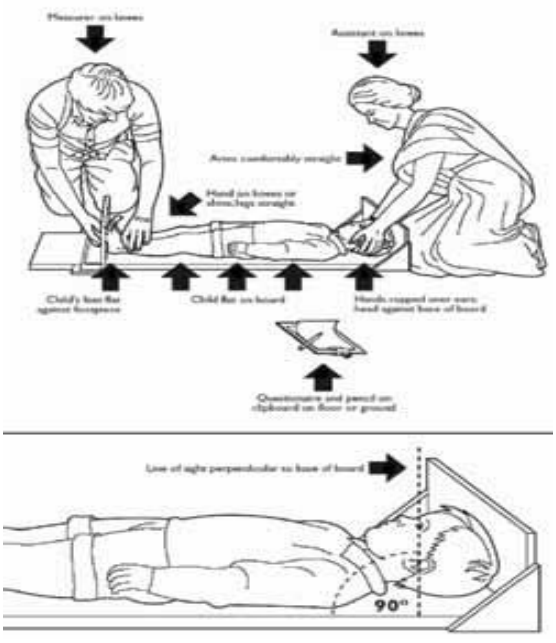
Measuring board was used. For children less than two years and those above and unable to stand, length was taken.

- Measuring board was put flat on the floor.
- The child was gently placed on the board and made to lie straight looking directly up.
- The soles of the feet were made to lie flat against the fixed vertical bar.
- The assistant on his/her knees holds the feet firmly against the fixed bar and placed one hand on the child's knees.
- The measurer moved the sliding bar gently against the crown of the head.
- The measurer read out loudly the reading at the base of sliding bar to the nearest 0.1cm.
- Since length is 0.5cm more than height due to gravity effect, 0.5 cm was subtracted from all lengths before recording.

For children two years and above and able to stand, a height was taken.

- Measuring board was placed vertically up.
- The child stood on the fixed flat surface of the board.
- The sliding bar was lowered gently against the crown of the head.
- The measurer read out loudly the correct measurement to the nearest 0.1cm





Appendix 4: Weight measurement

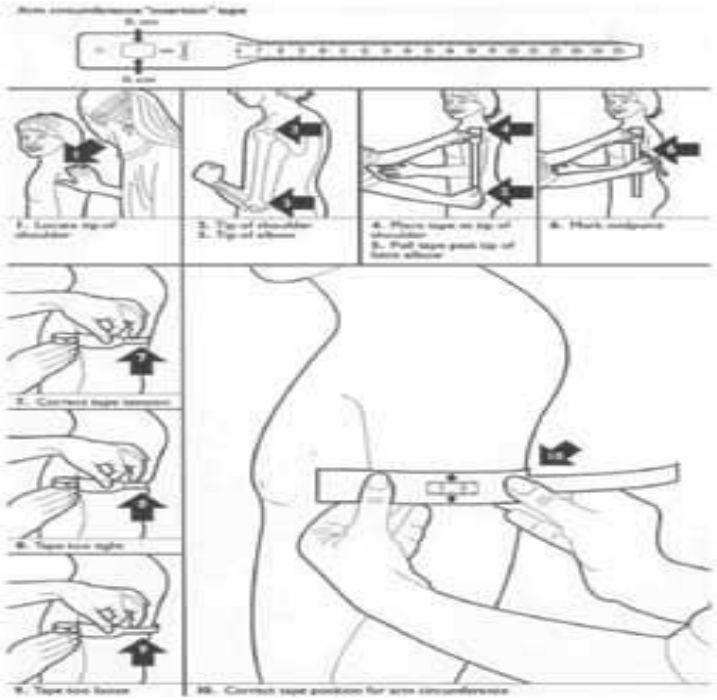
- A bathroom weighing scale was used.
- Calibration to zero was done every day and checking against 10kg weight.
- A child stood on the scale and the measurement taken.
- The measurer made the reading perpendicular to the pointer to the nearest 0.1 kg and announced loudly.
- The guardian was weighed holding the child who was unable to stand and his/her weight subtracted from the total weight to get the child's true weight.
- Two readings were made and an average of the two taken.

Appendix 5: MUAC measurement

- An arm circumference tape was be used**.**
- A child sits on a stool or stands upright with the left arm dropped down and flexed at right angle at the elbow.
- The shoulder tip (acromion) and elbow tip (radial tuberosity) are identified
- The tape is placed from the tip of the shoulder to the elbow and the length noted and the midpoint thereby determined and marked.
- The arm circumference tape is applied round the arm at the marked point.
- The reading is made and recorded in millimeters.

Interpretation of results was done according to the WHO classification follows:

- **<**11.5 cm…….severely malnourished
- 11.5-12.4 cm……..moderately malnourished
- 12.5-13.4 cm……..At risk
- >13.5 cm ……..Normal



Appendix 6: Consent form

Title: THE NUTRITIONAL STATUS OF PEDIATRIC BURN PATIENTS HOSPITALISED AT KNH USING ANTHROPOMETRIC MEASUREMENTS

Investigator: Dr Doreen Karimi Mutua (Department of Pediatrics and Child Health, University of Nairobi(UoN), tessmutua@gmail.com, MobileNo. 0722384218)

Supervisors: **Dr D. Wamalwa** (Senior lecturer, Dept. of Pediatrics and Child health, UoN), **Dr A. Bashir** (lecturer, Dept. of Pediatrics and Child health, UoN), **Dr K. Wanjeri** (Lecturer, Dept. of Surgery, UoN), **Mrs Lina Njoroge** (Consultant nutritionist, KNH)

Aim: I will be conducting a study to determine the effect of burn injury on the nutritional status and the factors associated with malnutrition in children admitted to the Plastic surgical unit at Kenyatta National Hospital.

Procedure: I will recruit patients whom the parents give consent and meet my inclusion criteria (below 14years) and do not have any excluding factors (critically ill, ventilator support, TBSA >80%). I will administer a questionnaire to the care giver so that I can obtain details of the patient and the burn injury. I will take your child's weight, height/length and mid upper arm circumference on the 3rd and 14th day after admission. I will then describe the changes noted in these measurements and the factors that are likely to be associated with them. I will also administer a food intake questionnaire to some of the patients to evaluate the feeding practice in this unit.

Benefits: Participating in this study will help improve the feeding practice of the children admitted with burns and for the basis for establishing surveillance mechanisms for monitoring the nutritional status of these patients.

Risks: These measurements will cause no pain or added risks to your child. I will minimize disturbance to your child by taking my measurements in the morning when the ward procedures are being done.

Confidentiality: I will not include the names of your child in my questionnaire. I will store the information gathered coded in my computer which will be kept under lock and Key. I will only use this information for the purposes of my study and to accord treatment to any child who develops malnutrition.

Reassurance: The management of your child will in no way be affected by your decision to decline or participate in this study.

Ethical consideration: I have been granted approval from the Ethical committee to conduct the study. Inquiries on ethical concerns can be forwarded to:

Prof A N Guantai,

Secretary, KNH/UON-ERC,

Kenyatta National Hospital

Hospital Rd, along Ngong Rd.

P.O.Box 20723, Nairobi

Tel: 726300-9

Fax: 725272

Email: KNHplan@Ken.Healthnet.org

To indicate that you understand the conditions of this study and that you consent to participate in it, please sign or put your thumbprint in the space provided below.

I ……. confirm that the study has fully been explained to me and I give consent to participate in it.

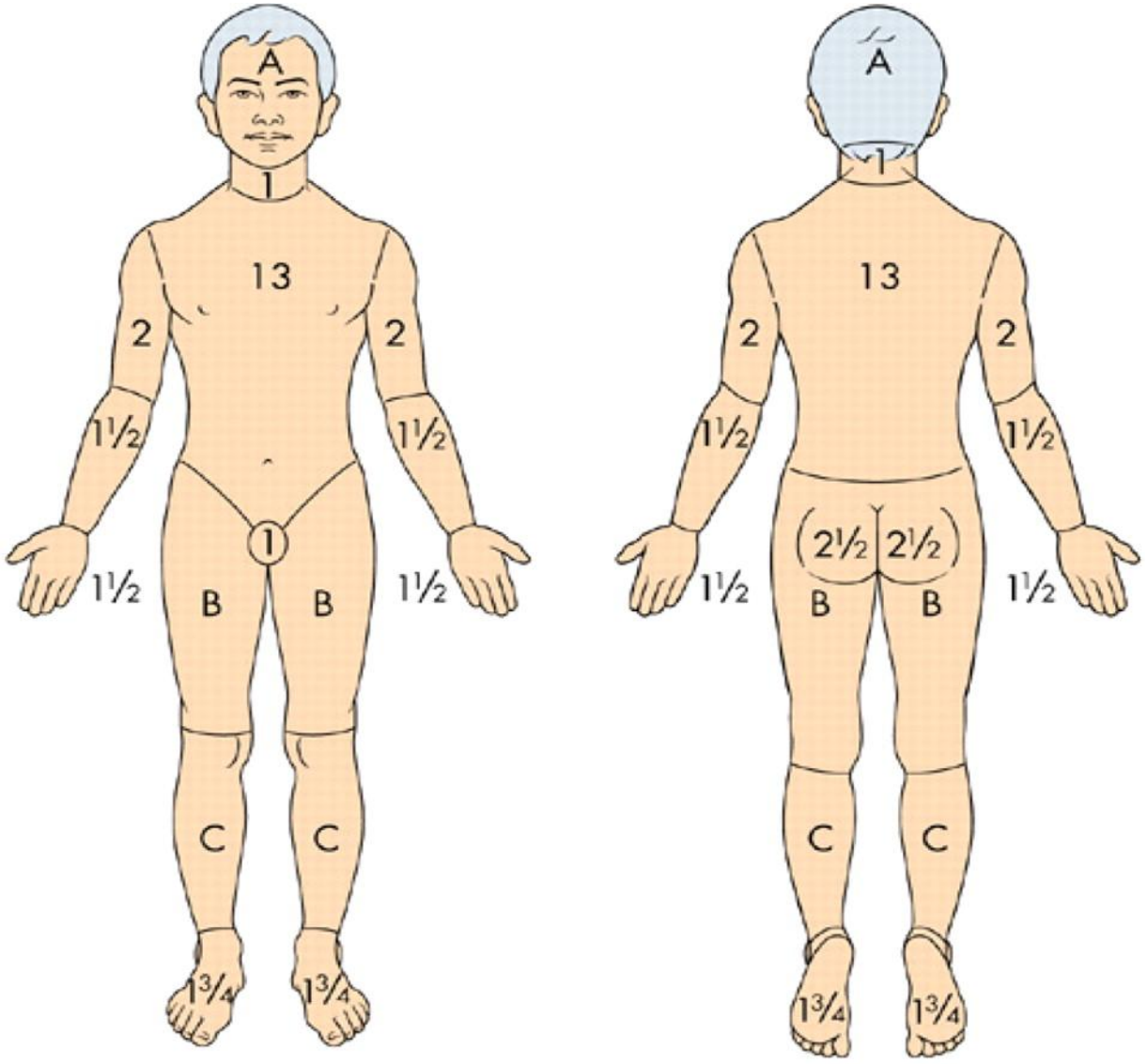
Signature/Thumb print ……

Date: …….

Investigators Signature ……

Date .....

Appendix 7: Lund and Browder Chart



	Age in years				
Area in diagram	0	1	5	10	15
A = ½ of head	9½	8½	6½	5½	4½
B = ½ of one thigh	2¾	3¼	4	4¼	4¼
C = ½ of one lower leg	2½	2½	2¾	3	3¼

Appendix 8: KNH-UON Ethical approval Letter (scanned copy)

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along, Ngong Rd.
P.O. Box 20723, Nairobi.
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP", Nairobi.
Email: KNHplan@Ken.Healthnet.org

Ref: KNH-ERC/ A/152

30th June 2011

Dr. Doreen Karimi Mutua
Dept. of Paediatrics & Child Health
School of Medicine
University of Nairobi

Dear Dr. Mutua

Research Proposal: "The nutritional status of pediatric burn patients hospitalized at Kenyatta National Hospital using anthropometric measurement" (P101/03/2011)

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and **approved** your above revised research proposal . The approval periods are 30th June 2011 29th June 2012.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

On behalf of the Committee, I wish you a fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely

PROF A N GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The Chairman, Dept. of Paediatrics & Child Health, UON
The HOD, Records, KNH
Supervisors: Dr.Dalton Wamalwa, Ezekiel, Dept.of Paediatrics & Child Health, UON
Dr. Admani Bashir, Dept.of Paediatrics &Child Health, UON
Dr. Kimani Wanjeri, Dept. of Paediatrics & Child Health, UON
Mrs. Lina Njoroge, Dept. of Nutrition, KNH