International Journal of Medical, Medicine and Health Sciences
ISSN: 2517-9969
Vol:10, No:9, 2016

Determinants of Selenium Intake in a High HIV Prevalence Fishing Community in Bondo District, Kenya

Samwel Boaz Otieno, Fred Were, Ephantus Kabiru, Kaunda Waza

***Abstract*—**A study was done to establish determinants of selenium intake in a high HIV prevalence fishing community in the Pala Bondo district, Kenya. It was established that most of the respondents (61%) were small holder Farmers and Fishermen {χ^2 (1, N=386) p<0.000}, and that most of them (91.2%) had up to college level education {χ^2.(1, N=386) p<0.000}, while the number of males and females were not significantly different {χ (1, N=386) p=0.263} and 83.5% of respondents were married {χ^2 (1, N=386) p=0.000}. The study showed that adults take on average 2.68 meals a day (N=382, SD=0.603), while children take 3.02 meals (N=386, SD=1.031) a day, and that in most households (82.6%) food is prepared by the women {χ^2 (1, N=386) p=0.000} and further that 50% of foods eaten in that community are purchased {χ^2 (1, N=386)=0.1818, p=0.6698}. The foods eaten by 75.2% of the respondents were *Oreochromis niloticus*, *Lates niloticus*, and *Sorghum bicolour*, 64.1% vegetables and that both children and adults eat same types of food, and further that traditional foods which have become extinct are mainly vegetables (46%). The study established that selenium levels in foods eaten in Pala sub-locations varies with traditional vegetables having higher levels of selenium; for example, *Laurnea cornuta* (148.5 mg/kg), *Cleome gynandra* (121.5 mg/kg), *Vignia ungulata* (21.97 mg/kg), while *Rastrineobola argentea* (51 mg/kg), *Lates niloticus* (0), *Oreochromis niloticus* (0) *Sorgum bicolour* (19.97 mg/kg), and *Sorgum bicolour* (0). The study showed that there is an inverse relationship between foods eaten and selenium levels {RR=1.21, p=0.000}, with foods eaten by 75.2% of respondents (*Oreochromis niloticus*/*Lates niloticus)* having no detectable selenium. The four soil types identified in the study area had varying selenium levels with pleat loam (13.3 mg/kg), sandy loam (10.7 mg/kg), clay (2.8 mg/kg) and loam (4.8 mg/kg). It was concluded from this study that for the foods eaten by most of the respondents the selenium levels were below Daily Reference Intake.

***Keywords*—**Determinants, HIV, food, fishing, selenium.

I. Introduction

HIV and AIDS are having a major impact on nutrition food security and agricultural production in rural societies in many African countries [1]. All dimensions of food security; availability, stability, access and use of food is affected where HIV prevalence is high. In households coping with HIV/ AIDS, food consumption generally decreases, the family may lack food and the time or means to prepare the food. Reduced capacity for farming translates to reduced subsistence ability of the infected households [2]. Access to quality food such as meat, fish and vegetables may be affected while there is inevitable shift to low quality foods. In addition, frequency of eating may be reduced and limited to few items that the available budget can accommodate.

Food plays a central role in care and management of diseases including HIV/AIDS [6]. There is evidence of inadequate nutrition for women of child bearing age, particularly in high risk areas with poor food resources, which may reduce mother to child transmission of HIV.

A. Materials and Methods

1. Subjects

The study focused on communities in Pala Sub-Location Bondo District. The choice of study District was based on HIVAIDS prevalence, and the predominant livelihood activity, which is farming. The district lies at an altitude between 1125 to 2275 meters above sea level and is relatively, highly populated. The farming activities are bound by rituals many of which involve sex [8], traditionally, widows retain use of the land through inheritance; however, due to the stigma most of them end up on the beaches where they continue spreading the disease. This is particularly the case for AIDS widows.

B. The Study Design

This was cross-sectional and involved a household survey on dietary patterns of the study subjects and foods they consumed.

C. Sampling Procedure

A four step sampling method was used to select the households. The sampling was based on administrative boundaries since prior-knowledge of the household's strata was not available. All households living within the area were eligible to be sampled. The urban/market areas were excluded because of their cosmopolitan nature. The first step sampling focused on administrative divisions within the district; the second stage focused on administrative locations, while the third stage focused on selecting the sub-locations. The fourth stage was the random selection of households within the sub-locations, after consultation with the local leaders to identify the areas with the greatest impact of HIV/AIDS and livelihood activities, which are predominantly farming and fishing. Using the list from the Kenya Bureau of Statistics individual respondents were chosen. The sample size of households was

Samwel Boaz Otieno, PhD is with the Nutrition Department, Kenyatta University, Nairobi, Kenya. Fred were PhD. School of Medicine, University of Nairobi Kenya, Ephantus Kabiru PhD, School of Public Health Kenyattaa University, Kaunda Waza MMD, Keneth Kaunda Foundation Zambia (e-mail: samwelbotieno@yahoo.com).

determined by an earlier formula suggested [10], in which the required minimum sample be given by the formula:

$$N = \frac{Z^2 P (1-P)}{C^2}$$

where Z= Value of level of significance, P= of 7.8%, which is the prevalence of HIV/AIDS in Bondo, C= Expected error level (level of precision preferred).

The desired C for this study will be set at 10% or 0.1, the statistical significance of 95% or 1.96. While the value is determined by the prevalence of HIVAIDS in the Bondo District, which is 7.8% or 0.078 [7]. Thus, the resulting minimum sample size was 27 households.

1. Specific Study Site

The Pala sub-location in Bondo Division lies about 27 kilometers west of Bondo Town and, and is typical a mixed farming and fishing community located along Lake Victoria [3]. Fishing is the predominant activity with 75% participating in it. The beaches attract a continual inflow of people, young men in pursuit of immediate income, and women following them. Drinking, casual sex, theft, HIV/AIDS and high death rates are common features. Farming is mainly at the subsistence level. Nearly all households plant a local variety of maize and sorghum. The maize yields are low, about 1-1.5 tons per acre. The average land holdings are 2 acres with most of the land preparations is being carried out manually.

2. Training of Enumerators

About 10 enumerators were identified. They were given training on the purpose of the research and methods of data collection. Care was taken to select only those who understand the local language and who have at least secondary school level of education.

3. Obtaining Consent from the Community

Before sampling, official information regarding the study was conveyed to the local chief and village headmen to ask them to inform the villagers of the intentions research. The research team also attended *Baraza* to be introduced to community members. The permanent residents were identified. Following preliminary acceptance, the study procedures and implications were explained and their consent was sought.

4. Inclusion Criteria

1. The respondents had to be permanent residents of the sub-location.
2. They had to be over 18 years.
3. They consented to be interviewed.

5. Exclusion Criteria

1. Those living in urban areas.
2. Those below the age of 18 years.
3. Non-permanent residents of the study site.
4. Respondents who did not consent to taking part in the study.

D. Data Collection

Research assistants helped identify the households in Pala sub-location using census registers. The rapid appraisal methods, which included, interview with structured questionnaires, focused group discussion, and interview of key informants, was used to collect the data.

1. Data Collection Methods

Data collection was done by three methods:

(a) Direct Observations

Activity analysis was undertaken to establish the work the communities are involved in on daily basis. The enumerators recorded relevant information they observed in the surroundings.

(b) Standardized Questionnaire

The enumerators carried out in-depth interviews of sampled respondents using a standardized questionnaire. This enabled us to acquire quantifiable information.

(c) Key Informant Interviews

In-depth interviews were conducted with key informants, who were used to explore and deepen the understanding of the issues raised and to validate the information collected by the questionnaires. The key informants include Agricultural Officers, Healthcare Medical Officers, District Veterinary Officers, Social Workers, and the Local Chief. The interview was centered on agricultural productivity, food security and the dietary behavior patterns of the study population in Pala. The discussion also explored the corroborating evidence of the already adduced factors from the individual interviews of respondents.

(d) Sampling of Foods

About 17 foods commonly eaten in Pala were sampled. The foods were transported in sealed polythene bags at room temperature to the Kenya Bureau of Standards laboratory in Nairobi for analysis.

(i) Laboratory Analysis of the Foods

The foods were analyzed by the method suggested earlier [9], [11]. Food materials (0.5 grams) were first put in hydrogen peroxide followed by digestion in Perchloric acid to remove organic matter. The selenium level was determined by an Atomic Absorption spectrophotometry after making the appropriate dilutions as follows; approximately 0.50 grams of sample was accurately weighed and put in a graduated tube. Nitric Acid (0.75 ml) and 2.25 ml hydrochloric acid (HCl) were measured and carefully added (in the case of food stuffs, 30% Hydrogen Peroxide and 1.25 ml HCl was used because of the high organic content). The contents were thoroughly mixed with test tube shaker. The mixture was heated at 80 °C for one hour on an aluminum heated block, before it was allowed to cool. Approximately 11.5 ml of distilled water was added, mixed thoroughly and allowed to settle. A portion of the solution was centrifuged for AAS (Perkin Elmer AAnalyst 300, Germany). The standards were prepared from TITRISOL

stock solutions with same amount of acids i.e. 1 ppm concentration of solution equals 30 ppm in the sample.

The solvent was evaporated from the analyte, through a desolvation process at 2500 °C leaving particles monometers in size. The resultant solid particles were converted into gasses molecules. The resultant particles were irradiated from a hallow cathode lamp, through the long axis of the flame. The radiation atomizes the analyte particles into ions, and the resultant atoms absorb radiation of a defined wavelength and the electrons are promoted to higher energy levels for nanoseconds. The resultant radiation flux with the analyte and without (the standard) analyte (absorbance) was by a detector and gave a ratio which was converted into quantity in milligrams of analyte in the sample.

II. Statistical Analysis

Selenium levels in food sample were calculated as milligrams per kilogram, while the mean food consumption was calculated from the frequencies of responses. The frequencies of food eaten were done as percentages. The frequencies were calculated and further analysis of the variables done using χ analysis.

III. Results

A. Households' Demographics

In this study, 386 respondents were interviewed in four villages in the Pala sub-location of the Bondo district. The permission to interview the farmers was obtained from the local administration. Most farmers were willing to be interviewed after the purpose of the research was explained to them. Most respondents interviewed were mainly small scale farmers and artisan farmers. The dietary behavior of farmers was obtained by asking respondents about what they eat, where they obtain it from, how many meals they take per day, and if there are some foods they do not consume. Additional information focused on foods which have become extinct. As shown in Table I, most respondents were crop/livestock farmers (33.8%) and Fishermen and women (27.6%), the two categories constituted 61.4%. Petty trade and other occupations constitute only about 38.6% {(χ^2 (1, N=386)=13.430, P<0.05)}.

TABLE I
Demographic Characteristics of Study Population

Characteristic	Number (%)	χ^2 (df)	P-value
Level of Education			
None	34 (8.8)	282.265 (df=1)	P<0.05
Primary-College	352 (91.2)		
Marital Status			
Single	61 (16.2)	166.227(df=1)	P<0.05
Married	309 (83.8)		
Gender			
Male	204 (52.8)	1.254 (df=1)	P>0.05
Female	182 (47.8)		

Most respondents (67.9%) were in the age group 18-35 years. The results show that the age group 46 to 55 years constitute only 11%, while age group 56 years and above constitutes 13%, which reveals the characteristic "chimney effect". This age distribution was found to be significant {χ^2 (1, N=386), =13.430 p=0.000}.

It was also found that 52.8% of respondents were males, while 47.2% were female, as shown in Table 6, below. This distribution was found not to be significant, {χ^2 (1, N=386), =1.254 p=0.263}. It was established that most of the respondents were married (83.5%) while 16.2% were single, and 0.3% were widowed. This distribution of marital status was found to be significant {χ^2 (1, N=370,) 166.227 p=0.000}. The results indicate that the majority of respondents (71%) had a primary level of education, while some 8.8% had none. The distribution of the level of literacy was found to be significant {χ^2 (1, N=386) =262.285 p=0.000}. Most of the respondents (46%) reported that they have more than three children while, 40% less than three children and 14% had none.

B. Food Consumption Patterns

1. Sources of Foods Eaten in the Family

About 50% of respondents indicated that they normally purchase the food consumed in their households, while 41% of eaten are foods produced on the farm {(χ^2 (1, N=386) = 0.1818, p=0.6698} (Fig. 1).

Among the foods produced on the local farms are maize, sorghum, beans, cow pea, and ground nuts. The foods purchased include fish, omena (Kenya) (dagaa - Tanzania), sugar, meat, bread and rice. The majority of respondents indicated that normally they do not have enough to eat for six months of the year.

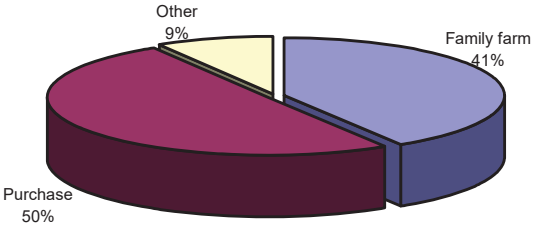

Fig. 1 Sources of food

The majority of respondents (97%) indicated that they do not have access to enough food between January and June. It was also established that 90.1% of respondents purchase food when the rains fail, while 1.6% receive food relief, 3.1% get food from relatives, while 0.3% are given food from friends.

2. Number of Meals Taken per Day

The majority of respondents indicated that both children and adults consume at least three meals per day, adults consume a mean of 2.68 ±0.603, while for children it is 3.02 ±1.031; the mode is of three meals for both adults and children. However, some adults indicated that they consumer only one meal per day, while the maximum meal intake was eight meals per day for children. It was also established that in most households (82.6%), the women prepare food for the family, which was found to be significant (χ^2, P<0.001). The

majority of respondents (88%) also indicated that their cooking style has changed, {χ^2 (1, N=382) =164.518 p=0.000}.

3. Foods Eaten by Adults and Children Throughout the Year

It was found that the majority of respondents (75.2%) eat fish (Nile Perch and Tilapia) and Ugali (red/brown/white sorghum). About 64% also indicated that they eat vegetables, with 24% indicating they consume omena (dagaa), which is a small silvery sardine-like fish which is high in calcium.

It was established that foods eaten by children throughout the year varied and included ugali (red/white/brown sorghum) at 68.1%, fish (Nile Perch/Tilapia) 60.7%, as well as vegetables (54.4%) and omena (21.1%), as illustrated in Table II.

TABLE II
FOODS EATEN BY ADULTS AND CHILDREN THROUGHOUT THE YEAR

Foods	Frequency (n=379) adults		Frequency (n=298) Children	
	n	(%)	n	(%)
Fish (*L. niloticus*, *O. niloticus)*	285	75.2	181	60.7
Ugali (*S. biclour spp-white*)	285	75.2	203	68.1)
Vegetables (Miscellaneous)	243	64.1	162	54.4
Omena (*R. argentea*)	91	24.0)	63	21.1
Tea	61	16.1	49	16.4
Meat (*red beef*)	55	14.5	26	8.7
Beans	52	13.7	43	14.4
Sukuma Wiki (Collard Greens)	47	12.4	-	-
Rice (*Oryza* ssp.)	25	6.6	23	7.7
Nyoyo (*Githeri*)	24	6.3	12	4.0
Chicken (*Gallus domesticus)*	22	5.8	-	-
Sweet Potatoes	20	5.3	-	-

4. Selenium Levels in Foods Eaten in Pala Sub-location

As shown in Fig. 2, the selenium levels in foods eaten in Pala varied. Three types of cereals eaten in this community were identified; these are Sorghum, Finger millet, and Maize. The selenium levels in the cereals varied with *Sorghum bicolor spp*. (Red) 19.67 mg/kg, (Brown) 12.27 mg/kg, *Zea mays* var. *everta* 15.67 mg/kg while *Sorghum bicolour* spp. (White), *Eleusin coracona* and *Zea mays* var. *amylacea* had no detectable levels selenium. Six vegetable species were eaten in this community. The indigenous vegetables had high levels of selenium, *Cleome gynandra* 121.97 mg/kg, *Laurnea cornuta* 148.50 mg/kg, *Vigna ungulata* 21.97 mg/kg while *Solanum nigram*, *Vignae radiate* and *Crotolariae ochroleuca* had no detectable levels of selenium. Four fish species eaten were identified. The selenium levels in most fish species were undetectable, *Lates niloticus, Oreochromis niloticus,* and *Hapochromine* sp., while *Rastrineobola argentea* had 51.00 mg/kg.

IV. Discussion

A. Demographics of the Study Population

In this study most respondents interviewed were either crop or livestock farmers (61.4%), while 24.6% were observed to rely on off farm income activities such as small scale business-men or women. These findings, which tends to be similar to the findings in earlier studies [3] cited above, could be as a result of coping responses due to a lack of production or could due to changes in attitude towards farming. It was also observed that there is increase of the off farm income, of which petty trade labour for pay constitutes 30%. These results also tend to be similar to other observations [4] and do compromise the food security in households, while they are also likely to affect the environment due to a reliance on wild vegetables.

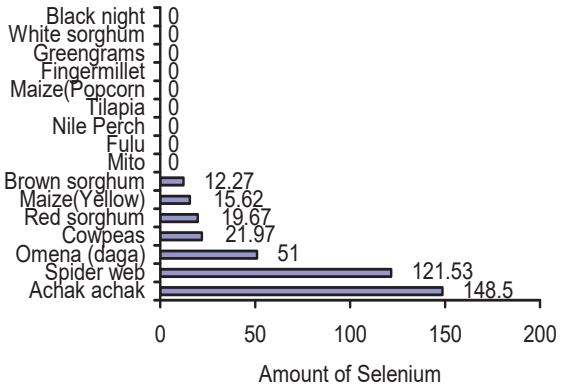

Fig. 2 Selenium levels (mg/kg) in foods consumed in Pala sub-location

Education is a basic need for human development and several studies have shown that as basic education increases, so too does the rate of economic growth and rise in agricultural productivity. Literacy levels in Kenya vary with gender with female literacy levels being 74.8%, compared to males at 88.3%. In this study, the combined literacy level is 91.2%, which compares very well with the national literacy rate. It is possible that this level is slightly higher due to the free primary education policy adopted by the government. This literacy level is quite encouraging, as it is not clear why it is not translated into higher agricultural productivity, and hence food security and good nutrition in households in this particular community.

The age distribution of respondent's shows that the largest number of small-hold farmers were in the age group 18 to 40, which constituted about 67.9 % of all age groups. It is likely that the demographic changes observed, the "chimney effect", is due to the impact of HIV and AIDS in this community. These observations are similar to those first reported in 1989 and are typical of a highly affected HIV/AIDS population. This has serious implications for food security in this community, since it compromises production and hence the supply of nutrient-rich foods due to the effects on intergenerational knowledge transmission and labour. It also reveals reduced life expectancy levels in this village, with 67.9% of the population living up to 35 years of age or below.

B. Food Consumption Patterns

Food security is associated with the capacity of a household to bring in income from other sources so as to access and

purchase food, in addition to farm production [5]. Eating well keeps a person healthy and productive, as well as improves the body's immunological system and helps protect against infection [5]. The efficiency of most drugs is also enhanced by better nutrition.

Respondents purchase 50% of the foods they consume, which include sugar, salt, rice, bread, and fish, which is produce that is mostly not grown locally. The majority of respondents (97%) also indicated that normally they do not have enough food to eat during certain periods of the year, mainly from January to June. During this time, it was established that 90.1% of the respondents purchase additional food, 1.6% receive relief food, 3.1% get food from relatives, while 0.3% from friends. These observations indicate the main factor influencing food consumption patterns is the seasonal variation of the rains.

Most of respondents take a mean three meals per day, for adults {2.68, N=386 SD=0.603} and for children {3.02 SD=1.031}. However, a small number indicated that they consume up to five meals per day, while some children consumed up to eight meals per day. This could supply adequate nutrition to respondents; however, further investigation revealed that some respondents classify the type of meals consumed varied and may not be nutritious enough to meet the Required Daily Intake of nutrients. These observations tend to suggest relatively conservative lifestyles among farming communities whose livelihood activities revolve around the homestead. This is further confirmed by the majority of respondents (82.6%) who reported that it is the women who prepare the foods at home, while 78% reported that firewood is the source of fuel, and the majority of respondents also reported taking their meals together, breakfast (72%), lunch (66%), and dinner (88.3%).

Cooking style in this community was reported to have changed, according to 88% of respondents. The reason given included the use of additives, as well as the increased literacy level and youthful population. It could also be due to the fact that 50% of the foods consumed at the household level are purchased, some of which are non-traditional, and hence require different methods of cooking. This factor is also likely to affect the consumption of selenium rich foods by the respondents in the community.

C. Selenium Levels in Foods

The study also observed that the food mostly eaten by adults are fish (Nile Perch, Tilapia, Fulu) 75.2%, *Ugali* (red millet/sorghum) 75.2% and vegetables 64%. Both fish and red millet/sorghum are traditional foods among the communities living along the shores of Lake Victoria Kenya. Hence the findings tend to confirm the narratives about the eating habits of the local communities. The study also found that the foods mostly eaten by children are *Ugali* (red millet/sorghum) 68.1%, fish (Nile perch/tilapia) and traditional vegetables. This is consistent with the observation on the dietary patterns of adults and indicates that both adults and children eat same types of foods, which could suggest that eating habits are determined by the cultural practices of the community. However, some types of foods mainly of animal origin, which includes pork, porcupine and some types of fish like *Okoko* with spines, are considered not safe for consumption by children. The selenium levels in foods eaten by the community were found to be highly deficient. Most of foods eaten in the community had no detectable levels of selenium. The foods with very high levels of selenium were found to be traditional vegetables, which were reported to have become extinct.

V. Conclusion

Selenium levels in foods eaten in this community varies, with traditional vegetables including *Cleome gynandra* (121.53 mg/kg) and *Laurnea cornuta* (148.5 mg/kg) having the highest level, although are only eaten by negligible number of respondents. While most of the foods consumed by respondents, such as *Lates niloticus (0)*, and *Oreochromis niloticus (0)* are deficient in selenium

VI. Recommendation

From the study it would be recommended to increase selenium levels in local diets, higher production and consumption of traditional vegetables should be encouraged, in the short term, while in the long term, intervention should include fortifying the foods commonly purchased and eaten in the community including sugar, table salt, and maize meal.

References

[1] Akande T, (2006) HIV/AIDS and Agriculture; Implications for food security in West and Central Africa; *Systemic Initiative on HIV/AIDS and Agriculture*, Africa Rice Centre; 88-90.

[2] Adeyeye VA, (2006); Elements of A frame Work for Analyzing, combating HIV/AIDS And protecting for food security; HIV/AIDS and Agriculture, *Implications for food Security in West and Central Africa*;39-40.

[3] FAO/IFAD (2002), Labor Saving Technologies and Practices for farming and Household Activities under Conditions of labor Stress: *A study of Constraints and the impact of HIVAIDS on Household Livelihoods in Busia and Bondo Districts, Western Kenya*, 18-22.

[4] MoLFD (2004), Impact of HIV and AIDS on Fisheries and how the Ministry of livestock and Fisheries can respond. *Report of Study on impact of AIDS Fisheries*.

[5] Mano R, Chipfupa U, (2005) Empirical Assessment of Impact of HIV/AIDS on Agricultural performance and Food Security of rural Families; *FANPRPAN- Zimbabwe,60-83*

[6] Moutairou E, (2005) Fortification of foods for HIV/AIDS-Affected people;25-28

[7] NACC (2007*), Kenya HIV/AIDS data booklet*; 14-16.

[8] Ochola, O. W, Muhia Njeri, R, Mwarasomba, L. I. (2000), Culture, Traditions, and Society the Challenge to Natural Resource Management, *A report from socio- cultural study of the Lake Victoria region: Kenya;* 13, 16, 23.

[9] Mitoko-Ohayo G J A (1995), Concentrations of heavy metals, organochlorine Pesticides, organic and microbial pollution in the Nairobi River and Its Tributaries, Volume 1: The government of Netherlands; *The Royal Netherlands Embassy, Nairobi, Kenya.19-20*.

[10] Otieno SB (2013) Selenium levels in foods in a high HIV prevalence community in Pala Bondo District Kenya, *East Africa Journal Of Public Health.*

[11] William RM, Stephen GC (2008) Elemental Analysis Manual: Section4.4A, Inductively Coupled Plasma-Atomic Emission Spectrometric Determination of Elements in Food Using Microwave Assisted Digestion; *Appendix A Supplemental Information of In house Method Validation Version I* (June 2008).