Nutritional status, quality of life and CD4 cell count of adults living with HIV/AIDS in the Ga-Rankuwa area (South Africa)

[a] Venter E, [b] Gericke GJ, [c] Bekker PJ

[a] Division of Human Nutrition, Faculty of Health Sciences, Stellenbosch University [b] Department of Human Nutrition, Faculty of Health Sciences, University of Pretoria [c] Biostatistics Unit, Medical Research Council, South Africa

Correspondence to: Me Evette Venter, e-mail: evettev@sun.avc.za

Keywords: CD4 cell count; Quality of Life; adults; nutritional status; nutritional intake

Abstract

Objective: To determine if there was a relationship between CD4 cell count, nutritional status and self-reported quality of life (QoL) in HIV-infected adults.

Design: Descriptive study in the quantitative research domain.

Setting: The out-patient antiretroviral (ARV) clinic at Dr George Mukhari Hospital (Ga-Rankuwa) (institutional).

Subjects: The study group (n = 90) consisted of male (n = 34) and female patients (18–50 years) diagnosed with HIV/AIDS. Convenience sampling was used.

Outcome measures: Anthropometry (weight, height, BMI, MUAC, TSF), dietary intake (habitual food intake recall) and QoL (WHOQoL-HIV questionnaire) were assessed. Data collection was done from January–April 2007.

Results: Significant, but poor, positive correlation was found for the following anthropometrical parameters and the CD4 cell count: weight ($r = 0.37$; $\rho = 0.00$), BMI ($r = 0.39$; $\rho = 0.00$), and MUAC ($r = 0.36$; $\rho = 0.00$). The study group had a poor dietary quality. Significant correlation with the CD4 cell count was found for the following domains of the QoL: physical activity ($r = 0.27$; $\rho = 0.01$), psychological ($r = 0.27$; $\rho = 0.01$), level of independence ($r = 0.36$; $\rho = 0.00$), and environmental ($r = 0.27$; $\rho = 0.01$). The overall QoL assessment was average, according to the WHOQoL-HIV questionnaire score.

Conclusion: Significant positive relationships existed between specific anthropometry and the CD4 cell count, and also between certain QoL domains and the CD4 cell count. Strategies for increasing dietary diversity and QoL ought to be identified and implemented in communities.

Recommendation: A longitudinal study would give better understanding of the relationship between nutritional status, the CD4 cell count and QoL.

S Afr J Clin Nutr 2009;22(3):124-129

Introduction

In 1981 the first case of human immunodeficiency virus (HIV) infection was recognised in a male subject. Since then, the HIV infection rate has reached pandemic proportions in many countries worldwide.[1] A recent survey has indicated that the prevalence of HIV in South Africa is highest among young adults, particularly those living in informal or township settings. Currently, the Department of Health estimates that 5.54 million South Africans (approximately 10.8% of the population) have been infected with HIV.[2]

Among all the intervention strategies applied to curtail the HIV pandemic, a reduction in viral load by efficient antiretroviral therapy has been considered a powerful tool.[1] The CD4 lymphocytes are the key cells in the collaboration of events in forming immune responses to foreign agents, as well as being the primary target cells for HIV. The progressive loss of these cells eventually results in the loss of the ability to mount a desirable immune response to any pathogen, so resulting in the death of those patients in the terminal stage of HIV infection or acquired immune deficiency syndrome (AIDS).[1,2] Nutritional status has been associated with immune status and function, including cytokine levels, as well as with the risk of opportunistic infections, all of which tend to lead to a more rapid HIV disease progression.[2,3] Studies of the nutritional status of HIV-infected patients have shown a substantial weight loss during the course of HIV infection.[4-6] According to Malvy et al, weight loss plays a predictive role in HIV disease progression to AIDS, independently of powerful indicators, such as low CD4 cell count.[4]

Quality of life (QoL) is defined by the World Health Organization (WHO) as an individual's perceptions of his/her position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns.[7] The assessment of QoL is central to understanding how people's lives are affected by HIV infection.8 Studies have found a strong association between the CD4 cell count and QoL.[9-12]

The aim of this study was to determine whether there was a relationship between CD4 cell count, nutritional status and self-reported QoL in HIV-infected adults in the Ga-Rankuwa area (South Africa). When a strong correlation is found for the QoL and CD4 cell count, the next question to be considered is how to maximise the QoL of individuals living with HIV/AIDS in the Ga-Rankuwa area (South Africa).[13]

Subjects and methods

A descriptive, cross-sectional survey in the quantitative research domain (correlational study) was undertaken. The study group consisted of 90 adult (18–50 years) patients who attended the out-patient antiretroviral (ARV) clinic at Dr George Mukhari Hospital. Convenience sampling was used. The subjects were recruited when they had a CD4 cell count < 250 cells/µl. The documented CD4 values had to be no older than one month. The subjects did or did not receive ARVs. A minimum educational level of Grade 9 was required of the subjects in order to increase their ability to comprehend the questionnaire. Patients diagnosed with diabetes mellitus (types 1 and 2) were not included in the study.

Approval for the study was obtained from the Ethics Committee of the Faculty of Health Sciences, University of Pretoria (UP) (No. S94/2006) as well as from Dr George Mukhari Hospital.

Documented laboratory results (National Health Laboratory Services) were recorded for the CD4 cell count of each subject.[14] Data regarding clinical features were reported by the subjects in an interview conducted by the researcher. Any medication being taken by the subjects at the time of the survey was reported by them and included prescribed drugs, vitamin and mineral supplements and any other medication.

Anthropometrical measurements

The subjects were weighed by the nursing staff from the ARV clinic. A calibrated scale was used. Patient's weight and height were used to calculate the Body Mass Index (BMI). BMI was classified as underweight (< 18.5 kg/m^2), healthy weight (18.5 kg/m^2–24.9 kg/m^2), overweight (25 kg/m^2–29 kg/m^2) and obese (> 30 kg/m^2) according to the WHO criteria. The mid-upper arm circumference (MUAC) and triceps skin fold (TSF) were taken on the right arm. Combining the MUAC and TSF measurements allows indirect determination of the arm muscle area (AMA) and the arm fat area (AFA).[16] All the measurements (except weight) were taken three times by the researcher, after which the averages were calculated and used. The calculated AMA and AFA values were plotted on a percentile chart (the Health and Nutrition Examination Survey – HANES) for estimates of the AFA and AMA to determine the classification of each patient.[17] Percentiles were used to categorise the AMA as muscle deficit (< 5th percentile), below average (5.1–15th percentile), average (15.1–85th percentile), and above average musculature (> 85th percentile). TSF values were categorised as fat deficit (< 5th percentile), below average (5.1–15th percentile), average (15.1–85th percentile), and excess fat (> 85th percentile).[18]

Dietary intake

Subjects reported their habitual food intake. A photo book with standardised food portion sizes was used to assist the subjects in recalling their food intake.[19] The researcher collected these data. The data were analysed by means of two methods. Firstly, food intake data were analysed by means of the FoodFinder software computer program[20] and secondly, the Healthy Eating Index (HEI) was used.[21] Analysed nutrient intakes were compared with the acceptable macronutrient distribution ranges (AMDRs).[22] The HEI was used to score the subjects' food intake. Their portion sizes were compared to the Food Guide Pyramid (FGP) reference values. The HEI score is the sum of ten components, each representing aspects of a healthy diet.[21]

The HEI was modified for the purposes of the current study. Seven components of the HEI were measured. Components 1–5 measured the degree to which the subjects' diets conformed to the serving recommendations for the five major food groups of the FGP: grains, vegetables, fruit, milk, and meat. Component 6 measured the total fat consumption as a percentage of the total food energy intake, and component 7 examined variety in a person's diet.[21] Each component of the Index has a maximum score of ten and a minimum score of zero. The maximum overall score for the seven components is 70. An HEI score > 56 implies a 'good' diet, 36–56 implies a diet that 'needs improvement', and a score < 36 implies a 'poor' diet.

Quality of life

The WHOQoL-HIV shows excellent psychometric properties of internal consistency, reliability, content and construct validity, and discriminant validity.[7,8] However, no values other than the Cronbach α were reported. The WHOQoL-HIV covers 29 facets of the QoL, organised into seven domains.[8] Items are rated on a 5-point Likert interval scale where one (1) indicates low perceptions and five (5) indicates high perceptions. Some of the facets were excluded from the current study, because they were not relevant to its aim and purpose. A shortened version of the questionnaire was also compiled in order to increase the cooperation and to maintain the optimal concentration of the subjects. The WHOQoL-HIV questionnaire was translated into Tswana and back-translated into English by three different native Tswana-speaking translators. Subjects completed the WHOQoL-HIV questionnaire in an interview conducted by a trained field worker, in the presence of the researcher. An explanatory tool was created by the researcher to increase the subject's comprehension of the Likert interval scale. The modified WHOQoL-HIV version covers 16 facets of the QoL, organised into seven domains. Table I summarises the modified WHOQoL-HIV instrument, and provides sample questions. The scores ranged from 4–20.[8] In this study, it was decided that a score of 4 would indicate poor QoL, 12 an average QoL and 20 a good QoL.

Pilot study

A pilot study was performed to assess the face validity of the WHOQoL-HIV questionnaire and the clarity and the comprehensibility of the questions, as well as to streamline all the data collection procedures. The outcome of the pilot study indicated that the subjects understood the questions, and that all the data collection procedures used were appropriate.

Statistical analysis

Anthropometrical, dietary and QoL data were presented by means of descriptive statistics (mean, standard deviation [SD], min, max, mode and frequencies). Correlations and differences (Welch test) were calculated for the different indicators. The Cronbach α was calculated to determine the internal consistency of the different domains of the WHOQoL-HIV instrument, with the statistical significance being set at $\rho < 0.05$. The STATA version 8.0 statistical software was used.[23]

Table I: The modified WHOQoL-HIV instrument

Domains	Facets	Questions
Physical activity	Pain and discomfort in PLWHA	How often do you suffer physical pain?
	Energy and fatigue	Do you have enough energy for everyday life?
	Sleep and rest	How well do you sleep?
	Symptoms	How much are you bothered by any unpleasant physical problems related to your HIV that you may have?
Psychological	Positive feelings of PLWHA	How much do you enjoy life?
	Physical appearance	Are you able to accept your bodily appearance?
	Negative feelings	How often do you have negative feelings, such as depression?
	Negative feelings of PLWHA	How much do you fear the future?
Level of independence	Activities of daily living	To what extent are you able to carry out your daily activities?
	Work capacity	Are you able to work?
Social relationships	Personal relationships of PLWHA	How alone do you feel?
	Practical social support	Do you get the kind of support from others that you need?
Environmental	Home environment	How comfortable is the place where you live?
	Physical environment	How healthy is your physical environment?
Personal beliefs	Death and dying	How much do you worry about death?
General quality of life	General quality of life	How would you rate your quality of life?

Results

Table II indicates the biographic characteristics of the study group. A total of 90 adults (34 males; 56 females) were included in the study. The females had a significantly lower age (mean: 35.96 yr; $\rho = 0.04$) than the males. The males had a lower mean CD4 cell count (males: 105 cells/µl; females: 117 cells/µl) and a significantly lower ($\rho = 0.00$) BMI (males: 20.69 kg/m^2; females: 23.53 kg/m^2) than the females. The mean BMI values for both genders ranged between the recommended healthy levels of 18.4 to 24.9 kg/m^2.[15] The minimum and maximum BMI values for both males and females were 14.95 kg/m^2–32.21 kg/m^2 and 11.3 kg/m^2–35.15 kg/m^2, respectively. In the current study, 34 subjects (17 males; 17 females) received ARV treatment. The subjects who received ARV treatment also received a vitamin B-complex supplement from the out-patient ARV clinic. Loss of appetite was the clinical feature most prevalent in both genders. Oral thrush and bloating occurred in both genders, although oral thrush was more prevalent among the females (30.36% vs 23.53%). Diarrhoea was more prevalent among the males (26.47%) than the females (12.50%). Food intolerances were experienced to some degree (17.65% of males; 19.64% of females).

Table II: Biographic characteristics of the study group (n = 90)

Parameter	Male (n = 34)			Female (n = 56)			Difference	ρ-value
	Mean (SD)	Min	Max	Mean (SD)	Min	Max		
Age (years)	39.29 (6.97)	24	50	35.96 (8.06)	23	50	3.33	0.04*
CD4 count (cells/µl)	105.71 (78.54)	2	250	117.27 (69.85)	3	250	–11.56	0.48
Weight (kg)	61.30 (13.43)	41.2	103.2	59.91 (13.71)	28.2	105.2	1.40	0.64
Height (m)	1.72 (0.07)	1.55	1.85	1.59 (0.07)	1.4	1.75	0.12	0.00*
BMI (kg/m^2)	20.69 (4.09)	14.95	32.21	23.53 (4.59)	11.3	35.15	-2.84	0.00*

Table III indicates the anthropometrical measurements of the study group. The majority of the male subjects fell below the 5th percentile for the AMA (67.65%) and the AFA (44.12%). In comparison, females classified below the 5th percentile for the AMA and AFA, comprised 4% and 25% of the group respectively.

Table III: Anthropometrical measurements of the study group (n = 90)

	Male (n = 34) n (%)	Female (n = 56) n (%)	Total n (%)
AMA			
< 5 percentile	23 (67.65)	2 (3.57)	25 (27.78)
5–10 percentile	3 (8.82)	3 (5.36)	6 (6.67)
10–25 percentile	5 (14.71)	8 (14.29)	13 (14.44)
25–50 percentile	2 (5.88)	14 (25.00)	16 (17.78)
50–75 percentile	0 (0.00)	18 (32.14)	18 (20.00)
75–90 percentile	0 (0.00)	4 (7.14)	4 (4.44)
90–95 percentile	1 (2.94)	3 (5.36)	4 (4.44)
> 95 percentile	0 (0.00)	4 (7.14)	4 (4.44)
AFA			
< 5 percentile	15 (44.12)	14 (25.00)	29 (32.22)
5–10 percentile	1 (2.94)	9 (16.07)	10 (11.11)
10–25 percentile	5 (14.71)	14 (25.00)	19 (21.11)
25–50 percentile	6 (17.65)	9 (16.07)	15 (16.67)
50–75 percentile	5 (14.71)	8 (14.92)	13 (14.44)
75–90 percentile	2 (5.88)	1 (1.79)	3 (3.33)
90–95 percentile	0 (0.00)	1 (1.79)	1 (1.11)
> 95 percentile	0 (0.00)	0 (0.00)	0 (0.00)

AMA = Arm muscle area; AFA = Arm fat area

The mean energy intake of the males and females fell below the recommended minimum value. Both genders met the AMDR [10–35% total energy (TE)] for protein (13.56% TE and 12.68% TE for males and females, respectively), whereas the fat intake was below the recommended intake of 20–35% TE (18.37% TE and 19.14% TE for the males and females, respectively). The mean carbohydrate intake fell above the recommended intake of 45–65% TE (75.36% TE for males; 74.93% TE for females).[22]

The highest HEI component score was for grain intake, averaging 8.55. With an average score of 5.50, the total fat score was the second highest. The vegetable component of the HEI had the lowest mean score (1.23), and the milk component the second lowest (1.68). The mean variety score for the study group was 4.24, indicating that the study group did not consume an adequate variety of food on a daily basis. The mean score of 28.24 for the study group as a whole indicated that the majority of the group had a poor HEI and did not meet the dietary recommendations on any given day.

Although the results of the HEI indicated that the study group had the second highest score for the fat component, it does not mean that the fat intake was adequate. It only indicates that the fat component (according to food groups) formed a major part of the diet.

Table IV indicates the WHOQoL-HIV scores for the male (n = 34) and female (n = 56) study groups, respectively. The mean for each domain score varied between 12.85 and 14.88 for the males, and between 13.28 and 14.33 for the females. The mean domain scores for the study group as a whole ranged from 13.35 (psychological domain) to 14.51 (social relationships domain), which indicated at least an average QoL. There were no statistically significant differences found between the domain scores for the males and the females.

The study group presented with significant, though weak, positive correlations between the following anthropometrical parameters and the CD4 cell count: weight ($r = 0.37$; $\rho = 0.00$), BMI ($r = 0.39$; $\rho = 0.00$), and MUAC ($r = 0.36$; $\rho = 0.00$). Significant moderate positive correlations were demonstrated in the females in relation to the following parameters and the CD4 cell count: weight ($r = 0.48$; $\rho = 0.00$), BMI ($r = 0.53$; $\rho = 0.00$), and MUAC ($r = 0.43$; $\rho = 0.00$). There were no statistically significant correlations between the scores for nutritional intake and the CD4 cell counts. Table V shows the correlation between the CD4 cell count and the QoL. Significant, though weak, positive correlations were found for the CD4 cell count in relation to the following domains: physical activity ($r = 0.27$; $\rho = 0.01$), psychological ($r = 0.27$; $\rho = 0.01$), level of independence ($r = 0.36$; $\rho = 0.00$), and environmental ($r = 0.27$; $\rho = 0.01$). The same domains correlated significantly with the CD4 cell count of the male study group: physical activity ($r = 0.44$; $\rho = 0.01$), psychological ($r = 0.46$; $\rho = 0.01$), level of independence ($r = 0.49$; $\rho = 0.00$), and environmental ($r = 0.37$; $\rho = 0.03$). The general QoL domain had a significant correlation with the CD4 cell count ($r = 0.28$; $\rho = 0.04$) for only the females. A significant, though weak, positive correlation was found for the following WHOQoL-HIV domains and the total energy intake: physical activity ($r = 0.28$; $\rho = 0.01$) and level of independence ($r = 0.24$; $\rho = 0.02$). The protein intake and personal beliefs domain had a significant, though weak, negative correlation ($r = -0.20$; $\rho = 0.05$).

Table V: Correlation between the CD4 cell count and the quality of life of the study group (n = 90) and males (n = 34) and females (n = 56)

WHOQoL-HIV domains	CD4 cell count					
	Study sample (n = 90)		Male (n = 34)		Female (n = 56)	
	Correlation (r)	ρ-value	Correlation (r)	ρ-value	Correlation (r)	ρ-value
Physical activity	0.27	0.01*	0.44	0.01*	0.07	0.59
Psychological	0.27	0.01*	0.46	0.01*	0.12	0.38
Level of independence	0.36	0.00*	0.49	0.00*	0.22	0.11
Social relationships	0.18	0.09	0.27	0.12	0.13	0.33
Environmental	0.27	0.01*	0.37	0.03*	0.22	0.11
Personal beliefs	0.19	0.06	0.26	0.14	0.16	0.24
General quality of life	0.20	0.06	0.09	0.61	0.28	0.04*

*$\rho < 0.05$
WHOQoL-HIV: World Health Organization Quality of Life-HIV

There were no significant relationships between the food intake of those subjects receiving and those not receiving ARV treatment. Statistically significant differences existed between the males who received ARV therapy and those who did not, for the following domains: level of independence (difference: 3.79; $\rho = 0.01$) and personal beliefs (difference: 4.12; $\rho = 0.05$). For the females, there were significant differences for those subjects who received ARV therapy and for those who did not, for the following domains: psychological (difference: 1.29; $\rho = 0.04$), level of independence (difference: 2.35; $\rho = 0.01$), and the general QoL (difference: 2.5; $\rho = 0.02$). Subjects who received ARV treatment had better QoL scores than those who did not receive treatment.

Table IV: WHOQoL-HIV scores for the male (n = 34) and female (n = 56) study group

WHOQoL-HIV Domains	Male (n = 34)				Female (n = 56)				Difference of means	ρ-value
	Median	Mean	Min	Max	Median	Mean	Min	Max		
Physical activity	13.25	12.85	4	20	14	13.92	4	19.2	–1.06	0.19
Psychological	13.28	13.46	8.55	17.75	12.85	13.28	10.35	17.75	0.18	0.73
Level of independence	12.5	12.92	4	20	14	14.19	8	20	–1.26	0.15
Social relationships	14.58	14.80	8.83	18.67	14	14.33	7	19.33	0.47	0.42
Environmental	14.75	14.63	9	20	14	13.91	7	20	0.72	0.28
Personal beliefs	18	14.88	4	20	14	14.05	4	20	0.83	0.51
General quality of life	12.5	13.44	4	20	12	13.71	8	20	–0.27	0.74

*$p < 0.05$
WHOQoL-HIV: World Health Organization Quality of Life-HIV.

Follow-up visits took place for 10% of the study group one month after the initial visit to determine the reliability of measured components such as dietary, WHOQoL-HIV and anthropometrical parameters. There were no significant differences between the first and the second visit for nutritional intake or the anthropometrical parameters. The change in the WHOQoL-HIV domain scores from baseline was not significant for six of the domains. The level of independence domain score, however, differed significantly ($\rho = 0.000$).

Discussion

The findings of the study cannot be generalised because of the small sample size ($n = 90$). The current study revealed significant correlations between the CD4 cell count and weight and between the CD4 cell count and BMI for the study group as a whole. Although longitudinal data is not available, there is growing evidence that increased BMI is associated with an increased CD4 cell count and with lower rates of the events that characterise the progression of HIV disease.[25] Weight and body composition, in relation to the CD4 cell counts, indicate that there is a significant trend towards lower weight and BMI with lower CD4 counts.[25] The findings of this study revealed a similar trend. The Nutrition for Healthy Living (NFHL) study grouped patients into CD4 cell count strata. Each 100 cell/µl decrease was associated with a 1.9 kg lower body weight. The results suggest that weight loss in HIV-infected adults is not essentially a loss of lean body mass (LBM), but is an intricate interaction of lean body and fat mass, depending on baseline body weight and composition.[5,25-27] In the current study, a significant correlation was found between the MUAC and the CD4 cell count. It is suggested that weight loss should concern fat mass whereas at a more advanced stage of immunosuppression, lean mass could be affected.[5] This seemed to be true for the results from this study.

The current study found that neither of the genders met the daily total energy expenditure (TEE) through their diet. These findings revealed serious implications for the micronutrient intake and dietary diversity of the study group. The overall mean score of 28.[24] indicated that the study group had a poor HEI and did not meet the dietary recommendations on any given day.

A single habitual food intake recall per participant was done. The accuracy of the short durations of recall may not reliably capture longer-term dietary trends, therefore food records seemed to be imperative. There were no significant correlations between nutritional intake and the CD4 cell count. Castetbon et al found that those patients with a CD4 cell count < 200 cells/µl consumed protein and fat quantities significantly higher than patients with a higher CD4 cell count.[5] It is likely that dietary habits are independent of the degree of immunosuppression but dependent on their clinical status, except when the CD4 counts fall very low.[5,27] The CD4 cell count may offer a long-term prognosis concerning disease progression[28] but nutritional status remains an important predictor of the survival rate in adults with HIV after adjusting for CD4 cell counts.[29]

According to Malvy et al the most frequent AIDS-defining event diagnosed among patients was invasive candidiasis.[4] Clinical events associated with malnutrition as well as with weight loss, are chronic diarrhoea and chronic fever.[5] The clinical features experienced by the current study group could have had an effect on their reported food intake.

For the study group as a whole, the poorest QoL was reported for the physical and psychological domains (see Table IV). The highest mean QoL scores were for the social relationships and personal beliefs domains (see Table IV). In this study, a significant correlation between the CD4 cell counts and the following domains were demonstrated: physical activity, psychological, level of independence, and environmental. These findings are in line with the analysis of the WHOQoL-HIV pilot version where it was found that the subjects who reported that they were currently ill, unwell or at later stages of HIV infection, reported poorer QoL.[8] These results are also supported by Jelsma et al who concluded that health-related quality of life (HRQoL) was severely compromised during the advanced stages of AIDS.[2] According to Gill et al, higher CD4 cell counts were associated with better HRQoL.[9]

A significant correlation was found between the physical activity domain and the daily energy intake, and between the level of independence domain and the daily energy intake. The physical activity domain contains questions about pain and discomfort, energy and fatigue, sleep and rest and symptoms. The level of independence domain enquires after the activities of daily living and work capacity. There was a significantly negative correlation between the personal beliefs domain and protein intake. It can be concluded from the observations that low energy intake, lack of activity and level of independence seemed to be interrelated. The results of the follow-up study on 10% of the study group indicated a significant difference between the first and the second visit for the level of independence domain alone. On the second visit, the follow-up group had higher QoL scores. This could probably be due to the fact that they had been receiving ARVs for the period of one month.

The impact of HIV/AIDS can be dramatically decreased if individuals take care of their health, plan for the future for their family and prevent further spread of the infection to others.[30] The following guidelines are set to increase the QoL of patients infected with HIV/AIDS. The guidelines should aim to be implemented on both the meso level (of communities and health care workers) and the micro level (of patients) to be truly successful. Patients need to receive nutritional education on topics like dietary diversity, food safety principles and the management of clinical features of the disease condition.[30-32] The guidelines and recommendations set for the communities include targeted food assistance and community and home food gardens. Health care workers need to provide nutrition education and establish support groups for individuals affected by HIV/AIDS.[30,33,34]

Conclusion

The assessment of QoL is central to understanding how peoples' lives are affected by HIV infection. Good dietary practices are also essential for maintaining a healthy lifestyle.

One habitual food intake recall per participant was done. The accuracy of the short durations of recall may not reliably capture longer-term dietary trends therefore food records seem to be imperative.

An additional objective, to compare the nutritional status, CD4 cell count and nutrition-related side-effects of those receiving and those not receiving ARV treatment, could have provided additional insight. For purposes of future research, longitudinal studies should give a better understanding of the relationship between nutritional status, the CD4 cell count and QoL. It is also recommended that a larger study sample and follow-up sample size should be used to increase the validity of the results.

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