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Contribution of Amaranth Grain (*A. Cruentus*) on dietary intake and Nutritional Status of Adults Living with HIV in Mweiga, Nyeri, Kenya

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ABSTRACT

Globally, there is high prevalence of macro and micronutrient deficiency among people living with HIV (PLHIV) which can jeopardize the quality of life. Under nutrition is a major cause of death among PLHIV. Use of nutrient dense foods can be one of the interventions to deal with this challenge. Amaranth grain has high kilocalories, high biological value proteins, better amino acid and micronutrient profile than nearly all cereals. However, it is not commonly used as part of diet especially among adults. The main objective of this study was to determine the contribution of amaranth grain consumption on the dietary intake among PLHIV for improved nutritional status. Experimental design was used to conduct an intervention study which involved daily consumption of amaranth grain porridge for six months. A comprehensive sample of 66 Adults living with HIV attending Mweiga homebased care group and not on antiretroviral therapy was used. Results showed increase in mean energy consumption by 13.1% and 16.7% for males and females respectively after inclusion of amaranth grain in the diet. The proportion of respondents consuming adequate protein increased from 19.4% to 96.8% for males and from 22.9% to 97.1% for females. The proportion of the respondents who met the RDAs for zinc, iron, magnesium, and calcium increased from below 40% to over 77%. Mean weight gain during intervention was 3.35 ± 0.5 kg. Proportion of respondents who were underweight reduced from 71.2% at baseline to 7.6% at month six. Consumption of amaranth grain was positively associated with improved dietary intake among PLHIV. The porridge enabled respondents to meet the RDAs for energy, protein and micronutrients. This lead to the observed weight gain. This study recommends adoption of amaranth grain by PLHIV for improved nutritional status.
KEY WORDS; Amaranth grain, HIV, PLHIV, dietary practices, weight gain, nutritional status.

INTRODUCTION

Human immunodeficiency virus (HIV) is among the world's most devastating health conditions [28]. The disease affects about 33.2 million people in the world of which about 70% are in sub-Saharan Africa [32]. The prevalence of HIV infection in Kenya is 6.3 %. In Central region in Kenya where Mweiga lies, HIV prevalence is 4.6% [17]. Prevalence both of macro and micronutrient deficiency among PLHIV is high. This is due to opportunistic infections related to HIV that leads to increased nutrient needs, reduced nutrient intake, nutrient losses, altered metabolism and poor utilization of nutrients in the body [18]. These increased nutrient requirements if not met, lead to quick progression from initial stages to full blown AIDs and under nutrition [19] [35]. Micronutrient deficiency can lead to low quality of life among PLHIV [29] [30]. To curb this problem, PLHIV are expected to eat extra kilocalories and nutrients [7]. Consumption of large volume of food is a challenge due to symptoms related to opportunistic infection thus a nutrient dense food product can improve nutrient intake. However, there is scarce information on use of locally available nutrient dense food products [33], which can be sustainable at the community level hence need to explore local nutrition interventions. Amaranth grain was first discovered in Mexico and it gained popularity due to its healing and nutrition value [3]. In addition, it has received much research attention because of its resistant to drought compared to other grains and cereals [16]. According to Silva et al (2009) amaranth grain has unique composition of carbohydrates, protein and fat [30]. It contains high biological value protein with high digestibility and bioavailability with a score of 75-82% [10] [2]. The varieties grown in Kenya have been found to have protein content of 17-21%. Amaranth grain is very high in lysine (3.2–18%) an essential amino acid that is so low in most other grains [10]. Lysine helps the body to inhibit the growth and multiplication of the herpes virus which weakens the immune system of those with HIV and AIDS [7] [23] [30]. The starch in amaranth grain consists mainly of amylopectin (94.3%) which are easy to digest [26]. The amaranth grain is also rich in unsaturated fatty acids, especially linoleic acid [21]. A study done on the efficacy of amaranth grain on pig indicated tremendous weight gain [39]. However, similar studies on human being are limited and there is need to explore the potential of amaranth grain on weight gain [26]. The levels of nutrient inhibitors such as tannins (0.1 mg/ 100 grams) and phytates (0.2 mg/ 100 grams) in amaranth have been reported to be within the non-critical range [7]. The high amounts of micronutrients in amaranth grain are beneficial to PLHIV in boosting the immunity and for energy metabolism [30]. However, consumption of the grain in Kenya is still low especially in Central Kenya where only amaranth leaves are used [23]. This is due to minimal awareness of its nutritive value. Restoring both the macro and the micronutrient supply with amaranth grain could be one of the

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most important strategies for improving nutritional status among PLHIV. Therefore this study sought to establish the contribution of amaranth grain consumption on dietary intake and nutritional status of adults living with HIV in Mweiga–Nyeri County.

Objectives
To determine the contribution of amaranth grain consumption on dietary intake and nutritional status of adults living with HIV.

MATERIAL AND METHODS

Raw materials
Amaranth grain was purchased from ALL GRAIN Company. The study used pre-cooked amaranth grain.

Study design and sampling method
Experimental design was used to conduct a study in Mweiga location, Kieni West Division in Nyeri County [6]. Mweiga is one of the areas in Nyeri County that is dry, stricken by high poverty levels and food insecurity [1]. Compressive sample of 66 PLHIV attending Mweiga Home Based Care Group (MHBCG) at Mary Emmaculate Hospital was used.

Data collection tools
The study used a structured questionnaire to collect demographic and socio-economic characteristics of the households. 24-Hour recall, diet diversity questionnaire and food frequency questionnaire were used to generate data on dietary practices. Weight was measured using an electronic weighing scale (SECA model) and a stadiometer for measuring height. Focus group discussions (FGD) were used to generate more information on research variables. This was to generate information on community's perception on amaranth grain consumption and challenges encountered by households with PLHIV in obtaining health care and food**.**

Calibration and pretesting of data collection tool and instruments
The weighing scales were well calibrated using a known weight before use to enhance validity and they were adjusted to zero after every measurement. The weighing scales were calibrated after every ten measurements. For pre-testing, the data collection tools were used twice on the same sample to see if they collected the same data. Data obtained was used to modify the questionnaires. The reliability of the instrument was 0.82 after evaluation using the Cronbach's coefficient test.

Ethical considerations
This study obtained ethical approval from Kenya Medical Research Institute (KEMRI) ethical committee. Written informed consent was obtained from all the respondents.

Description of the intervention
The intervention involved use of amaranth grain (*A. cruentus*) flour. A baseline survey was done at the beginning of intervention to generate information on dietary practices and nutritional status of the respondents. Intervention period lasted for six months. During this period respondents were supplied with 100 gms of amaranth grain flour to prepare 600 mls of porridge for daily consumption. Respondents consumed 300 mls of porridge in the morning and 300 mls in the evening. Every respondent was provided with 1.4 kilograms of amaranth Grain flour fortnightly for six months. For respondents with other affected family members or children under five, amaranth grain flour was increased to cater for each additional member in the household. To enhance adherence, respondents were adequately sensitised on nutritional value of amaranth grain. CHWs were trained and involved in follow up and monitoring process. Data on dietary intake from other foods, weight of the respondents, household food status were all monitored on monthly basis.

Data collection

Each Research Assistant was provided with a questionnaire, a set of anthropometric equipment (bathroom scale, a stadiometer and calibration stones) and a kitchen weighing scale. The Research Assistants accompanied by a community health worker (CHW) visited the homes of the respondent after identifying them from the MHBCG and the questionnaire was administered.

Anthropometric measurements
Height was taken using a stadiometer when the respondent was standing straight and without shoes. The readings were taken at the apex of the head with 0.1 cm accuracy. Weight was taken using electronic bathroom scale (Seca model 770; Seca

Hamburg, Germany) with the respondent having minimal clothes. Measurements were taken to 0.1 grams accuracy. All measurements were taken three times and the mean recorded. Weighing scales were calibrated using the standard calibration stones after every ten measurements.

Dietary assessment

Dietary intake was assessed by use of a 24-hour recall, 7 days food frequency questionnaire and dietary diversity questionnaire.

Data analysis

Quantitative data were analyzed by use of statistical package for social sciences (SPSS) software version 16 at 95% confidence intervals. Data from 24- hour recall were analysed by use of Nutri-survey computer Software. The amounts in grams of ingredients from foods consumed were entered into nutri-survey software to generate the actual amount of kilocalories and selected nutrients consumed per day. These were then compared with the RDAs for PLHIV. Body mass index (BMI) calculator software was used for nutritional status analysis which was classified according to WHO classification [36]. Pearson product moment correlation (r) was used to determine the relationship between nutrient intake and nutritional status. To determine if there was a significant difference between the dietary practices, nutritional status for the pre-test and post-test, t–test for non-independent samples was used. Simple and multiple regression analysis were used to determine the contribution of dietary intake to nutritional status.

RESULTS

Energy intake

Average consumption of energy at baseline was below the RDAs for both males and females (3139 $\pm$ 365 Kcals for males and 2479 $\pm$ 312Kcals respectively) (Figure 1). From month one after introduction of amaranth porridge as part of the diet, up to month six, the mean energy consumption increased to 3549 $\pm$ 386 Kcals and 2892 $\pm$ 330Kcals for males and females respectively. This was above the RDAs. Mean energy intake at baseline and after six months was significantly different ($P<0.05$).

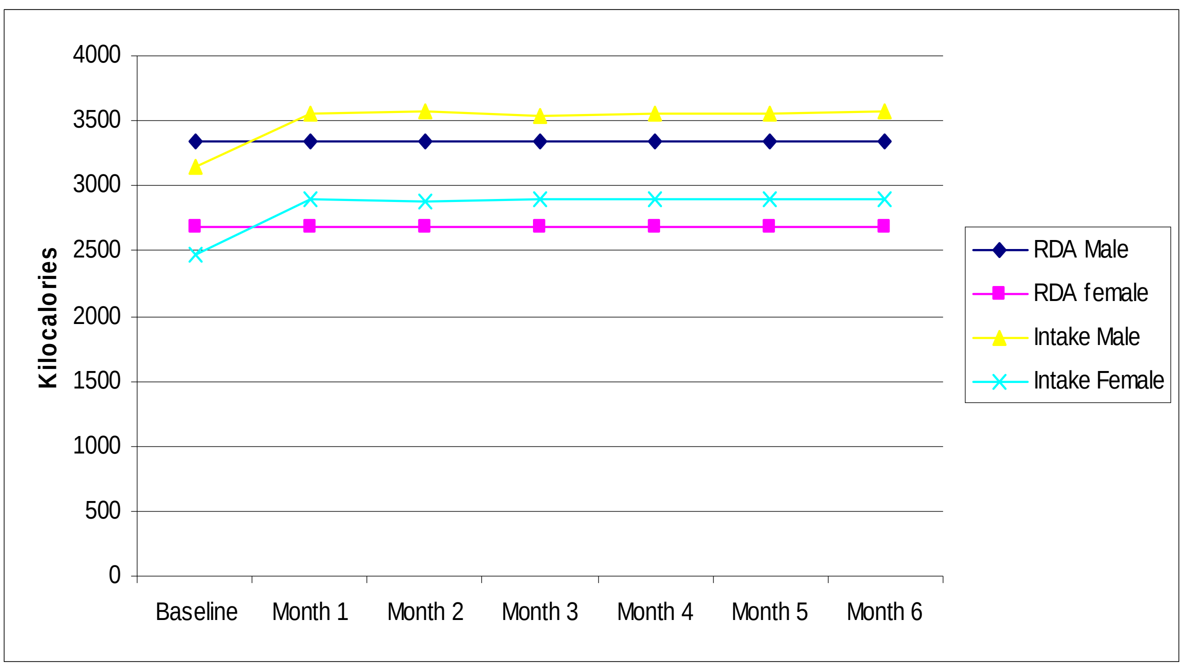

Figure 1. Mean energy intake among PLHIV in MHBCG at baseline and during intervention

Protein intake among PLHIV

There was inadequate consumption of protein by the respondents at baseline (Figure 2). During intervention, the mean intake of protein rose to 59.6 $\pm$ 2.62 g (males) and 56.3 $\pm$ 2.45 g (females) which was above the RDAs. This was due to high content of protein in amaranth grain. Protein intake before intervention and during intervention was significantly different (t (30) =3.46; P=0.046) for males and (t (34) =3.74; P=0.032) for females.

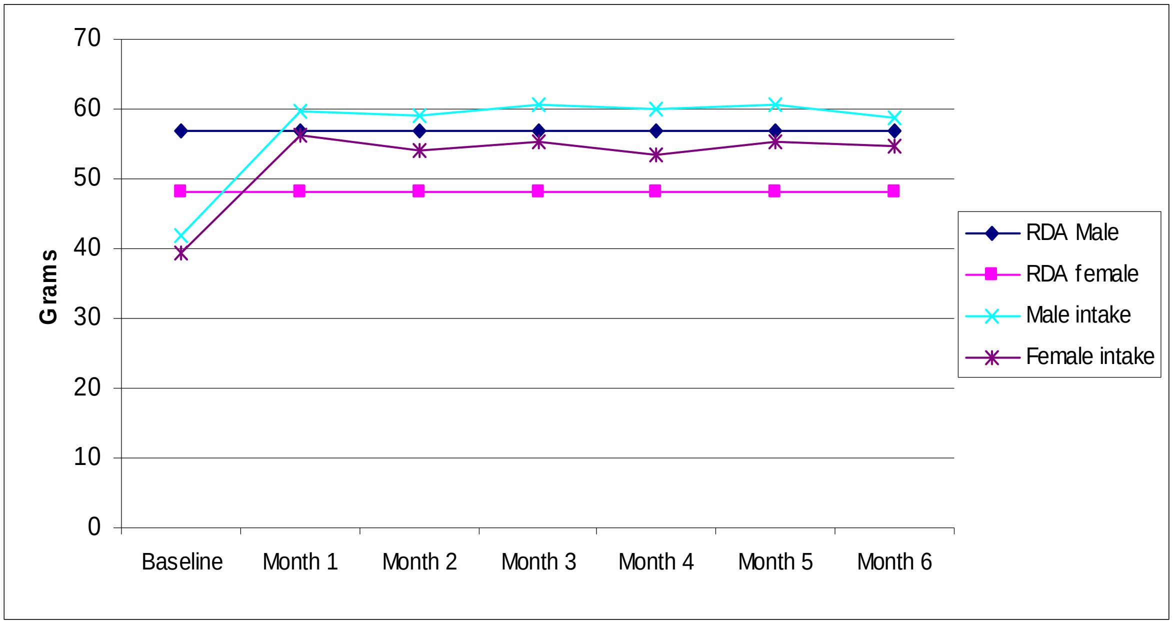

Figure 2: Mean protein intake among PLHIV in MHBCG

Micronutrient intake

Mean intake of selected micronutrients for iron, zinc, calcium and magnesium was below RDAs at baseline (Table 1). However, with introduction of amaranth porridge intake of selected micronutrients increased significantly enabling the respondents to meet the RDA This was attributed to amaranth grain intake which is rich in these micronutrients [17].

Micronutrients (mg)	Baseline		Mean month 1 to 6		P value	
	Female	Male	Female	Male	Female	Male
Calcium	836 ± 7	889 ± 83.0	1102 ± 9	1023 ± 79.0	0.032	0.035
Iron	11.6± 2.8	10.6 ± 2.5	22.6 ± 2.6	21.4 ± 2.1	0.023	0.034
Zinc	4.3 ± 2.4	5.8 ± 2.9	8.6 ± 2.8	10.5 ± 2.2	0.021	0.022
Magnesium	190 ± 75.0	201 ± 82.3	350± 76.2	371 ± 74.8	0.035	0.043
Vitamin E	9 ± 2.2	8 ± 0.3	42 ± 3.3	46 ± 5.1	0.028	0.023

Table 1: Comparison of mean intake of micronutrients at baseline and at six months

Nutritional status among PLHIV in MHBCG

Comparison of nutritional status at baseline and month six among PLHIV

Based on the BMI classification, most respondents were underweight (BMI below 18.5 kg/m^2) at baseline, as compared to BMI at sixth month after intervention (Figure 3). This study attributed this high rate of malnutrition at baseline to inadequate energy intake as noted from the baseline data.

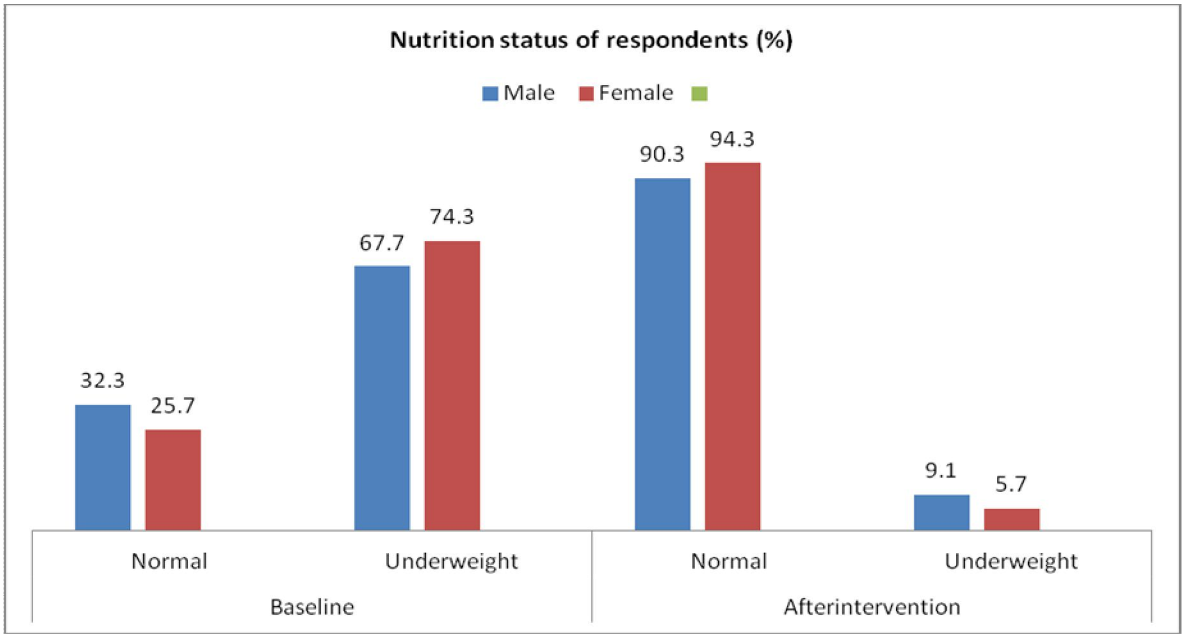

Figure 3: Nutrition status of respondents at baseline and at month six

There was a steady rise in body mass index among the respondents across the intervention period (Figure 4.). The mean BMI for males increased from 18.2 ± 0.17 at baseline to 19.83 ± 0.62 after the intervention which was significant (t (30) =3.72; P=0.041). Equally for females, the increase was significant (t (34) =3.75; P=0.042) that was from 18.0 ± 0.43 at baseline to 20.05 ± 0.26 after the intervention.

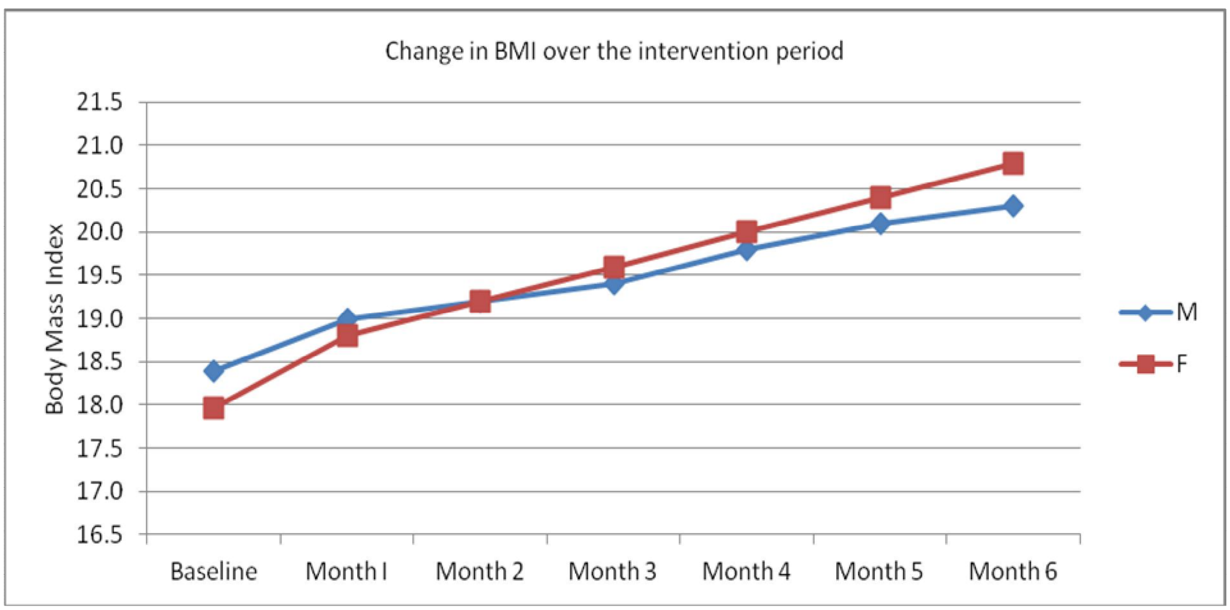

Figure 4: BMI change during intervention

Weight gain during intervention among PLHIV in MHBCG

The study observed a mean weight gain of 3.6 ± 1.1 among females and mean weight gain of 3.2 ± 1.2 among males (Figure 5). The mean weight gain for all the respondents was 3.35 ±1.5. The study found a steady weight gain throughout the intervention period with greater change being noticed from month three as the respondents continued to consume amaranth grain which supplied extra energy.

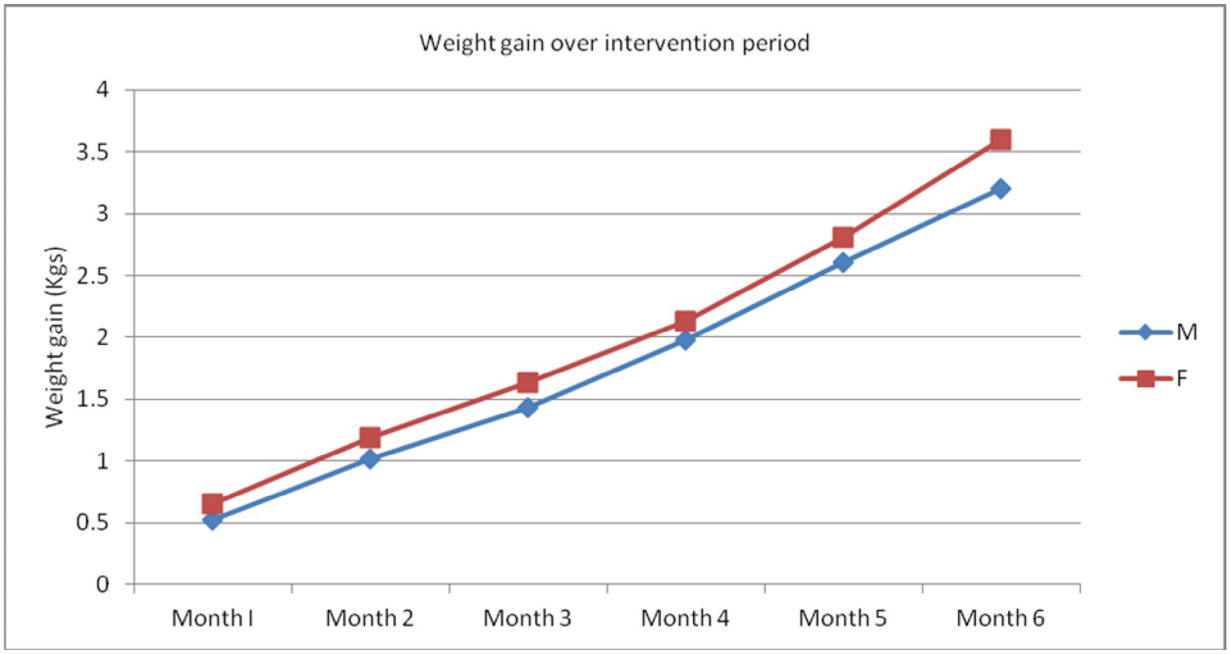

Figure 5: Trends in weight gain during intervention

DISCUSSION

Effect of dietary practices on nutrition status Dietary practices

This current study found out that PLHIV in Mweiga had inadequate intake of energy, protein and micronutrients. This was due to less number of meals consumed per day, no consumption of snacks in between meals and low diet diversity. The findings of this study was in line with other Several studies which indicated PLHIV are associated with poor dietary practices [12] [25] [35]. Poor diets in terms of quantity and quality have a negative impact on nutritional status [5] [14]. Less number of meals led to inadequate energy intake by the end of the day while low DDS affects the quality of diet consumed in terms of micronutrients. Proteins are necessary for maintenance of the muscle tissue among PLHIV and thus inadequate intake leads to muscle Wasting [15]. Though increasing energy intake among PLHIV is one of the recommended critical nutrition practices, this study found out that it was hard for PLHIV in Mweiga to meet the RDAs for energy, protein and key micronutrients required for boosting body immunity without a food based intervention. This agrees with studies by Rawat et al (2010) and Megazzin, (2006) which showed that to meet the RDAs without any food supplementation for PLHIV is a challenge. This is because most households affected by HIV and AIDS are food insecure [4]. In addition, nutrients requirement for PLHIV are high. For PLHIV in food insecure areas like Mweiga, a food based intervention is needed for them to meet the RDA for the increased nutrient requirements. Malvy et al (2009) found food supplementation program a key strategy towards achieving improved diet quality and hence improved nutritional status. In this intervention study amaranth grain porridge increased the intake of energy, protein, iron, magnesium, calcium and iron among the respondents. This enabled the respondents to bridge the energy and nutrient gap in their diet. Study done by (Mugalavai 2013) in India and Mexico show that the amaranth grain has a nutritional value that is better than that of conventional food grains, and is therefore considered to be a good supplement to the commonly used cereal grains. This property contributed to the quality of diet of PLHIV in Mweiga. Another study done in Uganda on consumption of amaranth grain has shown high nutritional profile of the diets and acceptability among communities that have used amaranth grain in the diet [23]. This current study found an improved quality of diet in terms of adequacy of energy and nutrient with consumption of amaranth grain. Dietary intake had a positive correlation with nutritional status. This was in line with a study by (Hendricks et al 2008) who found out those respondents who had high energy intake had higher BMI compared to those with low energy and nutrient intake. The findings of this study also agree with study by Mutunga and Mwadime (2010) in Kenya whereby the result showed that increased food intake though food supplementation to PLHIV with energy dense foods significantly contributed to weight gain among malnourished adult living with HIV.

Nutritional status among PLHIV in MHBCG

High prevalence of underweight among respondents in MHBCG at baseline is not uncommon. Gerrior (2005) and Mangilli et al (2004) cited high rates of wasting among PLHIV as a result of inadequate intake of energy foods, protein, vitamins and minerals which are vital towards achieving and maintain good nutritional status. Consumption of amaranth grain increased the energy intake which in turn resulted to steady increase of BMI among the respondents. According to Tony (2008), adequate kilocalorie intake among people infected with HIV was found to prevent muscle wasting. Moreover, Bukusuba et al (2007), showed that inadequate nutrient intake are common among most HIV affected households and infected individuals. This has been shown to significantly contribute to low BMI. This was the case in this study where most respondents had low quality diets hence poor nutritional status among majority of the respondents. Studies have also indicated a strong relationship between energy consumption and BMI [13] [14] [22]. Amaranth grain intake increase daily energy intake which impacted positively on the BMI of the respondents. This was in line with a study conducted in Uganda by Munyonga et al (2008) which reported improvement of nutritional status among respondents whose diet was supplemented with amaranth grain. There have also been reports of improvement in the health and nutrition status of people who have been fed on amaranth grain (Mwangi, 2003). According to (Mugalavai 2013) amaranth grain contains exceptionally high levels of the amino acids which help in building body cells, repairing body tissues and formation of antibodies to combat invading bacteria and viruses thus it helps in improving nutritional status. A study done among communities in Zimbabwe on consumption of amaranth grain reported the grain to have nutritional and health benefits. These included improvement of specific ailments and symptoms, recovery of severely malnourished children and an increase in the body mass index of people especially those wasted by HIV and AIDS [32].

CONCLUSION

This study concludes that PLHIV in Mweiga had poor nutritional status attributed to low energy and protein intake at baseline. The situation was unlikely to change without nutrition intervention due to food insecurity at household level. Consumption of amaranth grain increased the energy, protein and selected micronutrients (zinc, iron, magnesium and calcium) intake among the study respondents. This increased energy intake resulted to improved nutrition status as evidenced by weight gain and increased BMI at the end of intervention compared to baseline results. Since there was no significant change in dietary intake from the usual food intake of the study population, the observed change in weight can be attributed to amaranth grain consumption. This study recommends amaranth grain consumption as part of the diet for vulnerable population such as PLHIV. This is because it is nutrient dense and can be adopted and grown in Mweiga.

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