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ORIGINAL ARTICLE

Effect of Nutrition Supplementation in Children Living with HIV at ART Centre

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Abstract
Objective To assess the benefits of nutrition supplementation in children living with HIV (CLHIV).
Methods A prospective observational study was carried out at antiretroviral therapy (ART)/pediatric centre of excellence (PCOE), Niloufer hospital for a period of one year in CLHIV (N = 164) aged 1 to 18 y referred to ART/PCOE. Nutrition supplementation was given in the form of Ready to Use Food (About 350 kcal and 12 g of protein per day) supplementation to assess improvement in Height for age Z (HAZ), Weight for Age Z (WAZ), Weight for Height Z (WHZ) and Body Mass Index for age Z (BMIZ) scores over a period of one year.
Results At baseline, 65.5 % and 57.5 % of children below and above 5 y respectively were stunted. 24.1 % and 45.3 % children below and above 5 y respectively were wasted/thin (as assessed by BMI for age). Mean BMIZ score significantly improved in both the age groups (0.96 Z score, $P < 0.001$) in below and above 5 (0.37 Z score, $P < 0.001$) respectively at the end of 12 mo. Mean HAZ score also significantly improved in children above 5 y (0.09 Z score, $P < 0.05$) with non-significant improvement below 5 y (0.14 Z score, $P < 0.57$) by the end of 12 mo.
Conclusions Nutrition supplementation over one year resulted in moderate improvement in the nutritional status of CLHIV. However, it is unclear, whether the improvement in nutritional status was due to regular visits to ART centre that may have resulted in better adherence to treatment or an additional benefit of nutrition intervention. This warrants a well-designed randomized controlled trial to examine the benefits of nutrition supplementation in CLHIV attending ART centre.

Keywords Children living with HIV · Nutrition supplementation · Nutrition status

Abbreviations

AOR	Adjusted Odd Ratio
AP Foods	Andhra Pradesh Foods
ART	Antiretroviral Therapy
ARV	Antiretroviral
BMI	Body Mass Index
BMIZ	Body Mass Index for Age Z Score
CD4	Cluster of Differentiation-4
CED	Chronic Energy Deficiency
CLHA	Children Living with HIV/AIDS
CLHIV	Children Living with Human Immunodeficiency Virus
HAZ	Height for Age Z Score
HIV	Human Immunodeficiency Virus
NACO	National Aids Control Organization
PCOE	Pediatric Centre of Excellence
Pre-ART	Pre Antiretroviral Therapy
RCT	Randomized Controlled Trial
RPC	Regional Pediatric Centre
RUTF	Ready to Use Therapeutic Food
WAZ	Weight for Age Z Score
WCD	Women & Child Development
WHO	World Health Organization
WHZ	Weight for Height

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Introduction

Human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) has a devastating impact on health, nutrition and food security of the individual and the community. According to WHO in 2010, 4.8 million people were living with HIV in Asia and nearly half (49 %) of all people living with HIV in Asia are in India [1]. With already high levels of under nutrition in the country [47 % stunting, 47 % under wasting, 17 % wasting in children under 5 y and 52 % of chronic energy deficiency (CED) in adults] [2], HIV poses a greater risk for developing malnutrition in children affected with HIV [3–5]. Malnutrition in HIV infected individual is also a marker for poor prognosis among HIV infected individuals [6, 7].

Guidelines suggest that asymptomatic HIV-infected children may require up to 10 % and symptomatic HIV infected individuals may require 20–30 % more energy than uninfected children, and their growth should be monitored very carefully to detect any increased energy needs [8]. Though studies exist on micronutrient supplementation in HIV infected children, only few studies outside India have assessed the effect of nutrition supplementation (Calorie and protein based) in children living with HIV and none from India. The authors, therefore, planned an observational study on impact of nutritional supplementation in children living with HIV on nutritional status of children aged 1 to 18 y at the Centre.

Material and Methods

This prospective observational study was conducted at Pediatric Centre of Excellence (PCOE) centre, Niloufer hospital, Hyderabad from June 2012 through September 2013. The ART centre of Niloufer hospital is one of the 56 ART centres designated by National AIDS Control Organization (NACO) which has been functioning since March 2008. To ensure provision of high quality pediatric HIV care and capacity building activities in pediatric HIV across the country, it is one of the 7 reputed centres that are nominated as Regional Pediatric Centres (RPCs), later that are developed and strengthened as Pediatric Centre of Excellence (PCOE).

Being attached to a Pediatric hospital, the centre provides medical services to the children (From birth to 18 y) and their parents living with HIV. Patients with confirmed HIV positive are referred to PCOE centre, where the child is registered in the PCOE by care coordinator, weight and height recorded by staff nurse and the patient is referred to the counselor. The authors have used WHO definitions and growth standards (2006) for stunting, wasting, and underweight [9]. The counselor conducts 3–4 counseling sessions related to, treatment and its importance, side effects of ARV drugs, and limitations of ART, adherence counseling and personal issues. The counselor provides emotional, social and psychological support to the patients, addresses issues of stigma and discrimination and rights of CLHA. This information is recorded in the pre-ART and ART registers and also in patient treatment records (White and Green cards). Caregivers are encouraged and counseled on the nutritional needs of growing children, the nutritional value of different foods, the avoidance of obesity and general food hygiene.

Then the patient is referred to the medical officer. The medical officer examines the patient (General and Physical examination), advises and reviews the required investigations, prescribes the treatment which is based on CD4 count (All patients with less than 350 cells/ul are started on ART and otherwise given pre-ART treatment), ensures drug adherence and counseling the patient towards proper nutrition positive living.

Since 2010, this PCOE centre has started nutrition supplementation program with the help of women & child development (WCD) and Andhra Pradesh (AP) Foods (A state government subsidiary). All children who are suffering from under nutrition (Based on weight for age criteria for children less than 5 y and BMI for age in children more than 5 y) or are from very low socio-economic group (based on one to one interactions) as decided by the medical officer are given nutrition supplements (2–3 packets, each weighing 1 kg, every visit based on weight of the child). The quantity of the supplements, which they should take daily, was informed to them during the nutritional counseling. At each follow-up, the nutritionist monitored child's nutritional status and provided 2–3 packets of nutrition supplements, details of which are provided in Table 1. Before the start of the study, Institutional Ethical Committee clearance was taken for necessary clearance. For the purpose of the study, information was obtained regarding age, gender, height, weight and treatment received (ART or pre ART). Height and weight of children below 2 y was measured using infantometer (LAICA, BarbaranoVicentino, Italy) and Baby weighing scale (DOCBEL, New Delhi, India) respectively. Height and weight of children above 2 y was measured using stadiometer (BIOPLUS, New Delhi, India) and adult weighing scale (EQUINOX – MODEL EB6171, New York, USA) respectively. Height (to nearest 0.1 cm) and weight (to nearest 100 g) were measured using standard equipment at baseline, 6 mo and 12 mo. All children were followed at monthly interval, where food supplements were given by the nutritionist.

R Programming Software (Version 3.0.2), an Open Source software, was used to carry out statistical analysis. For continuous variables, mean and standard deviation, for categorical variables, frequencies were calculated. Nutritional indices were calculated using WHO growth standards available as R Macro. For main outcome measures, Repeated Measures analysis was carried out using nlme package and post hoc analysis (contrasts) was carried out using multicomp package.

Table 1 Nutrient composition of each of the foods given to children living with HIV at ART centre

Per 100 grams	MTF	Snack food	Upma mix	Halwa mix
Ingredients	Roasted water, Roasted soya flour, vanaspathi and sugar	Wheat flour, Maize flour, Bengal gram dhal, Refined palmoline oil, Salt, Citric acid and Spices	Roasted Wheat rawa, Roasted soya rawa, Refined palmoline oil, Salt, Black gram dhal, Mustard seeds and Dried chillies	Roasted Wheat rawa, Roasted soya rawa, Sugar, Vanaspathi and Cardamom powder
Energy (Kcal)	440	400	420	432
Protein (g)	14	12	14.4	12
Fat (g)	15	6	15	14
Vitamin A(μg)	200	200	200	200
Vitamin B1(μg)	0.4	0.4	0.4	0.4
Vitamin B2 (mg)	0.4	0.4	0.4	0.4
Vitamin C (mg)	20	20	20	20
Folic Acid (μg)	15	15	15	15
Niacin (mg)	4	4	4	4
Calcium (mg)	200	200	200	200
Iron (mg)	8	8	8	8

Results

Overall, 164 children aged 1–18 y (Fig. 1), were recruited for the study and followed for period of 1 y. Sixty percent of the study subjects were boys. Among them, 161 and 156 children were followed till 6 mo and 12 mo respectively. Reasons for lack of follow up included transfer to another centre, went to native place during the study period and unable to trace the subjects. There were no deaths during the study period among those who could be traced. On an average, all children received 352 cal of energy and 12 g of protein per day for a period of 1 y. For the purpose of analysis, children were stratified by age (Below 5 y and above 5 y) and treatment (Pre ART and ART) into 4 groups (Tables 2 and 3). Pre ART group were those children where ART treatment was not initiated. Under weight (WAZ) and wasting (WHZ) indices were calculated only for children below 5 y. The other two indices, Height for age (HAZ) and BMI for age (BMIZ) were calculated for all the children.

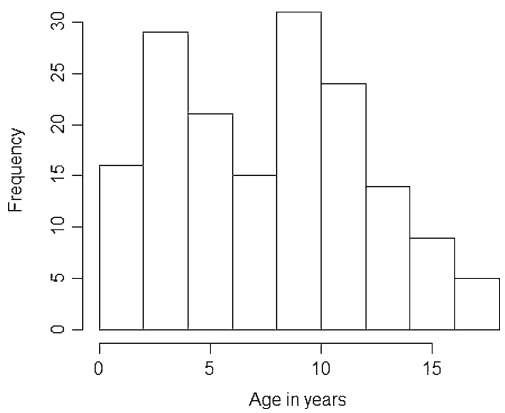

Fig. 1 Histogram of age of the study children

Tables 2 and 3 provide baseline information on study subjects. More children were stunted than thin (wasted) in both the age groups. Median age of the study subjects was 96 mo (Range 12–204) (Not shown in table). Compared to children above 5 y, children below 5 y were more stunted (65.5 % *vs.* 57.5 %) but had better BMI for age or heavier (24.1 % *vs.* 45.3 %). Among below 5-y-olds, only few children were receiving pre ART in this study (N = 12). More children less than 5 y receiving ART were underweight (67.4 *vs.* 41.7 %), stunted (69.6 % *vs.* 50 %) and wasted (37 % *vs.* 8.3 %) compared to children receiving pre ART treatment, with 17.4 % receiving ART below 5 y, suffering from severe wasting (an indicator of severe acute malnutrition). This trend was similar in children above 5 y, where nutritional indices were worse in those receiving ART.

Table 4 shows change in mean HAZ, BMIZ, WAZ, WHZ scores from baseline to 6 mo, baseline to 12 mo and 6 mo to 12 mo. All nutritional indices improved from baseline to 12 mo, with more recovery in wasting (thinness) than stunting.

In children below 5 y, there was a non-significant increase in HAZ score from baseline to 6 mo (0.14 Z score change, P 0.57), with a slight decrease and increase in HAZ scores in children receiving pre ART and ART. In children above 5 y, mean HAZ scores improved significantly in all the groups (0.17 Z score change Overall, $P < 0.001$) and was higher in children receiving ART (0.20 Z score change, $P < 0.001$).

Mean BMIZ scores improved significantly in all groups of children, except children below 5 y receiving pre ART treatment. Z scores change from baseline to 12 mo was highest in children below 5 y receiving ART (1.19 Z score change, $P < 0.001$), with most of the improvement in the first 6 mo of the study period (0.82 Z score change, $P < 0.01$).

Table 2 Baseline characteristics of children below 5 y living with HIV at ART centre

	ART	Pre ART	*P*	Overall
N	46	12		58
Age[a]	30.00 [12.00, 48.00]	36.00 [12.00, 48.00]	0.283	36.00[12.00, 48.00]
Sex [M/F](%)	30/16 (65.2/34.8)	6/6 (50.0/50.0)	0.526	36/22 (62.1/37.9)
Height (cm)	77.55 (9.36)	87.75 (5.74)	0.001	79.66 (9.64)
Weight (kg)	9.11 (2.25)	11.25 (1.74)	0.003	9.55 (2.31)
HAZ Score[b]	−2.69 (3.29)	−1.39 (1.97)	0.200	−2.42 (3.10)
WAZ Score[c]	−2.34 (2.41)	−1.55 (1.52)	0.286	−2.18 (2.27)
WHZ Score[d]	−1.33 (1.75)	−1.07 (1.30)	0.638	−1.28 (1.66)
BMIZ Score[e]	−0.82 (1.88)	−0.92 (1.29)	0.857	−0.84 (1.77)
Stunting (%)			0.031	
Normal and Above	14 (30.4)	6 (50.0)		20 (34.5)
Moderate	9 (19.6)	5 (41.7)		14 (24.1)
Severe	23 (50.0)	1 (8.3)		24 (41.4)
Underweight (%)			0.045	
Normal and Above	15 (32.6)	7 (58.3)		22 (37.9)
Moderate	9 (19.6)	4 (33.3)		13 (22.4)
Severe	22 (47.8)	1 (8.3)		23 (39.7)
Wasting (%)			0.137	
Normal and Above	29 (63.0)	11 (91.7)		40 (69.0)
Moderate	9 (19.6)	0 (0.0)		9 (15.5)
Severe	8 (17.4)	1 (8.3)		9 (15.5)
BMI for age (%)			0.303	
Normal and Above	33 (71.7)	11 (91.7)		44 (75.9)
Moderate	6 (13.0)	0 (0.0)		6 (10.3)
Severe	7 (15.2)	1 (8.3)		8 (13.8)

[a] Median [Range] for age, Mean (standard deviation) for other continuous variables, n (%) for categorical variables

[b] Height for Age, [c] Weight for Age, [d] Weight for Height, [e] Body Mass Index for Age Z scores

Table 3 Baseline characteristics of children above 5 y living with HIV at ART centre

	ART	Pre ART	*P*	Overall
N	52	54		106
Age[a]	132.00 [60.00, 204.00]	108.00 [60.00, 168.00]	0.001	108.00 [60.00, 204.00]
Sex [M/F](%)	29/23 (55.8/44.2)	34/20 (63.0/37.0)	0.578	63/43 (59.4/40.6)
Height (cm)	127.82 (17.32)	119.31 (16.43)	0.011	123.49 (17.32)
Weight (kg)	24.29 (9.03)	20.87 (8.12)	0.042	22.55 (8.71)
HAZ Score[b]	−2.35 (1.37)	−2.16 (1.39)	0.488	−2.25 (1.38)
BMIZ Score[c]	−2.07 (1.13)	−1.64 (1.15)	0.057	−1.85 (1.16)
Stunting (%)			0.714	
Normal and Above	20 (38.5)	25 (46.3)		45 (42.5)
Moderate	18 (34.6)	16 (29.6)		34 (32.1)
Severe	14 (26.9)	13 (24.1)		27 (25.5)
BMI for age (%)			0.277	
Normal and Above	25 (48.1)	33 (61.1)		58 (54.7)
Moderate	16 (30.8)	15 (27.8)		31 (29.2)
Severe	11 (21.2)	6 (11.1)		17 (16.0)

[a] Median [Range] for age, Mean (standard deviation) for other continuous variables, n (%) for categorical variables

[b] Height for Age, [c] Body Mass Index for Age Z scores

For children above 5 y, WAZ and WHZ were not calculated

Table 4 Change[a] in HAZ[b], BMIZ[c], WAZ[d]and WHZ[e] in children below and above 5 y in ART and pre ART groups from baseline to 12 mo

	6 mo - Baseline	12 mo - Baseline	12 mo - 6 mo	F test
ART Below 5 y				
HAZ score	−0.08 ± 0.14 (0.84)	0.23 ± 0.14 (0.24)	0.31 ± 0.14 (0.07)	141.92
BMIZ score	0.82 ± 0.25 (<0.01)	1.19 ± 0.25 (<0.001)	0.37 ± 0.25 (0.30)	0.83
WAZ score	0.25 ± 0.21 (0.46)	0.65 ± 0.21 (<0.01)	0.40 ± 0.21 (0.14)	76.43
WHZ score	0.87 ± 0.22 (<0.001)	1.33 ± 0.22 (<0.001)	0.45 ± 0.22 (0.11)	13.06
Pre ART Below 5 y				
HAZ score	−0.09 ± 0.35 (0.96)	−0.23 ± 0.36 (0.81)	−0.13 ± 0.36 (0.93)	13.67
BMIZ score	−0.82 ± 0.42 (0.13)	0.08 ± 0.44 (0.98)	0.90 ± 0.44 (0.10)	10.57
WAZ score	−0.50 ± 0.29 (0.19)	−0.08 ± 0.29 (0.96)	0.42 ± 0.29 (0.33)	18.26
WHZ score	−0.81 ± 0.40 (0.11)	0.03 ± 0.42 (0.99)	0.84 ± 0.42 (0.11)	12.47
Below 5 y (all)				
HAZ score	−0.08 ± 0.14 (0.81)	0.14 ± 0.14 (0.57)	0.22 ± 0.14 (0.23)	136.03
BMIZ score	0.47 ± 0.22 (0.09)	0.96 ± 0.23 (<0.001)	0.49 ± 0.23 (0.08)	4.96
WAZ score	0.09 ± 0.18 (0.86)	0.50 ± 0.18 (<0.05)	0.41 ± 0.18 (0.06)	95.3
WHZ score	0.52 ± 0.20 (<0.05)	1.06 ± 0.21 (<0.001)	0.54 ± 0.21 (<0.05)	23.06
ART Above 5 y				
HAZ score	0.12 ± 0.04 (<0.01)	0.20 ± 0.04 (<0.001)	0.09 ± 0.04 (0.06)	144.06
BMIZ score	0.10 ± 0.1 (0.58)	0.47 ± 0.10 (<0.001)	0.37 ± 0.1 (<0.001)	154.58
Pre ART Above 5 y				
HAZ score	0.07 ± 0.06 (0.44)	0.13 ± 0.06 (0.08)	0.06 ± 0.06 (0.60)	125.18
BMIZ score	−0.06 ± 0.11 (0.85)	0.28 ± 0.11 (<0.05)	0.34 ± 0.11 (<0.01)	128.29
Above 5 y (all)				
HAZ score	0.09 ± 0.03 (<0.05)	0.17 ± 0.04 (<0.001)	0.07 ± 0.04 (0.10)	270.24
BMIZ score	0.02 ± 0.07 (0.96)	0.37 ± 0.07 (<0.001)	0.35 ± 0.07 (<0.001)	279.56

[a] Change in Z scores presented as Mean ± Standard deviation (*P* value based on Post hoc tests) based on Repeated Measures analysis

[b] Height for Age, [c] Weight for Age, [d] Weight for Height, [e] Body Mass Index for Age Z scores

Similar to changes in BMIZ scores, maximum improvement was seen in ART children below 5 y, who improved by 0.65 WAZ score ($P < 0.01$) and 1.33 WHZ score ($P < 0.001$), while, there were non-significant changes in pre ART children.

Discussion

HIV children are at higher risk of malnutrition, due to decrease in energy intake [10] and increased energy expenditure [11]. Under nutrition in authors' setting is considerably higher than the national level estimates of under nutrition below 5 y [2]. In this study, 65.5 % and 57.5 % of children below and above 5 y were stunted and 17.4 % receiving ART below 5 y were suffering from severe wasting, which requires active nutrition rehabilitation.

To authors' knowledge, this is the first study from India, reporting the effects of calorie and protein based nutrition supplementation on nutritional status in children living with HIV below 18 y. Studies on nutritional supplementation in children living with HIV have been few and far. Of those few, majority of the studies focused on the effect of micronutrient supplementation on nutritional status and progression of disease. Vitamin A [12, 13], Zinc [14] and other micronutrient supplementation [15] in HIV children have been shown to reduce malnutrition, diarrheal morbidity, mortality and progression of disease in different studies.

Supplementation of Ready to Use Therapeutic Food (RUTF), an energy dense food supplement, in HIV children (Mean age 37 mo) in Tanzania, has reduced the Odds of being Underweight [Adjusted Odd Ratio (AOR) =0.19, CI: 0.04, 0.78], and wasted (AOR = 0.24, CI: 0.07, 0.81) at the end of four months of intervention [16]. In the index study, BMI for age Z score increased significantly in children below 5 y (0.96 Z score, $P < 0.001$) and above 5 y (0.37 Z score, $P < 0.001$). In children below 5 y, WAZ increased by 0.50 Z score ($P < 0.05$) at the end of 12 mo of study.

Though studies on effect of nutrition supplementation on stunting in HIV affected children is lacking, a recent meta-analysis has concluded that nutritional supplementation (Both food and micronutrients) in under 5 malnourished children of low socio economic group, reduced HAZ scores by 0.41 Z score [17]. There was a marginal non-significant and significant increase in HAZ score in children below 5 y (0.14

Z score, $P < 0.57$) and above 5 y (0.17 Z score, $P < 0.001$) respectively, at the end of 12 mo of study period.

The present study has certain limitations. As the index study is an observational study and did not have age and sex matched controls, and it is unclear, whether the improvement in nutritional status was due to regular visits to ART centre that may have resulted in better adherence to treatment or an additional benefit of nutrition intervention. As the supplements were given to the caretakers, to be consumed at home, a possibility of sharing of food may have negatively impacted the nutritional status of the individual. Another limitation of the study is, restricting the study to nutritional indices alone rather than including other important indicators such as CD4 count (an indicator of disease progression) and mortality.

Conclusions

The period of nutrition supplementation over one year resulted in a moderate improvement in nutritional status of CLHIV. However, it is unclear, whether the improvement in nutritional status was due to regular visits to the ART centre that may have resulted in better adherence to treatment or an additional benefit of nutrition intervention. This warrants a well-designed randomized controlled trial to examine the benefits of nutrition supplementation in CLHIV attending ART centre.

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Conflict of Interest None.

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