

Risk of Cardiovascular Disease among HIV Patients on Highly Active Anti-Retroviral Therapy: A Cross-Sectional Study

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ABSTRACT

Background: The risk of cardiovascular diseases (CVD) in human Immunodeficiency virus (HIV) infected patients on Highly Active Antiretroviral Therapy (HAART) from some rural parts of Africa and Uganda isn't well known. We assessed CVD risk factors, and used the lipid panel relationship to estimate the risk to CVD in persons with HIV infection on HAART in Gulu, Uganda.

Methods: A cross-sectional study in which data on demographic, lifestyle, diet and physical activity were collected using the WHO Stepwise approach to surveillance questionnaire, Biochemical measurements were tested using standard Biochemical methods on the Humastar 200 chemistry analyzer, Physical measurements; BMI and Hip to waist circumference were measured using standard methods, alongside the blood pressure. Multivariate logistic regression was used to analyze predictors of CVD risk factor.

Results: Mean HDL-C was 38.8 (SD 14.4) (CI: 36.8–39.8), mean T.CHOL was 187.8 (SD 42.3) (CI: 169–200), the mean TRIG was 130.2 (SD 7.5) (CI: 121–148) and the mean FBS was 4.5 (SD 1.1) (CI: 4.2–5.0). The most common risk factor was the low HDL-C of 40.4%, the HAART regimen that caused the most dyslipidemia was the Efavirenz based HAART regimen (TDF-3TC-EFV), Hypertriglyceridemia of 5.9%, Hypercholesterolemia of 3.6%, Hyperglycemia of 2.9% and by the TC/HDL-C ratio; 33(9.9%) participants were at risk for CVD while by the TG/HDL-C ratio 61(18.3%) participants were at risk for CVD. Obese participants were 2(0.6%), combined hypertension was 11(3.3%), systolic hypertension 11(3.3%) diastolic hypertension 3(0.9%).

Conclusion and Recommendations: The risk factors for CVD exist at 9.8%(TC/HDL>1.49), 18.3%(TG/HDL>5) and a combined Risk of 28.1% lower than the risk in Mashinya et al., [14] so the Null hypothesis was rejected and Alternative accepted hence justifies clearly a considerable health burden that can possibly be reduced by increasing educational programs on CVD prevention for people on HAART. There is however a need to develop and evaluate a race/ethnicity-specific CVD risk estimation tool for HIV infected Africans and assessment at HAART initiation and follow-up alongside developing a testing Algorithm for lipid panel during monitoring for HAART.

Keywords

Cardiovascular disease risk, Human Immunodeficiency virus, Antiretroviral therapy 46.

Introduction

Human immunodeficiency virus (HIV) infection has remained to be one of the major public health challenges in both developing and developed countries [1]. As several millions of HIV infected

individuals are managed with antiretroviral therapy (ART), there has been dramatic decline in immunodeficiency-related complications and death [2-5]. Several studies have however indicated the effects of HIV infection and ART the induction of metabolic disorders such as diabetes mellitus, dyslipidemias, hypertension, lipodystrophy and endothelial dysfunction either working singly or in concert with other factors [6-9].

A limited number of studies have assessed CVD risk factors in HIV infected people on ART from low-income countries [5,10]. Furthermore, the number of CVD risk factors, type and duration of ART reported in these studies varied. Most studies on CVD risk factors in persons with HIV infection were done in Western countries [11,12] and a few in Africa [13,14].

Studies on CVD risk among HIV infected people are however scarce in Africa [14,15] and Uganda specifically but a recent attempt to describe the CVD risk in rural people on ART from Mpumalanga in South Africa was made [9,15]. The use of ART was self-reported and according to the authors, the CVD risk prevalence in that population on ART may have been underestimated given the level of stigma associated with HIV in that area. In Uganda, the high number of people living with HIV [16] and a 33000 HIV related death in 2014 [16], presents a high risk of CVD among people infected with HIV and needed to be investigated. While CVDs are preventable, little is known regarding CVD risk in HIV infected rural Ugandans on HAART [16]. We determined the prevalence of CVD risk, the estimated risk in reference to the TC/HDL-C ratio and the TG/HDL-C ratio in persons with HIV infection on HAART at Gulu regional referral Hospital, Gulu District, Northern Uganda *and* the objective of the study was to assess the risk of cardiovascular disease in people living with HIV on HAART at Gulu Regional referral Hospital, Antiretroviral clinic, Gulu District.

Methodology and Materials

Ethical considerations

The study was approved by Research and Ethics committee of Clarke International University and Institutional Review Committee of Gulu University teaching hospital in conjunction with GRRH. Prospective participants provided written informed consent before enrolment in the study. People living positively with HIV who had been on HAART for less than 1year, Lactating mothers, confirmed Diabetic patients, Patients already confirmed of CVD before, Pregnant mothers, Patients with acute illness that needed immediate attention and treatment were excluded from participating in the study.

Sample size estimation

The study used the Kish and Leslie technique to determine the least sample size denoted n.

$$n = \frac{Z^2 p (1 - p)}{d^2}$$

Where n = the required sample size

Z = the statistical certainty chosen at 95% confidence interval and is 1.96

P = prevalence of CVD in HIV patients as at 31.1% from DAD score [14].

d= the deviation error set at 0.05

Therefore; **n = 329 patients (sample size)**

To cater for errors and sample loss, the sample size was increased by 1.5 (5 samples increased) making the sample size became **n = 334 patients**

Study Design and Data collection procedures

A cross-sectional study was conducted in the HIV/AIDS health care clinic of Gulu Regional Referral Hospital (GRRH), the largest metropolitan area in Northern Uganda. The study was approved by Research and Ethics committee of Clarke International University formerly International Health Sciences University and Institutional Review Board of Gulu University in conjunction with GRRH. People living positively with HIV attending HAART clinic at GRRH, Aged 18-60yrs were consented and enrolled in the study. People living positively with HIV who had been on HAART for less than 1year, Lactating mothers, confirmed Diabetic patients, Patients already confirmed of CVD before, Pregnant mothers, Patients with acute illness that needed immediate attention and treatment were excluded from participating in the study. Participants were selected by the systematic random sampling method considering the fact that the clinic receives 50 clients in a day for their routine appointment by getting every sixth Patient who came and was sampled till the 334 participant was realized and the first patients was determined randomly by tossing a coin A and B and if the choice was B then s/he was our first sixth patients to start the sampling. Participants were prepared for fasting blood sampling using the WHO protocol for lipid profile testing (reference required).

After enrolment, anthropometric and blood pressure measurements were taken using protocols adapted from Mashinya et al., [14]. The patient's waist and hip circumference (WHC) was measured and recorded to the nearest 0.1cm and height was measured using a Stadiometer (200cm Stadiometer Black Wall Mounted Height Meter Growth, Model: CLGJ5556, made in China) and weight was measured to the nearest 0.1kg using the Indiamate weighing scale (Made in India) to assess the BMI. A BMI was considered as normal (18.5-24.99 Kgm-2), overweight (25-29.0 Kgm-2) and obese (>30.0 Kgm-2) according to the world health organization guidelines [17] and their blood pressure was measured twice at interval of 5 minutes and the average taken using a standardized Digital blood pressure machine using the Fully Automatic Electronic Blood Pressure Monitor (Arm Style Microcomputer intelligent made in china). High blood pressure was defined as a systolic blood pressure (SBP) above 140mmHg and/or a Diastolic blood pressure (DSP) above 90mmHg and or a self-reported history of Hypertensive treatment/medication.

Metabolic syndrome was defined as any three of the following five

risk factors; abdominal obesity (waist circumference of 88 cm for females and >102 cm for males), high Triglyceride concentrations (>1.7mmols/l), low HDL-C concentration (<1.3mmols/l for females and <1.1 for males), high blood pressure and raised fasting plasma glucose concentration (>7mmols/l) [2].

Blood Collection

Fresh 4mls of fasted blood samples was collected from the participants in plain blood collection bottles, transported immediately to the laboratory for lipid profile assessment and fasting blood glucose analysis. The blood samples upon reaching the processing room were centrifuged at 448G- force for 15mins and serum harvested and analyzed using the Humastar 200 (HUMAN Gesellschaft für Biochemica und Diagnostica mbH Max-Planck-Ring 2165205 Wiesbaden Germany) Clinical Chemistry analyzer for fasting blood glucose and lipid panels High Density Lipoproteins (HDL), Low density Lipoproteins (LDL), Triglycerides (TGs) and Total Cholesterol (TC).

Statistical analysis

The data derived from the study were analyzed with STATA software Version 10.0 (by StataCorp LLC 4905 Lakeway Drive College Station, Texas 77845-4512 and SPSS 23 by IBM 1 New Orchard Road Armonk, New York 10504-1722, United States). Multivariate regression analyses were used to determine the risk factors associated with cardiovascular disease. Associations between categorical variables were measured using Pearson's correlation test and differences in distribution of continuous variables were measured using t-tests, Statistical significance was inferred at the P-value < 0.05. TG/HDL ratio was used to get the risk in reference to the triglyceride and HDL-cholesterol ratio greater than 1.49 in which any participants value greater than 1.49 was taken to be at risk of Cardiovascular disease and TC/HDL ratio was used also to get data on the risk in references to the Total cholesterol and HDL-cholesterol ratio greater than 5 in which any participants value greater than 5 was taken as a risk for cardiovascular disease.

Results

Characteristics of the participants and risk factors

334 HIV positive clients on HAART between the age of 18-49yrs participated in the study of which 232 (69.5%) participants were females and 102 (30.5%) were males. The mean age of the participants was 36 years with a standard deviation of 7. majority of our participants were on based NNRTI- Efavirenz based drug regimens 260(77.8%), Nevirapine based regimens 68(20.4%), Lopinavir/ritonavir based regimens 4(1.2%), 2(0.6%), 28.1% of our participants were physically active while 71.8% were less active, 98.2% of our participants were non-smokers while 1.8 were smokers or had smoked, 77.25 of our participants were alcoholics while 22.8% were non alcoholics, 24.3% were consuming high salt while 75.7 used less salt, 49.1% of our participants were not sure of what oil they were using while 31.1% used other sources of oil and 19.8 used vegetable oil respectively, 60.55 of our participants took low fruits and 14.7% eat less vegetable on daily bases.

Abnormal lipids profile among HAART clients at Gulu Regional Referral Hospital

The mean plasma total cholesterol was 187.8 mg/dL (SD 42.3 mg/dL) and the mean serum triglyceride was 130.2 mg/dL (SD 7.5 mg/dL, mean HDL-C was 38.8 (SD 14.4mg/dl), mean TRIG was 130.2 (SD 7.5mg/dl) and mean FBS was 4.5 (SD 1.1) (Table 2). Up to 135 (40.4) participants had low serum HDL – cholesterol (< 35 mg/dL), 12 (3.6) of the participants had high serum total cholesterol (> 200 mg/dL), with only 10 (3.0%) having high FBS and 20 (5.9%) had high serum triglyceride (> 160 mg/dL). Up to 17 (5.1%) participants had elevated plasma LDL-cholesterol value (>140 mg/dl) calculated from the Friedewald equation.

Table 1: The markers of cardiovascular disease (n=334).

Marker	Mean (± SD)	95% Confidence interval
Total Cholesterol (mg/dL)	187.8 (42.3)	169-200
HDL-cholesterol (mg/dL)	38.8 (14.4)	37— 40
Triglycerides (mg/dL)	130.2 (7.5)	121 -148
Fasting blood Glucose (mmol/L)	4.5 (1.1)	4.2 – 5.0

Other risk factors Risk factors for cardiovascular disease risk markers

Majority of the participants (309) had normal blood pressures [7,18]. Eleven of the participants (3.3%) had systolic hypertension and 3 (0.9%) had diastolic hypertension with the rest 11(3.3%) had combined hypertension.

Interpretation of the table

The table showed that FBS was significant to total cholesterol and smoking, fruits intake, salt intake, vegetable intake, exercise intake, and drinking were not significant. Also vegetable intake, FBS, exercise was significant to triglycerides with smoking, fruits intake, salt intake and drinking not significant. Vegetable intake, exercise, FBS were significant to HDL while smoking, fruits intake salt intake and drinking were not significant to HDL.

Deranged Anthropometric measures indicative of cardiovascular disease among HAART clients at Gulu regional referral hospital

The mean BMI of the participants was 20.9 kg/m² (95% CI 20.6 – 21.2 kg/m²). By sex, the mean BMI in female participants was 21 kg/m² (95% CI 20.6 – 21.3 kg/m²) and the mean BMI in male participants was 20.8 kg/m² (95% CI 20.6 – 21.4 kg/m²) (p value = 0.7) t-test showed no significance since the P-value is greater than 0.05 hence we rejected the null and accepted the alternative hypothesis.

According to the WHO BMI criteria [18] 2 (0.6%) of the participants were obese (BMI>30.0 kg/m²) and 30 (9%) of the participants were overweight (BMI 25.0 to 29.9 kg/m²). One fourth 83 (25%) of the participants were underweight [7,18].

All of the participants both female and male had no abdominal obesity in reference to the waist circumference i.e. waist

Table 2: Multivariate logistic regression showing relationships between the different biochemical markers of cardiovascular disease and associated factors 173.

Total Cholesterol	Coefficient	Standard error	95% CI	P value
Smoking	1.39	18.12	-34.25 – 37.03	0.94
Alcohol intake	6.41	6.36	-6.11 - 18.93	0.32
Fruit intake	6.02	4.86	-3.55 – 15.59	0.22
Salt intake	-4.79	6.24	-17.08 – 7.48	0.44
Vegetable intake	-2.28	6.72	-15.50 – 10.94	0.74
Exercise	-4.30	5.30	-14.73 - 6.13	0.42
Fasting blood sugar	12.03	4.32	3.53 – 20.53	0.01
HDL	Coefficient	Standard error	95% CI	P value
Fruits intake	1.09	1.61	-2.07 – 4.26	0.49
Vegetables intake	4.75	2.22	0.38 -9.11	0.03
Smoking	-3.72	5.99	-15.51 – 8.02	0.54
Salt intake	-0.26	2.06	-4.32 – 3.80	0.90
Exercise	4.20	1.75	0.76 – 7.65	0.02
Drinking	0.71	2.10	-3.43 – 4.85	0.74
Fasting blood sugar	5.45	1.43	2.64 -8.26	<0.001
Triglycerides	Coefficient	Standard error	95% CI	P value
Fruits	-4.98	5.75	-16.29 – 6.33	0.39
Vegetables intake	-19.18	7.94	-34.80 - -3.56	0.02
Salt intake	-3.53	7.38	-18.05 – 10.99	0.63
Fasting blood sugar	13.78	5.12	3.73 – 23.82	0.01
Exercise	-13.07	6.27	-25.40 - -0.74	0.04
Drinking	6.18	7.52	-8.62 – 20.98	0.41
Smoking	23.76	21.42	-18.37 – 65.89	0.27

circumference of >88cm in female and 102cm in male.

Common HAART regiments associated with deranged cardiovascular markers

Dyslipidemia and Dysglycemia	Regiments In Use				
	1	2	3	4	Total
Hypercholesterolemia	3 (25.0)	8 (66.7)	1 (8.3)	0 (0.0)	12 (3.6)
Hypertriglyceridemia	5 (25.0)	14 (70.0)	1 (5.0)	0 (0.0)	20 (6.0)
Low HDL-C	28 (20.7)	103 (76.3)	2 (1.5)	2 (1.5)	135 (40.4)
High FBS	3 (30.0)	6 (60.0)	1 (10.0)	0 (0.0)	10 (2.9)
Total	68 (20.4)	260 (77.8)	4 (1.2)	2 (0.6)	334 (100)

Key: 1=NRTI-Nevirapine based, 2=NRTI-Efavirenz based, 3=NRTI-Lopinavir, 4=NRTI- Atazanavir

Most of the participants were on first line therapy combination of TDF-3TC-EFV and generally, Efavirenz based HAART regiment was the most common regiment being used by our participants and the one that contributed to dyslipidemia most also being the Efavirenz based HAART regiment.

Abnormal Blood glucose level among the HAART clients at Gulu Regional Referral Hospital

Hyperglycemia was taken to be any value above 6.1mmols/L. The mean fasting blood glucose was 4.5mmol/L, (SD 1.1 mmol/L). Up to 126 (37.7%) of the participants had hypoglycemia and 10 (3.0%) of the participants had hyperglycemia. 10% of the participants had Hyperglycemia mostly commonly associated with the NNRTI-Efavirenz and 60% had hypoglycemia.

Table showing the abnormal blood glucose levels among the clients at Gulu regional referral hospital

Hyperglycemia	Regiments				Total
	1	2	3	4	
Hyperglycemia (%)	3 (30)	6 (60)	1 (10)	0	10 (2.9)
Total	3 (30)	6 (60)	1 (10)	0 (0.00)	10 (100)

Key: 1=NRTI-Nevirapine based, 2=NRTI-Efavirenz based, 3=NRTI-Lopinavir, 4=NRTI- Atazanavir

Table 1 showing the distribution of the hyperglycemia with the HAART regiment being taken.

Discussion

Deranged Biochemical Markers of Cardiovascular disease

Risk to CVD was taken to be high with hypertriglyceridemia values of >2.3mmol/l (204mg/dl). The prevalence of hypertriglyceridemia contrary to the hypertriglyceridemia in Riddler SA et al., [19] was low (6.0%) maybe due to the NNRTI Efavirenz based regimen used and not PI's as some studies reported a high triglyceride value in patients using the PIs [20] and also high in Ritonavir treated patients in some other study [21]. The regiment of choice was the main cause of the variation in the prevalence and the use of a stavudine containing regimen in certain other studies [3,4,13] may explain why a prevalence more than twice as high was observed in those studies. Older age was a significant predictor of hypertriglyceridemia as previously reported [14,22]. High TG levels in our study were associated with low intake of vegetables and not clearly with fruit as reported in other studies [14,23,24].

Risk to CVD was taken to be high with values of HDL <1.0mmol/l (34.8mg/dl) although HAART increases lipid levels, HDL-C may not return to normal levels thus high prevalence of high low HDL-C (40.4%) has been observed in this and other studies [10,14,25,26] but the adherence rate of the regimens contributed to the dyslipidemia in other studies [27]. Older age, vegetable intake and exercise were independent predictors of a low HDL-C concentration. These results show the importance of doing exercise and eating vegetables to minimize the risk for developing low HDL-C concentration [7] when people on HAART ages and hence avoiding the risk of developing cardiovascular disease since HDL-C is considered beneficial in clearing away bad fats [14].

Risk to CVD was taken to be high with Hypercholesterolemia values of >10.3mmol/l (220mg/dl). Hypercholesterolemia was present in 4.0% of the participants which is close to results from other studies [10,25,26,28]. The Hypercholesterolemia was common to the Efavirenz based HAART and not the PIs as other studies confirmed [20] and the variation could be due to the wide spread use of the Efavirenz based NNRTI drug regimens hence causing lipids abnormality. The hypercholesterolemia was closely associated to the vegetable intake and exercise or physical activity since it helps break down the stored fats hence low value of cholesterol since visceral lipohypertrophy increased the likelihood of having a high total cholesterol concentration. None of our participants was using lipid lowering drugs, possibly accounting for the observed proportions of dyslipidemia. Lipid ratios are regarded as better predictors of CVD than individual lipids [29].

Risk factors for cardiovascular disease

In our study, most people were not physically active 240 (71.8 %) and that offers a high risk to developing CVD given the effect of the HIV itself which has been found to cause chronic inflammation which is partially corrected by HAART dyslipidemia and all that would be controlled by the level of activity [14,30]. However, the use of a different instrument for data collection may explain variations observed in physical activity between our study and others [14,28,31].

Cigarette use data showed; 98.2% non-smokers and smokers 1.8% hence confirmed the general knowledge by Craig et al., that smokers had a poor lipids profile than non-smokers in the general population [32] and among HIV clients [33] and the data is in agreement with this knowledge since cigarette increases the risk of cardiovascular disease but information bias and low number of men could have affected it too, explaining the low prevalence of the CVD risk taking to consideration the low number of smoking participants [7].

Alcohol use showed that non alcoholics were 77.2% and those alcoholic 22.8% which supports the low risk of CVD since alcohol has a protective effect on the lipid panels by breaking down the lipids and fats hence low CVD risk [7] but the level of drinking should be determined if it's to be cardio-protective something our study didn't so much assess, Salt intake data showed that 24.3%

took high salt with 75.7% low salt intake which is beneficial since high salt intake is associated with increased risk to hypertension [7], while the oil use showed 49.1% didn't know the kind of oil they were consuming while 31.1% were using other sources for cooking, 19.8% using the vegetable oil and that supports the findings that vegetable oil is cardio-protective given all factors constant and the physical activity data showed 28.1% very active with 71.8% were less active physically which is cardio-dangerous given all factors constant [7].

The low intake of fruits at 60.5% (202) and vegetables at 14.7% (49) of the whole participants was supported by most participants in our study cited non availability of fruits and vegetables coupled with unaffordability as reasons for low intake. This low intake remains a major challenge as it increases the risk of nutritional deficiencies [23,24], CVD incidence and mortality [34]. Consistent with our findings, a low intake of fruit and vegetable was reported among the general population of South Africa and Dikgale HDSS [13,14].

The participants were taken to be Hypertensive with Systolic Bp of >140mmHg showing Systolic Hypertension, Diastolic Bp of >90mmHg showing Diastolic Hypertension Among metabolic risk factors, majority of the participants (309) had normal blood pressures < [7,18] given the fact that they were not on any hypertensive drugs at the moment and this prevalence was due to the low salt intake and younger age as supported by other studies [6,10,25] contrary to the other studies [14,35]. Eleven (3.3%) of the participants who had systolic hypertension coupled with combined hypertension and three 0.9% with diastolic hypertension.

Deranged Anthropometric measures indicative of CVD; BMI and Hip to Waist Circumference

Clients BMI Obesity was taken to be any value >30.0kg/m² [18], HIV patients on HAART usually manifest evidence of fat redistribution which is characterized by subcutaneous extremity loss of fats, preservation of the fat in the trunk and an increased waist-to-hip ratio [7].

Increased WHR (waist to Hip ratio) comes due to reduced hip circumference and increased waist which is associated with increase in the metabolic risk indices like hyperlipidaemia the prevalence of obesity (0.6 %) and abdominal obesity (0.00%) in our study differed from prevalence reported from the rest of Africa [1,10,14] and Asia [6,22].

According to Crum-Ciaflone et al. [36] and Mashinya et al. [14], the variations in obesity and abdominal obesity may partly be explained by differences in HAART duration which in our study we didn't consider specifically but took those who had stayed on HAART for at least 1 year on words and the different cut-off for waist circumference used in various studies, advancing age, female studies rather than the male gender in some studies [37], ethnicity and HAART regimens used. Females in our study were more likely to be obese or overweight than males, although the

difference was not significant due to the small number of male participants contrary to other studies [14,38].

Common HAART regimens associated with the deranged biochemical markers of cardiovascular disease

The study found the most common HAART regimen that affected the total cholesterol value being the Efavirenz based NNRTI regimen with a prevalence of 66.7% contributed by the Efavirenz based NNRTI followed by 25.0% by the Nevirapine based all being first line HAART regimens and lastly the Lopinavir/ritonavir accounting for 8.3% of the participants and that low use of Lopinavir at the site compared to the wide use of NNRTI based Efavirenz given the fact that it's an adult second line HAART could have contributed to the low prevalence of Hypercholesterolemia compared to other studies that found a high prevalence with Lopinavir based HAART being a PI drug [39].

Looking at the hypertriglyceridemia the regimens that contributed most was that of 70.0% by the Efavirenz based HAART regimen, compared to the 25.0% by the Nevirapine based HAART all being first line regimens and the least contributor to hypertriglyceridemia was the Lopinavir/ritonavir accounting for 5% of the participants and it being a PI was used as a second line regimen hence less use by the clients and this explains the low prevalence from the regimen compared to the Reinsch N et al., [39] which showed high prevalence in PI drugs use [14,39].

Also to consider is the high prevalence of the low high density lipoprotein (HDL-C) which was most common in the Efavirenz based HAART regimen 76.3% followed by the Nevirapine based HAART 20.7% and least common with the lopinavir/ritonavir 1.5% and Atazanavir/ritonavir 1.5%. The low prevalence use of the Lopinavir/ritonavir and Atazanavir/ritonavir regimen is because of the that being PI's and second line regimens which are always used after treatment failure with the first line and the low prevalence is in agreement with the Reinsch N et al., [39] if it were to be highly used.

Abnormal blood sugar level by HAART regimen

In this study, a participant was considered to be Hyperglycemic if they had fasting blood glucose levels >6.1 mmol/l. Costa et al., found hyperglycemia to be high in HIV patients than naive patients [30].

Hyperglycemia in males and females in our was 3.0% not as Weber R, et al., reported and also among people on HAART in other African studies [14, 25,28,40] as caused by the NNRTI also in this case.

Unlike other study findings, a high prevalence of Hypoglycemia, probably due to feeding and the variation in the methods used; fasting serum samples for glucose analysis using the Humastar 200 not whole blood in gray topped bottle may have contributed to the low sugar level as the sodium fluoride isn't there to control glycolysis and others get lost during the clotting of the blood hence

low value [7].

The overall prevalence of Hyperglycemia among the participants was estimated at 3.0 % less than other prevalence of 9.0% in South Africa and 9.3 % prevalence for United States of America [8,14] and the variation could be due to the methods of diagnosis used for the blood sugar measurement using the Humastar 200 analyzer that uses the serum for assaying the glucose and not the plasma as in the other study hence low prevalence.

Conclusion and Recommendation

In conclusion, the cardiovascular disease risk exist in the HAART clients though low at a prevalence of 9.8% using the total cholesterol to HDL-C ratio (TC/HDL-C >1.49) and at 18.3% using the triglycerides to HDL-C ratio with a combined cardiovascular disease risk of 28.1% which is slightly lower than the Prevalance from the Mashinya et al., [15] at 31.1% hence shows a considerable health burden that needs to be addressed promptly before it escalates with its impact.

A relationship was found to exist between the HAART therapy and Lipids panel hence a moderate risk of Cardiovascular disease so with that finding the Null hypothesis was rejected and the Alternative hypothesis was accepted showing that; —There is a relationship between HAART therapy and Cardiovascular disease risk development in people living with HIV on HAARTI.

Recommendations

There however is a need to develop and evaluate race/ethnicity CVD risk estimation too for HIV infected Africans since the Framingham and the DAD methods have proved not to be so much ethnic related to the African population if risk is to be estimated.

The TC/HDL-C ratio and TG/HDL-C ratio would be the best option in our view to assess the risk and estimate CVD risk since its independent of race. Also since it has been confirmed that there exist a relationship between the two variables, it should be taken up as a common practice to check the lipid profile of the HIV patients in accordance to the test and treat guidelines of the Ministry of health and WHO at initiation and also as the viral load test protocol is being followed or else a testing protocol be devised for lipids panel control in HIV patients on HAART probably after the 48 weeks approximately 1-year.

Education of the clients and care givers about the risk portals and risk factors to mitigate the mortality rise expected.

A large sample size study needs be done to clearly bring the relationships between the variables since our sample size was a little small.

A follow-up study/Cohort study is the best to study the cause effects relationship of the variables compared to cross sectional study.

Limitation

Limitations of our study included its cross-sectional design used, therefore we cannot fully conclude that the associations between covariates and CVD risk factors are casual the best would have been to perform a cohort study to ascertain true relationship in our view if it were possible.

Information on tobacco use, alcohol use, physical activity, fruit and vegetable intake was obtained using the WHO STEP questionnaire. This is considered to be a reliable instrument, however recall bias may have influenced the results.

The control of fasting in the clients was dependent on the participants and we couldn't ascertain if they indeed fasted before the sampling of blood so it might have also affected our results.

While our sample size may not be representative of the whole population of HIV infected Ugandans in Gulu receiving ART our study provides valuable and useful information for comparison with other published studies from both developing and developed countries. We also acknowledge the small sample size of our study as on limiting factor probably.

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