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Full Length Research Paper

Level of micronutrient supplements uptake among people living with HIV/AIDS in Kayole, Nairobi County, Kenya

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Micronutrients reduce morbidity and slow the rate of disease progression and thus, micronutrient supplementation in HIV is recommended. This study established the level of uptake of micronutrient supplements among people living with HIV in Kayole, Nairobi County. A cross-sectional analytical design was adopted on a comprehensive sample of 153 adults living with HIV, enrolled at Comprehensive Care Centre in Kayole Health Centre. Data is described by use of percentages while relationships are assessed using chi-square. Qualitative data from focus group discussions and key informants was transcribed and analyzed to complement the quantitative findings. Results showed that only 13.7% of the respondents were on micronutrients at the time of the study. The micronutrient supplements commonly supplemented were vitamin and mineral mix (50.3%), zinc (34%), vitamin B6 (24.2%), vitamin A (24.2%), folate (12.4%), and iron (15%). The main reason for supplementation was; those on Antiretroviral Therapy (66.7%), due to the presence of opportunistic infections (40.5%), those who had no appetite (28.1%), underweight cases (21.6%) and those on tuberculosis treatment (17.0%). The main reason for low uptake was due to stock outs at treatment centre (24.8%), the high cost of supplements (13.7%) and side effects after intake (5.9%). Adults living with HIV are aware of the importance of micronutrients and had taken micronutrient supplements at one point during the treatment period. However, uptake at the time of the study was low. This was due to lack of guidelines for supplementation, high cost of supplements, stock-outs in health facilities and side effects. This study recommends proper education and sensitization on supplementation. Standard guidelines and policies for micronutrient supplementation should be developed. A pull system should be adapted in the supply of supplements.

Key words: Micronutrients, supplementation, people living with HIV, Kenya, adults.

INTRODUCTION

Human immunodeficiency virus (HIV) remains a major cause of mortality worldwide. Micronutrients improve physiological, immunologic functions and metabolic processes important for optimal health. A deficient

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micronutrient profile has been reported in people living with HIV (PLHIV) even when antiretroviral therapy (ART) is taken (Balfour et al., 2014). Micronutrient deficiencies have been problematic in sub-Saharan Africa with a link to high morbidity and mortality rates (Fawzi et al., 2004). Kenya has been reported to have increased rates of HIV infection (Kimanga et al., 2014; Waruiru et al., 2014). It is common that patients with HIV suffer from micronutrients deficiencies especially vitamins A, B complex, C and E and minerals like zinc and selenium (Mehta and Fawzi, 2010). These are fundamental for the integrity of the immune response (Villamor and Fawzi, 2005; Webb and Villamor, 2007). Specifically low levels of vitamins A, B_6, B_{12}, C, D, E, beta-carotene and minerals namely; selenium, zinc, copper, magnesium and iron have been reported in the blood of various HIV positive populations (Tang et al., 2005). These deficiencies are particularly common in HIV-infected persons in developing countries where diets are inadequate (Hussey et al., 2005). Micronutrients deficiency in PLHIV has been associated with accelerated disease progression and mortality (Fawzi et al., 2004). Micronutrient deficiencies are commonly observed with advanced HIV disease and have been associated with higher risks of HIV disease progression and mortality (Balfour et al., 2014). Micronutrient deficiencies may increase viral load by enabling HIV to replicate faster or by weakening the immune system (Baum et al., 2013). Research has found that people with HIV are more likely to show signs of micronutrient deficiencies, compared to uninfected people (Drain et al., 2007; Tang et al., 2005).

Some studies have shown that micronutrients supplementation can correct micronutrient deficiency among malnourished PLHIV (Fawzi et al., 2004). It has been hypothesized that micronutrient supplementation can help to reduce morbidity and mortality of HIV-infected individuals (Balfour et al., 2014). This would be particularly significant for developing countries, where nutritional deficiencies are common due to dietary insufficiencies and recurrent infections (Bhutta et al., 2013). Multivitamin supplements delay the progression of HIV disease and provide an effective, low-cost means of delaying the initiation of antiretroviral therapy (Fawzi et al., 2004). Daily selenium supplementation can suppress the progression of HIV-1 viral burden and provide indirect improvement of the CD4 count. A study by Villamor et al. (2008), showed that micronutrient supplementation had a positive influence on the CD4 count, reduction of genital ulcers incidence, reduction of risk for peripheral neuropathy and decreased risk for clinical diagnoses of extra-pulmonary tuberculosis (TB).

Fortified blended food (FBF) is designed to facilitate faster recovery of moderate and mild malnutrition in HIV (Wood et al., 2008). These are nutrient-dense and contain recommended daily allowances (RDAs) for selected vitamins and minerals levels. The aim is to provide about 50% (1350 kcal day or 300 g FBF/day) of energy, over 70% of whole protein and essential fatty acids along with about RDA of key micronutrients for moderately undernourished adults (Bello et al., 2011).

Micronutrients play very important roles in the proper functioning of the body. The deficiencies have an adverse effect on HIV where the immunity is compromised. Selenium prevents morbidities and risk of diarrhea (Ximena et al., 2002). Zinc plays a critical role for immune functions with its deficiency leading to increased susceptibility to infections (Fraker et al., 2002; Mburu et al., 2010). Vitamin A has immunoregulatory properties and promotes the maintenance of epithelia integrity (McClelland et al., 2004; Fawzi et al., 2004). Vitamin B6 is useful for increased lymphocyte and antibody production, cell-mediated toxicity and delayed-type hypersensitivity responses Vitamin B-12 promotes humoral responses, folic acid promotes the cell-mediated immunity response vitamin E reduces the production of inflammatory cytokines and vitamin C improves a cell-mediated immune response. Riboflavin promotes the generation of a humoral antibody response (Villamor et al., 2008).

Use of micronutrients is ideal for improving the quality of life among PLHIV. However, this has not been practically realized in the management of HIV (Nunnari et al., 2012). Most PLHIV research to date evaluates the impact of micronutrients on the quality of life (Forrester and Sztam, 2011). However, minimal information on the level of uptake of micronutrients among PLHIV exists especially in the low-income setting where nutrient intake is compromised and vulnerability to deficiencies is high. This study was conducted to determine the level of micronutrient supplements uptake among PLHIV in Kenya and the determinants. This is with a hypothesis that the micronutrient uptake among PLHIV in Kenya is low.

METHODOLOGY

This study adopted a cross-sectional analytical design to determine the uptake of micronutrient supplements in PLHIV. The study population consisted PLHIV, above 18 years who were not bed ridden. The study purposively focused only on PLHIV. From hospital records, the Comprehensive Care Center in Kayole Health Centre have 160 PLHIV who are enrolled and visits the clinic once a month. The study focused on the comprehensive sample from which only 153 responded.

A researcher-administered questionnaire, key informants interviews (KIIs) and focus group discussions (FGDs) guides which were pretested were used for data collection. The participants were interviewed by the researchers on the dates when they were scheduled to visit the clinic. This was by administering the questionnaire which took an average of 20 minutes. The outcome variables that the study focused on were the level of micronutrient uptake and the associated determinants. The questions asked included; the type of supplements taken, reason as to why they were given the supplements, how frequent they were taken and an explanation for the uptake status. Individual medical records were assessed for clarification on the type of micronutrient the participants were taking. The schedule for uptake was provided by

Table 1. Socio-economic characteristics of respondents (see author guides).

Socio-economic characteristics		n (153)	%
Sex	Male	49	32.0
	Female	104	68.0
Age	18-30	63	41.2
	31-45	76	49.7
	>46	14	9.2
Marital status	Married	67	43.8*
	Widowed	51	33.3
	Divorced/separated	22	14.4
	Single	13	8.5
Educational level	None	9	5.9
	Primary	17	11.1
	Secondary	38	24.8
	Middle-level colleges	67	43.8*
	University	22	14.4
Occupation*	Self-employed	61	39.9*
	Formal employment	32	20.9
	Casual labour	47	30.7
	Unemployed	13	8.5

the respondent. To test for knowledge, 10 questions were asked, where the expected response was either agree or disagree. The questions were based on what they thought micronutrients paly to PLHIV. This were later translated to a score. The participants also responded to an open ended question on the various challenges that affected their micronutrient uptake.

Data from the completed questionnaires were entered into Cs-Pro software and cleaned. It was later exported to SPSS software version 20.0 for analyses. Data for seven participant with incomplete data were removed from the total sample to remain with a sample of 153. The quantitative data was described by use of frequencies and percentages. Chi-square was used to assess relationships between selected variables namely education level, occupation, income, gender, age marital status and the level of micronutrient uptake. Qualitative data complemented the quantitative findings. From the list of the 153 participants, a sub-sample of 10 men and 10 women was randomly selected using random number generator and invited to participate in the FGD. The key informants interviews (KIIs) were conducted on health workers from the comprehensive care center who directly dealt with the PLHIV. This included 3 nurses, one Clinical Officer and one Pharmacist.

Ethical approvals were obtained and protocols for research in Kenya were observed. Ethical clearance will be obtained from Kenya Medical Research Institute (KEMRI) Ethical Review Committee. Informed consent was be sought from the respondents whose confidentiality was assured. There was no direct reference of their names. The PLHIV were notified that participation in the study was voluntary. They were assured that confidentiality on information given would be maintained and information would only be used for the purpose of the study. All the procedures to be followed or any associated with answering the questions were explained. They were infromed that they had the right to decline participation and as such they would be treated the same as those who agree to join the study. They were to ask questions related to the study at any time and could refuse to respond to any questions and or stop an interview at any time without any consequences. The interviews and examinations was conducted in a private setting within the hospital where the respondent was comfortable. They were assured that the name would only be recorded and only initials for questionnaire tracking purpose but not for any other use.

RESULTS

Respondents' characteristics

The majority of the respondents were females (68%) (Table 1). The age category with the highest proportion of participants was 31-45 years (49.7%). Further the study identified that majority of the respondents were either married (43.8%) or widowed (33.3%). The majority of the respondents had attended middle-level college. The main occupation was self-employment in small business (39.9%) followed by casual labour (30.7%), which could be due to the setting of the study, which is a low-income setting.

Majority were females who were married, with middle-level college education who engaged were self-employed.

*The question established what participants actually did for a living, which was later categorized.

Knowledge on the role of micronutrients by respondents

From the nutrition knowledge test, all the respondents

Table 2. Micronutrient supplementation in HIV.

Response		Male		Female		All	
		n (49)	%	n (104)	%	n (153)	%
Taking supplements at the time of study	Yes	5	3.3	16	10.5	21	13.7
Type of supplement ever taken	Vitamin/mineral mix	6	3.9	12	7.8	18	11.8
	Zinc	3	2.0	5	3.3	8	5.2
	Vitamin A	5	3.3	11	7.2	16	10.5
	Vitamin B6	2	1.3	5	3.3	7	4.6
	Iron	2	1.3	7	4.6	9	5.9
	Folate	1	0.7	4	2.6	5	3.3
	Not aware	15	9.8	19	12.4	34	22.2
Have ever taken food supplements	Yes	10	6.5	22	14.4	32	20.9

Table 3. Reasons for micronutrient supplementation.

Micronutrient supplementation	Male		Female		All	
	n (49)	%	n (104)	%	n (153)	%
On ART	39	25.5	63	41.2	102	66.7
Presence of opportunistic infections	25	16.3	37	24.2	62	40.5
Had no appetite	10	6.5	33	21.6	43	28.1
Underweight cases	8	5.2	25	16.3	33	21.6
On TB treatment	9	5.9	17	11.1	26	17.0

Reasons as to why they were given supplements.

were reported to understand the importance of micronutrient supplements and indicated that they were necessary to help protect the body from recurrent infections. These were complimented by information from FGDs which noted that PLHIV appreciated the function of micronutrients with the main functions mentioned as boosting the immune system, preventing them from getting opportunistic infections (OIs), faster healing when with OIs and in reducing the number of hospitalizations.

Micronutrient supplementation status

Only 13.7% of all respondents were taking micronutrients at the time of the study. However, all respondents indicated that they had been on micronutrients supplements at one point during the treatment period. From the total sample (n=153), the micronutrient supplements commonly supplemented were vitamin and mineral mix (50.3%), zinc (34%), vitamin B6 (24.2%), vitamin A (24.2%), folate (12.4%) and iron (15%) (Table 2). The proportion of the respondents who indicated that they were on FBF was (27.5%). This is an indication of the number of patients who were acutely malnourished at the time of the study.

Some of the respondents (41.2%) indicated that they were not aware of the type of micronutrient they were taking. From FGDs this was attributed to lack of proper counseling before the prescription could be made. All respondents who reported to have had malnutrition at any point of their treatment were given multivitamin supplements and FBF. All respondents on TB treatment (19.0%) also indicated that they were on vitamin A and vitamin B6 (pyridoxine) supplementation, respectively. The main reason for vitamin B6 supplementation was the effect of TB drugs on the vitamins metabolism and utilization.

Reasons for providing supplements to people living with HIV

Supplements were given to respondents on Anti-Retroviral Therapy (ART) (66.7%), due to the presence of opportunistic infections (40.5), those who had no appetite (28.1%), underweight cases (21.6%) and those on TB treatment (17.0%) (Table 3).

Morbidity profile and micronutrient intake among people living with HIV

The prevalence of opportunistic infections as asked and

Table 4. Various illnesses among the PLHIV.

Illness	Presence of illness		Proportion taking supplements	
	n (153)	%	n	%
Upper respiratory infections	77	50.3	62	40.5
Urinary tract infections	59	38.6	51	33.3
Diarrhea	54	35.3	48	31.4
Lack of appetite	43	28.1	42	27.5
Tuberculosis	28	18.3	26	17.0
Candidiasis	17	11.1	12	7.8
Dermatitis	10	6.5	6	3.9
Peripheral neuropathy	6	3.9	4	2.6

Illness among the respondents.

Table 5. Relationship between the level of uptake and socio-demographic characteristics.

Variable	Statistical test	P value
Education level	Chi-square	0.016*
Occupation	Chi-square	0.031*
Income	r = 0.41	<0.001*
Gender	Chi-square	0.0401
Age	r = 0.13	0.312
Marital status	Chi-square	0.14

confirmed from the health card was; upper respiratory infections (50.3%), urinary tract infections (38.6%), diarrhea (35.3%) and dermatitis 65%. Some respondents were noted to have multiple illnesses. Those with various illness were taking supplements (Table 4).

Relationship between the level of uptake and socio-demographic characteristics

The study show significant relationship between the level of uptake and education level, occupation, income and gender. Higher level of education, occupation that was not very time consuming and high income was found to increase the level of uptake. In addition, women were found to have a higher uptake of supplements than men (Table 4).

Challenges effecting micronutrients uptake

The study noted that the factors affecting the uptake of micronutrient supplements were diverse. More than half (55.6%) of the respondents indicated that supplementation intake schedule was inconsistent throughout the treatment period. The reasons given included stock outs at treatment centres (24.8%), high costs of supplements (13.7%), bad taste (23.5%) and the presence of side effects (24.2%) (Table 6). Information from the KIIs indicate that, replenishment of micro-nutrients in the health facility was inconsistent and this affected their availability. The high cost of micronutrients also affected the uptake as most respondents were economically unable to procure the supplements when prescribed by clinicians.

The presence of side effects of the supplements leads to withdrawal from the intake. The side effects reported were; vomiting and nausea (86.5%) and change in urine coloration (70.3%) (Table 5). From FGDS and KIIs, the inconsistency in supplementation was reported as due to lack of comprehensive guidelines and policies to micronutrient supplementation in HIV. In addition, it was attributed to failure by the supplier agency to honour the actual requests by the health facilities.

DISCUSSION

There were more females attending comprehensive care center than males. This is similar to a study by KDHS (2014) that indicated that there are more females infected than men and one by Gielen et al. (2001) that show that more women than men attend care centers for PLHIV. The study noted that the uptake was significantly lower

Table 6. Challenges effecting micronutrients uptake.

Challenge		N	%
Challenges effecting micronutrients uptake	Stock-outs at treatment centre	44	28.8
	High cost of supplements	21	13.7
	Side effects of the supplements	37	24.2
Side effects experienced after micronutrient intake	Vomiting/nausea	32	20.9
	Change in urine coloration	26	17.0
	Diarrhea	21	13.7
	Rashes	13	8.5
	Drowsiness	7	4.6
	Dizziness	4	2.6

than by a studies by Semba et al. (2007) and Visser et al. (2011). This is an indication of decline in uptake. The main challenges attributed to this are supplements being out of stock, high cost as well as presence of side effects of the supplements which lead to withdrawal from intake. This study accepted the hypothesis that the uptake of micronutrients supplements is low.

A study by Semba et al. (2007), noted that micronutrients were given mainly to those on ART and TB treatment. A study done in Kaplan et al. (2009) and Masur et al. (2014) noted that micronutrients supplements were given to PLHIV who presents with opportunistic infections which is in agreement with this study. Other studies in agreement with this study indicate situations where PLHIV were provided with micronutrients supplements due to lack of appetite and for those who were underweight (Rehman et al., 1999; Kayira et al., 2012). Studies have attributed the low uptake to poor knowledge on importance of supplements, lack of guidelines to both the prescribers and the PLHIV (SS et al., 2015).

Limitations of the study

This study mainly relied on recall of various aspects of uptake of micronutrients. Recall bias, would have limited the accuracy of the information. Some participants did not remember the type of supplement given. The study mainly focused on use of health card for confirmation as much as possible to address this limitation.

Conclusion

PLHIV clearly understood the importance of micronutrient in improving the quality of life. However, the uptake of micronutrients was low mainly due to lack of guidelines for supplementation to PLHIV, high cost, stock-outs in health facilities and side effects. All respondents had taken micronutrient supplement at one point as prescribed due to prevailing OIs.

RECOMMENDATION

Based on the research findings, micronutrient supplementation for PLHIV should be regulated. Policies should be formulated to support PLHIV at levels of treatment. Proper assessment and counseling should be conducted before supplementation to prevent defaulting due to side effects. Based on the poor uptake of nutrients from food, there is need of ensuring that all HIV persons take micronutrients consistently. To ensure consistency, supplementation and avoid stock outs, the PULL system should be adapted.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Efficacy of amaranth grain consumption on CD4 count and morbidity patterns among adults living with HIV in Nyeri, Kenya

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Human immunodeficiency virus (HIV) is associated with increased nutrient needs and compromised body immunity. Minimal information exists on effect of food-based interventions on health status of people living with HIV (PLHIV) and not on antiretroviral therapy (ART). This study investigated the efficacy of amaranth grain (*Amaranthus cruentus*) consumption on CD4 count and morbidity patterns among PLHIV. A one group pre-test-post-test study design was used on a sample of 66 pre-ART adults living with HIV. The study involved collection of baseline characteristics of the respondents; this was followed by consumption of amaranth grain porridge (100 g) for six months. Post-test data was collected and paired t- test was used to compare pre-test and post-test data. Daily consumption of 100 g of amaranth grain porridge increased nutrient intake. A significant increase (P=0.004) in CD4 count from 498.2±163 SD at baseline to 608 ± 157 SD post-test was observed. There was a significant decline in the number of respondents with any form of illnesses from a total of 52 (78.8%) at baseline to 21 (31.8%) respondents at month six (P=0.031). Amaranth grain increased nutrient intake, CD4 count and consequently reduced the prevalence of illness. The study recommends that nutrition and health practitioners should educate PLHIV on importance of use of amaranth grain to complement usual dietary intake.

Key words: Amaranth grain, CD4 count, morbidity pattern, people living with human immunodeficiency virus (PLHIV).

INTRODUCTION

People living with human immunodeficiency virus (PLHIV) are at a greater risk of malnutrition (Hailemariam et al., 2013). This is because human immunodeficiency virus (HIV) compromises the immune system resulting to increased susceptibility to opportunistic infections (Cahn et al., 2013; Luckheeram et al., 2012). This leads to

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increased energy and nutrient needs, reduced nutrient intake, increased nutrient losses, altered metabolism and poor utilization of nutrients in the body (Rajeswari et al., 2015). This makes both macronutrient and micronutrient deficiencies to be common among PLHIV (Ivers et al., 2009; Rawat et al., 2010). The challenge therefore remains on how to meet the increased nutrient needs amidst compromised intake. If these increased nutrient needs are not met, it leads to incomplete HIV suppression and decline in CD4 count (Tagwira et al., 2006). The number of CD4 cells count is an indicator of how strong immune system is and guides the initiation of antiretroviral therapy (ART) (Hazenberg et al., 2000). According to national ART guidelines, a CD4 count of <350 cells/mm3 is considered low and calls for initiation of antiretroviral (ARVs) (NASCOP, 2011).

The World Health Organization (WHO) recommends use of food based interventions to boost nutrient intake among PLHIV and to prolong the Pre-ART period (WHO, 2003). Studies have demonstrated that intervention with food supplements; including nutrients dense foods and other bio-active food components reconstitute the immune function by suppressing the viral load hence increasing the CD4 cell count (Cahn et al., 2013; Ivers et al., 2009; Rawat et al., 2010). However, the fundamental nutritional concern for HIV infected people remains the availability of adequate and quality diets on a continuous basis. With the raging global HIV epidemic, there is an urgent need to exploit all potential interventions to halt its continued effect on the health and quality of life of those already infected and not on ART. This study therefore assessed the efficacy of locally grown amaranth grain as a food based intervention on the health status of PLHIV.

Amaranth grain has been consumed throughout history as a staple food in most Mexican region (Kauffman et al., 1990). An increased interest in amaranth grain appeared in the 1980s, when the United States National Academy of Sciences performed research on the grain and described its high nutritional and health benefits (Caselato-Sousa et al., 2012). Amaranth grain has higher quality and quantity of protein than most staples (Tibagonzeka et al., 2014). Amaranth grain contains twice the level of calcium in milk, five times the level of iron in wheat, higher potassium, phosphorous, zinc, vitamin E and folic acid than cereal grains. Amaranth grain also consists of 6 to 10% oil, which is predominantly unsaturated and is high in linoleic acid, an essential fatty acid (Mburu et al., 2012). The varieties grown in Kenya have been found to have very high content of lysine (3.2 to 18%) an essential amino acid that is so low in most other grains (Mburu et al., 2012). Lysine has been used to manage infections with strains of the herpes virus along with other viral infections including HIV that causes AIDS (Gaby et al., 2006). The starch in amaranth grain consists mainly of amylopectin (94.3%) which are easy to digest (Tibagonzeka et al., 2014). The levels of nutrient inhibitors such as tannins (0.1 mg/100 g) and phytates (0.2 mg/100 g) in amaranth grain have been reported to be within the non-critical range (Mburu et al., 2012).

The high amounts of micronutrients in amaranth grain are beneficial to PLHIV in boosting the immunity and for energy metabolism (Onyango et al., 2015). Grain amaranth would, if adopted for consumption, therefore, enrich local diets and increase nutrient intake especially among vulnerable populations such as PLHIV (Tibagonzeka et al., 2014). However, consumption of amaranth grain in Kenya is still low especially in Central Kenya. This is due to minimal awareness of its nutritive value (Mwangi, 2003). Restoring both the macro and the micronutrient supply with amaranth grain could be one of the most important strategies for improving health status among PLHIV. This study therefore sought to establish the contribution of amaranth grain consumption on dietary intake, CD4 cell count and morbidity patterns of adults living with HIV in Nyeri, Kenya.

MATERIALS AND METHODS

Study design and sampling method

The study adopted a one group pre-test post-test experimental design (Dimitrov and Rumrill, 2003) to conduct a study in Nyeri County. Due to ethical reasons the study did not have a control group. The study targeted adults living with HIV attending home-based care groups in Mweiga ward, Nyeri County. At the time of study, Mweiga ward had three home based care groups and Mary Immaculate Home Based care group (HBCG) was randomly selected. The group had a total of 149 members. This study focused on PLHIV not on ARVs. According to national guidelines, initiation of ARVs is recommended when CD4 count falls below 350 cells/mm^3 (NASCOP, 2011).

The study also excluded PLHIV who were beyond 60 years of age, pregnant and lactating mothers. This was because physiological status such as old age pregnancy and lactation have been associated with immune suppression and decline in CD4 count (Hargrove and Humphrey, 2010; High et al., 2008). For ethical purposes all the 149 members of the group benefited from the food intervention but for the purpose of monitoring the effect of the intervention on CD4 count and morbidity pattern, the study focused only on the 83 who met the inclusion criteria. Data from seventeen (17) respondents was not analyzed due to various reasons such as relocation from the study area, missing data on CD4 count, inconsistencies in daily consumption of the amaranth grain porridge and any respondent who had no data on dietary intake and morbidity patterns for at least one single month.

Description of the study intervention

Baseline data on demographic and socio-economic characteristics, dietary practices, CD4 count and morbidity patterns among PLHIV was collected before the start of the study in January 2011 using a structured questionnaire. This was then followed by a food-based intervention from February to July 2011. The intervention involved consumption of 100 g amaranth (*Amaranthus cruentus*) grain in form of porridge. The nutrient content of the amaranth flour (Table 1) was established at Kenyatta University laboratory as the first phase of this study (Mburu et al., 2012).

The researchers demonstrated on how to prepare the amaranth grain porridge. Every respondent was provided with 4 kg of amaranth grain flour fortnightly. Also given was a standard cup to measure 100 grams of amaranth flour and a calibrated jug for measuring water. The respondents consumed the porridge daily for six months. Extra amaranth grain flour was issued to the respondents with other infected family members or under five children to avoid food leakage. To

Table 1. Nutrient content of amaranth grain used in this study.

Nutrient	Amaranth grain per 100 g
Energy (Kcal)	402.4
Protein (gms)	16.7
Lysine (gms)	0.59
Fat (gms)	7.0
Zinc (gms)	4.8
Iron (gms)	13.0
Calcium (gms)	189.1
Pyridoxine (mg)	0.4
Vitamin C (mg)	0.4
Potassium (mg)	324.4
Niacin (mg)	0.9
Riboflavin (mg)	0.5
Thiamine (mg)	0.2
Sodium (mg)	8.0
Magnesium(mg)	219
Vitamin E (mg)	44.4
Vitamin A (µg)	Trace

enhance adherence, every respondent was assigned a trained Community Health Worker for follow up and monitoring process to adherence on consumption at the household's level. Respondents were also adequately sensitized on nutrition and health benefits of amaranth grain to enhance consumption.

A 24 h recall questionnaire was used to monitor monthly food intake. Three 24-hour recalls were administered to the respondents on the fourth week of every month during the intervention. This included 2 week days and one weekend day. All food items consumed in the previous 24 h were assessed. To minimize on systematic errors, food photographs and food models which depicted food portion sizes were used. A 24h multiple pass recall method was used to probe for complete description of foods and to overcome the recall bias which is a limitation of using 24 h recall questionnaires. Morbidity data was collected on monthly basis based on 2 weeks recall where respondents were asked if they had suffered from any illness in the previous two weeks. The CD4 count was done at the baseline, at the third month and at sixth month at the Nyeri County Referral Hospital laboratories.

Data analyses

Quantitative data were entered, cleaned and analyzed by use of statistical package for social sciences software (version 16.0). Mean, frequencies and percentages were used to summarize descriptive statistics of the data. The amounts in grams of ingredients from foods consumed were entered into Nutri-survey software to generate the actual amount of selected nutrients consumed per day from daily usual food intake and from amaranth grain porridge. These were then compared with the recommended daily allowances (RDAs) for PLHIV as provided by NASCOP (2006).

Pearson product moment correlation (r) was used to determine the relationship between amount of nutrient intake and CD4 count. The t–test for non-independent samples was used to determine if there was a significant difference between the dietary practices, morbidity patterns and CD4 count for the pre-test and post-test data. Logistic regression was used to calculate the association between CD4 count and presence of illness as an index of odds ratio. Multiple regressions was used to determine the contribution of nutrients from amaranth grain to CD4 count while adjusting for confounding factor namely sickness status and nutrients from other foods.

Ethical considerations

The research protocol was approved for implementation by Ethical Review Committee (ERC) of the Kenya Medical Research Institute (ERC No: KEMRI/RES/7/3/1). A consent form was signed by the respondents prior to beginning the study. This included the nature and purpose of the study, what would occur during the intervention, any risk, assurance that all data collected would be coded to protect their identity and privacy, thus confidentiality was assured.

RESULTS

Characteristic of the respondents

The study had recruited 83 respondents at the beginning of the intervention, however, due to attrition data is reported for 66 respondents. Slightly more than half (53.0%) were females (Table 2). The mean age was 34.30±1.2 SD. The majority of the respondents (69.7%) were farmers. The highest educational level attained by about half of the study respondents was secondary education (51.5%). Close to half (48.5%) of the respondents were married. The mean income of the respondents was 66.75 ±23.50 US dollars. There was no significant change in mean monthly income (P=0.06) between baseline and month six.

Change in nutrient intake during intervention

The mean nutrient intake was below the RDA for most of the nutrient at baseline. This increased significantly with introduction of amaranth grain in the diet, enabling the respondents to achieve the required dietary intake for energy, protein and selected micronutrients (Table 3).

The proportion of respondents who met the RDAs for energy increased from 27.3% at baseline to 92.4% at month six. For protein the increase was from 21.2 to 95.5%. Over 70% of the respondents were found to consume adequate micronutrients at month six that was 97% iron, 92.4% zinc, 77.3% calcium, 95.5% magnesium, 89.4% vitamin B1, 86.4% B2, 92.4% B3, 72.7% B6 and 100% vitamin E compared to an average of below 40% of the respondent at baseline (Table 4).

Change in CD4 count during intervention

The mean CD4 count (cells/mm^3) was assessed at baseline, month three and at month six. Figure 2 shows the change in mean CD4 count (cells/mm^3) during the six months of amaranth grain consumption. The mean CD4 count increase in the first three months was 42 ± 4.4 SD (cells/mm^3) and 63 ± 7.1 SD (cells/mm^3) from month three to month six. Total CD4 count increase was 105 ± 25.8 SD (cells/$mm^{3)}$ of blood. There was a significant difference in CD4 count between baseline and month six (P=0.041).

Table 2. Characteristic of the respondents

Respondent's characteristics (n=66)		n	%
Sex	Males	31	47.0
	Females	35	53.0
Age category	20-29	22	33.3
	30-39	28	42.4
	40-49	9	13.6
	50-59	7	10.6
Occupation	Farmer	46	69.7
	Casual labor	10	15.2
	Formal employment	5	7.6
	Small business	5	7.6
Education level	Primary	26	34.9
	Secondary	34	51.5
	Tertiary	6	9.1
Marital status	Married	32	48.5
	Separated	15	22.7
	Single parent	11	16.7
	Widow/ widower	8	12.1
	Baseline	**At six months**	**t test P Value**
Monthly income	66.75 ± 23.50 USD	68.09 ± 22.29 USD	0.066

Table 3. Energy and nutrient intake at baseline and at month six of intervention.

Nutrients	Baseline		Month 6	
	Female	Male	Female	Male
Energy (Kcals)*	2479± 312	3139± 365	2892± 330	3549± 386
Protein (gms)*	39.3 ± 2.3	41.9± 4.2	54.8 ± 2.7	58.8 ± 2.6
Vitamin B1 (mg)[€]	1.2± 0.1	1.3 ± 0.2	1.4 ± 0.2	1.5 ± 0.2
Vitamin B2(mg) [€]	1.0 ± 0.1	1.1 ± 0.1	1.3 ± 0.2	1.4 ± 0.1
Vitamin B3 (mg) [€]	16 ± 0.3	17.1 ± 0.3	16.7 ± 0.2	17.8 ± 0.4
Vitamin B6 (mg)*	1.0 ± 0.2	1.1 ± 0.1	1.4 ± 0.2	1.5 ± 0.1
Calcium (mg)*	836 ± 7	889 ± 83.0	1102 ± 9	1023 ± 79.0
Iron (gms)*	11.6± 2.8	10.6 ± 2.5	22.6 ± 2.6	21.4 ± 2.1
Zinc (gms)*	4.3 ± 2.4	5.8 ± 2.9	8.6 ± 2.8	10.5 ± 2.2
Magnesium (mg)*	190 ± 75.0	201 ± 82.3	350± 76.2	371 ± 74.8
Vitamin E (mg)*	9 ± 2.2	8 ±0.3	42 ± 3.3	46 ± 5.1
Vitamin A (µg)[ɗ]	413 ± 26.0	483 ±19.0	430 ± 43.0	471 ± 22.0
Selenium (mg)[ɗ]	19 ± 1.7	22 ± 2.5	22 ± 1.9	24 ± 2.3

*Nutrients where significant increase was observed after the diet was supplemented with nutrient dense amaranth grain;
[ɗ]Nutrients where no significant differences were observed even after introduction of amaranth grain in the diets of the respondents; [€]Nutrients where respondents had adequate intake at baseline even without amaranth grain.

Relationship between nutrient intake and CD4 count

The amount of CD4 count and amaranth grain consumption had significant ($P < 0.001$), positive moderate correlation (R^2=0.63) (Table 5). From simple regression iron intake contributed about 13.3% to CD4 count, calcium (11.2%) vitamin B6 (16.8%), vitamin C (12.0%), zinc (17.6%), magnesium (11.3%), vitamin E (20%), protein 8.7% and Kcals 16.9%. From multiple regression, nutrients intake from amaranth grain

Table 4. Proportion of respondents consuming adequate nutrients.

Nutrient	Baseline (n=66)		At month 6 (n=66)	
	n	%	n	%
Energy (Kcals)	18	27.3	61	92.4
Protein (g)	14	21.2	63	95.5
Iron (g)	17	25.8	60	90.9
Zinc (g)	18	27.3	61	92.4
Calcium (g)	25	37.9	51	77.3
Magnesium (g)	23	34.8	63	95.5
Vitamin C (g)	25	37.9	33	50.0
Vitamin B1 (mg)	49	74.2	59	89.4
Vitamin B2 (mg))	50	75.8	57	86.4
Vitamin B3 (mg))	50	75.8	61	92.4
Vitamin B 6 (mg)	26	39.4	48	72.7
Vitamin E (g)	36	54.5	66	100.0
Vitamin A (µg)	24	36.4	28	42.4
Selenium (mg)	23	34.8	33	50.0

Table 5. Determinant of CD4 count.

Simple regression	r	r^2	%	P-value
Iron	0.365	0.133	13.3	0.003
Calcium	0.335	0.112	11.2	0.002
Vitamin B6	0.410	0. 168	16.8	0.001
Vitamin C	0.346	0.120	12.0	0.004
Zinc	0.420	0.176	17.6	0.000
Magnesium	0.336	0.113	11.3	0.008
Vitamin E	0.447	0.200	20.0	0.001
Protein	0.432	0.187	18.7	0.001
Kcal	0.411	0.169	16.9	0.001
Multiple regression	R	**R^2**		
Iron, calcium, vitamin B6, vitamin C, zinc, magnesium, Kcal, proteins	0.630	0.397	39.7	0.000

contributed to 39.7% of CD4 count (R=0.630; R^2=0.397; P=<0.001). This was when intake of nutrients from other foods and sickness status were adjusted for.

Presence of illnesses among respondents

At baseline upper respiratory tract infections (URTI), diarrhea, loss of appetite and oral thrush were the most common opportunistic infections (Figure 1).

There was a significant decline in the number of respondents with either of the illnesses from a total of 52 (78.8%) at baseline to 21 (31.8%) respondents at month (P=0.031). The prevalence of URTI, diarrhea, oral thrush, loss of appetite was 27.3, 13.6, 19.7 and 18.2%, respectively. This significantly reduced to 12.1, 7.6, 1.5 and 10.6% respectively by the sixth month. Significant association was observed between CD4 count and presence of illness [OR] 2.4, 95% confidence interval [CI] 2.16-2.67), (P= 0.018**)** where respondents with low CD4 count were 2.3 times more likely to become ill compared to those with high CD4 count.

DISCUSSION

Households with PLHIV are mainly food insecure and have challenges of meeting their increased energy and nutrient requirements (Tibagonzeka et al., 2014). This is compounded by presence of opportunistic infections which further increase nutrients requirements while compromising intake and utilization. Therefore,

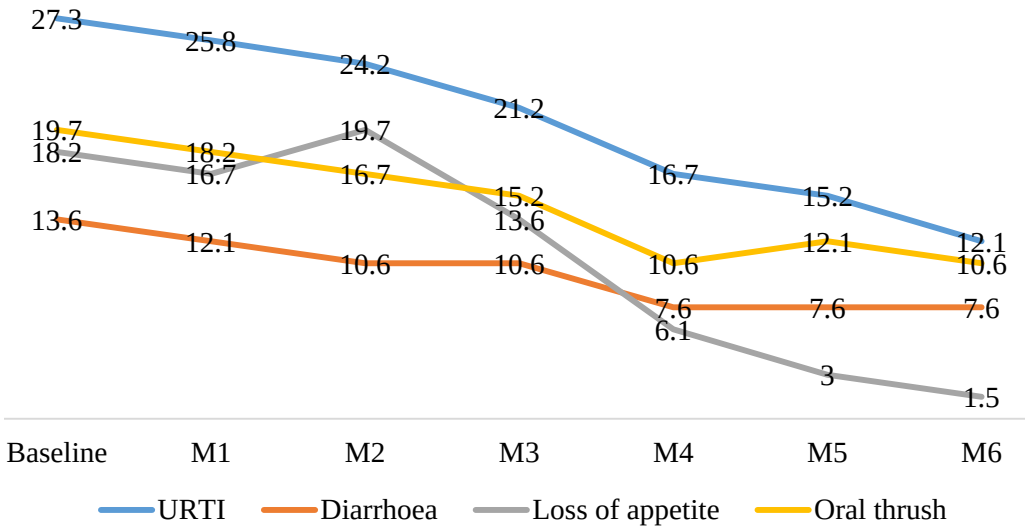

Figure 1. Morbidity pattern among adults living with HIV in Mweiga.

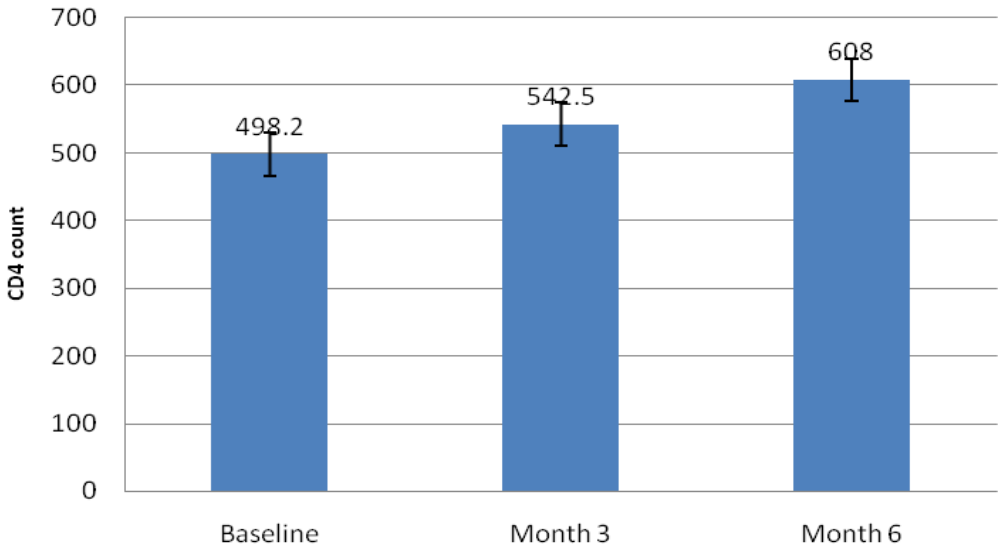

Figure 2. Mean CD4 count among respondents in MHBCG

intervention aimed at supplementing diet for vulnerable PLHIV in such households has been shown to improve nutrient intake (USAID, 2015). Despite this growing recognition of integrating targeted food assistance to PLHIVs, there have been few studies to evaluate the health and nutritional impact of these interventions especially using locally available nutrient and energy dense food products. From the findings of our study, supplementing the diet of PLHIV with amaranth grain led to increased intake of calcium, iron, zinc, vitamin B6, Vitamin E, magnesium, protein and energy. This study finding demonstrates that an aggressive, individualized intervention that promotes daily optimal energy, protein and micronutrient intake is feasible and effective in increasing the CD4 count hence reduction of opportunistic infections. Nutrients intake among the respondents at baseline was below the RDAs while morbidity profile was high. The consumption of amaranth grain significantly raised nutrients intake and contributed to 39.7% of the CD4 count (R=0.630; R2=0.397; P=<0.001) when nutrient intake from other foods and sickness status were adjusted for. The respondent CD4 count continued to rise during the intervention period which was an indication of improved immune system.

This was also confirmed by reduction in proportion of respondents with various illnesses by the end of the

study.

An increase in CD4 count after increased intake of micronutrient in HIV-infected persons has previously been reported (Fawzi et al., 2004). A study by Palermo et al. (2013) and Rawat et al. (2010), confirmed positive relationship between consumption of nutrient rich diets and increase in CD4 count. Consumption of micronutrients showed a potential to increase the CD4 count by mean of 65 cells/mm^3 after three months in a study in USA (Kaiser et al., 2006). Other similar studies suggested that food based intervention improved nutrient intake and hence the outcome of health status of PLHIV (Koethe at al., 2009). A study conducted in the United States further showed that focus on food rations to increase energy and protein was more effective in management of opportunistic infections associated with HIV and AIDS (Mcdermott et al., 2003). There is also growing scientific consensus that nutrient adequacy is a critical component of the treatment of both malnutrition and malnutrition-mediated disease outcomes among PLHIV (Palermo et al., 2013; Thapa et al., 2015). Another study by Piwoz and Preble (2000) showed that intake of zinc improved immune status and reduced diarrhea among PLHIV. Moreover, in the same study vitamins E was found to reduce oxidative stress and HIV viral load. Zinc reduced incidence of opportunistic infections, stabilized weight, improved CD4 counts in adults with AIDS while iron was found to reverse anemia thus slowed down HIV progression and improved survival (Guarino et al., 2002).

Association of nutrient intakes with disease outcomes can be difficult to detect, especially in studies without a control group which was as a limitation in this study. However, since the entire respondent received the same treatment and monitoring during the experiment, any changes observed across the group of the participants was associated with the study treatment. However, other confounding factors that are likely to influence the outcome like usual dietary intake and sickness status were monitored and controlled for during data analyses. Previously food based intervention among PLHIV in Kenya has been donor based and has lacked sustainability and created dependency on food donations. The strength of our study lies on the fact that we explored use of locally grown amaranth grain which can be incorporated in the daily diets of PLHIV. Considering the climatic conditions of the research setting, amaranth grain can be easily grown locally. Due to its superior nutritional profile compared to other locally grown cereals, amaranth grain can easily solve the problem of inadequate dietary intake among vulnerable populations which will translate to improved health outcome.

Conclusion

This study has demonstrated that grain amaranth has a potential to contribute to the alleviation of inadequate dietary intakes among PLHIV. Consumption of amaranth grain porridge was found to enhance levels of the nutrients previously reported to be inadequate in the diets of PLHIV from the baseline data. The intake of amaranth porridge was not only able to fill the nutritional gaps but was also found to boost the immunological status of the respondents as evidenced by increased CD4 count which resulted to reduced prevalence of common illnesses.

This important outcome is entirely plausible, given that amaranth grain is high in zinc, iron, calcium, vitamin E, B vitamins and essential amino acids which play a vital role in immune system. Since there was no significant change in dietary intake from the usual food intake in the study population, the change in CD4 count, morbidity patterns between the pre-test and post-test data is attributed to amaranth grain consumption. In addition, it was observed that none of the respondents CD4 count fell below 350 (cells/mm^3) which is the recommended level for initiating ARV (NASCOP, 2011). This was a very crucial outcome and shows the need for early nutrition intervention among PLHIV to delay initiation of ARVs.

RECOMMENDATION

The study recommends that nutrition and health practitioners to educate PLHIV on importance of use of amaranth grain to complement usual dietary intake for improved health outcomes.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Predictors on mortality of human immunodeficiency virus infected children after initiation of antiretroviral treatment in Wolaita zone health facilities, Ethiopia: Retrospective cohort study

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Worldwide Human Immunodeficiency Virus/Acquired Immune Deficiency syndromes (HIV/AIDS) have created an enormous challenge on the survival of infected patients. Identifying baseline factors that predict morbidity could allow their possible modification in order to improve pediatric HIV care. Retrospective cohort study was conducted in 228 HIV infected children starting antiretroviral treatment at Wolaita zone selected health facilities, Ethiopia. WHO reference population was used to calculate Z-scores for height-for-age, weight-for-height, and weight-for-age. Data were analyzed by bivariate and multivariate analysis using Cox regression proportional hazard model. Survival were calculated and compared with the Kaplan Meier and log rank test. Males account 121(53.1%), mean age was 6.29 years. Mean survival time using Kaplan Meier analysis was 89.3 months (95% CI 85.71-92.97). Incidence of mortality rate 21.02 per 1000 person years of observation (95% CI 12.8-34.3). Overall nutritional status was, 62.5% stunted, 43.0% underweight and 44.7% wasted at baseline. As a result, rural residence AHR 4.30 (95% CI, 1.25-14.8), fair/poor of first three-month ART adherence AHR 8.95(95% CI 2.624-33.72), severely wasted children at baseline AHR 7.040 (95% CI, 1.27-39.13) and age of children were predictors of mortality. Mortality among HIV-infected children was high and strongly associated with malnutrition, residence in rural area, low adherence to ART, and beginning of ART at an advanced age; highlighting the urgent need for targeted interventions including promotion of early initiation and adherence to ART.

Key words: Children, malnutrition, mortality, HIV/AIDS.

INTRODUCTION

Worldwide human immunodeficiency virus/acquired immune deficiency syndrome (HIV /AIDS) have created an enormous challenge on the survival of infected patients. Globally, an estimated 35.3 (32.2–38.8) million

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people were living with HIV in 2012. Around 9.7 million people in low- and middle-income countries received antiretroviral therapy (ART), representing 61% of all who were eligible under 2010 World Health Organization (WHO) HIV treatment guidelines. From 1996 to 2012, ART averted 6.3 million AIDS-related deaths worldwide, including 5.2 million deaths in low- and middle-income countries (United Nations Program on HIV/AIDS (UNAIDS), 2013).

HIV develops very rapidly among infants and children. Pooled analysis from Africa showed that mortality in infected children was about nine-fold greater than that of uninfected children. They estimated that by 12 months of age, 35.2% of infected children would have died, compared with an estimated 4•9% of uninfected children. At 2 years of age, an estimated 52•5% of` infected and 7•6% of uninfected children would have died (Newell et al., 2004).

Despite children on ART, study in South Africa showed mortality rate of 4.7 deaths per 100 child years on ART (Zanoni et al., 2011). Another study in Asia-pacific showed that during a median follow up of 3.1 years after ART, 6.6% deaths occurred, giving a crude mortality rate of 1.9 per 100 child-years (95% CI, 1.6-2.4) (Lumbiganon et al., 2011).

In Ethiopia, also death rate was calculated to be 4.0 per 100 child-years of observation (Koye et al., 2012). In Addis Ababa, also 8.8% died during a median study follow up of 12 months (Taye et al., 2010).

A number of risk factors contributes to the mortality of these children after starting ART. Some of them are malnutrition status at initiation of ART, lower hemoglobin, age of children, CD4% at initiation of ART, chronic diarrhea, gender, not receiving cotrimoxazole preventive therapy at baseline and severe immunodeficiency (Zanoni et al., 2011; Lumbiganon et al., 2011; Koye et al., 2012; O'brien et al., 2007; Fenner et al., 2010).

Malnutrition is a common condition in HIV-infected children and one of the predictors of mortality among HIV infected children after initiation of ART except study done in Bahir Dar in which malnutrition has no association with mortality (Zanoni et al., 2011; Lumbiganon et al., 2011; Taye et al., 2010; O'brien et al., 2007). Study in Addis Ababa, Ethiopia, showed that malnutrition has an impact on survival of HIV infected children after initiation of ART. This study also showed malnutrition prevalence is higher in HIV infected children but this study is done in Addis Ababa which has minimum prevalence of malnutrition in Ethiopia (Fenner et al., 2010; Ethiopian Central Stastical Authority (CSA), 2011).

Ethiopia is one of the highest malnutrition and HIV prevalent areas in the world. According to the Ethiopian Demographic and Health Surveys (EDHS) HIV prevalence ranges from 0.9% in SNNPR and 1.0% in Oromia region to 5.2% in Addis Ababa and 6.5% in Gambella region (Ethiopian Central Stastical Authority (CSA), 2011). The Government of Ethiopia launched fee-based ART in 2003 and frees ART in 2005. During 2011, a total of 333,434 people had ever started ART. There were 249,174 adults (86% of eligible) for a CD4 (cluster of differentiation 4) cutoff less than 200 and 16,000 children currently on treatment (20% of eligible) by the end of 2011 (Ethiopian Federal HIV/AIDS Prevention And Control Office (FHAPCO), 2012). Almost three fourth (64%) of severely malnourished children were found in Oromia and SNNPR (Southern Nation Nationals and Peoples Region) in 20012/2013. Wolaita zone is one of malnutrition and HIV prevalent areas in SNNPR (Federal Democratic Republic of Ethiopia Ministry of Health, 2012/2013).

To have better survival of children after initiation of ART, knowing predictors of mortality is important. Therefore, the aim of this study was assessing predictors that affect the mortality of HIV positive children after initiation of ART.

METHODOLOGY

Study area and period

Study was conducted in Wolaita zone from February 28, 2014 to March 14, 2014.Wolaita zone is found SNNPR and it has 12 woredas and three town administrations. Wolaita Sodo town is administrative town of the zone and 330 km south of the capital city (Addis Ababa). There are 3 hospitals and 68 health centers and 2 non-governmental health centers that render preventive, curative and rehabilitative service for the catchment area population in zone. From these 12 health centers and all hospitals give ART service in Wolaita zone during the study period. Totally 4208 adult patients and 321 children were ever enrolled in ART during the study period. Patients enrolled on HIV care are followed intensively based on national and WHO recommendation.

Study design

Retrospective cohort study was conducted among HIV infected children who had started ART from February, 2006 to March, 2014.

Source population

All children with HIV/AIDS, aged <15 years and started ART treatment in Wolaita zone health facilities were source population.

Inclusion criteria and exclusion criteria

HIV positive children aged <15 years and at least age should be more than 6 months at initiation of ART and who were on ART at least one full month from February, 2006 to March, 2014 were included. Children HIV patients with incomplete intake form at least with nutritional data, registers and follow up form were excluded.

Sample size

Sample size was determined using a formula for two population

proportions and calculated by OpenEpi version 2.3 statistical software package by considering that P_1 is percent of exposed (severely underweight) with outcome 17.68% P_2 is percent among the non-exposed with outcome 4.83% is estimated from other study (6). $Z_{\alpha/2}$ is taking CL (Confidence Limit) 95%, Z_{β} 80% power and r is ratio of non-exposed to exposed 1:1. After calculating, sample size was 109 for each total 218. Accordingly, after adding 10% for contingency, a total sample size was 240.

Sampling procedure

Health facilities were selected based on their number of pediatrics ART user. From all 12 health centers, which have given this service we choose 3 which have maximum user which were Bodity, Soddo and Areka health center. From 3 hospitals, which give ART service we choose Wolaita sodo referral hospital and Dubo Sent Marry hospital based on their number of ART user. At the beginning, profiles of all children on ART who have been managed between February, 2006 and March, 2014 in selected health facilities were evaluated. Finally, all individuals ever started ART at that facility were selected.

Variables

Dependent variable is survival status from the initiation of ART to March 2014 and main outcome measure is time to survival from the initiation of ART. Independent variables are socio demographic characteristics, base line clinical, laboratory and ART information, anthropometric data (weight, height/length) and ART treatment.

Data collection instrument

Questionnaire consists of the Socio demographic, clinical, laboratory and Anthropometric, ART treatment related and follow up.

Data collection and quality control

Data collection form was developed from ART entry and follow up form used in the ART clinic. Data was collected by reviewing pre-ART register, laboratory request, monthly cohort form, and follow up form, ART intake form and patients' card. Most recent laboratory result prior to initiation of ART was used as a base line value. In case, there is no pre-treatment laboratory test, results obtained within one month of ART initiation was used. If two results are obtained within a month time the mean was used.

Data was collected by trained ART health officers and nurses at Hospital and health center. Two days long training was given for 1supervisor and 5 data collectors. Overall activity was controlled by principal investigator of study. Data quality was assured through designing a proper data collection material and through continuous supervision. All completed data collection form was examined for completeness and consistency during data management, storage and analysis. Data was entered and cleaned by principal investigator respectively before analysis.

Operational definitions

Drop out: If a patient discontinued ART for at least three month as recorded by ART physician.

Fair adherence: If percentage of missed dose is between 85 and 94%(3-5 doses of 30 doses or 3-9 dose of 60 dose) as documented by ART physician.

Good adherence: If percentage of missed dose is between >95% (<2 doses of 30 doses or <3 dose of 60 dose) as documented by ART physician.

Lost: If a patient discontinued ART for at one to three month as recorded by ART physician.

Poor adherence: If percentage of missed dose is between <85% (> 6 doses of 30 doses or >9 dose of 60 dose) as documented by ART physician

CD4 count normal threshold defined as if CD4 cell count >500 cells/mm^3 when the child age is greater than 5 years.

CD4 percentage normal threshold were defined as if CD4 percentage is >35% for <12-month-old child, >30% for children 12-35 months of age, and >25% for 36-59-month child.

Survival: Lack of experience of death

Data entry, analysis and processing

Data were entered, cleaned and edited in Epi-Info 3.5.3 for windows and analyzed using SPSS version 21 for windows to see frequency and predictors. Nutritional status was defined by ENA for SMART software for generating Z score. Cox proportional hazard assumption was checked using STATA 11 by schoenfeld residuals test which P>0.1 assumes fulfill the criteria.

Patient's cohort characteristics were described in terms of central tendency and dispersion value for and frequency distribution for categorical data. Death was confirmed by reviewing death certificates, medical registration in the hospital, or registration by ART adherence supporter through calling using the registered phone number. Individuals alive on ART, lost follow up and transfer out at the end of the study period was censored. Finally, the outcome of each subject was dichotomized into censored or death.

Univariate analysis was used to describe patient's baseline characteristics. Actuarial table was used to estimate survival after initiation of ART, and log rank test was used to compare survival curves. Cox proportional-hazard regression was used to calculate the bivariate and adjusted hazard ratio and then determine independent predictors of time to death.

In multivariate cox regression analysis, only those variables that were significantly associated with survival on a crude analysis were entered to the final model.

Ethical consideration

This research was approved by the Research and Ethics Committee (REC) of the School of Public Health, College of Health Sciences of Addis Ababa University (AAU) Ethiopia. Official letter of co-operation was written to the concerned bodies by the School of Public Health AAU. As the study was conducted through review of medical records, the individual patients were not subjected to any harm as far as the confidentiality is kept. No personal identifiers were collected and analyzed. Patient's record/information were anonymized and de-identified prior to analysis.

RESULTS

Cohort baseline characteristics

Of the 260 children's records reviewed, 228 were

Table 1. Sociodemographic characteristics of children on ART follow up in Wolaita Zone health facilities, March 2014.

Variable		Frequency n=228	Percent
Sex	Male	121	53.1
	Female	107	46.9
Age group	<18 months	16	7
	18-59 months	89	39.1
	5-14 years	123	53.9
Residence	Urban	158	69.3
	Rural	70	30.7
Parent status	Both alive	104	45.6
	mother alive but father dead	43	18.9
	Mother dead but father alive	36	15.8
	Both dead	45	19.7
Caregiver	Parents	165	72.4
	Other relative	42	18.4
	NGO	21	9.2

included in the final analysis the rest were not fulfil the inclusion criteria. Above half were males 121(53.1%), rest 107 (46.9%) were females. Median age 6 years ((Inter Quartile Range) IQR = 3-9), and mean age was 6.29 years. From the cohort 158 (69.3%) were urban in residence. Children parent status were 104 (45.6%) both alive, 45(19.7%) were both dead at baseline (Table 1).

Baseline clinical and laboratory baseline characteristics

Majority (91.2%) of the HIV positive children were had at least one history of past opportunistic illness at the initiation of ART. Leading opportunistic illness were Pneumonia 62(29.8%), unexplained persistent diarrhea (>=14 day) 59(28.3%) and unexplained persistent fever (>=30days) 51(24.52%). Functional status of children at baseline 202(88.6%) were working or ambulatory. Above half of 163(71.5%), children developmental status was appropriate for their age. At baseline majority 90(39.5%) were WHO classified as clinical stage II. Fifty-nine percent (135) of children CD4 count or percentage were below normal threshold at baseline. Majority 151 (66.2%) had hemoglobin level of >10 gm/dl at baseline the rest were ≤ 10 gm/dl at baseline.

From 150(65.8%) screened for pulmonary TB (Tuberculosis) based on tuberculin skin test 44(29.33%) were positive and 45(30%) of them were took TB treatment. Eighty percent were taking Cotrimoxazole prophylaxis before initiation of ART and 31(13.6%) were taken INH (Isonaizide) prophylaxis. Majority 90(39.5%) were eligible for ART based onCD4 count or percentage cutoff points. For 86.0% of children first Three-month ART adherence was good. From all 12% of children experience at least minor type of drug side effect like 59.25% was nausea, 25.92% were diarrhea and others (Table 2).

From all 24% of children were change their regimen during follow up due to new TB 29.09%, drug out stock 29.09% and drug side effect or toxicity 21.8%. The commonest regimen were 4a = d4t-3TC-NVP which is 59.2% (Table 2).

Baseline nutritional characteristics

Based on weight for height Z score, nutritional status of this historical cohort at base line was 83(41.9%,95% CI, 35.3 - 48.9) had global malnutrition of these 50.5% were males and 31.9% were females respectively. Prevalence of moderate malnutrition based on weight for height Z score was 13.1% (95% CI 9.1-18.5), with sex distribution of 18.7% (95% CI 12.4-27.1%), and 6.6% (95% CI 3.1-13.6%) for males and females respectively. Prevalence of severe malnutrition was 36% with 43 % in males, 28% in females. Overall nutritional status, 143(62.5%) stunted, 98(43.0%) underweight and 102(44.7%) were wasted at baseline (Table 3).

Survival time

Mean follow up duration was 40.05 months; minimum and maximum follow up time was 1 and 97 months respectively. Mean survival time using Kaplan Meier

Table 2. Clinical, laboratory characteristic of children on ART at Wolaita zone health facilities in March 2014.

Variable	Frequency (N=228)		Percent
Functional status	Working/Ambulatory	202	88.6
	Bed ridden	26	11.4
Developmental history	Appropriate	163	71.5
	Delayed	60	26.3
	Regressive	5	2.2
WHO clinical staging of HIV	Stage I	23	10.1
	Stage II	79	34.6
	Stage III	90	39.5
	Stage IV	36	15.8
CD4 count or percentage	Below normal threshold	137	60.1
	Above normal threshold	91	39.9
Hemoglobin level	≤10 gm/dl	77	33.8
	>10 gm/dl	151	66.2
Tuberculin skin test for TB result n=150	Positive	44	29.3
	Negative	106	70.6
Past TB treatment n=45	2SRHZ/4EH	19	42.2
	2HRZES/1HRZE	2	4.4
	2HRZE/4EH	24	53.3
	No	197	86.4
ART eligibility criteria	CD4<350 or 500	90	39.5
	WHO stage III &IV	43	18.9
	WHO stage II or III and TLC<1200	88	38.6
	DBS positive	5	2.2
	Others	2	0.9
First three-month ART adherence	Good	196	86
	Fair	16	7
	Poor	13	5.7
Regimen change during follow up	No	168	73.7
	Yes	55	24.1
Recent adherence	Good	182	79.2
	Fair	21	9.2
	Poor	20	8.8
Regimens during follow up	4a=d4t-3TC-NVP	135	59.2
	4b=d4t-3TC-EFV	22	9.6
	4c=AZT-3TC-NVP	31	13.6
	4d=AZT-3TC-EFV	26	11.4
	2ndline regimens	2	0.9
	Others specify	12	5.3

analysis was 89.3 months (95% CI 85.7-92.9). No median was found (Figure 1). Further analysis of mean survival time was done using socio demographic, nutritional and clinical and laboratory characteristics. Mean survival time had significant difference between urban and rural with log rank test X^2 = 9.07 df = 1 p<0.003. Mean survival time had difference across age of children. Mean survival time did not show a difference

Table 3. Baseline nutritional status of children started ART at Wolaita zone health facilities. March 2014.

Nutritional parameter	Age category			
	<18months (n=16)	18-59 months (n=89)	5-14 years(n=123)	Total (n=228)
Stunted (HAZ<-2)	10(62.5%)	51(57.3%)	82(66.7%)	143(62.5%)
Severely stunted (HAZ<-3)	6(37.5%)	36(40.4%)	46(37.4%)	88(38.6%)
Underweight (WAZ<-2)	5(31.3%)	45(50.6%)	48(39.0%)	98(43.0%)
Severely underweight (WAZ<-3)	3(18.8%)	35(39.3%)	40(32.5%)	78(34.2%)
Wasted (WHZ<-2)	5(31.3%)	39(43.8%)	58(47.2%)	102 (44.7%)
Severely wasted (WHZ<-3)	4(25%)	34(38.2%)	44(35.8%)	82(36%)

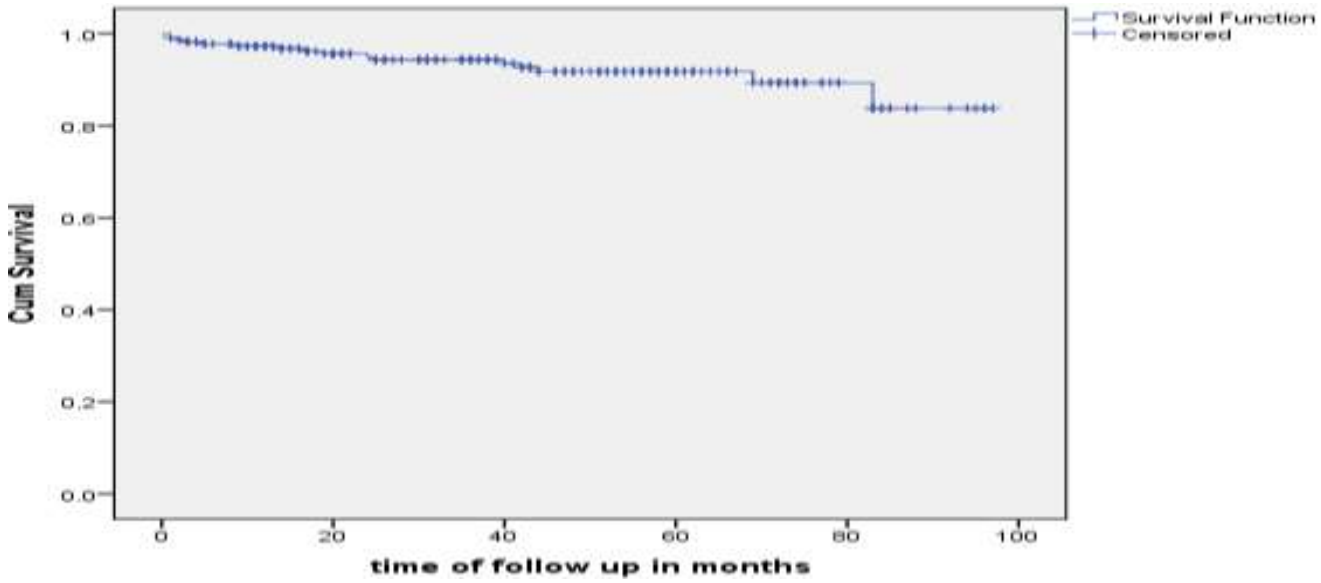

Figure 1. Survival curve for children on ART at Wolaita Zone health facilities, March 2014.

across sex of children with log rank test X^2 = 1.083 df = 1 p = 0.298. Mean survival time has also difference across severely wasted children stratified by age of the children. Mean survival time among severely wasted HIV infected aged <18 months children on ART was 16 (95% CI, 1-39) compared to non-severely wasted children with mean 80(95% CI 70-89.3 months).

Predictors of mortality

Cumulative incidence of mortality rate 21.02 per 1000 PYO (Person Year of Observation) (95% CI 12.8-34.3 per 1000 PYO). Estimated mortality was 2, 3, 6, 8 and 16% at 6, 12, 24, 60 and 96 months of follow up respectively. Incidences of mortality rate for severely wasted children 3.79 (95% CI 1.3-10.9) times higher than non-severely wasted children.

Relationship between main variable and risk of death was analyzed using Cox proportional model. Result has shown children age, residence, WHO clinical stage III and IV, functional status, developmental status at base line, first three-month ART adherence, hemoglobin value (< = 10 gm/dl), severely underweight, wasted and severely wasted children has significant association on Hazard rate of death (HZ). The rest has no significant association with mortality status.

In multivariate Cox regression analysis, only those variables significantly associated with survival on bi-variate were entered to the final model. After adjusted, independent significant predictor of mortality in children living with HIV/AIDS after initiation of ART remain residence of children, age of children, first three-month ART adherence and severely wasted. Residence of children is predictor of mortality of children on ART living in rural AHR 4.302 (95% CI, 1.25-14.8) than urban children. Children aged < 18 months were less likely to survive than aged 18 to 59 month, 5 to 14 years of age

Table 4. Multivariate predictors of survival among children started ART at Wolaita Zone health facilities March 2014.

Covariates		Survival status		Crude hazard ratio (95% CI)	Adjusted hazard ratio (AHR)(95%CI)
		Censored	Died		
Age of the child	<18 months	12	4	1	1
	18 -59 months	87	2	0.083(0.015-0.453)	**0.047(0.006-0.368)**
	5-14 years	113	10	0.274(0.086-0.873)	**0.145(0.032-0.663)**
Sex of the child	Male	115	6	1	
	Female	97	10	1.703(0.617-4.696)	*
Residence of child	Urban	151	7	1	1
	Rural	61	9	4.20(1.53-11.60)	**4.302(1.25-14.8)**
History of Past opportunistic illness	No	18	2	1	
	Yes	194	14	2.031(0.45-9.11)	*
Functional status at base line	Working/ambulatory	194	8	1	1
	Bed ridden	18	8	9.12(3.43-24.73)	1.80(0.28-11.54)
WHO clinical staging of HIV at baseline	Stage I or II	98	3	1	1
	Stage III	85	6	2.22(0.55-8.88)	1.04(0.213-5.09)
	Stage IV	29	7	7.02(1.81-27.28)	3.12(0.40-24.35)
CD4 count or percentage	Above normal	86	5	1	
	Below normal	126	11	1.53(0.53-4.48)	*
Developmental History at base line	Appropriate	157	6	1	1
	Delayed/ regressive	55	10	4.26(1.55-11.72)	0.98(0.15-6.61)
First three month ART adherence	Good	192	6	1	1
	Fair/poor	20	10	13.0(4.7- 35.97)	**8.95(2.62-33.7)**
Hemoglobin level	>10 gm/dl	145	5	1	1
	≤10 gm/dl	67	11	5.35(1.86-15.88)	2.27(0.62-8.3)
Severely underweight	No	144	6	1	1
	Yes	68	10	2.98(1.08-8.22)	0.55(0.09-3.49)
Wasting	No	122	4	1	*
	Yes	90	12	3.38(1.09-10.51)	
Severely wasted	No	136	5	1	1
	Yes	60	11	3.79(1.34-10.99)	**7.04(1.27-39.1)**

with AHR 0.047(95% CI, 0.006-0.368), 0.145(95% CI 0.032-0.663) respectively. Fair/poor of first three-month ART adherence of children was not surviving as good adherence with AHR 8.95(95% CI 2.624-33.72). Severely wasted at baseline was important predictor of mortality in HIV/AIDS infected children after initiation of ART with AHR 7.040 (95 % CI, 1.267-39.13) (Table 4).

DISCUSSION

Overall nutritional status, 62.5% were stunted, 38.6% were severely stunted, 43.0% were underweight, 34.2% were severely underweight and 44.7% were wasted and 36% were severely malnutrition at baseline. There was high prevalence of severely wasted, underweight and stunted which was in line with finding of study done in Zewditu memorial hospital that indicated with 61.1% underweight children, 55.6% stunting of children, 27.3% wasting of children at base line were (5,6,). The finding of this study also has similar result with finding in Tanzania (Sunguya et al., 2011). This could be due to substantial impact of HIV infection on the nutritional status of infected people due to poor food intake as a result of poor

appetite and difficulty eating, intestinal mal-absorption because of chronic diarrhea and HIV caused intestinal cell damages, metabolic changes and increased nutrient requirements related to opportunistic infections (OIs).

In our study the cumulative incidence of mortality rate, cumulative proportion of survival and mean survival time for this cohort using Kaplan Meier analysis was lower in our study compared with study done in 2006 by Medicines Sans Frontie`res HIV/AIDS programs in 14 countries, the overall probability of survival (O'brien et al., 2007). Our finding also had lower mortality rate compared study done in Ethiopia in AA zewditu and Bahir Dar (Koye et al., 2012; Taye et al., 2010; Atnafu and Wencheko, 2012). This could be explained in two ways. Firstly, the difference in the study period as there were changes in the treatment and care of children on ART through time. Secondly our study includes health centers which give ART service so health centers have most of simple cases as severe cases were refer to hospital.

After adjusted by multivariate Cox proportional regression, the independent significant predictor of reduced surviving in children living with HIV/AIDS after initiation of ART remain residence of the children, age of the children, first three-month ART adherence and severely wasted.

Residence of children is one of the predictor of reducing survival of children on ART living in rural four times higher than urban children. This is similar with EDHS 2011 shows Mortality rates in urban areas are consistently lower than in rural areas in child mortality. This could be due to hygiene and sanitation, malnutrition is prevalent in rural, poor knowledge of on care of HIV and others (Federal Democratic Republic of Ethiopia Ministry of Health, 2012/2013).

In our study the only socio demographic predictor for survival was children age as < 18 months were more not surviving than age 18 month-5 year, 5 to 14 years of age. This is in line with study done in South Africa shows age of <3 years 2.6 times higher to die than the others (Zanoni et al., 2011). Our study also in line with study done in south Africa from this study age comparing ≥120 months with <18 months were risk factor for death (Fenner et al., 2010). Study done in Malawi also in line with our result Children <18 months old were 2.15 times more likely to die as children aged at least 18 months (Fetzer et al., 2009). Our study also support WHO new 2013 guideline which says ART should be initiated in all children infected with HIV below five years of age, regardless of WHO clinical stage or CD4 cell count (World Health Organization (WHO), 2013).

But our result is not congruent with result from Ethiopia done in Bahir Dar Felege Hiwot referral hospital and AA zewditu memorial Hospital. These studies end that age is not the predictor in the multivariate cox regression. This could be due WHO guideline change for ART initiation that uses age as starting for ART.

However, sex and other socio demographic characteristic were not predictors of mortality in in our study and another study from Ethiopia (Koye et al., 2012; Taye et al., 2010).

In our study fair/poor of the first three-month ART adherence of children was not surviving as good adherence with 8 times higher. According to WHO Retaining people receiving ART in care and ensuring good treatment adherence are critical determinants of successful ART outcomes. Our finding is similar with finding from British Non-adherence over time (<95%) was strongly associated with higher risk of mortality (AHR: 3.13; 95% CI: 1.95 to 5.05). This was also in line with study in Uganda which was good adherence reduces the hazard rate adherence to HAART was associated with survival (HR 0.46, 95% CI 0.47 to 0.50) (World Health Organization (WHO), 2013a, b; Abaasa et al., 2008; Lima et al., 2009). Due to fair/poor adherence of the ART leads to virologic, immunologic and clinical failure that is mediated mainly by two potentially reinforcing mechanisms. Fair/poor adherence to ART leads to failure to suppress viral replication, thus increasing the likelihood of developing HIV mutations that could lead to the development of drug-resistant viral strains. Secondly, fair/poor adherence to ART fails to prevent further viral destruction of the cellular immune system with consequent reduction in the level of CD4+ cells and development of opportunistic infections (Maggiolo et al., 2007).

Severely wasted children at baseline were seven times higher to die early than not severely wasted children with which is consistent with study done in AA Zewditu memorial Hospital, but in study done in Bahir Dar nutritional predictors were not associated with survival (Koye et al., 2012; Taye et al., 2010; Atnafu and Wencheko, 2012). Households of HIV-positive children under ART had lower economic status, less education, and greater proportions of unemployed caregivers. Despite the effectiveness of ART in ameliorating disease burdens, persistent socio-economic backwardness may ultimately retard the progress (Fetzer et al., 2009). The mechanism malnutrition might act to decrease survival is uncertain: The hypothesized reason is malnutrition impair immune reconstitution and there by prolong the period at which patient remain at increased risk of opportunistic infection.

However, in contrary to another study presence of OIs, WHO clinical stage, hemoglobin level, absolute CD4 value, Cotrimoxazole preventive therapy at baseline and delayed or regressing developmental history were significant predictors of mortality but not in our study (Koye et al., 2012; Taye et al., 2010). This could be explained by the study there are high missing value for example for hemoglobin and absolute CD4 value were have number of missing value and missing value analysis was done for these variables.

Limitation of the study was using secondary data with incomplete data and excluding these incomplete data might cause selection bias. A second limitation is computing risk of death which may overestimate the predictors due to inability of controlling competing risk of death as well as underestimated mortality that might be lost to follow up patient. Other limitations such as important predictors of mortality, viral load and micronutrient deficiency were not considered.

CONCLUSION

Children on ART at baseline have high prevalence of malnutrition. Incidence of mortality for children infected with HIV and initiated ART was lower in this cohort. Malnutrition due to severe wastage was an important predictor of reducing survival of children on ART. Other independent predictors of mortality or survival reduction were residence, age of the child, and first three-month ART adherence registered by physician at baseline.

RECOMMENDATION

Based on the study finding, the following recommendations to researchers, hospitals and health centers can be forwarded. The first one is careful monitoring and follow up of patients with who came from rural, age less than 18 months are necessary particularly during the first 6 months of ART initiation. The second recommendation is malnutrition as severely wasted children on ART at baseline should be carefully assessed and treated accordingly and seeks special follow up. Last is about Careful follow up for poorly or fairly adhered patients and giving them drug counseling is crucial to improve survival. Further study is recommended on prospective by controlling such as viral load and micronutrient deficiency.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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