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A nutrition education programme improves quality of life but not anthropometric status of adults living with HIV in Abeokuta, Nigeria

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Abstract

Objective: The focus of interventions for adults living with HIV (ALH) in Nigeria has been mostly on prevention and provision of antiretroviral therapy (ART) with little consideration to nutrition-related matters. Therefore, the present study aimed to improve the quality of life (QoL) and anthropometric status of ALH in Abeokuta, Nigeria.

Design: A quasi-experimental design where 200 conveniently selected participants were stratified by gender and duration on ART. The intervention group (n 100) received the nutrition education programme (NEP) for 12 weeks. The control group received a brochure on nutrition guidelines for ALH. Socio-biographical information, QoL and anthropometric status were assessed using previously validated questionnaires and standard techniques at baseline, week 12 and week 24. Generalised least squares (GLS) regression analysis was used for group comparisons. Anthropometric status was summarised by gender.

Setting: Two tertiary hospitals in Abeokuta, Nigeria.

Participants: ALH.

Results: The NEP led to significant improvement in the physical functioning (week 12 and 24: $P < 0{\cdot}01$), role limitation due to physical health (week 12: $P = 0{\cdot}01$; week 24: $P = 0{\cdot}002$) and pain (week 12: $P = 0{\cdot}01$) constructs of the QoL of the intervention group compared with the control group. There was no significant difference ($P = 0{\cdot}07$) between the mean weights of the two groups at baseline.

Conclusions: There was a significant improvement at week 12 and week 24 in the QoL of the intervention participants. The results indicated that a tailored NEP could make a positive contribution to the management of ALH.

Keywords
HIV
Nutrition
Nutrition education
Quality of life
Anthropometric status
Behavioural theories
HIV management

Infection caused by HIV remains a public health issue due to it psychological, economic, social and clinical implications[1]. HIV/AIDS is still one of the leading causes of death in Africa despite millions of dollars being spent on prevention, control and provision of antiretroviral therapy (ART). As at the end of 2016, an estimated one million deaths occurred globally from HIV/AIDS-related illnesses of which 16 % occurred in Nigeria[1]. The pace of decline in the rate of death resulting from HIV/AIDS-related illnesses is too slow to reduce its societal effects. Hence, there is a need for the consideration of other types of health-care management such as appropriate nutrition support.

Research has shown that appropriate nutrition education (NE) in conjunction with the provision of ART and nutritional supplements is essential for the reduction of HIV-related morbidity and mortality rates[2]. Various studies have confirmed that healthy dietary choices are vital for the improved quality of life (QoL) and anthropometric status of adults living with HIV (ALH). Adequate nutrition is needed by HIV-infected individuals to maintain a healthy life, to strengthen immunity and resistance against opportunistic infections, and to reduce muscle wasting[3]. For an improved QoL, weight gain and its maintenance, foods high in energy and protein are needed[2]. This may be due to the complex and close relationship that exists between the virus' life cycle and nutrition as established by Semba and Tang[4].

Change in weight is common among ALH and is a good indicator of disease progression[5–8]. The study of

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Carbonnel *et al.*[9] confirmed that damage to the lining of the gastrointestinal tract of seventy-nine weight-losing ALH was associated with depletion of micronutrients caused by a reduction in the absorption of nutrients. Consequently, HIV can cause weight loss and wasting among ALH, thereby altering their QoL.

Previous nutrition intervention studies confirmed that dietary supplements in conjunction with NE can lead to an improved nutritional status and QoL of ALH[10–14]. Unfortunately, in Nigeria, where 3·2 million of the 36·7 million people globally who are infected with HIV reside, little attention has been given to HIV and nutrition-related matters.

The aim of the present study was to implement a theory-guided nutrition education programme (NEP) for 12 weeks and to evaluate its effects on the primary (QoL) and secondary (anthropometric status) outcomes of ALH in the intervention group in comparison to those in the control group at week 12 and week 24. The constructs of the Social Cognitive Theory and the Health Belief Model, which have revealed success not only for fruit and vegetable consumption[15], but also in HIV prevention, smoking cessation[16] and other health-related behaviours, were incorporated in the NEP.

It was hypothesised that the intervention group would show a significant improvement in their QoL and anthropometric status compared with the control group at week 12 and week 24 (post-intervention).

Methodology

Research setting

The present study was conducted at two tertiary government hospitals in the urban setting of Abeokuta South, one of the twenty local government areas of Ogun State. The hospitals were selected because they were the only government hospitals in Abeokuta to provide free ART under the Nigerian Government's National Antiretroviral Drug Access Programme. Approximately 1400 ALH at each hospital received free ART which they collected on a monthly basis. A needs assessment, conducted prior to the current study to determine the NE needs of the ALH at the two hospitals, showed the ALH attending the two hospitals to have similar demographic and anthropometric characteristics ($P > 0{\cdot}05$)[17].

Study design

The present study was designed to evaluate the NEP's effects on QoL and anthropometric status of ALH using a quasi-experimental design.

Sampling and sample size

A simple randomisation technique (tossing of a coin by a person not involved in the study) was used to randomise the two hospitals into intervention and control sites. Convenience sampling was used to recruit 200 ALH who met the inclusion criteria and consented to participate in the study. The sample size was determined from the results of the prior needs assessment[17] where 169 of the 243 participants answered all the Short Form (SF)-36 QoL questions with a mean of 65 (SD 14·7) %.

A sample of at least fifty participants per group would have 90 % power to detect an improvement of 10 % points in the QoL construct of scores of the intervention group. Therefore, a sample of at least 100 participants for each group was required to also allow for a 50 % dropout. The participants were stratified according to the duration on ART (0–<24 months and >24 months) and gender. Stratification for gender was based on the results of the needs assessment of 25 % male and 75 % female[17].

Participants were conveniently recruited with the assistance of the staff at the Centres for Public Health of the two selected hospitals. Participants were considered ineligible if any one of the following criteria was met: (i) <18 years or ≥50 years; (ii) unable to provide logical answers to questions asked on personal characteristics and family history; (iii) being on ART for ≥5 years[11]; (iv) inability to attend 12 weeks of NEP and reassessment at 12 weeks post-implementation; (v) refusal to give both written and oral consent; (vi) pregnant or breast-feeding; and/or (vii) presence of active HIV-related opportunistic health conditions (tuberculosis, cancer, liver diseases) as documented on their medical records[18]. The upper cut-offs for age and duration of ART were set to limit possible age- and ART-related co-morbidities. In addition, older age is often associated with reluctance to modify behaviour[19].

Intervention

The intervention entailed the implementation of the NEP at the intervention hospital.

The NEP was developed by the authors to address the NE needs identified by the prior needs assessment within the context of the study sample[17]. Selected constructs of the Social Cognitive Theory and the Health Belief Model were incorporated to enhance learning and positive changes in attitudes and dietary behaviour in order to improve QoL and anthropometric status. The NEP addressed the importance of nutrition in improving QoL and anthropometric status, and provided guidance to overcome the barriers to healthy eating to enable the intervention group to adopt the ideal behaviours[20–22]. The educational objectives and curriculum of the NEP are given in Table 1.

The intervention participants received NE materials and the 12-week NEP. The intervention participants were allocated to one of seven groups on a first-come-first-served basis with a maximum of fifteen and a minimum of thirteen participants per group. The NEP was

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Table 1 Nutrition education programme (NEP) curriculum[17]

Educational objectives based on the results of the needs assessment		
To improve, through the NEP over 12 weeks, and to sustain the improvement at post-implementation follow-up (week 24), the: 1. QoL 2. nutrition knowledge, attitudes and practices 3. anthropometric status 4. dietary quality		
Nutrition education programme content		
Week	**Lesson topic**	**Content description**
1	Understanding HIV/AIDS and the impact on health and nutritional status	• What is HIV and AIDS? • What is the immune system? • What are the symptoms of HIV/AIDS? • What are the modes of transmission of HIV? • What is the impact of HIV/AIDS on health and nutritional status?
2	Management of HIV/AIDS	• Drug therapy including the interaction with nutrients • Dietary management and nutritional care in HIV/AIDS management
3	Guidelines on good nutrition: well-planned varied meals	• Good nutrition and well-planned varied meals based on classes of food • Importance of good nutrition
4	Guidelines on good nutrition: well-planned varied meals continued	• Nigerian guidelines on nutritional care and support for people living with HIV/AIDS
5	Good nutrition: planning well-planned varied meals continued	• Group planning of well-planned varied meals based on available foods and resources
6	Good nutrition: management of nutrition-related problems during HIV infections	Nutritional problems and how to deal with them: • Weight loss • Diarrhoea • Fever • Anaemia
7	Tips for positive living	• Tips for positive living (medication and foods) • Food handling: animal products, fruits and vegetables • General hygiene • Importance of exercise/physical activities for positive living with HIV/AIDS
8	QoL and HIV	• What is QoL? • Who is responsible for your QoL? • How to improve your QoL?
9	Dealing with barriers to healthy eating	• Facilitate group discussion on overcoming barriers to healthy eating
10	Management of food budget and purchasing	• Describe the purpose of meal planning • Describe tips for shopping • Describe how to use limited budgets for healthy foods
11	Revision	
12	Question time and evaluation	Obtain participants' feedback on: • Experience with training components • Experience with the duration of education programme • Perceptions on overall NEP delivery quality and benefits

QoL, quality of life.

implemented from November 2015 to May 2016. The NEP consisted of: (i) an NE trainer's manual which covered 12 weeks of group education for at least one hour per session; (ii) a participant's workbook to be used at home by the intervention participants to revise the topics taught, this was to enhance participants' confidence in performing acquired knowledge and skills; (iii) flipcharts for pictorial demonstration, thus participants compiled evidence through visual literacy; and (iv) a brochure summarising the NEP for self-learning. The researcher, a registered dietitian and fluent in the local language, facilitated the NEP and was assisted by trained research assistants.

Implementation at the control hospital

The control group participants received only the brochure.

Data collection

Quality of life

The primary outcome (QoL) was assessed at baseline, week 12 and week 24 in both the intervention and control groups using the SF-36 QoL questionnaire[23–26]. The questionnaire had previously been validated among ALH in Italy[27] and Taiwan[28]. This questionnaire was pre-tested during the needs assessment among ALH at the two hospitals[17].

Anthropometric assessment

Participants' anthropometric data (weight, height, mid-upper arm circumference (MUAC) and triceps skinfold (TSF)) were obtained by the trained research assistants using standard

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techniques[28,29]. All the measurements were done twice[29,30]. A portable stadiometer (Leicester height measure; Invicta Plastics Limited, Leicester, UK) was used for the height measurement to the nearest 0·1 cm, and a portable calibrated electronic body scale (Seca flat weighing scale, four batteries type; Seca GmbH & Co. KG, Hamburg, Germany) was used for the weight measurements to the nearest 0·1 kg.

MUAC was measured according to standard procedures by using a non-stretchable tape measure. The measurement was recorded to the nearest 0·1 cm[30].

TSF was measured using a Slimglide calliper (ABS Plastics, Johannesburg, South Africa) according to standard techniques. Two measurements were taken per participant and recorded to the nearest 1 mm[29,30]. The measurements were at least 15 s apart to allow the skinfold site return to normal. The researcher ensured that the zero point coincided with the start of the scale before any measurement was taken.

Compliance with the nutrition education programme

Participant attendance of the NEP was recorded at each session. Participants were reminded via telephone of their NEP sessions (intervention group) and their week 12 and 24 assessments (intervention and control groups).

Data analysis

Data were analysed using the statistical software package Stata release 10 (2007). Data were subjected to the Shapiro–Wilk test for normality. Means and standard deviations, or medians and interquartile ranges, of continuous data were calculated. Frequency and percentage distributions of categorical data were described. The QoL questionnaire was scored using the SF-36 scoring tables[31]. All questions were scored on a scale of 0 to 100. A mean percentage score >70 % was considered good, 50–70 % as average or modest, and <50 % as poor[32]. The average of the two measurements for all the anthropometric data was used for analyses[29,33,34]. Generalised least squares (GLS) regression analysis was used for group comparison of overall QoL and for the QoL constructs of the intervention and control groups. The QoL and anthropometric outcomes were compared at baseline, week 12 and week 24 using baseline data as covariates. The GLS regression considered missing values, interactions and discrete changes within and between groups from baseline through to week 24. Cronbach's α was used to test the internal consistency of the QoL constructs. Testing was done at the 0·05 level of significance.

Ethical considerations

The study received approval from the Faculty of Health Science Research Ethics Committee, University of Pretoria, South Africa (number 311/2014) and from the two hospitals (numbers FMCA/470/HREC/2014 and SHA.144/vol. II/97). The procedures set down in the Declaration of Helsinki guidelines were strictly followed. Participants provided written informed consent prior to participation in the study. Participants were reimbursed for their transportation fare immediately after each training session.

Results

The flow of the participants through the study is shown in Fig. 1. In the intervention group, 23 % of the participants who started at baseline dropped out by week 12, and a further 7 % by week 24. In the control group, 28 % were not available at week 12 and a further 10 % at week 24. Of the 200 participants, fifty-one were males, comprising twenty-five in the intervention and twenty-six in the control group (Table 2). The mean age at baseline was 38 years for the intervention and 37 years for the control group. The majority (intervention: 57 %; control: 56 %) of the participants were married. The highest proportion of the participants in both groups had a junior secondary education and above (intervention: 76 %; control: 84 %). The majority of participants were self-employed (traders and contractors) in both the intervention (67 %) and control (58 %) groups. There were no significant differences between the distributions of educational status ($P = 0{\cdot}18$) and duration of ART ($P = 0{\cdot}89$) of the participants in the two groups. However, the difference between the income distributions of the participants was significant at baseline ($P < 0{\cdot}001$).

Compliance with the nutrition education programme

The extent to which participants followed the dietary advice was measured by the change in the number of food groups consumed (individual dietary diversity score (IDDS)) derived from non-quantified 24 h recalls administered to both the intervention and control groups at baseline, week 12 and week 24. Intervention participants provided feedback on their experience and perceptions of the NEP during an open-ended structured interview on completion of the NEP (week 12)[17].

All NEP sessions were attended by thirty participants while the remainder (n 47) attended at least 50 % or more sessions (Fig. 1). The percentage of intervention participants who achieved IDDS ≥ 5 increased from 41 % at baseline to 67 % at week 24, suggesting compliance with dietary advice. In comparison, the percentage of control participants with IDDS ≥ 5 decreased over the study period from 37 % at baseline to 32 % at week 24. Responses to the open-ended interview at week 12 indicated that participants believed they had benefited from the NEP, specifically

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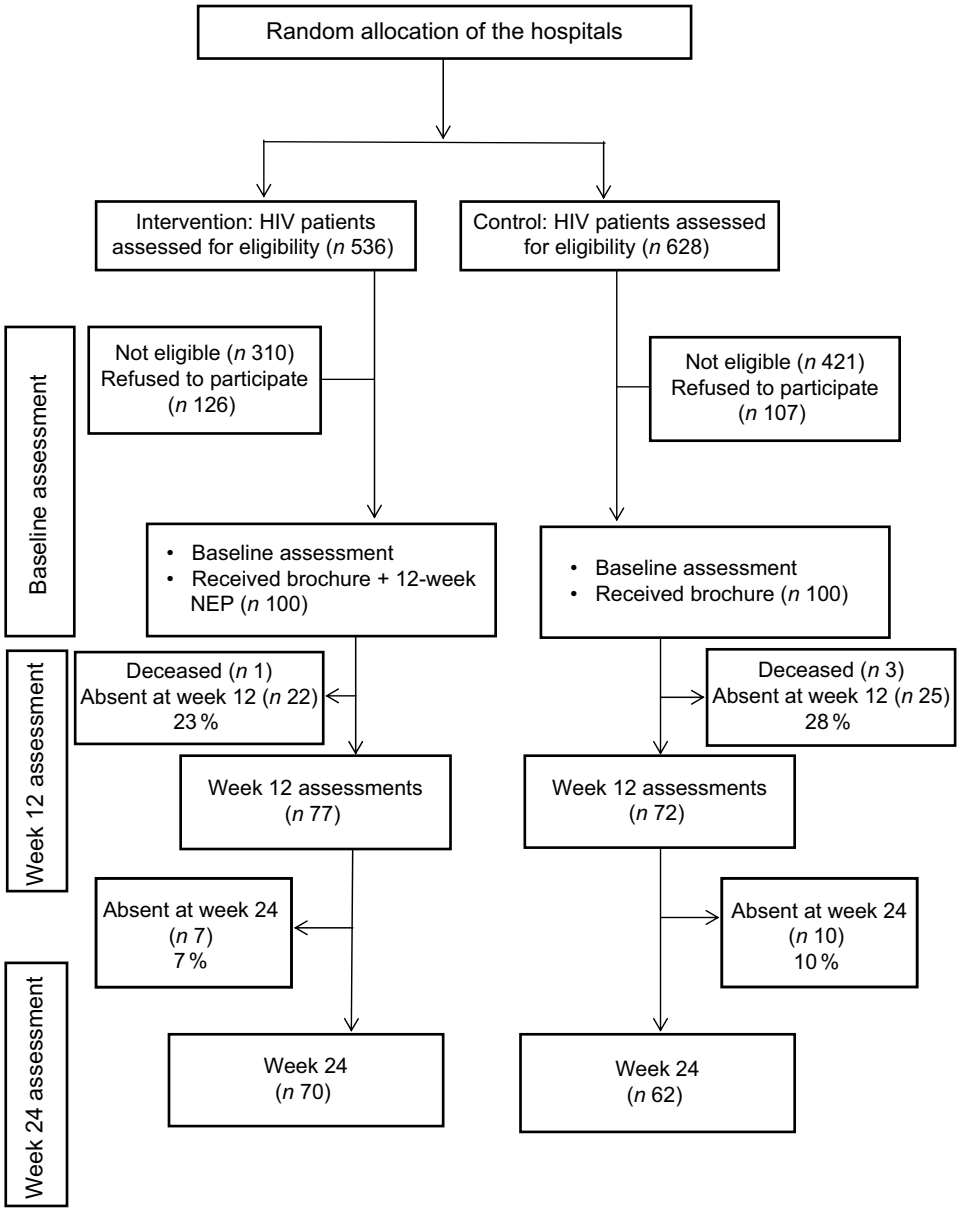

Fig. 1 Flow of participants through the study

mentioning the importance of increasing the variety of foods in their diets[17].

Quality of life

All participants (*n* 200) completed the QoL questionnaire at baseline. At week 12 (intervention: 77 %; control: 72 %) and week 24 (intervention: 70 %; control: 62 %), most of the participants completed the QoL questionnaire. Table 3 shows the mean percentage construct scores and the mean differences between the intervention and control groups.

The difference in mean physical functioning construct scores between the intervention and the control groups was not significant at baseline ($P = 0{\cdot}24$), but was significant at week 12 ($P < 0{\cdot}001$) and week 24 ($P < 0{\cdot}001$). The mean difference in role limitation due to the physical health construct scores between the intervention and the control groups was not significant at baseline ($P = 0{\cdot}11$), but significant at week 12 ($P = 0{\cdot}006$) and week 24 ($P = 0{\cdot}002$).

Table 4 shows the within-group differences in the QoL construct scores from baseline to weeks 12 and 24. There was a significant improvement ($P < 0{\cdot}001$), with an increase of 13 % from baseline to week 12 and 16 % to week 24, in the physical functioning construct score within the intervention group. The changes within the control group showed a non-significant decline of −0·5 % ($P = 0{\cdot}83$) at week 12 and −0·6 % ($P = 0{\cdot}83$) at week 24 in the physical functioning construct score. The intervention group had a significant increase in score in the role

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Table 2 Comparison of demographic characteristics between the intervention and control groups at baseline, week 12 and week 24: adults living with HIV (*n* 200), Abeokuta, Nigeria, November 2015–May 2016

	Baseline			Week 12			Week 24		
Variable	Intervention (*n* 100)	Control (*n* 100)	*P* value†	Intervention (*n* 77)	Control (*n* 72)	*P* value†	Intervention (*n* 70)	Control (*n* 62)	*P* value†
Mean age (years)	38·0	37·0	0·291	38·6	36·8	0·107	38·4	36·7	0·166
SD	7·4	6·6		7·4	6·5		7·4	6·6	
Gender (%)									
Male	25	26	0·871	16	21	0·236	14	19	0·159
Female	75	74		61	51		56	43	
Marital status (%)									
Married	57	56	0·953	46	39	0·851	41	35	0·979
Divorced/separated	12	10		9	8		7	6	
Widow	12	16		7	12		7	9	
Single/not married with children	19	18		15	13		15	12	
Education (%)									
Primary school certificate	24	16	0·181	19	13	0·596	19	12	0·614
Junior secondary certificate	11	13		7	9		6	7	
Senior secondary certificate	27	37		21	25		16	20	
Technical college	9	2		8	2		7	2	
National diploma/NCE	14	13		10	10		10	9	
Bachelor/HND	10	16		8	10		8	10	
Postgraduate/others	5	3		4	3		4	2	
Occupation (%)									
Civil/public servant	19	18	0·470	15	16	0·408	12	15	0·155
Trader (SE)	46	46		35	33		34	25	
Contractor (SE)	21	12		14	10		13	9	
Apprentice	5	13		5	8		3	8	
Student	2	8		1	3		1	3	
Full-time housewife	7	3		7	2		7	2	
Duration on ART (%)									
<24 months	52	51	0·887	36	37	0·572	33	27	0·679=
>24 months	48	49		41	35		37	35	
Monthly income (Naira) (%)									
<10 000	21	11	<0·001**	15	7	0·015*	15	3	0·005*
11 000–30 000	43	31		32	20		26	19	
31 000–50 000	30	37		24	30		24	25	
>50 000	5	21		5	15		4	15	
Don't know	1	0		1	0		1	0	

NCE, Nigerian Certificate in Education; HND, Higher National Diploma; SE, self-employment; ART, antiretroviral therapy.
*$P < 0·05$, **$P \leq 0·01$.
†*P* values derived from the *t* test for continuous variables (age) or Fisher's test for categorical variables (all others).

limitation due to physical health construct at week 12 (21 %; $P < 0·001$) and week 24 (25 %; $P < 0·001$). There was a decrease of −0·2 % ($P = 0·95$) within the control group in the role limitation due to physical health construct score at week 12, and an increase of 0·5 % ($P = 0·09$) at week 24, which were not significant.

There was a significant increase in the role limitation due to emotion construct score at week 12 (16 %; $P < 0·001$) and week 24 (22 %; $P < 0·001$) within the intervention group. In contrast, there was a decrease in the role limitation due to emotion construct score within the control group at week 12 (−2·7 %; $P = 0·5$) and an increase at week 24 (0·3 %; $P = 0·94$), which were not statistically significant.

Table 5 shows the internal consistency of the QoL questionnaire for the intervention and control groups using the Cronbach α reliability test. Cronbach's α for the physical functioning of the intervention group was 0·86, and 0·89 for the control group; for the social functioning construct, the Cronbach's α was low (intervention: 0·42; control: 0·20).

Anthropometric status

There were no significant differences in mean weight between the intervention and control groups at baseline ($P = 0·19$), week 12 ($P = 0·17$) and week 24 ($P = 0·14$). It follows that there was no significant differences in mean BMI between the intervention and control groups at baseline ($P = 0·20$), week 12 ($P = 0·19$) or week 24 ($P = 0·16$). At baseline, mean MUAC and TSF of the control group were significantly higher than those of the intervention group ($P = 0·033$ and $P = 0·04$, respectively). These significant differences remained at week 12 and, for mean TSF, at week 24 (Table 6).

Table 7 shows that there were no significant differences in weight status within the intervention and control groups at week 12 (intervention: $P = 0·18$; control: $P = 0·40$) and week 24 (intervention: $P = 0·08$; control: $P = 0·06$). Similarly, there were no significant differences in MUAC and TSF status within groups at week 12 (MUAC: intervention: $P = 0·5$; control: $P = 0·79$; TSF: intervention: $P = 0·5$; control: $P = 0·87$) and week 24 (MUAC:

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Table 3 Differences in mean quality of life (QoL) construct scores (%) between the intervention and control groups at baseline, week 12 and week 24: adults living with HIV (*n* 200), Abeokuta, Nigeria, November 2015–May 2016

	Baseline							Week 12							Week 24						
	Intervention construct score (%) (*n* 100)		Control construct score (%) (*n* 100)		Difference† (%)			Intervention construct score (%) (*n* 77)		Control construct score (%) (*n* 72)		Difference in baseline mean and predicted‡ (%)			Intervention construct score (%) (*n* 70)		Control construct score (%) (*n* 62)		Difference in baseline mean and predicted‡ (%)		
QoL construct	Mean	SD	Mean	SD	Mean	SE	*P* value†	Mean	SD	Mean	SD	Mean	SE	*P* value‡	Mean	SD	Mean	SD	Mean	SD	*P* value‡
Physical functioning	77·7	21·0	74·1	25·1	3·6	3·1	0·244	89·9	14·5	74·4	25·9	16·8	3·4	<0·001**	92·8	16·0	75·6	25·2	19·0	3·6	<0·001**
Role limitation due to physical health	66·3	30·9	73·5	36·0	−7·3	4·5	0·110	87·3	24·9	75·7	35·1	14·0	5·1	0·006**	90·4	23·4	76·6	33·2	16·5	5·1	0·002*
Role limitation due to emotion	64·7	33·1	72·0	38·4	−7·3	5·1	0·133	81·0	32·6	70·8	39·9	11·4	5·8	0·047	86·7	31·3	74·2	37·9	14·5	6·1	0·017*
Energy and fatigue	74·0	17·7	70·0	18·6	4·1	2·6	0·117	71·5	18·5	69·7	19·7	1·8	2·8	0·528	74·6	16·6	68·8	21·2	5·3	3·1	0·086
Emotional well-being	78·2	14·7	70·6	19·7	7·6	2·5	0·002**	73·2	17·0	70·9	20·7	2·4	2·8	0·390	74·4	14·2	70·5	5·9	3·5	3·0	0·243
Social functioning	78·5	20·0	68·1	21·2	10·4	2·9	<0·001**	74·8	19·8	70·5	20·9	5·7	3·3	0·081	68·6	21·9	69·3	21·3	0·2	3·4	0·961
Pain	72·7	25·4	72·1	22·1	0·6	3·4	0·846	61·7	27·3	71·6	22·2	−9·7	3·8	0·011**	68·1	23·8	70·3	23·2	−3·1	3·9	0·442
General health	80·4	14·1	73·9	17·5	6·5	2·4	0·006**	77·5	18·2	74·1	18·4	3·6	2·7	0·171	78·6	16·1	73·1	17·0	5·7	2·8	0·04*

**P* < 0·05, ***P* ≤ 0·01.
†Differences in baseline mean of the intervention and control groups derived from ANOVA; *P* values derived from ANOVA.
‡Differences in baseline mean (crude mean) and predicted mean at week 12 and week 24 between groups derived from GLS (generalised least squares) random-effects regression taking the missing values into account; *P* values derived from GLS random-effects regression taking the missing values into account.

intervention: *P* = 0·15; control: *P* = 0·35; TSF: intervention: *P* = 0·31; control: *P* = 0·69).

Table 8 shows the anthropometry for the intervention and control groups according to gender from baseline to week 24. The mean BMI of males and females in the control group were slightly higher than those of the intervention group at all measurement points. In contrast to the other groups, the mean BMI of the female control participants could be classified as overweight at baseline (25·2 kg/m^2) and increased over the study period to 26·2 kg/m^2 at week 24. The mean TSF and MUAC for both males and females remained within the values associated with good health from baseline to week 24[34,35].

Discussion

The first hypothesis related to QoL, as the primary outcome, was that the intervention group would have a significant improvement in their QoL compared with the control group at week 12 and week 24. The results supported this hypothesis. There was improvement in the construct scores of QoL of the intervention group compared with the control group. Some of the improvements were significant. There was no significant difference between the intervention and control groups' scores in the physical functioning construct at baseline (*P* = 0·24), but there were significant differences at week 12 (*P* < 0·001) and week 24 (*P* < 0·001). Similarly, there was a significant difference between the intervention and the control groups' scores in the role limitation due to the physical health construct at week 12 (*P* = 0·01) and week 24 (*P* = 0·002).

There are limited results available in the literature that focus on the impact of NE on QoL of ALH. However, the results of the present study are in agreement with previous studies. Mwamburi *et al.* demonstrated a similar significant improvement of 6 % in the physical construct of QoL among the intervention group, who received dietary counselling to increase energy intake by ≥2092 kJ/d (≥500 kcal/d), compared with the control group participants[11]. Another study focusing on the QoL of ALH, including nutrition counselling, documented a significant improvement in the physical functioning construct of both the intervention and control groups[10]. Ogalha *et al.* evaluated the impact of a 50 min education session on dietary needs and exercise on the QoL of seventy ALH in Brazil[10]. These authors found significant improvement from baseline (intervention: 71 (SD 24); control: 71 (SD 28)) to week 12 (intervention: 91 (SD 17), *P* = 0·004; control: 84 (SD 24), *P* = 0·001) within the intervention and control groups, but a non-significant difference in improvement between the groups (*P* > 0·05).

The significant improvements reported in the present study could have several explanations. The intervention group could have increased their physical activities since not only were they encouraged to do so during the

Table 4 Differences in quality of life (QoL) mean construct scores (%) within the intervention and control groups from baseline to week 12 and week 24: adults living with HIV (*n* 200), Abeokuta, Nigeria, November 2015–May 2016

					Construct score (%)						Difference in baseline mean and predicted† (%)					
		n at visit			Baseline		Week 12		Week 24		Week 12		Week 24		*P* value†	
QoL construct	Group	Baseline	Week 12	Week 24	Mean	SD	Mean	SD	Mean	SD	Mean	SE	Mean	SE	Week 12	Week 24
Physical functioning	Intervention	100	77	70	77·7	21·0	89·9	14·5	92·8	16·0	12·5	2·5	15·6	2·5	<0·001**	<0·001**
	Control	100	72	62	74·1	25·1	74·4	25·9	75·6	25·2	−0·5	2·2	−0·6	2·3	0·829	0·799
Role limitation due to physical health	Intervention	100	77	70	66·3	30·9	87·3	24·9	90·4	23·4	21·3	3·6	24·5	3·7	<0·001**	<0·001**
	Control	100	72	62	73·5	36·0	75·7	35·1	76·6	33·2	−0·2	3·4	0·5	3·6	0·949	0·885
Role limitation due to emotion	Intervention	100	77	70	64·7	33·1	81·0	32·6	86·7	31·3	16·3	4·9	22·0	5·1	<0·001**	<0·001**
	Control	100	72	62	72·0	38·4	70·8	39·9	74·2	37·9	−2·7	4·0	0·3	4·2	0·498	0·939
Energy and fatigue	Intervention	100	77	70	74·0	17·7	71·5	18·5	74·6	16·6	−2·7	2·2	0·5	2·3	0·237	0·814
	Control	100	72	62	70·0	18·6	69·7	19·7	68·8	21·2	−0·6	2·1	−0·7	2·2	0·788	0·756
Emotional well-being	Intervention	100	77	70	78·2	14·7	73·2	17·0	74·4	14·2	−5·0	2·1	−3·8	2·1	0·015*	0·073
	Control	100	72	62	70·6	19·7	70·9	20·7	70·5	5·9	0·1	2·3	0·3	2·4	0·953	0·884
Social functioning	Intervention	100	77	70	78·5	20·0	74·8	19·8	68·6	21·9	−3·8	2·7	−9·9	2·8	0·159	<0·001**
	Control	100	72	62	68·1	21·2	70·5	20·9	69·3	21·3	−0·05	1·7	−0·4	1·8	0·977	0·841
Pain	Intervention	100	77	70	72·7	25·4	61·7	27·3	68·1	23·8	−11·1	3·4	−4·9	3·5	<0·001*	0·160
	Control	100	72	62	72·1	22·1	71·6	22·2	70·3	23·2	−1·2	2·2	−1·3	2·3	0·590	0·581
General health	Intervention	100	77	70	80·4	14·1	77·5	18·2	78·6	16·1	−2·9	2·1	−1·8	2·2	0·176	0·412
	Control	100	72	62	73·9	17·5	74·1	18·4	73·1	17·0	−0·2	1·5	−1·2	1·6	0·916	0·459

*$P < 0·05$, **$P \leq 0·01$.

†Differences in baseline mean (crude mean) and predicted mean at week 12 and week 24 derived from GLS (generalised least squares) random-effects regression taking the missing values into account; *P* values derived from GLS random-effects regression taking the missing values into account.

Table 5 Internal consistency of the quality of life (QoL) questionnaire for intervention and control groups: adults living with HIV (*n* 200), Abeokuta, Nigeria, November 2015–May 2016

QoL construct	No. of items	Cronbach's α	
		Intervention (*n* 100)	Control (*n* 100)
Physical functioning	10	0·855	0·894
Role limitation due to physical health	4	0·564	0·831
Role limitation due to emotion	3	0·491	0·820
Energy and fatigue	4	0·475	0·470
Emotional well-being	5	0·564	0·648
Social functioning	2	0·421	0·196
Pain	2	0·867	0·639
General health	6	0·603	0·653

education sessions, but were also empowered to understand the scientific benefits of exercise as established in previous studies, such as that of Hu *et al.*, which showed that people who are physically active have a lower risk of cardiovascular and cancer diseases[36]. The NEP also addressed the roles of food in physical functioning, emotional well-being, energy and fatigue, social functioning, pain and general health. Furthermore, the improvement in dietary quality suggested by the 26 % increase in the percentage of participants with IDDS ≥ 5 at week 24 could have contributed to an improved sense of physical and emotional well-being and functioning. A study that evaluated the relationship between nutritional status and physical functioning among undernourished adults in Malaysia confirmed that poor nutrition can affect physical performance[37].

The importance of a positive attitude was also emphasised to the intervention participants since previous studies have confirmed that participants can increase their happiness through positive attitudes[38] and by improving social relationships[39,40]. Participants in the intervention group were also educated that negative attitudes can lead to role limitations because negative emotions can affect appetite, among other things[41,42]. The NEP might have been responsible for the significant improvement in role limitations related to emotional problems of the intervention group compared with the control group at week 24 ($P = 0·02$).

It was hypothesised that the anthropometric status of the intervention group would show significant improvements at weeks 12 and 24 when compared with the control group. Participants in the intervention group maintained the same mean BMI (24·0 kg/m^2) associated with good health from baseline to week 24. The mean BMI of the control group increased insignificantly ($P = 0·06$) from a BMI associated with good health (24·9 kg/m^2) at baseline to one associated with overweight at week 12 (25·4 kg/m^2) and week 24 (25·7 kg/m^2). The mean BMI of the intervention and control groups are comparable to those reported for ALH in other African studies. A large cross-sectional study in an HIV-prevalent rural South African area found a mean BMI of 25·4 kg/m^2 among the HIV-infected women, while the mean BMI of HIV-infected men (21·1 kg/m^2) was lower than that obtained in our study[43]. A cross-sectional study of ALH in Cameroon reported a mean BMI of 25 kg/m^2, with that of the women (25·2 kg/m^2) being higher than that of the men (23·8 kg/m^2; $P = 0·047$)[44].

Regarding change in weight and BMI, van Niekerk *et al.* reported similar findings of a stable weight among 73 % of HIV-infected patients not receiving ART following an NE and counselling programme[45]. Our results differed from those of Batterham and Garsia[46] who reported a significant mean weight gain of 1·13 (SD 0·36) kg among participants who received only NE for 12 weeks; and those of Tabi and Vogel who reported, after a secondary analysis of observational data, weight gains of 2·69 kg (female) and 3·37 kg (male) among patients who received dietary counselling to increase protein intake[47].

In agreement with the mean BMI, both intervention and control groups maintained their baseline TSF and MUAC results indicative of good health (TSF: 32 mm for males; 31 mm for females; MUAC: 29 cm for males; 30 cm for females)[34,35] to week 24. A review of the literature provided very limited reports on clinical trials measuring MUAC and TSF in ALH as part of the anthropometric prognostic indicators of a nutrition intervention. The literature review by Koethe *et al.* highlighted MUAC, TSF, waist and hip circumferences as being among the unexplored prognostic indicators in HIV in nutrition clinical trials[48].

Given that the mean BMI of the intervention group remained in the upper normal range and that mean TSF and MUAC were constant throughout the study, it is questionable whether an increase in anthropometric measurements would have been desirable. While wasting and weight loss associated with opportunistic infections[8] remain common complications of HIV/AIDS and must be appropriately managed when present, the increasing prevalence of overweight, obesity, lipohypertrophy and metabolic syndrome are concerns among ALH in the era post highly active ART in both high- and low- to middle-income countries[49–51]. A prospective cohort of South African HIV-infected women found that BMI increased

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Table 6 Differences in anthropometric mean values between the intervention and control groups at baseline, week 12 and week 24: adults living with HIV (*n* 200), Abeokuta, Nigeria, November 2015–May 2016

	Baseline							Week 12							Week 24						
	Intervention (*n* 100)		Control (*n* 100)		Difference†			Intervention (*n* 77)		Control (*n* 72)		Difference in baseline and predicted at week 12‡			Intervention (*n* 70)		Control (*n* 62)		Difference in baseline and predicted at week 24‡		
Variable	Mean	SD	Mean	SD	Mean	SE	*P* value†	Mean	SD	Mean	SD	Mean	SE	*P* value‡	Mean	SD	Mean	SD	Mean	SE	*P* value‡
Weight (kg)	64·9	12·6	67·3	13·7	−2·5	1·9	0·185	64·5	10·9	68·9	14·7	−2·6	1·9	0·170	64·2	11·7	69·8	14·3	−2·7	1·9	0·144
BMI (kg/m^2)	24·0	4·8	24·9	4·9	−0·9	0·7	0·201	23·9	4·5	25·4	5·2	−0·9	0·7	0·191	23·9	4·8	25·7	5·1	−1·0	0·7	0·163
MUAC (cm)	28·2	4·1	29·4	4·2	−1·2	0·4	0·033*	28·2	3·9	29·8	4·0	−1·3	0·6	0·031*	28·1	4·2	29·8	4·0	−1·1	0·6	0·058
TSF (mm)	31·0	4·1	32·6	6·3	−1·6	0·7	0·036*	31·2	4·0	32·5	6·4	−1·5	0·8	0·041*	31·0	4·1	32·9	5·9	−1·5	0·8	0·047*

MUAC, mid-upper arm circumference; TSF, triceps skinfold.
*$P < 0·05$, **$P \leq 0·01$.
†Differences in baseline mean of the intervention and control groups derived from ANOVA; *P* values derived from AVOVA.
‡Differences in baseline mean (crude mean) and predicted mean at week 12 and week 24 between groups derived from GLS (generalised least squares) random-effects regression taking the missing values into account; *P* values derived from GLS random-effects regression taking the missing values into account.

Table 7 Differences in anthropometric mean values within the intervention and control groups from baseline to week 12 and week 24: adults living with HIV (*n* 200), Abeokuta, Nigeria, November 2015–May 2016

		n at visit			Anthropometric variable value						Differences in baseline mean and predicted mean at week 12 and week 24†					
					Baseline		Week 12		Week 24		Week 12		Week 24		*P* value†	
Variable	Group	Baseline	Week 12	Week 24	Mean	SD	Mean	SD	Mean	SD	Mean	SE	Mean	SE	Week 12	Week 24
Weight (kg)	Intervention	100	77	70	64·9	12·6	64·5	10·9	64·2	11·7	0·06	0·04	0·08	0·04	0·175	0·075
	Control	100	72	62	67·3	13·7	68·9	14·7	69·8	14·3	0·20	0·20	0·30	0·20	0·398	0·062
BMI (kg/m^2)	Intervention	100	77	70	24·0	4·8	23·9	4·5	23·9	4·8	0·02	0·01	0·03	0·01	0·142	0·060
	Control	100	72	62	24·9	4·9	25·4	5·2	25·7	5·1	0·05	0·10	0·10	0·10	0·497	0·089
MUAC (cm)	Intervention	100	77	70	28·2	4·1	28·2	3·9	28·1	4·2	0·006	0·01	0·01	0·01	0·500	0·149
	Control	100	72	62	29·4	4·2	29·8	4·0	29·8	4·0	0·03	0·10	−0·10	0·10	0·785	0·351
TSF (mm)	Intervention	100	77	70	31·0	4·1	31·2	4·0	31·0	4·1	−0·02	0·03	−0·03	0·03	0·474	0·312
	Control	100	72	62	32·6	6·3	32·5	6·4	32·9	5·9	−0·03	0·20	−0·09	0·20	0·872	0·691

MUAC, mid-upper arm circumference; TSF, triceps skinfold.
*$P < 0·05$, **$P \leq 0·001$.
†Differences in baseline mean (crude mean) and predicted mean at week 12 and week 24 derived from GLS (generalised least squares) random-effects regression taking the missing values into account, *P* values derived from GLS random-effects regression taking the missing values into account.

Table 8 Anthropometric status of the participants by gender: adults living with HIV (*n* 200), Abeokuta, Nigeria, November 2015–May 2016

	Baseline				Week 12				Week 24				
	Intervention (*n* 100)		Control (*n* 100)		Intervention (*n* 77)		Control (*n* 72)		Intervention (*n* 70)		Control (*n* 62)		
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Reference values
Weight (kg)													
Male	67·6	10·7	69·4	12·3	69·9	9·5	71·2	12·1	69·1	9·6	71·7	12·8	
Female	63·9	13·2	66·6	14·2	63·1	10·9	67·9	15·6	63·0	7·9	69·0	15·1	
Height (m)													
Male	1·7	0·1	1·7	0·1	1·7	0·1	1·7	0·1	1·7	0·1	1·7	0·1	
Female	1·6	0·1	1·6	0·1	1·6	0·1	1·6	0·1	1·6	0·1	1·6	0·1	
BMI (kg/m^2)													
Male	23·7	3·6	24·0	3·9	24·0	3·2	24·5	3·8	23·6	3·2	24·5	3·9	BMI[32] associated with good health is 18·5–24·9 kg/m^2, underweight is ≤18·0 kg/m^2, overweight is 25·0–30·0 kg/m^2 and obesity is ≥30·0 kg/m^2
Female	24·1	5·1	25·2	5·2	23·9	4·8	25·7	5·6	24·0	5·2	26·2	5·5	
MUAC (cm)													
Male	28·6	3·8	30·2	3·4	29·2	2·9	30·2	3·0	28·9	3·0	29·9	2·9	MUAC[28] for wasting is <22 cm for females and <23 cm for males
Female	28·0	4·2	29·1	4·4	28·0	4·1	29·6	4·3	27·9	4·5	29·7	4·4	
TSF (mm)													
Male	32·0	4·2	33·5	5·7	32·8	3·7	34·0	5·3	32·5	3·7	33·5	4·5	TSF[33,34] of <15 mm is lean, 15–39 mm is good health and ≥40 mm is excess fat for both males and females
Female	30·7	4·1	32·3	6·5	30·8	4·0	31·9	6·7	30·6	4·1	32·7	6·5	

MUAC, mid-upper arm circumference; TSF, triceps skinfold.

from a median of 27 kg/m^2 at diagnosis to 30 kg/m^2 at 36 months ($P < 0·0001$), while the percentage women classified as obese rose from 34 % at diagnosis to 48 % ($P = 0·004$) at 36 months. Almost 11 % of the women developed metabolic syndrome during the 36-month follow-up period[52]. Cross-sectional studies from Kenya[53] and Nigeria[54] have reported metabolic syndrome prevalence of 19 and 24 %, respectively, among ALH.

One of the aims of an NEP should be to maintain a healthy body weight. The BMI maintained by the intervention group could be associated with the content of the NEP (Table 1). The NEP emphasised healthy food choices and increasing dietary variety (rather than increasing energy intake) while encouraging participants to become more physically active.

Several confounding factors might have contributed to the positive changes in the QoL of the intervention group. The control group received the NE brochure only, without any contact with the NEP team during the study period. Thus, the increased social interaction and attention from the NEP team, rather than the content of the NEP itself, might have resulted in the improved QoL of the intervention group. Furthermore, as ART compliance was not monitored, better compliance among the intervention group could have contributed to the improvement seen in the QoL. Likewise, changes in personal circumstances, illness or other factors unrelated to the NEP could have influenced the results of both the intervention and control groups.

A shortcoming of the present study was that physical activity of the participants was not assessed. It is therefore not possible to conclude whether the significant improvement in the physical functioning construct of the intervention group resulted from increased physical activity, a healthier diet or changed perceptions of the participants. A further limitation was that the study design was quasi-experimental and not a randomised controlled trial that serves as a gold standard[55]. The study involved only two government hospitals in one of thirty-six states in Nigeria, implying that the conclusions of the present study may not be generalised to all ALH in Nigeria. The study was also limited by lack of observation at private hospitals; the ALH attending private hospitals might have better economic power than their counterparts at government hospitals. Hence contrary results might be observed among the ALH at private hospitals.

Conclusions

It can be concluded that the NEP played a significant role in improving the general well-being (QoL) of the ALH. The study has shown that NE that focuses on healthy diet principles and practices could make a positive contribution to the management needed by ALH.

It is therefore recommended that policy makers and health-care workers incorporate NE in the management

among ALH in order to improve their QoL and maintain healthy anthropometric status.

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