The Typical Plasma Fat Profile and its Dynamics with CD4+ count and Viral load in Zambian Adults with HIV/AIDS

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ABSTRACT

Objective: To establish the characteristic plasma fat profile and its dynamics in association with the absolute CD4+ count and viral load presenting in adult HIV/AIDS patients attending antiretroviral therapy clinic

Design and Methods: A longitudinal and quantitative study involving 174 adult HIV/AIDS patients recruited over a period of 18 months at a University Teaching Hospital in Ndola, Zambia. Participants were subjected to clinical assessments with anthropometry, CD4+ count, viral load, and plasma fat measurements at baseline and repeated on a follow-up visit. The Wilcoxon rank-sum test for continuous variables and the Chi-square test for categorical variables were applied to compare the study population by gender. The graphic outputs were generated through the application of the graphics menu in stata.

Results: The lipid profiles were generally within normal for the laboratory reference ranges for both the male and female gender. However, the median total cholesterol [3.86 (3.02, 4.62) mmol/l], median triglyceride [1.19 (0.87, 1.51) mmol/l] and LDL-c [2.31(1.58, 2.90) mmol/l] concentrations were relatively higher in the females than the males [3.53 (3.06, 4.61) mmol/l], [0.96 (0.71, 1.60) mmol/l] and [1.86 (1.36, 2.80) mmol/l] respectively. Conversely, the median HDL-c concentration was found to be relatively higher in the male [1.4 (1.21, 1.55) mmol/l] than the female gender [1.33(1.13, 1.51) mmol/l]. The gender disparities in the lipid panel did not however suggest statistical significance. The dynamics in plasma fat status with CD4+ count and viral load suggested a positive and inverse interrelation respectively.

Conclusion: Normal plasma fat profiles were typical of the study population. Findings further suggest a plausible positive association between plasma fat and CD4+ count and, an inverse association with viral load.

Keywords: CD4+ Count, HIV/AIDS, Plasma Fat, Viral Load.

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Crossref Doi: https://doi.org/10.36437/irmhs.2022.5.1.D

1.0 Introduction

1.1 Background to the problem

People living with HIV/AIDS develop multiple nutrient deficiencies, both micro-and macronutrients. Micronutrient deficiencies which are commonly observed with advanced HIV disease have been associated with higher risks of HIV disease progression and mortality.[1] Prior research on micronutrients has quite extensively covered the role of multiple vitamins and minerals[2-5] but the role of macronutrients such as fats in immune mechanisms involving CD4+ counts and viral load suppression in HIV/AIDS patients in resource-limited settings like Zambia is not well known.

Fat is defined chemically as triglycerides; trimesters of glycerol with several fatty acids.[6,7] There are abundant diverse kinds of fats, but each is a distinction on the identical chemical arrangement. More specifically, the entire fats are sources of fatty acids and glycerol.[6] Cholesterol is a waxy-like substance that is found in the fat cells of our body and in the bloodstream. There are largely two types of cholesterol; one is HDL (high-density lipoproteins) and another is LDL (low-density lipoproteins) cholesterol[7] HDL cholesterol is also known as "good cholesterol" and LDL cholesterol is considered to be "bad cholesterol". Higher levels of HDL protect against heart attack and stroke because it keeps LDL cholesterol from building up around the heart.[6]

Triglycerides, cholesterol, and other essential fatty acids insulate us and protect our vital organs. They act as messengers, helping proteins do their jobs. They also start chemical reactions involved in growth, immune function, reproduction, and other aspects of basic metabolism. Fats help the body stockpile certain nutrients as well. The so-called "fat-soluble" vitamins--A, D, E, and K--are stored in the liver and in fatty tissues [8]. This study seeks to examine the potential role of total cholesterol, LDL-c, HDL-c, and triglycerides in modulating CD4+ and viral profiles to impact HIV disease progression.

1.2 Problem statement

Malnutrition in the form of macronutrient and micronutrient deficiencies may contribute to the high morbidity and mortality reported among HIV/AIDS patients.[9,10]

Most prior research work in Zambia has examined and suggested the beneficial role of micronutrients such as vitamin A, C, E, Zinc, and Selenium in the management of disease in both the HIV and non-HIV setting. The role of macro-nutrients such as fats in the management of HIV/AIDS has not been fully explored.

2.0 Research design and Methods

A quantitative and longitudinal study design in which subjects were followed-up at baseline, 2 weeks, and 3 months (**figure1**). Following recruitment the study subjects were subjected to history taking, physical examination with vital signs, and anthropometric measurements at baseline which point they were also screened for opportunistic infections and subjected to the routine and study-specific laboratory tests. At visit 1 follow-up which is 2 weeks following enrolment, participants were further followed up for review of lab workups and monitoring for drug toxicities in those who will have been recently initiated on cART or prophylaxis medications. At visit 2 (3 months from baseline) the participants were subjected to clinical assessments and blood sample draws for CD4+ count, viral load, and plasma fat testing as at visit 1.

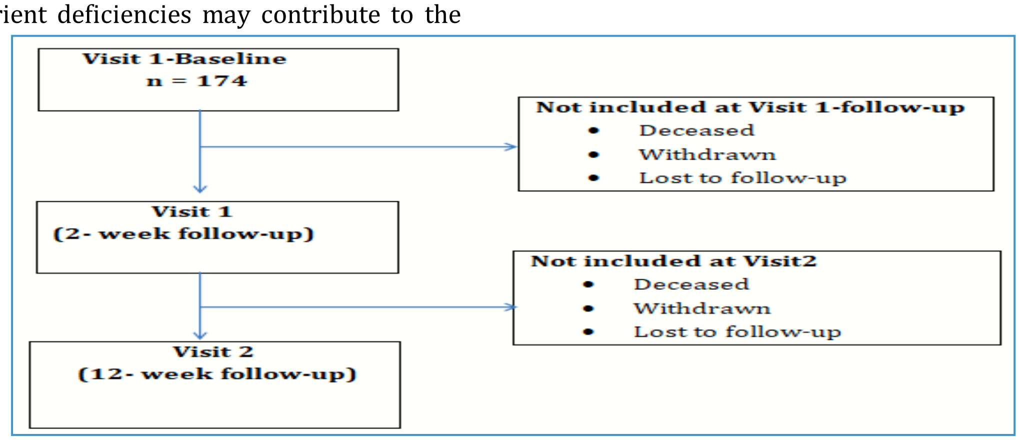


Figure1. Flow diagram depicting study visits

2.1 Target population

Adult HIV/AIDS patients were men and women aged 18 years and above receiving combination antiretroviral therapy (c ART) from the HIV clinic at Ndola Teaching Hospital.

2.2 Sample size estimates and justification

The study involved a population of approximately 174 adult HIV/AIDS patients at baseline. The sample size estimate was derived based on the Cochran formula and for the purposes of regression analysis, the sample size was further tested for adequacy in a regression model.

Sample size estimate, $n= z^2pq/d^2$, where n= sample size, p= 13.2% (HIV prevalence for the Copper belt province (MOH, 2019), q= 1-p, z= 1.96 and d= 0.05 at 95% confidence interval. This gives an n= 174.

3.0 Results

The total number of subjects whose results were available for analysis in the study was 174. Of the 174 subjects, 107 (61%) were female and 67(39%) were males. The study population was generally young, with males being older [40 (37.5, 42.4) years] than females [37 (34.5, 38.7) years], p=0.02 (table 1.).

The lipid profiles were generally within normal for the laboratory reference ranges for both the male and female gender respectively. However, the median total cholesterol [3.86 (3.02, 4.62) mmol/l], median triglyceride [1.19 (0.87, 1.51) mmol/l] and LDL-c [2.31(1.58, 2.90) mmol/l] concentrations were relatively higher in the females than the males [3.53 (3.06, 4.61) mmol/l], [0.96 (0.71, 1.60) mmol/l] and [1.86 (1.36, 2.80) mmol/l] respectively. Conversely, the median HDL-c concentration was found to be relatively higher in the male [1.4 (1.21, 1.55) mmol/l] than the female gender [1.33(1.13, 1.51) mmol/l]. However, the gender disparities in the lipid panel did not suggest statistical significance.

The median CD4+ counts were found to be lower than the lower limit of the normal for the laboratory reference range of (500-1500 cells/ul) in both genders. The value was especially lower in the males [245.5 (167.5, 407.5)cells/ul] than in the females [357(231, 543) cells/ul], p=0.002. The median viral loads were found to be relatively higher than expected for optimal suppression in both genders. The females were especially more poorly suppressed [355 (20, 6770) copies/ml] than the males [254 (23, 2694) copies/ml], though falling short of statistical significance, p=0.84 (table 1).

Variable	Female N= 107 (61%)	Male N= 67 (39%)	p
Age (years)	37 (34.5, 38.7)	40(37.5, 42.4)	0.02
BMI(kg/m2)	22.9 (20.4, 27.5)	21 (18.8, 23.9)	0.01
CD4+count (cells/ul)	357 (231, 543)	245.5 (167.5, 407.5)	0.002
Viral load (copies/ml)	355 (20, 6770)	254 (23, 2694)	0.84
Total cholesterol (mmol/l)	3.86 (3.02, 4.62)	3.53 (3.06, 4.61)	0.65
Triglyceride (mmol/l)	1.19 (0.87, 1.51)	0.96 (0.71, 1.60)	0.25
LDL-c (mmol/l)	2.31 (1.58, 2.90)	1.86 (1.36, 2.80)	0.19
HDL-c (mmol/l)	1.33(1.13, 1.51)	1.4 (1.21, 1.55)	0.15

Opportunistic infection			
Present	15 (15.2%)	17(27%)	0.06
Co-morbidity			
Present	14 (14.1%)	2 (3.23%)	0.02
Smoke status			
Yes	2 (3.08%)	9 (23.1%)	0.001
Alcohol status			
Yes	16 (16.2%)	23 (37.1%)	0.003

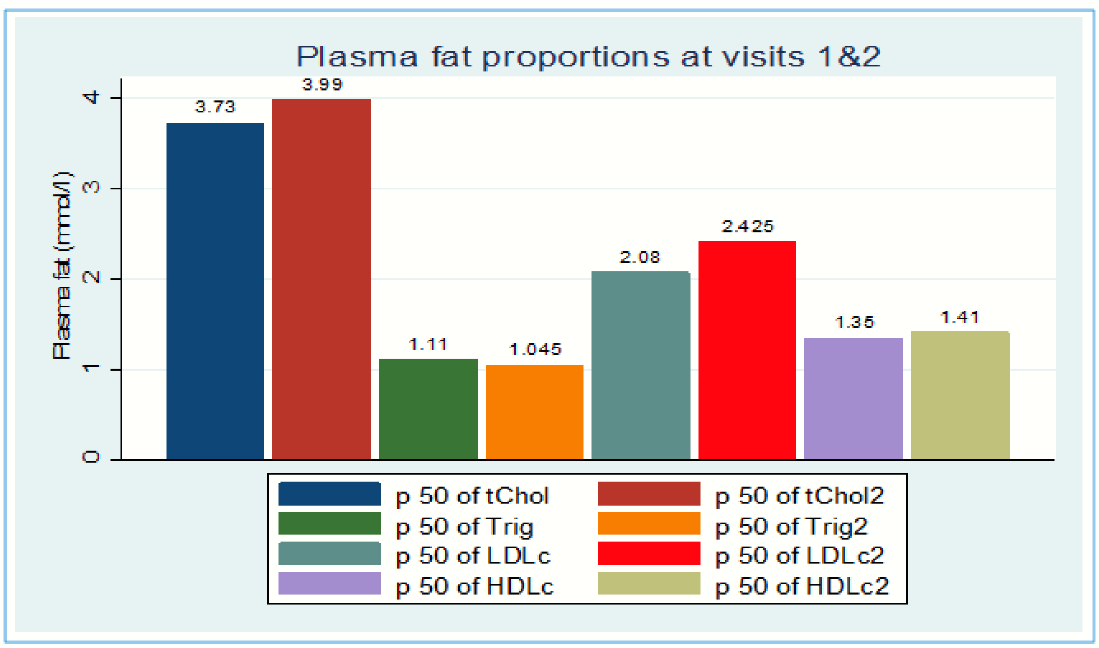
Table1. Baseline characteristics

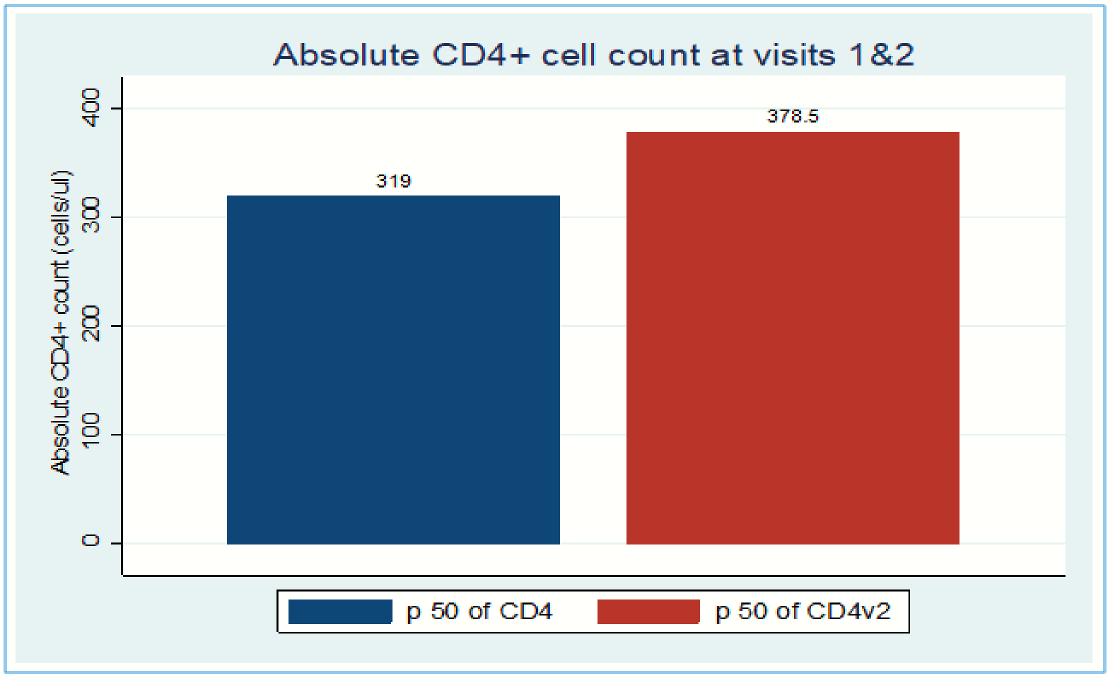
Values are median (interquartile range) unless otherwise stated, BMI= Body Mass Index, CD4+=Cluster Differential, LDL= Low Density Lipoprotein-cholesterol, HDL= High Density Lipoprotein-cholesterol, TC= Total cholesterol.

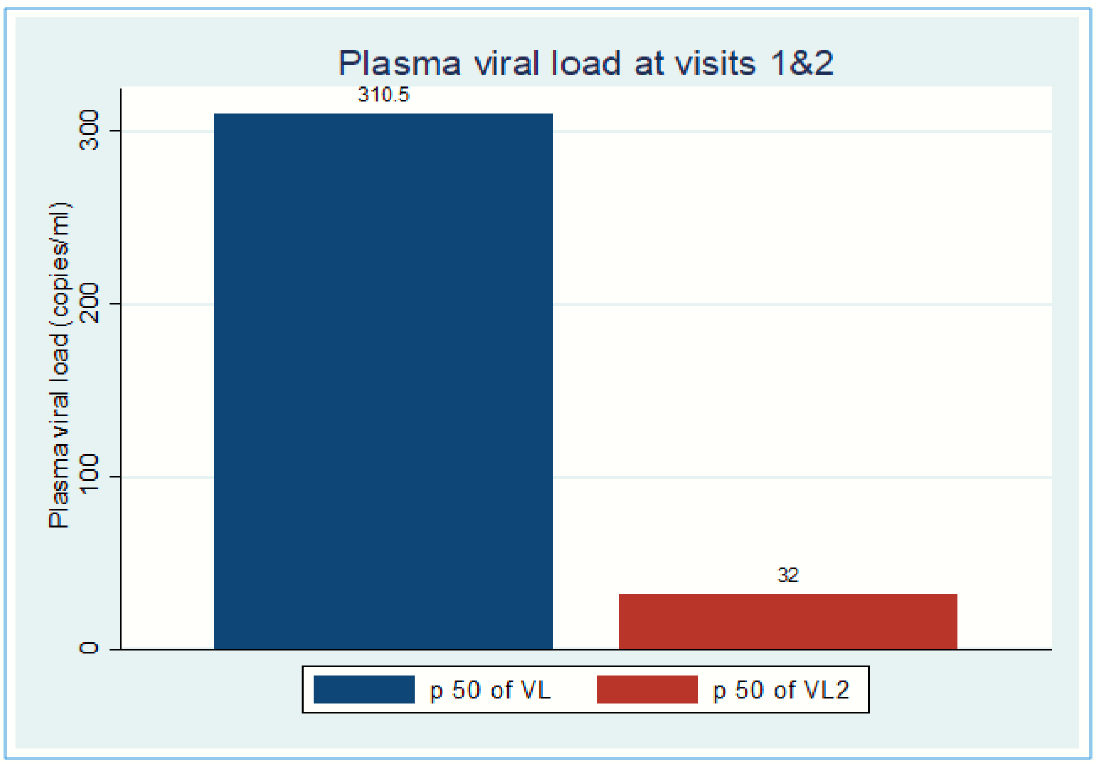
3.1 Primary results

3.2 Plasma fat, CD4 and viral load profiles by visit

Figure 2 is a bar graph depicting the plasma fat proportions at visit 1 and visit 2. The result suggests an incremental trend in the plasma fat proportions from visit 1 to visit 2 for all the plasma fat types except for the triglycerides. Similarly, an upward trend is suggested for the median CD4+ cell count at visit 1 (319) compared with that for visit 2 (378.5) in figure 3, while figure 4 depicts a decremental trend in the median viral load reported for visit 1 (310.5) compared with that at visit 2 (32).







4.0 Discussion

4.1 Plasma fat profiles

The trend suggesting generally improved plasma fat profiles from visit 1 to visit 2 is in keeping with findings from prior studies suggesting increased nutrient uptake (including fats) associated with enhanced appetite and resolving HIV enteropathy following the initiation of antiretroviral therapy.[11,12] The tight epithelial junctions, as well as the local immune system of the GI tract, protect against pathogenic organisms. However, in the face of HIV infection, normal defenses are disrupted leading to a wide range of clinical and pathogenic consequences.[13] The administration of HAART not only improves the systemic immune system but also the local cellular immunity of the GI tract and therefore being the cornerstone for both the prevention and treatment of opportunistic GI infections and HIV enteropathy.[14] Nutrient loses which may occur due to malabsorption, diarrhea, and vomiting are therefore expected to reduce through the suggested mechanisms and hence the upward trend in the plasma fat profile from the initial to the follow-up visit. It is also argued that while cART in HIV-1 infected subjects generally allows for immune reconstitution in peripheral blood, reconstitution of the GI tract occurs at a much slower pace and both immunological and structural abnormalities persist in the GI tract.[15] Further, because chronic gut inflammation is also characteristic of HIV-1 and SIV infection, the question of whether significant shifts in the gut microflora composition (dysbiosis) occurs in HIV-1 and SIV infection and how this can influence disease pathology has also been a subject under examination by researchers.[16,17]

4.2 CD4+ count and viral load profiles

The observed incremental trend for the CD4+ count which corresponded with the trend for plasma fat and a downward trend in the viral load may suggest a plausible positive and inverse interaction with plasma fat respectively. The trend may support prior study findings that cells of the immune system and in individuals with hypercholesterolaemia had greater phagocytic activity, more circulating lymphocytes, more total T cells, more CD8+ T cells, more immunoglobulin production, more proliferation and differentiation, and migration of lymphocytes than from individuals with lower cholesterol levels.[18-20] Consistent findings have also been reported in a study among ART-naïve HIV patients in Zambia where higher plasma arachidonic acid levels were found to be associated with better CD4+ cell counts and other markers of improved survival.[21]

5.0 Conclusion

The typical plasma fat profiles in the study cohort of adult HIV/AIDS patients presenting to ART clinics were generally within normal for the laboratory reference ranges. Further, the study has shown that there was a dynamically positive correlation between plasma fat types and absolute CD4+ count and an inverse correlation with plasma viral load, trends plausibly suggesting their potential role in immune augmentation and viral suppression respectively.

Acknowledgements

My sincere gratitude goes to my supervisors, Prof Grace Kahenya and Prof Elmi Muhamed for their guidance through the process of conducting research and its ultimate write-up. Special thanks to Dr. Ray Handema, Prof Douglas Heimburger, Prof Edmond Kabagambe, Prof Kasonde Bowa, Dr. Michael Nambozi, and Meridith Blevins for their inspiration and mentorship roles on my research career path. My co-investigators, Dr. Justin Chileshe, Dr. Kennedy Gondwe, Dr. Sandra Terry, Mr. Victor M Daka, Mr. Sydney Mwanza, Mr. Mubunu Lumamba, and Mr. Allen Chipipa for their moral and technical support. Appreciation further goes to all the participants and support staff on the study and at the Ndola Teaching Hospital HIV clinic. I would like to thank the faculty of the University of Lusaka and the University of Zambia for their critique and guidance on the Ph.D. program. Finally, I wish to thank the Copper belt University- School of Medicine, Ndola Teaching Hospital, and the TDRC managements for the funding and logistical support towards the research project.

7.0 Author contributions

The concept and design of the study were devised by Christopher Nyirenda. All authors contributed towards the content, review, and ultimate write-up of the manuscript.

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How to cite this Article: Christopher Nyirenda, Gamal Maksoud, Kennedy Gondwe, Samuel Phiri, Elmi Mohamed, Grace Kahenya, Kasonde Bowa; The Typical Plasma Fat Profile and its Dynamics with CD4+ count and Viral load in Zambian Adults with HIV/AIDS; Int. Res. Med. Health Sci., 2022; (5-1): 32-39; doi: https://doi.org/10.36437/irmhs.2022.5.1.D

Source of Support: Nil, **Conflict of Interest:** None declared.

Received: 7-1-2022; **Revision:** 21-2-2022; **Accepted:** 25-2-2022