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Nutritional Status of Children as an Indicator of Bushmeat Utilization in Western Serengeti

Rosemary Peter Mramba

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Supervisor: Eivin Røskaft, IBI

Co-supervisor: Julius Nyahongo, University of Dodoma, Tanzania
Angela Mwakatobe, Tanzania Wildlife Research Institute, Tanzania

Norwegian University of Science and Technology
Department of Biology

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Abstract

Serengeti ecosystem supports great number of large mammals ranging from grazers, browsers and carnivores. Some of these animals migrate between seasonal water sources and grasslands. The human population in the western boundary of the park is currently high and increases at the rate of 4% per annum. Majority of local communities are subsistence farmers who derive their needs such as bush meat from the park. The purpose of the study was to test if bush meat utilization contributes to nutritional improvement of local communities around Serengeti National Park. Three villages were selected at random along a gradient of distance from Serengeti National Park and Lake Victoria and a control village from Dodoma Region in central Tanzania. One hundred households were selected at random from each village and interviewed. Weight and height of children aged 3 to 12 years from the selected households were measured. Anthropometric data were analyzed by WHO AntrhoPlus software while questionnaires were analyzed by SPSS for windows version 18. The results revealed significant differences in the number of undernourished children from the villages which were in western Serengeti compared to the control village. Consumption of bushmeat was significantly higher in the villages which were close to the park compared to the village which was further away from the park. Fish consumption was higher than bushmeat in the village which was close to both park and Lake Victoria and negatively correlated with bushmeat meals, while consumption of livestock meat was higher in the control village. No significant relationship between nutritional status of children and number of bushmeat meals observed, but there was a negative relationship between mean body mass index and distance from the park/lake and the price of bushmeat. The study also revealed significant positive relationship between level of education of the parent and the mean body mass index of the children.

1 Introduction

Wildlife and fish are primary sources of animal protein for most rural households in forested regions of developing countries (Apaza et al. 2002). It has been estimated that around 80 percent of rural households depend on wild animal protein as a supplement to their diet - such as birds, reptiles, small mammals and amphibians (Anstey 1991; Asibey 1986). For example, Tsimane in Bolivia eat 475g of game meat and 310g of fish per adult equivalent per day compared with 250g of beef (Apaza et al. 2002). In Cameroon, bush meat contributes an estimated 70-80% of the total annual animal protein consumed in the southern forest region (Falconer 1990). Wildlife provides up to 30 percent of the protein requirements of the rural population (Nasi et al. 2008)

In many areas, livestock rearing has been frustrated by trypanosomiasis and domestic animals are perceived as savings or insurance against illness or disasters. Even in grassland areas, where cattle raring are common, cows are valued as a source of milk and prestige, rather than source of meat protein (Brashares et al. 2004). Loibooki et al. (2002) found that only 51.4% of livestock keepers in Serengeti obtain their primary source of protein from the animals they keep.

Bushmeat provides an equivalent and in some cases greater quality food than domestic meat of high protein and low fat (Hoffman 2008). Wild animals provide relatively high level of carbohydrates (ranging from 1% in river hog to 6% in forest genet) compared with domesticated animals from similar environments (ranging from 0.8% in pork and beef to 1.3% in mutton) (Hoffman 2008). The protein content of bushmeat ranges from 16-55% compared to 11-20% for domestic animals (Ajayi & Tewe 1983; Falconer 1990) . The average protein value of wild meat is estimated at around 30g of protein per 100g of meat (Ntiamoa- Baidu 1997). Snails provide good source of protein that are low in fat, (around 2-5% against 30% of domestic animals) (Ntiamoa- Baidu 1997). Moreover, bushmeat contains high iron, calcium and vitamins compared to domestic meat (Ajayi & Tewe 1983; Hoffman 2008).

The importance of wild animal meat and fish in the diets of both rural and urban dwellers varies considerably depending on the availability and supply (de Merode et al. 2004).

In a consumer survey in southern Nigeria it was reported that 62% of the rural and urban people interviewed stated that the lack of bushmeat limited their consumption (Falconer 1990). Distance from the source influences hunting intensity, bushmeat availability, and consumption (Cowlishaw & Dunbar 2000). According to Cowlishaw and Dunbar (2000), hunting intensity is greatest close to agricultural settlements where the incentive to hunt is driven by the need to control crop raiding. The shorter the travel time to the hunting area the greater the gain in hunting per unit time, hence prey species tend to become depleted along road side and around villages (Cowlishaw & Dunbar 2000). Wato et al. (2006) reported that snare density increased with decrease in distance from the park border at Tsavo National Park in Kenya. Ndibalema and Songorwa (2008) revealed significant influence of location on wild meat consumption whereby wild meat consumption was higher in Serengeti district (0.089 kg/person/day) which is close to the park compared to other districts which were farther away from the park. The number of meat meals have been reported to be higher in villages nearby Serengeti National Park boundary and the weekly number of meat meals per household in all villages within 30 km of the Park boundary increased with the seasonal influx of migratory herbivores (Nyahongo et al. 2009).

1.1 Research Problem

Human population in the western Serengeti is high and expected to increase due to both high birth rates and immigration into villages adjacent to protected areas (Hofer et al. 1996). The human population within a 45 km of the western boundary of the Serengeti National Park is currently high and increases at the rate of 4% per annum (Hofer et al. 1996; UNEP 2008). The majority of local communities along the boundaries of the western Serengeti are subsistence farmers, many of whom obtain resources such as firewood, poles for erecting houses, area for grazing and watering livestock especially during the dry season and game meat for household utilization and for sale close or inside the park (Arcese et al. 1995; Loibooki et al. 2002). The location arrangement where some villages are located very close to the boundary of the protected areas in the western Serengeti may make it easy for them to access more meat protein obtained illegally than those located farther away. Following that the children of the villages located close to protected area would be well nourished more than those located in distant villages. Commercial fishing in Lake Victoria has contributed to food insecurity and reduced nutrition by taking out substantial quantities of fish to global markets, which would

otherwise be available to local people (Geheb et al. 2008). This may increase dependence on wild meat for food.

Bushmeat and fish as major sources of protein to local communities around Serengeti ecosystem and its preference and spatial-temporal consumption have been reported (Loibooki et al. 2002; Ndibalema & Songorwa 2008; Nyahongo et al. 2009). However, there are limited studies on the contribution of bushmeat and fish to nutritional improvement of local people around the park and the lake. The present study aimed at assessing the nutritional status of children in villages near the park and lake, and the children of the same age in villages located farther away from the park and lake boundaries, in order to test if bushmeat contribute to nutritional improvement of local communities around Serengeti ecosystem.

1.2 Objectives and Hypothesis of the Study

1. 2.1 General objective

The general objective of this study was to test if bushmeat is contributing to nutritional improvement of local communities adjacent to Serengeti National Park.

1.2.2 Specific objectives

- To assess nutritional status of children aged 3-12 years in villages around Serengeti ecosystem and Kondoa District (control).
- To identify different sources of animal protein to local communities in the study areas.
- To determine the contribution of bushmeat on nutritional status of children in the study areas.
- To establish the relationship between bushmeat consumption and nutritional status of children in the study areas.

1.2.3 Hypothesis

The hypothesis of the study was that nutritional status of children in villages close to the park and the lake is better compared to children of the same age in villages that are located farther away from the park and the lake shore.

The hypothesis based on fact that fishing and hunting contributes to nutritional improvement of community directly through consumption of fish and bush meat. Fish are rich in essential nutrients such as protein with high digestibility, fatty acids, vitamins, calcium, iron and zinc (Deuel et al. 1945; Sikka et al. 1979; Vladau et al. 2008). Households engaged in small-scale fisheries are in better position to improve their own nutritional intakes by consuming some of the fish they capture. Bushmeat also provides an equivalent and in some cases greater quality food than domestic meat (Ajayi & Tewe 1983; Falconer 1990; Hoffman 2008). This implies that children who utilize these animal proteins are in better nutritional condition.

Hunting and fishing can have indirect benefit through income creation. The sale of fish and game meat and employment through tourism and related industries increases the household income which on the other hand increases their purchasing power. For example a survey of income of 53 fishing households and 52 non-fishing households at Lake Kyoga (Uganda) showed that a higher proportion of fishing households had higher income per month while a higher proportion of non-fishing households had low income (Te Lintelo 2008). Coad et al. (2010) also found a significant difference in income between hunting households and non hunting households (hunting households were wealthier than non hunting households) in Gabon. Higher household income increase access to other foods such as grains, vegetables and other protein sources which can improve their overall dietary intake (Kumpel et al. 2010; Loibooki et al. 2002).

1.3 Determinants of Nutritional Status of Children

Dietary intake (energy, protein, fat and micronutrients) and health status are immediate determinants of nutritional status of children (Smith & Haddad 2000). These two factors are interdependent. A child with inadequate dietary intake is more susceptible to diseases, on the other hand diseases depresses appetite and reduces absorption of nutrients from food (Smith & Haddad 2000). Hence, dietary intake should be adequate in quantity and quality and nutrients must be consumed in appropriate combination in order to enhance digestion and absorption (UNICEF 1990). Some studies have found a link between diet intake and nutritional improvement of children. For example Ojiako et al. *(*2009) found a positive relationship between soya bean intake and nutritional status of children in rural Nigeria. Das

et al. (2008) also revealed significant association between feeding practices and nutritional status of children in Bangladesh.

The immediate determinants of child nutritional status are in turn influenced by three underlying determinants manifesting themselves at household level. These are food security, adequate care for mother and children and proper health environment (UNICEF 1990). Food security is achieved when a person has access to enough food for an active and healthy life (WorldBank 1986). Resources required to get access to food are food production and income. Household food security status was a determinant of child nutritional status in Bangladesh and Nigeria as reported by (Das et al. 2008; Lawal & Samuel 2010). Food security has also been reported as determinant of under nutrition in Tanzania by (Leach & Kilama 2009). According to Leach and Kilama (2009), areas of Tanzania which are the source of cereal surpluses had relatively high rates of malnutrition while the Northern Highlands and Lake Zone were best in nutritional status. It was concluded that food security, in the limited sense of cereal crop production, does not seem to be strongly associated with nutrition security and animal protein is most limiting. Access to food was strongly affected by household income and the price of food (Leach & Kilama 2009).

The lack of ready access to water and poor environmental sanitation are important underlying causes of malnutrition as it affect health, food production, preparation and general hygiene directly (Smith & Haddad 2000). Caring practices includes child feeding, health seeking, and care and support of mother during pregnancy and lactation (UNICEF 1990). Access to care and health services was a best predictor of nutritional status of children aged 6-59 months in protected area of Gabon while access to natural resources was predictor of nutritional status of children aged 5-9 years (Blaney et al. 2009). Other studies in Tanzania (Leach & Kilama 2009), Nigeria (Lawal & Samuel 2010) and Bangladesh (Das et al. 2008) also revealed significant relationship between nutritional status of children and health services and maternal and child care.

Inadequate or improper education, particularly of women, is also an underlying cause of malnutrition. Women take large part in child care and improper education may affect their ability to generate resources for improved nutrition of their families (UNICEF 1990). A study by Tripp (1982) in Ghana found that children whose mothers had their own income had better nutritional status. Rahman et al. (2009) found that parent educations affected the nutritional status of children aged 24-59 months in Bangladesh. Furthermore mother's education had been reported to have positive associated with nutritional status of children in Bangladesh (Das et al. 2008) and Nigeria (Lawal & Samuel 2010; Ojiako et al. 2009). In Tanzania it has

been reported that children of mothers with secondary education are much less likely to be stunted, but the difference in nutrition between the children of mothers with no education and children of mothers with only primary education was not significant (Minot et al. 2006).

1.4 Storage of Excess protein in human Body

Protein is the nutrient which the body need for growth and maintenance. Excess protein is not stored in specific protein storage tissue (Insel et al. 2010; Rolfes et al. 2008). When more protein is consumed than the amount needed for tissue maintenance and repair, the body use it for energy. If it is not needed for energy, the body converts excess protein into body fat (Insel et al. 2010). The body uses the surplus protein first by replacing normal daily loses and by increasing protein oxidation. Any excess portions of protein have their nitrogen removed (deaminated) in the liver and the remaining carbon skeleton is used to make fatty acids which are stored in triglycerides in adipose tissue (Kirschmann & NutritionSearchInc. 2006; Rolfes et al. 2008).

People who eat huge amount of meat and other protein- rich food can have weight problem because of fat contained in these food and protein deamination when energy consumed exceeds energy need (Rolfes et al. 2008).

1.5 Anthropometric Indicators and Indices of Nutritional Status of Children

Once a child's height and weight have been measured and their age has been recorded, we can assess the child's growth and general nutritional status by using a standardized age and sex-specific growth reference to calculate height-for-age *z*-scores (HAZ), weight-for-age *z*-scores (WAZ) and body mass index-for-age *z*-scores (BMIZ) (Mei et al. 2008; WHO 2006). The *z*-score (standard deviation scores) system expresses anthropometric values as a number of standard deviations (SDs) below or above the reference mean or median value (WHO 2006).
Z-score cut-off point of <-2 SD classify low WAZ, low HAZ and low BMIZ as moderate and severe under nutrition, and <-3 SD to define severe under nutrition (WHO 2006).

1.5.1 Height - for - age z- scores

Height - for - age represents the child's height in comparison with the height of other children of the same age. Stunting is a measure of linear growth. It is an indicator of past growth failure (Balter 2000; WHO 2006). It is associated with a number of long-term factors including chronic insufficient protein and energy intake, inadequacies of health and care (WHO 2006). A child is considered stunted if HAZ fall below two standard deviations (< -2SD) of the median value of the National Center for Health Statistics/World Health Organization (NCHS/WHO) international reference (WHO 2006).

1.5.2 Weight -for- age z-scores

Weight - for- age represents a child's weight in comparison with the weight of other children of the same age. Underweight reflects low body mass relative to chronological age and is influenced both by the height of the child, and weight-for-height (Balter 2000). WAZ does not take height into account. Children who are taller would be expected to weigh more than other children, and children who are shorter would be expected to weigh a little less and still be healthy (Balter 2000). A child is considered underweight if WAZ fall below two standard deviations (< -2SD) of the median value of the National Center for Health Statistics /World Health Organization (NCHS/WHO) international reference. The cut-off point of >+2 SD classifies high weight-for-age as overweight (WHO 2006).

1.5.3 Body mass index for age z - score

Body mass index is the ratio of weight (in kg) / recumbent length or standing height (in m^2). Body mass index (BMI) is calculated the same way for children and adults, but the criteria used to interpret the meaning of the BMI for children and teens are different from those used for adults. For children and teens, body mass index - for - age and sex-specific z- scores are used because the amount of body fat change with age and differs between boy and girls (WHO 2006). BMI is correlated with total body fat. The following z-score cut-offs are used to classify body mass index - for - age: Overweight: (>+1SD), obesity: (>+2SD), thinness: (<-2SD) and severe thinness: (<-3SD) (WHO 2006).

2 Research Methods and Material

2.1 Study Areas

This study was conducted in the north-west part of Serengeti National Park and Dodoma region in June and July 2010. The North West area of Serengeti National Park follows the path of the Grumeti River west towards Lake Victoria. The Park is best known as the ecosystem with the greatest concentration of large mammals in the world; grazers, browsers and carnivores (UNEP 2008). Many of these animals migrate between seasonal water sources and grasslands, starting in May and June from the central plains to the western corridor and then northwards (Boone et al. 2006; Thirgood et al. 2004; UNEP 2008). Average annual rainfall ranges between 500-1200 mm, declining towards the Park boundary and increasing towards Lake Victoria. It falls mainly between October and May with peaks in November (the short rains) and from March to April (the long rains). The annual drying up in May triggers migration north; while the rains which start in October trigger the returning migration south (Boone et al. 2006; Norton-Griffiths et al. 1975; UNEP 2008). Generally the climate is warm and dry, coolest from June to October, with a mean annual temperature of 20.8°C (UNEP 2008). The western area is densely settled by a growing human population of farmers and herders. Population growth on this area is close to 4% per year (UNEP 2008). Agriculture is the main source of income, but many people are attracted by the wildlife and the touristic opportunities of the Park (UNEP 2008). Food crops grown include cassava, maize, millet, sorghum, vegetables and beans.

Another study area used as control was Kondoa district which is located in Dodoma region. The district is characterized by semi-arid to sub-humid conditions. The mean maximum and minimum temperatures are 29° C and 16° C respectively, and mean annual rainfall varies between 600 and 900 mm (Eriksson et al. 2003). The district covers an area of 13,210 km^2 with a population density of 34 people per km^2 and average growth rate of 2.4% per annum (Madulu 2004). The district has over ten ethnic groups with main activities ranging from crop production, livestock keeping and honey collection (Eriksson et al. 2003). Crop production and livestock keeping are the main economic activities. Various crops are grown both for subsistence and cash (Lane 2009). The main crops are maize, finger millet, oil seeds, bulrush millet and sorghum. Other crops include beans, pigeon peas, groundnuts, sugar cane and sweet potatoes (Lane 2009). This village has swampy areas where they grow rice and

sorghum. In this area there is a lot of *Quelea quelea* bird during the growing season which feed on rice and sorghum. Villages trap these birds as use them as food.

2.2 Methods

Three villages were selected randomly for this study along a gradient of distance from Serengeti National Park and Lake Victoria (Figure 1). One more village (control) was selected from Kondoa District in Dodoma Region.

The first village was Nyatwali which is in Bunda District. This village is located between the park and the lake. The village is close to the park (2 meters) and lake (1 meter) hence villagers have access to both fish and bush meat. The second village was Robanda which is close to park (4 meters) but far from the lake (95 meters). This village have more access to bushmeat than fish. The third village was Rwamkoma which is located far from both lake (37 meters) and park (28 meters) hence have lesser access to fish and bushmeat compared to the above villages. The fourth village was Kelema Balai (control) which is located in Kondoa District in Dodoma Region Central Tanzania.

One hundred households were selected randomly from each village by using village registers. Both open ended and close ended questions were used to assess the major protein sources and economic activities. The interview was conducted under the assistant of local leaders. The respondents (father or mother) were asked to give information about family background, their activities, sources of income, frequency of eating major protein food, food price and health problems associated with bushmeat consumption (see questionnaire in Appendix).

2.3 Anthropometric Measurements

A total number of 614 children (315 males, 299 females) aged 3 to 12 years were selected for anthropometric recordings. The anthropometric variables used in this study were weight and height. Weight was measured by using a platform scale and recorded to the nearest 0.5 kg with the child standing on it. Height of the child was measured by using a tape measure. Shoes and bulk clothes which might interfere measurements were removed and the child stood on the floor with feet flat, together and against the wall. The measurer was making sure that the child was looking straight ahead, and the measurement was taken while the child was

standing with at least head, shoulders, buttocks, and heels touching the wall. A flat headpiece was used to form a right angle with the wall and the headpiece was lowered until when it firmly touched the top of the head. The area where the bottom of head piece touched the wall was marked by using chalk. Then the tape was used to measure from the base on the floor to the marked point on the wall. The height was recorded to the nearest 0.1 cm.

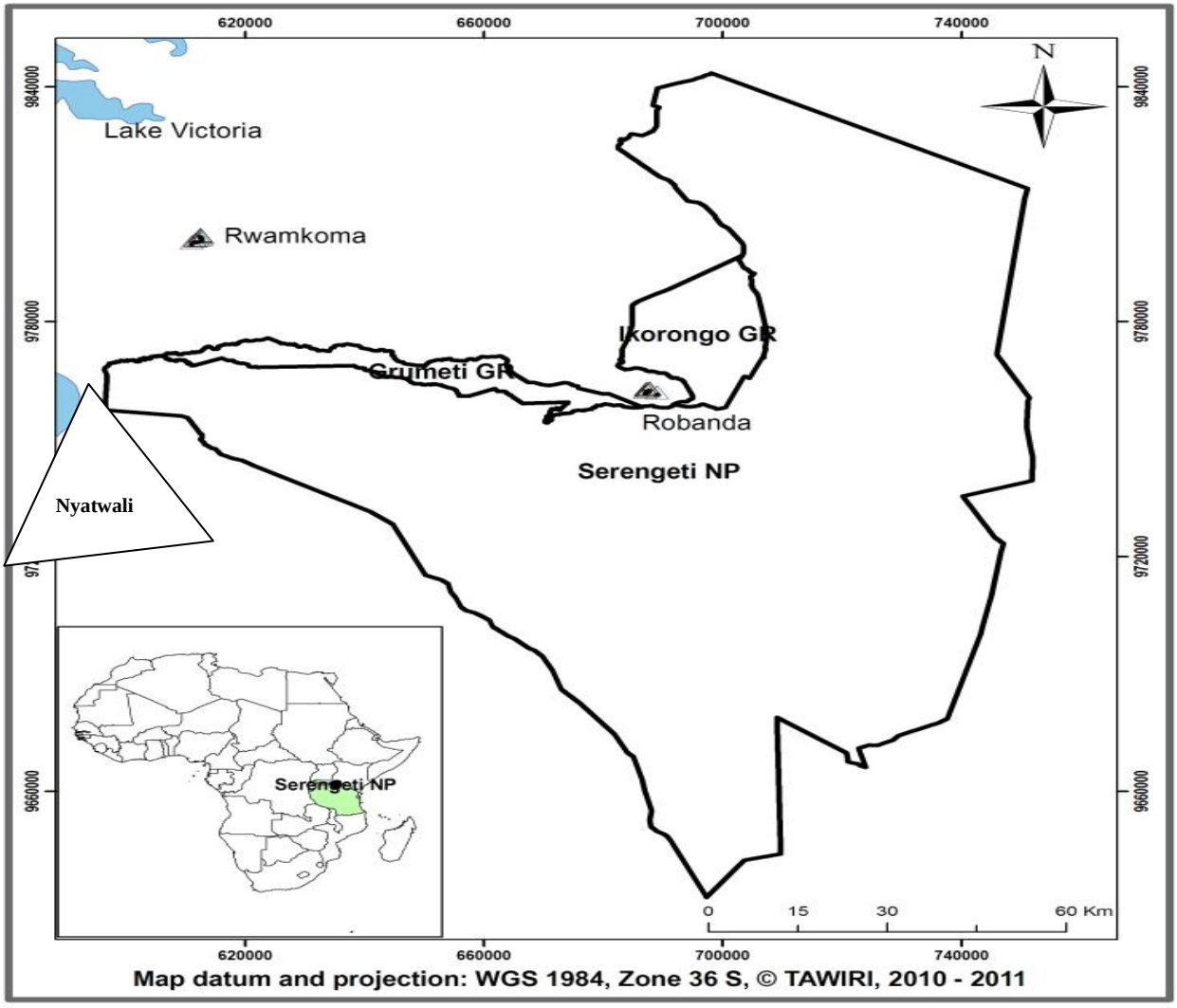

Figure 1. Map of the study location showing; Serengeti National Park, Grumeti and Ikorongo Game Reserves, Lake Victoria and surveyed villages (namely Rwamkoma, Robanda and Nyatwali villages).

2.4 Statistical Analyses

Anthropometric data were analysed by using WHO AnthroPlus software which computed WAZ (for children aged 3-10 years), HAZ and BMIZ for each child, and these were compared with the World Health Organizaiton reference values. Classification of nutritional status was made according to public health criteria recommended by World Health Organization. A child whose z-score value were below -2 SD were classified as undernourished and those whose z- score values were ≥ -2SD were classified as normal nourished.

Further analyses of anthropometric data and questionnaires were done by using Statistical Package for Social Science (SPSS) version 18 for windows. Pearson chi square was used to test the relation between villages and frequency of undernourished children. Pearson correlation was used to test for relationship between animal protein meals and village, income, number of livestock owned by the family and food price. One way ANOVA tests were used to compare means and post-hoc test was used in pair wise comparison of means between villages.

3 Results

3.1 Gender, Age and Education Level of Respondents

Age and gender of respondents are summarized in table 1. Most of respondents have been at least to primary education (table 1). Twenty among those who had been to school finished the secondary school education and one had been to college education.

Table 1: Gender, age and educational level of respondents

Variables		Frequency	Percent
Gender:			
	Males	69	20.7
	Female	265	79.3
	Total	334	100
Age (years) :	15-30	127	38.0
	31-45	146	43.7
	> 46	61	18.3
	Total	334	100
Education level:	Illiterate	50	15.0
	Been to school	284	85.0
	Total	334	100

3.2 Nutritional Status of Children Based on Anthropometric Indices

The nutritional status of children based on WAZ, HAZ and BMIZ is given in table 2. The results revealed a statistically significant difference in frequencies of undernourished children between the villages.

Table 2: Nutritional status of children based on WAZ, HAZ and BMIZ in the sampled villages (differences were tested with χ^2 tests, df = 3).

Villages sampled	WAZ		HAZ		BMIZ	
	Under nourished	Normal nourished	Under nourished	Normal nourished	Under nourished	Normal nourished
Nyatwali	4	76	6	85	3	87
Robanda	2	140	13	149	5	158
Rwamkoma	9	174	21	159	13	167
Kelema	31	110	35	131	32	123
Total	46	500	75	524	53	535
χ^2 =	46.80		17.14		36.84	
p =	0.000		0.001		0.000	

3.3 Comparison of Mean WAZ, HAZ and BMIZ between Villages

Table 3 indicates the results of one way ANOVA tests of WAZ, HAZ and BMIZ between villages as well as Bonferroni's pair wise comparisons. There was significant difference in mean scores between villages. Bonferroni comparison revealed insignificant difference in mean scores between the village which was close to both park and lake (Nyatwali) and the one which was close to park but far from the lake (Robanda).

Table 3: Mean WAZ, HAZ, BMIZ and Bonferroni post- hoc comparisons. The superscripts indicate pair wise statistically significant difference between villages (Nyatwali and Robanda = 1, Nyatwali and Rwamkoma = 2, Nyatwali and Kelema = 3, Robanda and Rwamkoma = 4, Robanda and Kelema = 5 and Rwamkoma and Kelema = 6) (differences were tested by One way ANOVA tests).

Villages sampled	WAZ			HAZ			BMIZ		
	Mean	Std	N	Mean	Std	N	Mean	Std	N
Nyatwali	-0.16[2,3]	0.89	82	-0.93	1.14	96	0.39 [2,3]	1.23	96
Robanda	-0.21[4,5]	0.67	141	-0.72[5]	0.89	169	0.08 [4,5]	0.91	169
Rwamkoma	-0.53[2,4,5]	0.77	183	-0.86[5]	0.88	205	-0.07[2,4,6]	0.91	204
Kelema	-1.06[3,5,6]	0.92	115	-1.05	0.97	140	-0.78[3,5.6]	1.05	139
F =	30.15			3.18			30.56		
p =	0.000			0.024			0.000		

3.4 Relationship between weight, height, and body mass index of children

There was a positive correlation between weight and height of children (r = 0.910, n = 611, p = 0.000), weight and body mass index (r = 0.195, n = 531, p = 0.000) and negative correlation between height and body mass index (r = -0.114, n = 534, p = 0.008). Furthermore, analyses done in separate age groups revealed significant correlation between height and body mass index for children aged 3-6 years only (r = -0.245, n = 330, p = 0.000). For children aged 7- 12 years no significant correlation between height and body mass index was found (r = -0.025, n = 201, p = 0.72), other correlations were significant in all age groups.

3.5 The Frequency of Eating Major Animal Protein Foods

Table 4 indicates the frequency of consuming major animal protein meals in the sampled villages. There were statistically significant differences in the number of major animal protein meals between the four sampled villages. The number of fish meals per week was highest in Nyatwali village and lowest in Robanda village. On the other hand, the number of bush meat meals per week was highest in Robanda village and lowest in Rwamkoma village. Mean number of meals was highest in Robanda village and lowest in Nyatwali village.

Table 4: The mean number of fish, bushmeat, beef, chicken, milk and egg meals per week from the studied villages. Differences between villages were tested by one-way ANOVA tests, df = 3.

Meals	**Nyatwali** **Mean** ± SD	**Robanda** **Mean** ± SD	**Rwamkoma** **Mean** ± SD	**Kelema** **Mean** ± SD	**n**	**p value**
Fish	5.86 ± 0.92	1.51 ± 0.95	4.01 ± 1.70	2.25 ± 1.59	333	0.000
Bush meat	3.22 ± 1.95	3.96 ± 1.82	2.47 ± 2.29	3.87 ± 1.83	302	0.000
Beef	2.67 ± 1.93	3.15 ± 1.52	3.28 ± 1.37	3.91 ± 1.51	332	0.000
Milk	4.35 ± 1.99	5.25 ± 1.57	4.00 ± 2.1	4.74 ± 1.5	333	0.000
Eggs	2.10 ± 1.98	3.29 ± 1.85	2.65 ± 1.64	2.59 ± 1.84	333	0.004
Mean	2.79 ± 1.19	3 .41 ± 0.89	3.04 ± 1.07	3.33 ± 1.17	332	0.000

3.7 Relations between Number of Animal Protein Meals, Price, Income and Number of Livestock

Price of one protein food had an effect on its consumption as well as consumption of other protein food. For example, price of fish had a negative effect on number of fish meals ($r = -0.204$, $p = 0.000$) while price of bushmeat had a positive effect on the number of beef meals ($r = 0.164$, $p = 0.021$). Significant relationships observed between number of meals from different protein sources are given in table 5.

Table 5: Results of bivariate correlation analyses of number of animal protein meals per week and food price, household income and total number of livestock

Variables	r	p =	n
Fish meals * bushmeat meals	-0.158	0.004	331
Fish meals * fish price	-0.204	0.000	303
Fish meals * beef price	-0.162	0.003	325
Fish meals * house hold income	0.119	0.032	325
Beef meals* price of bushmeat	0.164	0.021	199
Beef meals*number of livestock	0.149	0.007	330
Milk meals*number of livestock	0.234	0.000	331
Milk meals* household income	0.261	0.000	325
Chicken meals*household income	0.153	0.006	325
Egg meals * number of livestock	0.169	0.002	330
Egg meals * household income	0.307	0.000	324
Price of fish*price of bushmeat	-0.240	0.001	187
Price of bushmeat * price of beef	-0.306	0.000	198
Price of bushmeat * household income	-0.439	0.000	244

3.8 Relationship between Mean Body Mass Index as Dependent Variable and Village, Price of Bushmeat, Number of Beef Meals, Level of Education of Parent and Number of Fish Meals as Independent Variables

A simple linear regression analysis revealed a negative relation between mean body mass index of children and village sampled, price of bushmeat, number of beef meals, and a positive relation with level of education of respondent (parent) and number of fish meals (table 6). However there was no significant relationship between mean body mass index and number of bushmeat meals, income level, and number of livestock owned by the hosehold (table 6).

Table 6: Results of linear regression of body mass index as dependent variable and villages, price of bushmeat, number of beef meals, level of education of respondents and number of fish meals as independent variables (df = 1).

Independent variables	Mean BMI	
	t- values	p =
Village sampled	-8.49	0.000
Price of bushmeat	-5.15	0.000
Number beef meals	-1.99	0.04
Level of education of respondent	1.93	0.05
Number of fish meals	1.72	0.08
Household income	1.04	0.30
Number of bushmeat meals	0.68	0.49
Number of livestock owned	0.23	0.82

4 Discussion

4.1 Gender, Age and Education Level of Respondents

The number of respondents hence the number of children was lowest in Nyatwali village. There was little cooperation from the village leaders, and most people from this village were not willing to be interviewed especially concerning bushmeat. The differences in samples size between villages may have affected the comparison and interpretation of results. Most respondents (79.3%) were females. In most households fathers were not present at home because they were involving in activities like fishing and hunting, and some had several wives in different areas. In some cases even if the father was at home they were not willing to be interviewed. They told their wives to answer the questions claiming that they don't have information about their children and food because they are not taking care of children and cooking food. Some fathers didn't even know the number of children they have. This suggests that women are playing major role in care of children and family than economic activities. This interpretation is supported by (Geheb et al. 2008) who found fewer women compared to men been involved in the harvest of fish from Lake Victoria in Uganda. Most of respondent attained primary education with a few who had attained secondary education. Low education level limits their access to formal employment. As a result they depend on agriculture and natural resources for their livelihood.

4.2 Nutritional Status of Children Based on Anthropometric Indicators

The number of undernourished children was significantly lower in villages which were in the western Serengeti compared to control village which was in Kondoa district. No significant difference in the mean scores between the village which was close to both lake and park and the one which was close to park but far from lake. These results support the hypothesis that children in communities adjacent to Serengeti National Park and Lake Victoria are in better nutritional status. Nyatwali village was close to both park and the lake, hence have access to both bush meat and fish, while Robanda was close to Park hence have access to bush meat. Accessibility to these animal protein sources can be one of the reasons for better nutritional status of children from villages in the western Serengeti. Fish are more nutritious than staple foods, such as cereals, providing high levels of animal protein, essential fatty acids and

micronutrients. The digestibility of fish is approximately 5-15% higher than plant source foods and the concentration of all essential amino acids is well balanced (Deuel et al. 1945; Kawarazuka & Bene 2010; Sikka et al. 1979; Vladau et al. 2008).

The control village had quelea (*Quelea quelea*) which was used by households as an alternative source of protein. Since this was the only source of bushmeat in this area, it was highly competitive and birds were very small hence big households need to have several birds. Birds are available only during the growing season when sorghum and rice matures. The villagers claimed that trapping was a best way of controlling quelea because it does not use chemical and on the other hand they get food. Fish was available only during the rainy season from a nearby river. The number of beef meals and milk meals was high in this village. Despite of high livestock protein meals, presence of quelea birds as alternative source of protein, the number of undernourished children was highest in this village. The results are supported by Leach & Kilama (2009), who found low rates of malnutrition in the lake zone compared to eastern and western areas which are sources of cereal surpluses. Differences in culture may affect life style and eating behavior which may affect nutritional condition of children. Since the control village was located far away from Serengeti ecosystem, this may have affected the comparison of the results.

Fish and bushmeat serves as alternative source of protein to livestock meat and other agricultural products especially during the lean season. (de Merode et al. 2004) found that bushmeat and fish consumption in Democratic Republic of Congo increases several times during the lean season. Household which are involving in fishing and hunting may be in better nutritional status compared to households which are not involved in hunting and fishing activities. Gaheb et al. (2008) found lower rate of under nutrition in communities around Lake Victoria compared to communities which were in the agriculture hinterland (25-35 km from the lake). Another study by Priebe and Graeb (2009) reported similar results whereby children who were residing close to Lake Victoria had significantly better height for age. Contribution of natural resources to nutritional improvement of communities has also been reported by Blaney et al. (2009). According to the author, the use of natural resources (mammals, reptiles, amphibians, and birds, fish, crustaceans and wild plants) was the best predictor of nutritional status of children aged 5-9 years in protected area of Gabon mainly through its contribution to the achievement of nutrient requirements. On the other hand, the results of the present study are in disagreement with de Merode et al. (2004) who found small role of bushmeat and fish in household consumption in Democratic Republic of Congo.

No significant relation between nutritional status and number of bushmeat meals was observed, but there was a negative relationship between price of bushmeat and body mass index. This may be contributed by the unwillingness of some respondent to give information concerning bushmeat hunting and consumption. For example some respondents claimed that they haven't tasted bushmeat but they were responding positively to questions which were asking about bushmeat price, preference and taste. This indicates that they were hiding information about bushmeat consumption in their household because the meat was obtained illegally. Hence for these households only data about bushmeat price and preference was given. Also, there was no significant influence of tribe on nutritional status of children.

Bushmeat and fish can have indirect contributions to nutritional improvement through generation of income. In the present study, mean household income per month was significantly higher in villages close to the park and lake compared to the control village. Higher income of households in Serengeti ecosystem may be contributed by fishing and hunting activities. Loibooki et al. (2002) found that three quarter of people who were arrested because of illegal hunting in Serengeti National Park claimed that they were hunting primarily to generate income. Bushmeat sales may be equivalent to almost a third of average income from faming activities (Emerton & Mfunda 1999). Another study by Campbell et al. (2001) in Serengeti revealed that a day's hunting was capable to produce an average profit equivalent to over 100 days of a normal villagers earning. Coad et al. (2010) found that households in which members hunted (hunting households) were significantly wealthier than households in which no one hunted (non hunting households) in Gabon. Higher household's income can increase access to other foods such as grains, vegetables and other protein sources which can improve their overall dietary intake (Kumpel et al. 2010; Loibooki et al. 2002). Hence bush meat and fish can improve nutritional status of community indirectly through the earnings from hunting and fishing.

The results also revealed positive association between nutritional status of children and level of education of respondents (parents). Several studies had reported similar results (Das et al. 2008; Lawal & Samuel 2010; Minot et al. 2006; Ojiako et al. 2009; Rahman et al. 2009). Since 79% of respondents were women, it indicates that women are taking large part in child care. It is expected that the more educated the parents are, the more likely they are to be accessible to developmental initiatives which improved family nutrition and less risk of childhood malnutrition. Proper knowledge of mothers in relation to nutrition and health concepts contribute to improvement of nutritional status especially in Africa where women involve much in caring of children and family.

Weight of children was positively correlated with height. Body mass index was positively correlated with weight and negatively correlated with height. Similar results have been reported by Anderson (1979), Garn (1986), Smalley (1990) and Micozzi (1986). However, Garn (1986) suggests that the magnitude and sign of correlation between height and body mass index is age dependent. It is positive with children, decreases with age and becoming negative in middle age. The present study revealed opposite results. Correlation between height and body mass index in children aged 3-6 years was negative while for children aged 7- 12 years no significant relationship between height and body mass index observed.

Nutritional status of a child is determined by many factors. The present study did not include factors such as food security, access to health services, maternal and child care and sanitation that might affect nutritional condition of children. For example Blaney et al. (2009) found that access to care and health services was the best predictor of nutritional status of children aged 6 months to five years in protected areas of Gabon.

4.4 Relationship between Number of Meals, Food Price, Household Income and Number of Livestock the Household Own

Increase in distance from the park and the lake was related with decrease in bushmeat and fish consumption. This is in agreement with Campbell et al. (2001) and Nyahongo et al. (2009) The observed negative correlation between fish meals and bushmeat meals suggest that increase in availability of fish reduce consumption of bushmeat and vice versa. This can also be explained by the observed negative correlation between fish meals and price of fish and between price of fish and price of bushmeat. In addition, bushmeat meals were positively correlated with fish price. Hence, fish and bushmeat were substitute diets. The results are in agreement with a study by Brashares et al. (2004) in Ghana based in 30 years data which revealed that years of poor fish supply coincided with increased hunting in nature reserves and sharp declines of wildlife species. According to the author, fish supply was linked negatively to the price of fish, the number of wildlife hunters, and the sales and supply of bushmeat in local markets. Another negative relationship between fish and bushmeat consumption has been reported in Gabon by Wilkie et al. (2005) and in Congo by (Nasi et al. 2008). This implies that bush meat consumption in western Serengeti is high during the movement of migratory herbivores since its availability is high (Nyahongo et al. 2009). Apaza

et al. (2002) found that the price of fish and meat from livestock was positively correlated with consumption of wildlife by Tsimane Amerindians in the rainforest of Bolivia. However, Wilkie and Godoy (2001) found that decrease in the price of meat from livestock is likely to decrease the consumption of fish but not bushmeat in Amerindians society.

Fish meals, milk meals, egg meals and chicken meals were positively correlated with income while bushmeat price was negatively correlated with income. This suggests that bushmeat is an alternative source of protein to fish and livestock product and is consumed more by poor households. Increase in income results into increase in consumption of fish and livestock products and decrease in bushmeat consumption. When fish supply decrease, fish price increase and poor people will not afford to buy it; hence they will shift to bushmeat. The results are in agreement with Loibooki et al. (2002) who found negative correlation between wealth and participation in illegal hunting. According to the author, people with access to alternative means of generating income and getting protein were less likely to be involved in illegal hunting. In Democratic Republic of Congo it was found that poorer households use less fish compared to rich households. Wilkie et al. (2005) also reported similar results in Gabon. However, the results are in disagreement with Fa et al. (2009). According to the author, in areas where average wealth was highest, bushmeat was more expensive and wealthier households ate it more in Equatorial Guinea. In addition, they found that wealthier households ate less fish. Kumpel et al. (2010) also reported positive correlation between income and bushmeat consumption in Equatorial Guinea.

The number of beef meals, milk meals, and egg meals were positively correlated with number of livestock. The price of beef was higher than price of bushmeat and negatively correlated. Seventy two percent of respondents said they preferred bushmeat because it was cheaper than beef and chicken. Campbell et al. (2001) found that increase in income and livestock ownership was related to decrease in number of arrested hunters. This suggests that livestock play a major role in food and income generation hence reduce the dependence on wildlife as source of food and income. However no relation observed between number of livestock owned and number of bushmeat meals. This is in agreement with Mfunda and Røskaft (2010).

5 Conclusion and Recommendations

Nutritional status of children from villages which are close to Serengeti National Park and Lake Victoria is better compared to children from communities further away from the Park and the Lake. Fish meals were higher than bushmeat meals in the village which was close to both the lake and the park while bushmeat meals were highest in the village which was close to the park. However, there was no significant relationship between bush meat utilization and nutritional condition of children.

Beef and milk meals were highest in the control village. Consumption of livestock products (milk, beef and eggs) was positively correlated with the number of livestock and income. Improvement of livestock production especially chickens which are easy to protect from predator can increase food and income, hence reducing dependence on wild meat.
Education level of parents had positive effect on nutrition status of children. Nutrition and health education can improve the nutrition of children.

The present study focused only on the contribution of bushmeat and fish to nutritional improvement. Since nutritional status of a community is determined by many factors, I recommend further studies which will address other factors such as access to health services, sanitation and food security in order to come up with clear findings on the effect of each factor.

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7 Appendix: Questionnaire

1. Questionnaire no. _____ 2. Date: _____ 3. Interviewer:_____

Personal information

4. Village: _____ 5. Ward: _____, 6. District: _____

7. Gender: male /female

8. Age: (a) 15-30 years (b) 31-45 years (c) 46-55 (d) more than 55 years

9. How long have you lived in this village? (a) less than 15 years (b)16-30 years (c) 31-45 years (d) more than 45 years

10. Tribe……..

11. Level of education completed……. (a) Non (b) primary education (c) secondary education (d) Collage education (e) graduate degree (f) post graduate degree

12. Did you born in this village? (a) yes
(b) no

13. If no, why did you move here?

(a)To acquire land for agriculture

(b)To find employment

(c) Hunting
(d) Others, specify

14. How many children do you have?.....

15. What is the main source of family incomes? Rank it from 1-6, 1 = the major one and 6= the last one

Activity	Ranking order
Farming	
Livestock	
Fishing	
Formal employment	
Business	
Hunting	

16. What is the total income of the family per month?
(a) Less than 50 thousands (b) 50-100 thousands (c) 101-150 thousands (d) more than 150 thousands

17. Do you own livestock? (a)Yes (b) No
If yes, how many?

Livestock	Number
Cattle	
Goats	
Sheep	
Pigs	
Chicken/poultry	

16. How do often eat the following foods?

Food	Never or less than once per months	Once per month	2-3 times per month	Once per week	2-4 times per week	once per day	2 times or more per day
Fish							
Livestock Meat							
Bush meat							
Milk							
Eggs							

18. What is the price of livestock meat? (per kg)…….....
……

19. Do all family members take bush meat meals? (a)Yes (b) no

20. If no, which group of the family members do not take bush meat meals? What are the reasons?.....
.....
.....

21. Why do you eat bush meat?.....
Cheap price
Good taste
Have high nutrients
Medicinal reasons
It is our culture

22. Where do you get the bush meat?
Hunting yourself
Buying from other hunters

23. If you buy from hunters, what is the price? (Per kg)……..

24. If you are a hunter, do you hunt inside the National Park (or Game Reserve)? (a)Yes (b) No.

25. During which time of year is hunting most common? (a) Spring (b) Summer (c) Autumn (d) Winter

26. Are you aware on laws relating to bushmeat hunting? (a) Yes (b) no
If yes, what is your opinion concerning the laws? ……
……

27. Which animals do you prefer most?

Animal	Reasons
1.	
2.	
3.	
4.	

28. have you experienced any health problem (disease) because of consuming bush meat? (a)yes (b) no
29. If yes, what was that disease?.....
.....

30. Who suffered from the disease? (a) kids (b) father (c)mother (d) whole family
(e) others, specify

31. How did you handled it?.....
.....

32. Where do you get the fish for your family? (a) fishing (b) buying from fishermen (c)buying from the market/shops

33. What is the price of fish? (per kg).....

34. Measurement of children in the household:

Gender of a child	Birth date	Weight	Height