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Nutritional intake in acute care surgery patients in Kigali, Rwanda- A single institution descriptive analysis

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ABSTRACT

INTRODUCTION: Nutrition is essential for health and healing, especially in the perioperative period. However, little is known about the nutritional intake of hospitalized patients in low and middle-income countries.
This paper aimed to characterize the composition and quantity of food in acute care surgery patients at a tertiary referral hospital in Rwanda.
METHODS: Acute care surgery patients were queried about nutritional intake during hospitalization from May 21, 2018, to June 3, 2018, for 100 patient days. Calorie and protein intake were estimated and compared to standards for an average Rwandan adult.
RESULTS: Median daily calorie intake was 1472 kcal/day (Interquartile range (IQR): 662, 2116). The median daily protein intake was 45.99 g (IQR: 24.38, 70.22). Assuming a calorie need of 25 kcal/kg/day and a protein need of 1g/kg/day, this is 98.1% of the estimated daily calorie needs and 76.7% of estimated daily protein needs. Estimating higher energy needs for a surgical patient, the daily intake is 70.0-81.9% of calorie needs and 51.1-63.9% of protein needs.
CONCLUSION: Overall, the calorie and protein intake for the average Rwandan acute care surgery patient were low compared to the needs of a 60 kg surgical patient. More education and accessibility to high-quality foods are needed to ensure adequate nutrition in the postoperative period to optimize clinical outcomes.

Keywords: General Surgery, Nutrition Therapy, Energy Intake, Proteins, Acute Care Surgery, Emergency

INTRODUCTION

Adequate nutrition is vital for recovery from major surgery or critical illness [1]. General surgery patients are especially at risk for malnutrition due to the need for bowel recovery, potential for decreased absorptive capability, or nil per os status [1]. Critical illness and perioperative wound healing both promote a catabolic and inflammatory state, resulting in increased energy and protein demands [2]. Malnourished surgical patients incur higher costs and increased length of stay for patients, hospitals, and healthcare systems [3]. In under-resourced regions of the

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world, nutrition can become one of the major complicating factors in patients recovering from surgery [3]. Current research highlights the need to survey and understand the nutritional needs of hospitalized patients [3, 4]. For example, in a recent 2019 observational study of perioperative Malawian patients who underwent laparotomy, 80% of patients were moderately or severely malnourished and had associated poor outcomes [5].

Rwanda is a mountainous low-income country in the Great Rift Valley of East Africa with a population of approximately 12.4 million [6]. Approximately 38% of the population lives below the poverty line [6]. It is estimated that 44% of Rwandan children experience stunting as a result of undernutrition [7]. In addition, prior studies have shown malnutrition on hospital admission in 35% of Rwandan acute care surgery patients [8].

The study was conducted at Kigali University Teaching Hospital (Centre Hopitalier Universitaire de Kigali, C.H.U.K.), a teaching and tertiary care facility in Rwanda's capital of Kigali. The hospital has 565 beds, of which 48 are general surgery inpatient beds, and approximately 140 general surgery operations occur each month [8]. Nearly three-quarters of the general surgery procedures are classified as urgent or emergent [9, 10]. The acute care surgery (A.C.S.) service manages all urgent and emergent general surgery patients, including both trauma and non-trauma conditions [11]. Families and caretakers provided most food. There is a restaurant on the hospital grounds where patients can purchase food. Food is also occasionally provided in the ward from charitable organizations, though there is no set schedule. This study aimed to describe the composition and quantity of nutrition in patients on the A.C.S. service at C.H.U.K.

METHODS

Patients and caretakers admitted to the A.C.S. ward were interviewed on nutritional intake. In addition, we collected data from May 21, 2018, to June 3, 2018, on 100 patient days to achieve saturation regarding common foods consumed.

A convenience sample of patients and caretakers was selected for interview. This sample included all patients in the ward at the given time of data collection, including preoperative, postoperative, and non-operative patients. Respondents were queried on patient nutritional intake. Data collectors used standardized food intake logs, including age, sex, diagnosis, quantity, and quality for each meal of the day and where the food was obtained from. Each interview counted as one patient day. We divided each day into three "meals" to aid in recall based on Rwandan culture. Meals were not based on any prespecified time period but rather per the patients' interpretation. Snacks were included at the nearest meal time.

Data collectors captured data on specific ingredients for food when available. When specific ingredients were unknown, dishes were assumed to be based on a single recipe to standardize. For example, "potage" is a dish that might be prepared in various ways, but a single generic local recipe was used and applied broadly to each meal that listed "potage."

Volumes were estimated based on commonly used serving items. We purchased a variety of cups at the local market, based on commonly used cups in the ward, and measured the volume. One "cup" was estimated at 400 mL. We estimated a standard "plate" size to be 400 g. We estimated equivalent amounts of each ingredient for plates of food based on standard Rwandan practices when preparing a plate of food. For example, a plate of beans, rice, and vegetables was estimated to be composed of 33% beans, 33% rice, and 33% vegetables. Animal protein (e.g., fish, cow meat) was recorded separately as "pieces," which were estimated to be 56 grams per piece.

Data collectors documented if patients received food from a source other than families or caretakers. If any item from a given meal (morning, afternoon, or evening) came from the restaurant or charitable sources, it was documented in a binary fashion (0 or 1). A given meal may have multiple origins of food documented (e.g., 1 for restaurant and 1 for charitable source). Data was also recorded in a binary fashion on whether patients did not eat for any reason. Potential reasons for not eating included nil per os (N.P.O.) per doctor recommendations, having no appetite, or missing a meal due to lack of food. Patients who were N.P.O. were included in the study to capture what percentage of surgical patients were not eating, contributing to overall malnutrition.

Protein and calorie content were estimated for common foods (Supplementary Table). When possible, we used nutrition data labels. For non-labeled food items, the U.S. Department of

Agriculture (U.S.D.A.) FoodData Central database was used to estimate calorie and protein content [12].

Descriptive statistics were used, and daily calorie and protein intake were reported as the median and interquartile range (IQR). First, daily intake was compared with recommended standards assuming a standard mass of 60 kilograms for an average Rwandan adult. We also used a standard mass of 50kg as a sensitivity analysis. We used a standard mass for an adult Rwandan as many patients could not stand on a scale [8]. We then compared the median daily intake with a recommended caloric intake of 25 kcal/kg/day and a 1 g/kg/day protein intake. We then compared the median daily intake with recommended intake for trauma and surgical patients at a caloric intake of 30-35 kcal/kg/day and protein intake of 1.5-2 g/kg/day.

This study was approved by the University of Rwanda institutional review board (I.R.B.) (No 211/CMHS IRB/2017), University Teaching Hospital of Kigali Ethics Committee, and University of Minnesota I.R.B. (STUDY00000723).

RESULTS

From May 21, 2018, to June 3, 2018, nutritional intake data was collected for 100 patient days. Two patients were breastfed infants and were excluded from the final analysis. As a result, 98 patient days were included in the final analysis, representing 294 potential meals in 33 unique A.C.S. patients. The median patient age was 36 years (range 14 – 78 years).

Of the 294 possible meals, 133 meals (45.2%) were donated from charitable sources, 72 meals (24.4%) were purchased from a restaurant, 21 meals (7.1%) did not occur due to lack of food, and 20 meals (6.8%) did not occur because patients were either N.P.O., too ill to eat or had no appetite. The median daily calorie intake was 1472 kcal/day (IQR 662, 2116). The median daily protein intake was 45.99 g (IQR 21.49, 68.91) (Figure 1). Assuming standard calorie needs, this is 98.1% of estimated daily calorie needs and 76.7% of estimated protein needs. Estimating higher nutritional needs for trauma or surgical patient, the median daily intake is 70.0-81.9% of estimated calorie needs and 51.1-63.9% of estimated protein needs.

The most common individual foods were: porridge with and without sugar (69 patient-days), round bread (43 patient-days), bananas (36 patient-days), beef (32 patient-days), oranges (28 patient-days), soup broth (28 patient-days), plantain (27 patient-days), milk (20 patient-days), and ready-to-use therapeutic food (R.U.T.F.) Plumpy'nut bar (18 patient-days) (Table 1).

Of the possible 294 meals, 80 contained animal-based high-protein foods (egg, fish, meat, or milk). In addition, other significant protein sources

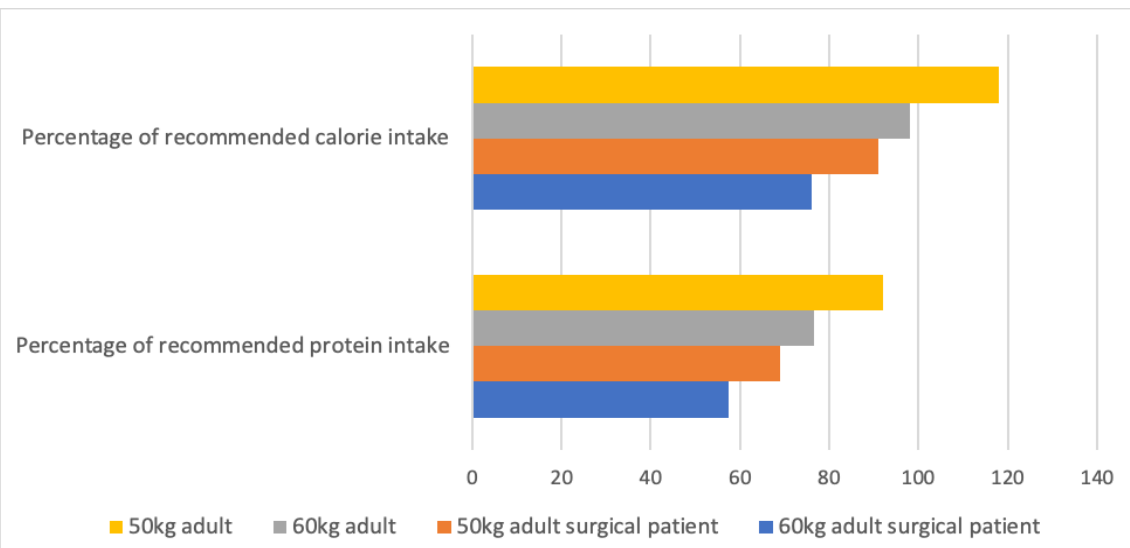

Figure 1: Nutritional intake in acute care surgery patients

Table 1: Knowledge of nurses in the early detection of AKI (n=165)

	Patient-days	Calories (kcal/serving)	Protein (g/serving)
Porridge, 400ml	69	94-113	2.41
Round bread, 1 piece	43	77	2.7
Bananas, 1 small banana	36	72	1.09
Beef, 56 grams	32	74	10.5
Oranges, 1piece	28	65	0.7
Soup broth, 400ml	28	184	6.76
Plantain 1 plantain	27	166	1.49
Milk, 300ml	20	201	10.2
Ready-to-use therapeutic food, 1 sachet	18	500	13.9

such as peanuts often come as part of a plate of food. Out of 294 possible meals, patients listed plated food combinations as a nutrition source in 104 meals (35.3%) (Table 2). Of 104 possible meals with a plate combination, beans were most common (present on 63.5% of plates), followed by vegetables (52.9%), potatoes (41.3%), rice (36.5%), plantain (31.7%), chips (13.5%), banana (7.7%), sweet potatoes (5.8%), peanut (3.8%), and spaghetti noodles (2.9%) (Table 3).

Table 2. Demonstrates the level of knowledge of nurses in the management of AKI (n=165)

Plate combinations	N	% Plates*	% Total Meals**	kcal/Plate	Protein (g)/Plate
Beans, Rice, Vegetables	12.0	11.5	4.1	716	19.11
Plantain, Vegetables	9.0	8.7	3.1	372	7.90
Beans, Potatoes	7.0	6.7	2.4	1058	18.04
Beans, Rice	6.0	5.8	2.0	104	6.38
Rice, Vegetables	6.0	5.8	2.0	930	19.06
Beans, Plantain	5.0	4.8	1.7	386	11.78
Beans, Potatoes, Rice, Vegetables	5.0	4.8	1.7	624	16.20
Beans, Potatoes, Rice	4.0	3.8	1.4	745	17.79
Beans, Potatoes, Vegetables	4.0	3.8	1.4	299	12.71
Beans, Chips, Potatoes	3.0	2.9	1.0	384	12.03

Table 3: Nutritional content of items commonly consumed in plates of food

Item	N	% Plate*	% Total Meals**	Kcal/100g	Protein (g)/100g
Beans	66.0	63.5	22.4	72	4.8
Vegetables	55.0	52.9	18.7	65	2.86
Potatoes	43.0	41.3	14.6	87	1.87
Rice	38.0	36.5	12.9	400	6.67
Plantain	33.0	31.7	11.2	121	1.09
Chips	14.0	13.5	4.8	129	2.35
Banana	8.0	7.7	2.7	89	1.09
Sweet Potatoes	6.0	5.8	2.0	76	1.37
Peanut	4.0	3.8	1.4	567	25.8
Spaghetti Noodles	3.0	2.9	1.0	357	5.33

DISCUSSION

This study describes the quality, quantity, and source of food consumed by A.C.S. patients in Rwanda as a tertiary referral hospital. This study is unique because it addresses the challenge of nutritional intake in a hospital-based setting for surgical patients in a low-resource setting. Most literature on nutrition intake and supplementation in low and middle-income countries (L.M.I.C.s) focuses on women and children at the community level, with few studies documenting the challenge of nutrition in hospitalized, adult, or surgical patients [13-15]. A recent study of surgery patients at C.H.U.K. patients found that 35% of patients were malnourished upon hospital admission [16]. Understanding the nutritional composition of surgery patients can help better indicate gaps in dietary needs during the perioperative period.

Overall, there is a reasonable degree of caloric intake for an average 60kg adult. However, overall protein intake is low, and the caloric and protein intake are insufficient to meet the higher nutritional needs of a surgical patient. Carbohydrates remain a predominant energy source in Rwanda, with low levels of protein intake, similar to other countries in sub-Saharan Africa [14, 17-19]. There are opportunities for improving nutrition intake by increasing the amount of protein consumed in each meal. While studies in high-income settings have shown an association between increased calorie and protein intake and clinical outcomes, no study to date has been performed in a low-resource setting. This study provides the first initial step in documenting nutritional intake and local food sources. There is an opportunity for future studies to assess whether improving nutritional intake correlates with improved healthcare outcomes.

There was a wide range of sources of nutrition for hospitalized patients. Finding adequate and appropriate nutrition in a new and foreign environment can be challenging due to limited access, time, and space to prepare foods [20]. In other sub-Saharan hospitals, patients often opt for street food or fast food, which may be nutritionally inadequate [20, 21]. In Rwanda, hospital food is generally provided by families and caretakers. However, additional sources are available, including a hospital restaurant and donations provided through charitable sources. It is unclear how many patients would be unable to eat if that support was not provided. There is an opportunity to standardize nutritional availability and provide it through the hospital system. One potential solution for improved perioperative nutrition would be for the hospital to provide nutritional support as part of patient care. However, that is not without challenges. In Malawi, food is provided to hospitalized patients, though the total energy and protein provided by the hospital diet were insufficient to meet surgical patient needs[5]. Further data is needed to assess the cost-benefit of hospital-sponsored nutrition and the optimal provision of nutrition services. If covered through their hospital bill, this can improve patients' financial impact, as the government-sponsored community-based health insurance program covers most hospital costs.

Commonly consumed foods highlight food that is likely to be affordable and available to these patients. Prior studies in rural Rwanda have found that the average diet is poor in animal-based proteins, fruit, and vegetables [14]. The deficit in protein intake could be due to a knowledge gap, difficulty in access or availability, or challenges with the cost of protein-rich foods. A nutrition and dietician service is available within the hospital that provides patient and caretaker education. In conjunction with the social worker, this service assists with nutrition for patients without the means to gain adequate nutrition.

R.U.T.F. was a common source of energy and protein and was often supplied by nutritionists. In Malawi, introducing a nutrition support program for pediatric patients provided nutritional fortifications, increased calorie and protein intake, and nutritional counseling for caregivers [22]. Other options include locally produced R.U.T.F. as a cost-effective alternative to standard R.U.T.F. [23].

This study has several limitations. First, while this was not a large study, it reflects the patient population[8] and nutritional intake of surgical patients at a tertiary referral hospital in Kigali. This study highlights and exemplifies the challenges of obtaining adequate nutrition at a referral hospital in sub-Saharan Africa. Understanding nutritional sources is the first step and guide for future work evaluating nutritional intake and its association with clinical outcomes. Second, data collection was based on patients' or caretakers' reports of the previous days' feedings. We relied on patient recall of the previous day as we could not have a data collector on-site for 24-hour recordings of intake. This was based on the prior day's intake, which minimized recall bias. Third, respondents were asked to estimate the volume of food consumed. While there is no standardized measurement tool, similar size plates and cups are commonly used, and therefore these were used for estimated volumes. Whenever possible, data collectors recorded the content of prepared food. Standardized quantification from a single generic local recipe was used when this was not available. We did not collect specific patient data or details of residence (i.e., how many lived within Kigali) which may influence food availability. We also did not capture data on the cost of food, which may influence food choice. As the study's goal was to characterize common foods available, we did not analyze intake with patient characteristics or clinical outcomes. More extensive studies with more detailed clinical characteristics would be needed for such a study. The duration of the study was conducted over approximately three months, limiting its scope to encompass annual seasonal variation in food. The food consumed represents what patients typically eat during their hospital stay but does not necessarily represent their regular diet. This study estimated foods' calorie and protein content but did not assess other nutritional components such as micronutrients which also affect perioperative care.

CONCLUSION

Overall, the calorie and protein intake for the average Rwandan acute care surgery patient was low compared to the needs of a 60 kg surgical patient. Postoperatively, more emphasis and education are needed to encourage nutrition, especially protein supplementation.

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Supplementary Table 1: Nutritional values

	Serving size	Estimated Calories (kCal)	Estimated Protein (g)
Plate Items			
Banana	81g	72	0.88
Beans	400g	288	19.20
Chips	400g	516	9.40
Legume	400g	876	100.00
Mushrooms	400g	136	8.96
Peanut	400g	2268	103.20
Plaintain	300g	363	3.27
Potatoes	400g	348	7.48
Rice	400g	1600	26.68
Superget	400g	1428	50.00
Sweet potatoes	400g	304	5.48
Tomatoes	400g	72	3.80
Vegetables	400g	260	11.44
Meat			
Egg	61g	91	6.09
Fish	56g	55	11.00
Liver [cow]	56g	74	11.40
Beef	56g	120	10.50
Potage			
Potage [ground beef]	300mL	250	52.60
Potage [tilapia]	300mL	298	40.60
Potage [vegetables]	300mL	219	26.60
Porridge			
Porridge	400mL	94	1.93
Porridge [sugar]	400mL	113	2.41
Sorghum Flower	400mL	1436	33.72
Soya Flower	400mL	2260	39.44
White Corn Flour	400mL	1440	32.00
Other			
Biscuit	100g	481	7.20
Bread	100g	77	2.70
Chapati / Copati	100g	100	3.00
RUTF / Plumpy'nut	92g	500	12.79
Sambusa	100g	200	10.00
Soup [broth]	400g	184	6.76
Soup [vegetables]	400g	128	5.28

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Superget (Spaghetti)	100g	357	12.50
Fruit			
Avocado	136g	227	2.67
Banana	81g	72	0.88
Citron	141g	503	0.00
Mango	504g	302	4.13
Orange	141g	65	0.99
Papaya	469g	202	17.21
Passion fruit	18g	17	0.07
Pineapple (Anana)	137g	69	0.74
Plaintain	137g	166	1.49
Tomato	123g	22	1.08
Tree Tomato	100g	30	1.03
Watermelon	137g	41	0.84
Beverages			
Coca Cola	330mL	129	0.00
Fanta [citron]	330mL	96	0.00
Fanta [cola]	330mL	149	0.00
Fanta [orange]	330mL	96	0.00
Fruit Juice	300mL	123	3.00
Juice [banana, orange, papaya, passion fruit, tree tomato]	300mL	122	4.13
Inyange Juice	300mL	123	3.00
Inyange Juice [orange]	300mL	123	3.00
Inyange Juice [passion fruit]	300mL	123	3.00
Milk [Inyange]	300mL	201	10.20
Sugar	4.92g	19	0.00
Tea	400mL	0	0.00
Tea [milk, sugar]	400mL	68	2.08
Tea [milk]	400mL	40	2.08