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Potential effects of nutrient supplement on the anthropometric profiles of HIV-positive patients: complementary medicine could have a role in the management of HIV/AIDS

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ABSTRACT

This is a purposive open-ended study that consisted of a baseline, monthly and final measurements (at the end of nutrient supplementation) that lasted for six months. Anthropometric measurements (BMI, percentage fat, waist-to-hip ratio and lean body mass) were done at baseline, monthly and at the end of study (final measurement) using known standard methods. The T-lymphocytes subsets were determined using flow cytometer. Participants fulfilled certain criteria for inclusion in the study. At baseline, of the 35 patients recruited into the study, 32 (94.1%) showed a fat percentage below normal range. Twenty-four of the patients (68.6%) had body mass index (BMI) within normal range, while a greater percentage of the patients had a normal waist-to-hip ratio (WHR). Of the 28 patients that completed the study, 26 (96.3%) reported a fat percentage of below 18.5%. There was no significant difference ($P>0.05$) between the fat percentage at baseline and end of the study in the whole group. The results showed that 19 (67.9%) of the 28 patients had a BMI within the normal range after nutrient intervention. There was a significant positive correlation between the BMI and fat percentage. At the end of the study, the CD4⁺T-cell count showed no positive correlation with any of the anthropometric indices. The supplement showed no significant effect on the anthropometrics. Further study with large sample size is recommended to confirm supplement effect on the anthropometric profiles. The short duration of the study probably limited the positive trend of the supplement on the anthropometric profiles.

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Key Words: HIV-positive/AIDS patients, supplement, lean body mass, percentage body fat, waist-hip-ratio, CD4⁺T-cell count

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INTRODUCTION

Infection with the human immunodeficiency virus (HIV) has a devastating effect on the nutritional status of infected persons (Gorbach & Knox, 1992; Oguntibeju *et al.*, 2005a). It has been noted that weight loss, often profound in magnitude depending on the stage of the infection and associated infections, are known features of HIV infection (Gorbach & Knox, 1992; Oguntibeju *et al.*, 2005b). HIV-positive/AIDS patients may lose 30-50% of their body mass before progressing to AIDS (erbert, 1973; Kotler *et al.*, 1989). According to different researchers, weight loss can be caused by five mechanisms, namely, inadequate food intake, reduced intestinal absorption, abnormal food utilization, increased excretion of nutrients and increased host requirements (Kotler *et al.*, 1989; Grunfeld & Feingold, 1992; Macallan, 1999). It is also agreed that weight loss contributes to the progression of HIV infection to AIDS (Chlebowski 1985; Dannhauser *et al.*, 1999).

Malnutrition has been an endemic problem in Africa for decades and it is complicated by a combination of factors including the recent impact of HIV/AIDS (Piwoz & Preble, 2000). HIV/AIDS and malnutrition is interrelated. Research suggests that malnutrition increases the progression of HIV infection and in turn HIV infection exacerbates malnutrition through its attack on the immune system and body composition (Fawzi & Hunter, 1998; Friis & Michaelsen, 1998; Oguntibeju *et al.*, 2003).

Research has shown that in the early period of HIV infection, weight gain or maintenance might be achieved through nutrition intervention, and this has helped to reduce the consequences of wasting in people living with HIV/AIDS [Babamento & Kotler, 1997; Dwyer, 1998; Cimoch, 1997; Niyongabo *et al.*, 1997). In the developing world, where the majority of people living with HIV cannot afford antiretroviral therapy, good nutrition combined with mineral and vitamin supplementation could be a strategic alternative source of therapy. Nutritional intervention may help to strengthen the immune system and reduce the severity and impact of

opportunistic infections in people living with HIV/AIDS (Raiten, 1990; Woznicki & D'Alessandro, 1997).

Few studies (Dannhauser *et al.*, 1999; Niyongabo *et al.*, 1999) have examined the relationship between HIV infection and adult anthropometry in South Africa and elsewhere in Africa. However, none has examined the association between HIV infection, anthropometry and nutrient supplementation in adult male and female populations, hence the reason to examine the potential effect of nutrient supplementation on anthropometric profiles of HIV-positive/AIDS patients. This paper examined the influence of nutrient supplementation on the anthropometric profile of HIV-positive/AIDS patients in black residential area of Bloemfontein, South Africa, so as to establish whether nutrient supplementation has any influence on the anthropometric indices or improve the quality of life of HIV-positive/AIDS patients.

Scientific evidence has revealed that several vitamins and minerals are critical for fighting HIV infection, because they are required by the immune system and major organs to attack infectious pathogens. Previous studies indicate that in the early period of HIV infection, weight gain or maintenance might be achieved through nutrient supplementation/good nutrition and has helped to reduce the consequences of wasting in people living with HIV/AIDS. Micronutrients have helped to strengthen the immune system and reduce the severity and impact of opportunistic infections in people living with HIV/AIDS. Data on supplementation in HIV-infected persons in industrialised countries are widely available. However, this is often scarce in Africa; therefore a study to evaluate the role of nutritional supplementation in HIV-positive patients becomes necessary, especially in a developing country such as South Africa. Besides, a study concerned with nutritional supplementation of HIV-positive patients could be considered as very important due to the following: (1) HIV infection frequently results in nutritional deficiencies and growth failure. (2) Benefits from nutritional supplementation include not only the improved health and well-being of individuals but an

improved chance of prolonged survival for those infected. (3) The knowledge acquired from this study would be vital in setting up nutrition intervention strategies for HIV-positive persons regarding various nutritional problems associated with HIV/AIDS.

MATERIALS AND METHODS

This is a purposive study that consisted of a baseline measurement and a monthly measurement that lasted from April to September 2003. Of the 35 patients recruited into the study at baseline, only 28 completed the study (2 dropped out while 5 died). The five respondents that died during the course of study were patients with severe immune deficiency and very poor nutritional status, compounded by secondary infections such as tuberculosis. An approval from the Ethics Committee of the Faculty of Health Sciences, University of the Free State (ETOVS 32/03) was obtained. The patients signed the consent form after they had been told the purpose and procedures of the study. Participants fulfilled the following criteria: male and female patients between 18 and 65 years of age and HIV positive; willing to undergo a pre-study physical examination; not on antiretroviral therapy; within the range of clinical acceptability in medical history and physical examination; CD4⁺T-cell count of 100-350 cells/mm³, able to comprehend; non-pregnant, non-diabetic, non-hypertensive or any other chronic disease and willing to sign a statement of informed consent. Only the patients that met the inclusion criteria participated in this study. For ethical reason, a placebo group was not included but results obtained during the screening period serve as internal control.

Blood collection and Laboratory investigations

Blood samples were collected from each patient into sterile EDTA sample tubes. The CD4⁺T-cell counts and CD8⁺T-cell counts were determined at baseline, monthly and at the end of the study. The CD4⁺T-cell and CD8⁺T-cell counts were determined using flow cytometer (O'Brien *et al.*, 1996).

Anthropometric measurements

At baseline and at the end of the study, the following anthropometric indices were determined and included body mass index (BMI) calculated from body weight and height in metres squared; waist-hip-ratio (WHR) calculated from waist circumference and hip circumference and skin-fold thickness (to estimate percentage of body fat). For the anthropometric measurements, the subjects presented themselves in minimal clothing to allow measurements to be done quickly, accurately and efficiently. Two persons were involved with the measurement: the measurer and the recorder. This was to ensure accuracy of site location, correct sequence of measurement sites and accurate reading. The recorder repeats the value as it is being recorded in order to enable the measurer to do an immediate check. The measurement was done twice at each site on each subject and the average value was taken. Throughout the marking and measurement session, each subject stood relaxed, with arms comfortably by the side and with feet together. However, a few measurements required the subjects to place their feet apart. During the measuring period, the measurer was able to move around the subject easily and to manipulate the equipment. All anthropometric measurements were done according to standard procedures (Lee & Nieman, 1993; 1996; Laquatra, 2004). The dietary intake of the patients in this study is reported in another paper that has been published in Medical Technology SA.

Supplementation of patients

Following the baseline measurement of the anthropometric indices, CD4⁺T-cell count, and CD8⁺T-cell count the patients were given 7.5 ml of the test supplement twice daily (between 7-9 am and 4-7 pm) for a period of six months. The research team and staff members of the South African Red Cross (home-based Care) in Bloemfontein handled the dosing and monitoring of the supplement intake on a daily basis. It was ensured that records of the receipt and administration of the study supplement were kept and that the supplement was not used for purposes other than as directed by the protocol.

Components of the supplement

The contents of the supplement include the following extract of hypoxis (500 mg), grape fruit seed extract (4 mg), sitosterol & sitosterolin (28 mg), beta-carotene (1 mg), vitamin E (12.5 mg), vitamin B₆ (7.5 mg), vitamin B₁ (3.75 mg), vitamin B₂ (10 mg), vitamin B₁₂ (3 µg), nicotinamide (5 mg), vitamin C (50 mg), olive green leaf extract (35 mg), folic acid (325 µg) and natural anti-oxidant (biocytin) (52 mg).

Follow-up Visits

The patients were assessed on a monthly basis (the relationship between patients' clinical features and viral load has been published in Medical Technology SA) and there was no observable side-effects reported resulting from taking the supplement indicating that the supplement was well tolerated. The CD4⁺T-cell count and CD8⁺T-cell count were repeated monthly while the anthropometric indices was repeated at the end of the study to determine any possible effect of the supplement on the anthropometric indices. Compliance with the regime was ensured by counting the supplements on a daily basis and by constantly reminding the patients of the need to follow the protocol. It was ensured that records of the receipt and administration of the study supplement were kept and that the supplement was not used for purposes other than as directed by the protocol.

Statistical analyses

The results for this study were analysed by an independent Biostatistician (as is the practice in the University) at the University of the Free State, Bloemfontein, South Africa, using SAS (1990). The results of the study are presented in mean, median, standard deviation and the significant difference put at $P < 0.05$.

RESULTS

The results of the baseline measurement of the 35 patients are indicated in Table 1. Thirty-two of the respondents (94.1%) had a fat percentage below 20% while 2 (5.9%) had fat percentage

above 25%. One patient (female) was excluded from fat percentage because she exceeded the cut-off range for age. Of these 35 patients, 8 (22.9%) had a BMI of less than 18.5 kg/m², 24 (68.6%) had a BMI range of 18.5-24.9 kg/m², while 3 (8.6%) of the respondents had a BMI greater than 25 kg/m². Seven (87.5%) of the respondents reported a WHR of less than 0.95 and 1 (12.5%) of the respondents reported a WHR of greater than or equal to 0.95 for males. In the female group, 13 (48.1%) of the respondents reported a WHR of less than 0.8 while 14 (51.9%) reported a WHR of greater than or equal to 0.8 (table 1).

The results of the 28 patients at the end of the study are also indicated in Table 1. The result showed that 26 (96.3%) of the patients reported fat percentage below 20% while one had fat percentage above 25%. Of the 28 patients, 7 (25%) had a BMI of less than 18.5 kg/m², 19 (67.9%) had a BMI within the range of 18.5 kg/m²-24.9 kg/m², and 2 (7.1%) had a BMI greater than or equal to 25 kg/m². Seven (87.5%) of the patients had a WHR of less than 0.95 and 1 (12.5%) had a WHR of greater than or equal to 0.95. Ten (50%) had a WHR of less than 0.8 and 10 (50%) had a WHR greater than or equal to 0.8 for female patients (table 1).

The mean, median, standard deviation, 25 percentile and 75 percentile of the anthropometric indices are presented in Tables 2. The median fat percentage of 19.2% at baseline was not significantly lower than the normal range ($20 \leq 25\%$). The fat percentage had not decreased significantly ($P > 0.05$) by the end of nutrient supplementation. The median BMI of the population (inclusive of male and female adults) fell within the accepted/normal range of 20 kg/m² and less than 25 kg/m². At baseline, the median BMI was 20.4 kg/m² (within a reference range). It showed a slight trend towards an insignificant increase to 20.7 kg/m² ($P > 0.05$) following supplementation. The median WHR of 0.81 showed normal waist circumference of the study population. The median WHR seem to be maintained up to the end of nutrient supplementation. The median LBM increased insignificantly ($P > 0.05$) from 45.5 kg at baseline to 46.1 kg by the end of nutrient supplementation.

Table 1:

The frequency and percentage of body fat, BMI and WHR of HIV-positive patients at baseline and at the end of study

Anthropometric profile	Baseline visit (n=35) Freq & percentage	Final visit (n=28) Freq & percentage
Fat %*		
<20	32 (94.1%)*	26 (96.3%)*
20≤25	0 (0%)	0 (0%)
>25	2 (5.9%)	1 (3.7%)
BMI (kg/m²)		
<18.5	8 (22.9%)	7 (25%)
18.5-24.9	24 (68.6%)	19 (67.9%)
≥25	3 (8.6%)	2 (7.1%)
WHR		
<0.95 (male)	7 (87.5%)	7 (87.5%)
≥0.95 (male)	1 (12.5%)	1 (12.5%)
<0.8 (female)	13 (48.1%)	10 (50%)
≥0.8 (female)	14 (51.9%)	10 (50%)

*One patient (female) was excluded from fat percentage because she exceeded the cut-off range for age.

Table 2:

Anthropometric profiles of HIV-positive/AIDS patients at baseline and end of study

Anthropometric Indices	Before nutrient supplementation (n=35)					After nutrient supplementation (n=28)				
	Mean	SD	Median	25 percentile	75 percentile	Mean	SD	Median	25 %centile	75 %centile
Weight (kg)	55.2	8.2	57.0	49.0	60.0	55.7	7.4	56.0	50	60.0
Height (m)	1.6	0.1	1.6	1.55	1.7	1.6	0.1	1.6	1.6	1.7
% fat	17.8	4.7	19.2	13.6	20.3	17.2	4.9	17.9	12.6	20.7
BMI (kg/M ²)	21.2	3.3	20.4	18.7	23.2	21.2	3.4	20.7	18.8	23.2
WHR	0.8	0.1	0.8	0.8	0.8	0.8	0.1	0.81	0.8	0.9
LBM (kg)	45.2	6.2	45.5	40.4	49.3	45.7	5.4	46.1	41.3	49.6

Table 3:

Correlation between different anthropometric profiles and CD4⁺T-cell count at baseline and final visit

Correlation Between		Baseline visit (n=35)		Final visit (n=28)	
Variable 1	Variable 2	R	p-value	R	p-value
LBM	% fat	0.036	0.84	-0.08	0.7
	BMI	0.39	0.02*	0.14	0.5
	WHR	-0.13	0.45	-0.07	0.7
	CD4 ⁺ T-cell count	0.25	0.2	0.08	0.6
% fat	BMI	0.74	<0.0001***	0.81	<0.0001***
	WHR	-0.38	0.02*	-0.4	0.05*
	CD4 ⁺ T-cell count	0.06	0.74	0.006	0.97
BMI	WHR	-0.45	0.006*	-0.31	0.1
	CD4 ⁺ T-cell count	0.2	0.32	0.02	0.9
WHR	CD4 ⁺ T-cell count	-0.07	0.7	0.05	0.7

NS (not significant): $P > 0.05$, $r =$ correlation; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Table 4:

T-lymphocytes subsets of HIV-positive/AIDS patients at baseline and end of study

Variables	Baseline visit n=35			Final visit n=28			P-value
	Mean	SD	Median	Mean	SD	Median	
Total Tcell count/mm ³	1615	736.3	1543	1495.7	758.9	1400	0.07
CD4 ⁺ T-cell count/mm ³	203.9	83.5	176	188.2	96.9	164	<0.03*
CD8 ⁺ T-cell count/mm ³	1407.2	672.2	1254	1267.1	686.9	1228	0.09

SD (standard deviation)

The P-value tested the difference between the immunological parameters at baseline and final visit

*P<0.05. Parameters with the same superscript showed statistical difference.

The correlation between anthropometric indices and CD4⁺T-cell count at baseline and at the end of nutrient supplementation were determined and are presented and shown in table 3. The T-lymphocytes subsets of the patients both at baseline and following the end of supplementation are presented in table 4.

Baseline measurement

This study did not indicate a correlation between the LBM and percentage of body fat (P>0.05), the WHR (P>0.05) and the CD4⁺T-cell count (P>0.05) (table 3). However, the results showed a positive correlation between the LBM and the BMI (P<0.05). The fat percentage showed a positive correlation with the BMI (P<0.0001) but a negative correlation with the WHR (P<0.05). There was no correlation between the fat percentage and the CD4⁺T-cell count (P>0.05). The BMI indicated a correlation with the WHR (P<0.05). No correlation was observed between the BMI and the CD4⁺T-cell count (P>0.05). There was no correlation between the WHR and the CD4⁺T-cell count (P>0.05), table 3.

Final measurement

In the final measurement, there was no correlation between the LBM and the fat percentage, the BMI, the WHR and the CD4⁺T-cell count (table 3). The fat percentage correlated with the BMI (P<0.0001) and negatively correlated with the WHR (P<0.05).

DISCUSSION

Studies in developed countries have reported the impact of HIV infection on nutritional status at different stages of the infection [Kotler *et al.*, 1989; Ott *et al.*, 1993]. It is reported that malnutrition is a general problem among HIV-infected patients, but it has become much less frequent among HIV-infected persons in developed countries, mainly due to the provision of highly active antiretroviral therapy (HAART) and nutritional interventions (Carbonnel, 1998). There have been increasing recommendations for supplementation to form part of the general nutritional interventions to correct some of the nutritional complications associated with HIV infection especially in Africa where people cannot afford highly active antiretroviral drugs. The goals of nutritional assessment and intervention are aimed at improving nutritional status, prolonging survival and enhancing quality of life.

In this study, anthropometric indicators of HIV-positive/AIDS patients were determined at baseline and the end of the nutritional supplementation so as to be able to observe the potential influence of the nutritional supplement on the anthropometric indicators. The body weight of the patients had not declined significantly by the end of nutrient supplementation. This finding agrees with the trend reported by Parisien *et al* (1993) for the body weight of HIV-positive/AIDS patients. Studies

have shown that weight loss and decrease in body weight have been indicated as signs of a deterioration of nutritional status in HIV-positive/AIDS patients (Macallan, 1999; Dannhauser *et al.*, 1999; Myers, 1997). In a study, McCorkindale (1990) reported that seven patients at an advanced stage of HIV infection did not show a significant decline in body weight or fat percentage. His patients were on an antiretroviral drug (AZT) for five months. This trend of change underscores the different but yet unclear mechanisms involved in the wasting process in HIV infection. However, in this study although the patients were not on any antiretroviral therapy, the supplement did not demonstrate an observable effect on the body weight. Other factors may explain why the expected weight gain did not occur. Firstly, patients with HIV infection/AIDS may be hypermetabolic, therefore the anticipated weight gain is an overestimation because energy needs and expected weight gain are calculated on the basis of normal metabolic states (Melchoir *et al.*, 1991). Secondly, HIV infection disrupts the normal lipid and protein metabolism and causes nutrients to be used inefficiently and wasted (Hellerstein *et al.*, 1993).

According to Wiley & Samuel (1989; Serwadda *et al.* (1985) and O'Sullivan *et al.* (1985), weight loss and/or a decrease in body weight is a prominent feature of HIV infection/AIDS. O'Sullivan *et al.* (1985) noted that of the 50 HIV-positive/AIDS patients admitted to hospital, despite the fact that their pre-illness weights were higher than normal body weights, 59% of the patients were classified as moderately depleted and 62% had lost >10 of their pre-illness weight. In this study, the pre-illness weights of the patients were not determined because patients were unable to recall their pre-illness weights. The reduction in weight of the patients by the end of nutrient supplementation in this study was not significant. If Serwadda's *et al.* (1985) report did reflect the process of nutritional depletion taking place in HIV-positive/AIDS patients as reflected in the reduction of weight, then we are tempted to believe that the supplement probably has a positive but non visible effect on the weight of the patients. In other words, since the patients were

not on antiretroviral therapy, weight reduction or reduction in other anthropometric indicators should have been higher than observed. Likewise, nutritional deterioration of the patients should have been clearly demonstrated in the clinical conditions of the patients. At the same time we are cautious with such interpretation in the presence of limitations such as sample size and lack of a placebo group that faced this study. Clinical conditions such as tuberculosis and other bacterial and fungal infections were treated; therefore treatment could have contributed in reducing the degree of wasting. The clinical and physical conditions of the patients improved with time following supplementation and/or treatment.

The percentage of body fat determined anthropometrically at baseline had not changed significantly by the end of the study (table 1). This result is similar to that reported by Dannhauser *et al.* (1999) At baseline 94.1% of the population reported fat percentage below the 18.5%, while 96.3% of the population (table 1) reported fat percentage by the end of the study, thus the fat percentage showed no significant depletion. This pattern of depletion resembles a stressed or injured state rather than starvation or semi-starvation that is associated with nitrogen saving and increased fat utilization. The result showed a positive correlation between the BMI and fat percentage while the latter did not show a significant correlation with the CD4⁺T-cell count, but a negative correlation with the viral load. Generally, the BMI, LBM and WHR were maintained over the course of the time in this study.

The fact that in this population of HIV-positive/AIDS patients, the LBM was relatively preserved possibly suggests that no major aggressive factor was obviously present in all the patients. One previous study (MacClave & Mittoraj, 1992) identified an aggressive factor (Tuberculosis-TB) that significantly contributed to the severity of malnutrition. TB was present in 6 of our patients (17.1%) at baseline but the patients with TB were treated during the course of the study. It is presumed that the treatment reduced the aggressive impact of TB on the lean body mass. It is possible that the wasting process was

curtailed, probably to a certain degree in the presence of the treatment with the supplement playing a secondary role. It is believed that the wasting process would have been more aggressive in the absence of the treatment and supplement (probably more of the effect of the treatment with anti-TB) because during active phases of infection, people with HIV/AIDS lose LBM rapidly (Gorbach & Knox, 1992).

The results obtained in this study for the BMI and LBM are similar to those reported by Kennedy *et al.* (1996) following nutrient supplementation. The BMI significantly correlated with the LBM. The LBM showed no correlation with the CD4⁺T-cell count.

The BMI and fat percentage were lower in patients with CD4⁺T-cell counts <200 cells mm³ than in those with CD4⁺T-cell counts >200 cells mm³. This is understood and expected in patients with immuno-deficient diseases such as AIDS, especially when the patients are not on antiretroviral therapy. This finding is similar to that reported by Castetbon *et al.* (Kennedy *et al.*, 2001) and (Dannhauser *et al.*, 1999). It has been shown that a decrease in the lean body mass is related to the decrease in body cell mass (Niyongabo *et al.*, 1997) and that body cell mass depletion is out of proportion to losses of body weight for fat (MacClave & Mittoraj, 1992; Castetbon *et al.*, 1997; Kotler, 1992). It has also been shown that death from wasting in AIDS is related to the body cell mass depletion rather than to the specific underlying cause of the wasting (Kotler *et al.*, 1989). As previously demonstrated by anthropometry, decline in weight and BMI have been associated with a decline in percentage of body fat.

Although a greater percentage of patients (68.6%) had a BMI within a range of 18.5-24.9 kg/m², 22.9% of the patients had a BMI of less than 18.5 kg/m² (table 1), therefore for those patients with a lower BMI, reduced body fat may have contributed. It is expected that as the HIV infection/disease progresses, wasting may become more pronounced, which in most cases is reflected in the amount of fat loss or lean body mass. In this study, instead of the wasting continuing significantly, as would have been indicated by a

significant decline in the anthropometric indicators, it was relatively curtailed. It is possible that certain factors such as malabsorption, short duration, and drug-nutrient interactions contributed to the non-significant effect of the supplement on the anthropometric indicators (Kotler, 1997; Pronsky *et al.*, 2001) but needs further investigation with large sample size to clarify.

Conclusion

In a population in which antiretroviral therapy is not readily available or accessible, the findings that nutrient supplementation more or less maintained the BMI or LBM or has the potential of maintaining the BMI or LBM, shows the contributing role of nutritional supplement on the quality of life and the general well-being of HIV-positive patients. However, nutritional supplement is not a substitute but complementary to antiretroviral therapy. Antiretroviral therapy is still by far a better approach for treating HIV/AIDS patients and African government should be encouraged to provide antiretroviral therapy to their HIV-infected citizens.

Application

Nutritional abnormalities are frequent and a characteristic feature of infection with the human immunodeficiency virus (HIV), and they represent a major determinant of survival. Nutritional status may have an impact at all stages of HIV infection: from the initial acquisition of infection, clinical manifestations, progression of HIV infection/disease and palliation of advanced disease. Nutritional care of HIV-infected patients should therefore begin at the time of diagnosis so as to assess baseline nutritional status/anthropometric indices and to provide dietary counselling/guidelines. Dietary guidelines should include the recommendation of a nutrient supplement containing anti-inflammatory agents and antioxidants. Close monitoring of nutritional status and clinical status is essential in identifying nutritional problems or need for nutrient supplementation.

Recommendations

The following recommendations are made in the light of the results obtained from this study:

- Nutritional intervention should begin early in patients with HIV infection and AIDS.
- Nutritional supplementation should form an important aspect of the clinical management of HIV-positive/AIDS patients as it may help to strengthen the immune system, replace lost vitamins/minerals and reduce the severity of impact of opportunistic infections in people living with HIV/AIDS.
 - Standardised evaluation of nutritional status should be done regularly.
 - In future, supplementation-based research studies should be directed towards patients with HIV infection and AIDS, with secondary infections and with or without wasting.
 - Confirmation of the results of our study is required using the same nutrient supplement and patient-entry criteria, and a control group but for a longer period, for example one year.

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