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Effects of Nutritional Counseling and Micronutrient Supplementation on Some Biochemical Parameters of Persons Living with HIV and AIDS in Uyo, Nigeria

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Abstract: The nutritional status of 290 randomly selected persons living with HIV and AIDS, who reported for anti retro viral therapy at the University of Uyo Teaching Hospital was evaluated. The study participants were randomly assigned subjects (78 females and 66 males), who received nutritional counseling and free daily micronutrient supplements and controls (76 females and 70 males), who did not receive. Their biochemical parameters (Serum albumin, packed cell volume, serum retinol and serum Vitamin C) were assessed at recruitment and the end of the four month study period. The results showed that there was significant difference (p<0.05) in the mean gain in packed cell volume between the subjects and their control. There was no significant difference (P>0.05) in the mean gain in total serum protein between male subjects and control, however there was a significant difference (p<0.05) in mean gain in serum protein between female subjects and female controls. The study also observed a significant difference (p<0.05) in the mean gains in serum albumin; serum retinol and serum vitamin c levels respectively between subjects and their controls. It is recommended that in resource-limited settings all PLWHA should be given individualized nutritional counseling and micronutrient supplementation, when undergoing anti-retro viral therapy.

Key words: HIV, AIDS, nutritional counseling, micronutrient supplementation

Introduction

Human Immunodeficiency Virus (HIV), the causative agent of the Acquired Immunodeficiency Syndrome (AIDS) is one of the greatest health challenges to this age. In 2003, about 40 million people were estimated to be living with HIV, including 37 million adults and 3 million children under 15 years of age (UN AIDS, 2002). Sub-Saharan Africa is bearing the greatest brunt of the disease, with 50% (28.5 million) of all people living with the virus in this region which is home to only 11% of the world's population (Harries, 2005).

Malnutrition is one of the major complications of HIV infection and a significant factor in advanced disease. In resource constrained settings, HIV infection combined with pre-existing malnutrition places a tremendous burden on people's ability to remain healthy and economically productive, especially as it affects mostly the productive age group. The vicious cycle between malnutrition and AIDS is the same as the well established relationship between malnutrition and infection (Schrimshaw *et al.*, 1968; Tomkins and Watson, 1989; Schrimshaw and San Giovanni, 1997; Fishman *et al.*, 2004). Changes in metabolism in HIV infected people, occur when the body mounts its acute phase response to infection, it releases pro-oxidant cytokines and other Reactive Oxygen Species (ROS). The body also responds to this release of pro oxidant cytokines by increasing demand for antioxidant vitamins and minerals. The antioxidant micronutrients counteract potentially damaging ROS. Integrated oxidant defences are presumably in equilibrium with continuously generated ROS. Disturbances to this equilibrium occur when production of ROS is increased by infection such as HIV, trauma, excessive exercise and high exposure to zenobiotics (Thurnham, 1990; Thurnham 1997; Schorah *et al.*, 1996; Diplock *et al.*, 1998).

Oxidative stress is believed to increase HIV replication and transcription, leading to higher viral loads and disease progression (Jiamton *et al.*, 2003; Piwoz *et al.*, 2004). Dietary antioxidants are micronutrients found abundantly in fruits and vegetables. The potential benefits from antioxidant micronutrients in protecting against disease has been used as an argument for recommending increased intake of these micronutrients above the RDI by persons at risk (Cathcart, 1985; Guthric and Picciano, 1995). Micronutrient deficiency often occurs because micronutrient intake is not linearly related to income and calorie intake. It has hidden quality and are concentrated in perishable foods and thus their consumption and availability is adversely affected by a complex of factors (ACC/SCN, 1993). Micronutrient deficiency can be addressed directly by dietary change, food and water fortification and pharmaceutical supplementation. Targeting is a key consideration in micronutrient supplementation. Many a time the cost of establishing baseline values of nutrients is very prohibitive and presumptive targeting is carried out for populations at risk (ACC/SCN, 1993).

It has been reported by Thurnham (1990), that the plasma concentration of ascorbic acid is low in HIV infection and supplementation with Vitamin C among other micronutrients reduces morbidity and mortality in persons living with HIV and AIDS (Piwoz *et al.*, 2004; Frils and Michaelson, 1998; Baum , 1997; Coutsoudis, 1999; Fawzi *et al.*, 2002; Fawzi, 2003). Studies reveal poor Vitamin C status among Nigeria adolescents (Ene-obong *et al.*, 2003). There are discrepancies in the linkage between incidence and severity of infectious morbidities of various aetiologies and vitamin A status. The weight of evidence supports an associations of Vitamin A Deficiency (VAD) with severity of infection once acquired (WHO/UNICEF, 1996). Vitamin A Deficiency (VAD) has been associated with progression of HIV to AIDS and poor birth outcomes (Fawzi *et al.*, 2002; Fawzi, 2003), it has also been reported that VAD is common in various stages of HIV infection and is associated with increased AIDS morbidity and mortality (Shils *et al.*, 1994; Semba *et al.*, 1999; Piwoz and Preble, 2000; Neera and Austin, 2002). Studies in Nigeria have reported low plasma vitamin A among women and adolescents in Nigeria (Atinmo *et al.*, 1993; Ene-obong *et al.*, 2003). If persons living with HIV and AIDS through nutritional counseling are exposed to a knowledge of the interaction between nutrition and HIV and AIDS, it is expected to positively affect their attitude to recommended dietary modifications and thus improve their nutritional status, knowledge is a very powerful determinant of health behaviour (Allen *et al.*, 1993). Preventive micronutrient programmes are needed where micronutrient malnutrition is a public health problem as is the case in Nigeria (Atinmo *et al.*, 1993). It is also needed for population at risk such as people living with HIV and AIDS.

Recently, WHO (2003) called for studies on the nutritional status of persons living with HIV and AIDS in resource poor settings. The study was therefore undertaken to establish the baseline biochemical parameters of HIV positive persons.

Secondly to document the effectiveness if any of micronutrient supplementation and nutritional counseling in improving the nutritional status of persons living with HIV and AIDS in a resource poor setting.

Materials and Methods

Study site: The study was carried out in Uyo, South Eastern Nigeria. The town serves the dual purpose of a local government headquarters and state capital. It lies within the tropical rainforest belt of the country on lat. $5°20^1$ and $5°32^1$ East of the Greenwich Meridian. The University of Uyo Teaching Hospital, Uyo, Akwa Ibom State, Nigeria, is a tertiary health institution. The hospital was a regional centre for federal government of Nigeria subsidized anti-retro viral treatment, taking care of 4 neighbouring states namely: Akwa Ibom State, Cross River State, Rivers and Bayelsa State (at the time of study 2004).

Study population: The study was conducted between November 2004 and March 2005. A total of 290 out of the 1280, who registered for anti-retro viral therapy where randomly selected for this study. Of the selected participants 144 (78 females and 66 males) received nutritional counseling and a free daily supply of commercially available micronutrients for 4 months, while 146 (76 females and 70 males) did not receive any counseling or supplementation, they acted as the control. Subjects were seen twice a month on scheduled hospital visits. Nutritional status was determined at the beginning of the study and at the end of the 4 months study period.

Biochemical determinations: After observing standard precautions 10 mL^{-1} of fasting venous blood was collected and centrifuged at 1200 rpm for five min and serum collected. The serum was stored in a freezer and analyzed within 72 h of collection.

Packed Cell Volume (PCV) was determined by microheamatocrit method as described by Cheesebrough (2000), Serum Albumin was determined by Bromcresol green dye binding method (Tiez, 1986). Serum reduced ascorbate was determined by modified titremetric method (Tiez, 1986). Serum retinol was determined by absolute ethanol and n-heptane extraction method as described by Tiez (1986).

Results

The packed cell volume of the male subjects taking the supplementation and their control is presented in Table 1, the highest (21.8%) mean gain in PCV value was observed among subjects aged 18-30 years, while the least (10.0%) was recorded among the age group of 57-69 years. There was a decrease in mean PCV value in the control (range-4.2% to-7.8%). There was a significant difference (p<0.05) in PCV values between the male subjects and their controls. The highest (18.4%) mean gain in PCV was observed in female subjects aged 44-56 years of age, while the least (14.8%) was recorded among those aged 31-43 years of age. There was a decrease in mean PCV in all the female control study participants (range-6.3% to-10.9%). There was a significant (p<0.05) difference in mean gain in PCV between the female subjects and their controls (Table 1).

The mean total serum protein of subjects and their control is presented in Table 2. Male subjects recorded a mean total Serum protein 74.6 to 78.6 (g L^{-1}) at the beginning of the study, they recorded a mean gain of 3.8+1.6(g L^{-1}). The male controls recorded a mean total serum protein of 70.8 to 75.9 (g L^{-1}) at the beginning of the study, by the end of the study, they made a mean

Table 1: Distribution of Respondents according to their age and mean PCV (%) at the beginning and end of study, UUTH, Uyo 2005

Age Category	Beginning of Study	End of Study	Mean Gain in PVC Value
18-30			
Male Subject	32.5±6.8 (range 18 -45) 3 (10%) < 30 n = 10	39.6±7.1 (range 30-48)	7.1±3.5 (21.8%)
Male Control	34±3.9 (range 30-40) 3 (10%) ≤ 30 n = 10	31.6±4.3 (range 27-40) 5(50%) ≤ 30	-2.4±1.8 -(7.0%)
Female Subject	32.9±4.3 (range 20-43) 7 (18.9%) < 30 n = 37	38±2.1 (range 35-44) 0 (0.0) < 30	5.2±3.3 (15.8%)
Female Control	35±4.7 (range 21-45) 2 (5.7%) ≤ 30 n = 35	32±5.7 (range 18-42) 6(17.1%) < 30	-2.2±1.5 (-6.3%)
31-43			
Male Subject	37±5.8 (range 27-47) 7 (18.3%) ≤ 30 n = 43	42.1±4.4 (range 34-50) 0 (0%) ≤ 30	6.5±3.6 (17.6%)
Male Control	35.4±3.7 (range 28-40) 6 (14%) ≤ 30 n = 43	33.1±3.9 (range 25-42) 17 (39.5%) ≤ 30	-2.3±0.9 (-6.5%)
Female Subject	32.4±6.1 (range 20-40) 10 (34.5%) ≤ 30 n = 29	37.2±3.1 (range 30-42)	4.8±4.7 (14.8%)
Female Control	32.5±4.6 (range 25-41) 9 (31.0%) ≤ 30 n = 29	30±3.8 (range 25-41) 15 (51.7%) ≤ 30	-2.5±2.8 (-7.7%)
44-56			
Male Subject	35.5±3.6 (range 28-40) 2 (20%) ≤ 30 n = 10	42±3.4 (range 38-48)	4.8±2.6 (13.5%)
Male Control	38.3± 3.3 (range 33-40) n = 10	35.3±3.3 (range 30-40) 1 (11.1%) ≤ 30	-3.0±0.6 (-7.8%)
Female Subject	32.6±4.9 (range 20-39) 2 (20%) ≤ 30 n = 10	38.1±1.7 (range 36-40)	6±3.7 (18.4%)
Female Control	33.9± 4.0 (range 29-40) 4 (57.1%) ≤ 30 n = 7	30.1±3.4 (range 25-35) 5 (71.4%) ≤ 30	-3.7±2.8(-10.9%)
57-69			
Male Subject	36 ±1.2 (range 36-39) n = 3	41.7±2.4 (range 40-45)	3.6 ±2.0 (10.0%)
Male Control	36±0.8 (range 36-37) n = 4	34.5±1.1 (range 33-36)	-1.5±0.3(-4.2%)
Female Subject	NONE		
Female Control	NONE		
Mean± sd			
Male Subject			5.5
Male Control			-2.0
Female Subject			5.3±0.5
Female Control			-2.8±1.5

Male calculated t value = 5.5; table t (p0.05) = 2.45 reject null hypothesis. Female calculated t value = 7.5; table t (p0.05) 2.45 reject null hypothesis

gain of 4.5±1.9 g L^{-1}. There was no significant (p>0.05) difference between male subject and their controls. Female subjects recorded a mean total serum protein of 68.5 g L^{-1} to 71.4 g L^{-1} at the beginning of the study and between 75.7 g L^{-1} to 78.2 g L^{-1} at the end of the study, with a mean gain in total serum protein of 3.3±1.3. The female control recorded a mean gain in total serum protein of 3.3±1.3g L^{-1}. There was a significant (p<0.05) difference between female subjects and control.

Mean serum albumin levels of subjects and controls at the beginning and end of study: Serum albumin levels of the study participants are shown on Table 3. Male subjects aged 18-30 years recorded a mean serum albumin of 37±4.7mg/dl, with 2 (20%) having inadequate levels (i.e.<36mg/dl) at the beginning of the study. The mean gain in their serum albumin was 8.3±2.4 mg/dl (22.4%) by the end of the study. The male control in the same age category recorded a mean of 38.3±3.9 mg/dl at the beginning and had a 10.4% decrease in mean serum albumin, recording 34.3±4 mg/dL at the end of the study, with 7 (70%) having inadequate levels. Male subjects aged 31-43 years made a mean gain of 8.6±3.4 mg/dl (22.6%), while the mean levels in the male control of the same age reduced from 39.7±6.4 mg/dl at the beginning to 37.6±6 mg/dl at the end (a decrease of 5.3%), with 10(23.3%) having inadequate serum albumin levels. Male subjects aged 44-56 made a mean gain in serum albumin of 8.1±4.9 mg/dl (22.6%), while the male control in the same age category lost

1.7±0.4 mg/dl a decrease of 3.8%.
Male subjects aged 57-69 years gained in mean serum albumin (10.1±1.7 mg/dl i.e 26.9% increase), while the male control in the same category recorded a loss of 3.1±0.6mg/dl (12.5% loss) in their mean serum albumin levels. Statistical analysis revealed a significant (p<0.05) difference in the mean gain in serum albumin by male subjects and male controls (Table 3).
Female subjects aged 18-30 years recorded a mean serum albumin of 38±5.5 mg/dl at the beginning and 48.4±4.1 mg/dl at the end of the study, an increase of 26.3%. Female controls in the same age category recorded a loss in mean serum albumin from 38.6±7.0 mg/dl at the beginning to 36.4±7.3 mg/dl at the end of the study, a decrease of 5.7%. Female subjects aged 31-43 and 44-56 recorded gains in serum albumin of 8.3±2.7 mg/dl (22.0%) and 5±1.8 mg/dl (12.6%) respectively. The female control in the same two age categories recorded losses in mean serum albumin of 2.2 mg/dl (6%) and 2.4 mg/dl (7.3%), respectively.
Statistical analysis revealed a significant (p<0.05) difference in the mean gain in serum albumin by female subjects and female controls (Table 3).

Mean serum retinol of subjects and controls at the beginning and end of study: The serum retinol levels of study participants at the beginning and end of the study are shown on Table 4. Male subjects aged 18-30 years recorded a mean serum retinol of 34.4±5.1µg L^{-1} with 2 (20%) having inadequate levels (i.e.<30ug L^{-1}). By the

Table 2: Distribution of Respondents according to their age and mean Total Serum protein (g L^{-1}) at the beginning and end of study, UUTH, Uyo 2005

Age Category	Beginning of Study	End of Study	Mean Gain inTSP
18-30			
Male Subject	75.2±8.3 (range 60.8-88.1) 2 (20%) > 82 n = 10	78.6±8.6 (range 67.3-83.5) (10%) > 82	3.4±1.3
Male Control	75.9±6.2 (range 63.4-81.9) n = 10	78.8±7.9 (range 61.2-80.9)	2.9±0.4
Female Subject	70.7±7.0 (range 55.2-83) 3 (81%) < 60 n = 38	76.5±7.7 (range 52.4-84.6) 2 (5.4%) < 60	5.8±0.9
Female Control	70.8±9.5 (range 54-88.1) 7 (20) <60 2 (5.7) >82 n = 35	75.7±8.2 (range 57.7-94) 2 (5.7%) <60 3 (8.6%) >82	4.9±1.7
31-43			
Male Subject	73.3±8.1(range 46.5-87.7) 2 (4.7%) < 60 4 (9.3%) > 82 n = 43	75±5.3 (range 61.6-80.8)	1.7±0.6
Male Control	72.2±7.3 (range 47.6-84.2) 3 (7%) >82 2 (4.7%) < 60 n= 43	78.3±8.6 (range 46.1-90.8) 2 (4.7%) <60 7 (16.3%) >82	6.1±0.6
Female Subject	71.4±9.4 (range 58-94) 2 (7.1%) <60 2 (7.1%) > 82 n = 29	79.2±9.8 (range 46-98.3) 1 (3.6%) <60 5(17.99) > 82	7.8±1.2
Female Control	72.8±7.9 (range 60-89) 2 (7.1%) > 82 n = 29	76.2±6.6 (range 68–90) 5 (17.9%) > 82	3.4±1.2
44-56			
Male Subject	72.2±4.6 (range 67-80.8) n = 10	76±6.4 (range 70.5-88.6) 2 (20%) > 82	3.8±0.7
Male Control	70.8±5.5 (range 62.9-78.6) n = 9	78.7±8.1 (range 59.5-89.4) 1 (11.1) <60 2 (22.2) > 82	7.9±1.8
Female Subject	68.5±6.5 (range 57.2-79.1) 1 (10.0%)< 60 n = 10	77.4±7.8 2 (20%) > 82	8.9±1.9
Female Control	76.5±6.8 (range 66.3-87) 2 (28.6%) > 82 n = 7	78.2±4.8 (range 70-86) 1 (14.3%) > 82	1.7±0.9
57-69			
Male Subject	67.9±0.7 (range 67-68.7) n = 3	74.6±2.2 (range 74.6-80)	6.3±1.6
Male Control	73.2±4.6 (range 67.5-78.6) n = 4	77±7.1 (range 67.5-85.6) 1 (20%) > 82	3.8±1.8
Female Subject	None		
Female Control	None		
Mean± sd			
Male Subject			3.8±1.6
Male Control			4.5±1.9
Female Subject			7.5±1.3
Female Control			3.3±1.3

Male calculated t value = 0.60; table t (p0.05) = 2.45 accept null hypothesis.

Female calculated t value = 3.0; table t (p0.05) = 2.78 reject null hypothesis

end of the study they recorded a mean serum retinol of 45.7±8.7µg L^{-1} range 30.7-58.7µg L^{-1}, i.e.a 38.8% increase in mean serum retinol.

The male controls in the same age category recorded a mean serum retinol of 35.4±8.8 µg L^{-1} range 20.9-54.1µg L^{-1} with 4 (40%) having inadequate levels, by the end of the study, their mean level was 27.8±11.6µg L^{-1} range 10.8-15.1 µg L^{-1} with 7 (70%) recording inadequate levels, that is a decrease in serum retinol level by 20.1%. The male subjects aged 31-43 made a mean gain in serum retinol level of 10.8±4.8 µg L^{-1} (i.e 31.4%), while the male controls in the same age category lost 3.0±0.4 µg L^{-1}, (i.e 8.1%). The male subjects aged 44-56 recorded 27.8±3.4 ug L^{-1} (range 20.8-31.6) at the beginning of the study with 6 (60%) recording inadequate levels. By the end of the study they made a mean gain of 12.3±5.3 µg L^{-1} (i.e 44.2%) in their serum retinol levels. Male controls in the same age category recorded a mean loss of 6.8 (i.e 18.9%) in their serum retinol with 5 (50%) of them having inadequate

levels; range 20.8-41.9 µg L^{-1}. The male subjects aged 57-69 made a mean gain of 13.8±4.5 µg L^{-1} (47.9%), while the male controls recorded a mean loss of 6.2±.02 µg L^{-1} (16.6%) with 2 (50%) recording inadequate levels. Statistical analysis revealed a significant (p<0.05) difference in the mean gain in serum retinol by male subjects and male controls (Table 4).

Female subjects aged 18-30 years recorded a mean serum retinol of 33.5±6.8µg/l range 25.6-49.1 µg L^{-1} with 15 (39.5%) having inadequate levels at the beginning of the study. By the end of the study their mean level was 36.1±7.3 µg L^{-1} range 34.7-60 µg L^{-1}, that is 36.1% increase in mean serum retinol. The female controls in the same age category recorded 34.1±4.3 µg L^{-1} at the beginning and 30.2 µg L^{-1}±6.1 at the end of the study with 16 (45.7%) recording inadequate serum retinol levels that is, an 11.4% decrease in level. The female subjects aged 31-43 made a mean gain of 14.1±9.3 µg L^{-1} (45.2%), while the female controls in the same age category recorded a mean loss of 2.6±6.3 µg L^{-1}

Table 3: Distribution of Respondents according to their age and mean serum albumin levels (mg/dl) at the beginning and end of study, UUTH, Uyo 2005

Age Category	Beginning of Study	End of Study	Mean Gain in Serum Albumin
18-30			
Male Subject	37±4.7 (range 30.7-46.7) 2 (20%) < 36 n = 10	45.3±5.9 (range 31.3-50.1)	8.3±2.4 (22.4%)
Male Control	38.3±3.9 (range 30.1-42.8) 1 (10%) < 36 n = 10	34.3±4.8 (range 23.8-38.8) 7 (70%) < 36	-4±0.2 (-10.4%)
Female Subject	38.4±5.5 (range 28.1-50) 4 (10.8%) < 36 n = 37	48.4±4.1 (range 36.3-52.6)	10.1±3.6 (26%)
Female Control	38.6±7.0 (range 30.1-50.1) 2 (5.9%) < 36 n = 35	36.4±7.3 (range 26-50.3) 4 (11.4%) < 36	-2±0.8 (-5.7%)
31-43			
Male Subject	38±5.7 (range 27.8-49.2) 6 (14%) < 36 n = 43 *	46.6±3.8 (range 36.2-51.1) 0 (0.0%) < 36	8.6±3.6 (22.6%)
Male Control	39.7±6.4 (range 28.9-50.6) 3 (7%) < 36 n = 43	37.6±6.9 (range 26.8-50.7) 10 (23.3%) < 36	-2.1±0.3 (-5.3%)
Female Subject	37.8±7.6 (range 20.1-50.8) 4 (14.4%) < 36 n = 29	46.8±4.7 (range 38-50.9)	8.3±2.7 (22.0%)
Female Control	36.6±6.0 (range 28.1-48) 6 (20.7%) < 36 n = 29	34.4±3.7 (range 26.8-44.1)	0.2±0.2 (-6%)
44-56			
Male Subject	35.8±5.5 (range 28.1-48.1) 1 (10%) < 30 n = 10	43.9±5.0 (range 36.7-50.1) 0 (0%) < 36	8.1±4.9 (22.6%)
Male Control	39.7±2.7 (range 37.1-46.7) n = 9	38.2±5.4 (range 30.2-49.)	-1.7±0.4 (-3.8%)
Female Subject	39.6±5.2 (range 29.8-48) n = 10	44.7±4.8 (range 36.1 –50.8)	5±1.8 (12.6%)
Female Control	32.8±3.2 (range 30-39) 2 (28.6%) ≤ 36 n = 7	30.4±2.5 (range 28-35) 3 (42.9%) < 30	-2.4±0.3 (-7.3%)
57-69			
Male Subject	37.6±4.0 (range 32-42.1) n = 3	47.7±2.2 (range 44.8-50.2)	10.1±1.7 (26.9%)
Male Control	37.6±9.6 (range 21.5-45.1) 1 (25%) < 36 n = 4	32.9±7.7 (range 20.3-40.8)1 (25%) > 36	- 3.1±0.6 (18.2%)
Female Subject		None	
Female Control	None		
Mean± sd			
Male Subject			8.8±7.9
Male Control			2.8±0.5
Female Subject			-0.2±0.16
Female Control			7.8±2.1

Normal values = 36-52 mg/dl *1 died serum albumin =26.1 mg/dl. Male calculated t = 3.7; table t (p0.05) =2.45 rejected nul hypothesis. Female calculated t = 7.94; table t (p0.05) = 2.78, reject null hypothesis

(7.8%) in their serum retinol levels at the end of the study. Female subjects aged 44-56 recorded a mean value of 30.8±10.7µg L^{-1} range 10.7-50µg L^{-1} with 4(40%) recording inadequate levels. At the end of the study they recorded 47.8 + 11.4µg L^{-1}, an increase of 51.6%.

The female controls in the same category recorded 30.1±8.5 µg L^{-1} range 18.9-48.6 at the beginning and 28.9±4.8 µg L^{-1} range 19-48.2 at the end of the study with 5(71.4%) recording inadequate levels, that is a decrease in serum retinol level of 29.2%. Statistical analysis revealed a significant difference in the gain in mean serum retinol by female subjects and female controls (Table 4).

Mean serum vitamin c levels of subjects and controls at the beginning and end of study: The serum vitamin C levels at the beginning and at the end of the study of study participants are shown on Table 5.

Male subjects aged 18-30 recorded a mean value of 0.4mg/dl±0.2 at the beginning of study with 9 (90%) recording inadequate levels (i.e <0.5mg/dl). By the end of the study, they gained 1.3±0.4 mg/dl, a fourfold increase in serum vitamin C levels. All male controls in the same age category recorded inadequate mean serum Vitamin C levels at both the beginning and the end of study (0.2±0.1 mg/dl and 0.3±0.2 respectively).

Majority of subjects and controls recorded inadequate levels at the beginning of the study. At the end of the study, all male subjects recorded adequate serum vitamin c levels (>0.5mg/dl), while all controls recorded inadequate levels (I.e<0.5mg/dl). Statistical analysis revealed a significant (p<0.05) difference in the mean gain in serum vitamin C levels by male subjects and male controls.

Majority of female subjects recorded inadequate serum vitamin C levels at the beginning of study and by the end of the study, they recorded adequate levels, making a

Table 4: Distribution of Respondents according to their age and mean serum retinol level (ug/l) at the beginning and end of study, UUTH, Uyo 2005

Age Category	Beginning of Study	End of Study	Mean Gain in Serum Retinol
18-30			
Male Subject	34.4±5.1(range 27.9-44) 2 (20%) <30 n = 10	45.7±8.7 (range 30.7-58.7)	11.3±5.7(38.8%)
Male Control	35.4±8.8 (range 20.9-54.1) 4 (40%) ≤30 n = 10	27.8±11.6 (range 10.8-51.1) 7 (70%) <30	-7.1±3.8 (-20.1%)
Female Subject	33.5±6.8 (range 25.6-49.1) 15 (39.5%) <30 n = 37	50.4±7.3 (range 34.7-60)	12.1±4.6(36.1%)
Female Control	34.1±4.3 (range 26.1-48) 12 (34.3%) <30 n = 35	30.2±6.1 (range 15.5-58) 16 (45.7%) ≤30	-3.8±2.9 (-11.4%)
31-43			
Male Subject	34.6±7.1 (range 18.8-48.4) 12 (27.9%) ≤30 n = 43	44.8±7.8 (range 31-60.1)	10.8±4.8 (31.4%)
Male Control	37.1±6.3 (range 27.8-48.8) 10 (23.3%) <30 n = 43	34.1±8.1 (range 22-50.1) 23 (53.5%) <30	-3.0± .4 (-8.1%)
Female Subject	31.2±9.7 (range 10.2-40.8) 4 (37.9%) <30 n = 28	45.3±9.2 (range 20.8-60) 2 (7.1%) <30	13.8±6.3 (45.2%)
Female Control	33.4±5.3 (range 20.8-50.2) 10 (34.5%) ≤30 n = 29	30.8±7.2 (range 10.5-50.1) 17 (58.6%) ≤30	-2.6±1.3 (-7.8%)
44-56			
Male Subject	27.8±3.4 (range 20.8-31.6) 6 (60%) <30 n = 10	40.6±10.9 (range 20.1-50.6) 1 (10%) <30	12.3±5.3 (44.2%)
Male Control	36±5.6 (range 28.1-43) 2 (22.2%) <30 n = 9	30.0±8.1 (range 20.8-41.9)5 (55.5%) ≤30	-6.8±3.1 (-18.9%)
Female Subject	30.8±10.7 (range 10.7-50) 4 (40%) <30 n = 10	47.8±11.4 (range 28.8-60) 2 (20%) <30	15.9±4.6 (51.6%)
Female Control	30.1±8.5 (range 18.9-48.6) 5 (71.4%) <30 n = 7	38.9±4.8 (range 19 - 48.2) 5 (71.4%) <30	-2± .7 (-29.2%)
57- 69			
Male Subject	28.8 ±2.2 (range 25.8-30) 3 (100.0%) ≤30 n = 3	40.2±6.0 (range 35.1-50)	13.8±4.5 (47.9%)
Male Control	37.4±5.1 (range 32.9-46.1) n = 4	31.2±4.6 (range 27.6-38.9) 2 (50%) <30	-6.2±0.2 (-16.6%)
Female Subject	None		
Female Control	None		
Mean±sd			
Male Subject			12.1±1.1
Male Control			-2.2±3.8
Female Subject			13.9±1.6
Female Control			-2.8±0.75

Normal values =30-60 µg L^{-1} calculated t value =8.7; table t (p0.05) =2.45; Calculated t value =12.85; table t (p0.05) =2.78; reject null hypothesis

mean gain of 0.9±0.5 mg/dl, while almost all the female controls recorded inadequate serum vitamin C levels at both the beginning and the end of the study.

Statistical analysis revealed no statistically significant (p>0.05) difference in the mean gain in serum vitamin C levels by female subjects and female controls (Table 5).

Discussion

This study has revealed the nutritional status of 290 persons living with HIV/AIDS. Anaemia was a major problem in Persons living with HIV and AIDS. While those that received nutritional counseling and micronutrient supplementation had a gain in PCV levels, their controls lost. About 49 (35.5%) of the controls were anaemic. This indicates that nutritional counseling and micronutrient supplementation were effective in improving the PCV level of PLWHA. This observation is in agreement with the work of Ojofeitimi and Fakande (1998); Piwoz et al., (2004).

It has been reported by Tiez (1986), Murray et al. (2000) that variation in total serum protein is affected by many factors such as genetic, physiological and pathological. This observation might have accounted for the non-significant difference in values of total serum protein obtained, since both subjects and control either lost or gained in mean total serum protein.

There was a gain in serum albumin among the subjects, with no subject recording inadequate serum albumin levels i.e. below 36mg 36mg/dl (Tiez 1986). However all control participants who did not receive nutritional counseling and micronutrients

supplementation recorded loses in serum albumin level. This finding is consistent with the opinion of Tiez (1986). Albumin is the most abundant protein in human plasma, it is synthesized at a rate that is dependent on protein intake (Cheesebrough, 1998). Serum albumin exceeding 30gL^{-1} is associated with longer survival in PLWHA. This study demonstrates that nutritional intervention improved the serum albumin status of sampled PLWHA.

Vitamin A Deficiency (VAD) was a major problem with sampled PLWHA. Shills et al. (1994) reported that VAD was common in various stages of HIV infection, even in 12 to 19 percent of asymptomatic HIV positive persons. There was a remarkable improvement in retinol levels among the subjects. Twenty one (21) male and 23 female subjects recorded inadequate serum retinol levels less than (30 µg L^{-1}) before intervention. At the end of the study only one male and female subjects maintained inadequate levels of serum retinol. Controls experienced a decrease in serum retinol levels. This finding was unexpected as palm oil is a major component of the traditional diet (Food and Nutrition Policy for Nigeria, 1995). However reduced bioavailability of plant sources of vitamin A may account for this (IVACG 1999; WHO, 1992).

Vitamin C is an antioxidant micronutrient. Jiamton et al. (2003) reported that a number of micronutrient deficiencies among HIV infected patients was associated strongly with faster disease progression to AIDS and death. It was observed in this study that majority of the study participants recorded inadequate

Table 5: Distribution of Respondents according to their age and mean serum vitamin C level (mg/l) at the beginning and end of study, UUTH, Uyo, 2005

Age Category	Beginning of Study	End of Study	Mean Gain in Serum Vitamin C
18-30			
Male Subject	0.4±0.2 (range 0.2 –0.7) 9 (90%) < 0.5 n = 10	1.7±0.4 (range 0.8–2.2)	1.3±0.4 (425%)
Male Control	0.9±0.3 (range 0.1 –0.3) 10 (100%) <5 mg/l n = 10	0.3±0.2(range 0.2–1.3) 10(100%) <0.5)	0.06±0.08(-66.6%)
Female Subject	0.3 ±0.3 (range 0.2-0.4) 37 (100%) < 0.5 n = 37	1.4±0.5 (range 0.9–1.4)	1.1±0.8 (366.7%)
Female Control	0.3±0.1 (range 0.2 –0.5) 28 (80%) < 0.5 n = 35	0.4±0.2 (range 0.3–0.4) 32 (91.4%) < 0.5	0.1±0.05 (33.3%)
31 - 43			
Male Subject	0.5±0.2 (range 0.3–0.7) 39 (90.7%) <5 n = 43	1.5±0.5 (range 0.9–1.8)	1.0±0.3 (200%)
Male Control	0.9±0.2 (range 0.4–1.2) 33 (76.7%) < 0.5 n = 43	0.5±0.2 (range 0.4–0.5) 37 (86%) < 0.5	-0.4±0.05 (-44.4%)
Female Subject	0.4±0.6 (range 0.4–0.6) 39 (90.7%) < 0.5 n = 29	1.6±0.6 (range 1.2–1.6)	1.0±0.9 (250%)
Female Control	0.3±0.2 (range 0.2–0.5) 21 (72.4%) < 0.5 n = 29	0.4±0.1 (range 0.3–0.6) 27 (93.1%) < 0.5	0.1±0.03 (33.3%)
44–56			
Male Subject	0.4±0.3 (range 0.2-0.6) 10 (100%) < 0.5mg/l n = 10	1.6±2.0 (range 1.2 –2.0)	1.2±0.4 (300%)
Male Control	0.3±0.2 (range 0.3–1.2) 7(77.8%) < 0.5 n = 9	0.3±0.13 (range 0.2–0.3) 9 (100%) < 0.5	0.01±0.0 (3.3%)
Female Subject	0.3±0.2 (range 0.2-0.5) 10 (100%) < 0.5 n = 10	1.7 ±0.8 (range 1.1 –1.7)	1.4±0.6 (466.7%)
Female Control	0.3±0.2 (range 0.2 –0.4) 7(100%) < 0.5 n = 7	0.3±0.1 (range 0.2–0.4) 7 (100%) < 0.5	0.01±0.02 (3.3%)
57–69			
Male Subject	0.3±0.5 (range 0.3 –0.5) 2 (67%) < 0.5 n = 3	1.9±0.9 (range 1.8–2.1)	1.6±0.2 (533.3%)
Male Control	0.3±0.3 (range 0.2–0.4) 4 (100%) < 0.5 n = 4	0.4±0.4 (range 0.3–0.4) 4 (100.0%) <0.50	0.1±.02 (33.3%)
Mean±sd			
Male Subject			0.95±0.39
Male Control			-0.5±0.03
Female Subject			0.93±0.5
Female Control			0.07±0.04

Calculated t value = 1.39; table t (p0.05) = 2.78; accept null hypothesis.
Calculated t value =1.39; table t (p0.05) =2.78; accept null hypothesis

levels (less than 0.5mg L^{-1}) at recruitment. At the end of the study, all subjects recorded adequate serum vitamin c levels, while only 14% of the controls recorded adequate serum Vitamin C levels. This finding is in consonance with the work of Baum (1997), that supplementation with Vitamin B, C and E improved immune status, reduced oxidative stress and reduced the risk of morbidity and mortality. It is therefore suggested that the importance of nutritional counseling and micronutrient supple-mentation should be emphasized to PLWHA.

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