



Serum Concentration of Fasting Blood Sugar, Total Cholesterol, Low-Density Lipoprotein, High-Density Lipoprotein and Triglyceride in Patients on Highly Active Antiretroviral Therapy Attending Embu Prison Dispensary

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Summary

BACKGROUND

Metabolic syndrome (MS) is a combination of interrelated risk factors of metabolic origin. The components include increased insulin resistance, obesity, dyslipidemia and hypertension. The prevalence of MS among HIV –infected patients globally ranges from 17.0% to 45.4%, with most reports produced in developed nations. The diagnosis of MS using the International Diabetes Federation shows a rise in triglycerides greater than 1.7m Mol/l, elevated fasting blood sugar greater than 5.6mMol/l and reduced HDL cholesterol less than 1.03mMol/l. The objective of the study was to determine the serum concentration of fasting blood sugar, TC, LDL-C, HDL-C and triglyceride, among inmates on Highly Active Antiretroviral Therapy (HAART) in a Kenyan prison.

MATERIALS AND METHODS

The study design was a hospital-based cross-sectional study of patients on HAART for at least six months. It was conducted in Embu G.K. Prison CCC clinic and Biochemistry Laboratory of Embu Teaching and Referral Hospital. A sample of 217 inmates attending Embu GK Prison Dispensary CCC clinic and on HAART for at least six months, participated in the study. Before the Laboratory analysis, the recruitment of the patients was done and they were required to fast overnight. A fasting sample was collected for the estimation of blood glucose and lipid profile.

RESULTS

Among the sampled, 13.4% ($n=29$) showed hypertension, 10.6% ($n=23$) had low HDL, 17.1% ($n=37$) had hypertriglyceridemia, 22.1% ($n=48$) showed high fasting blood sugar, and 25.4% ($n=55$) indicated central obesity. The most frequent component observed was central obesity (25.4%) and the lowest was hypertension (10.6%). Regarding the distribution of the risk factors against gender; of those indicated with low HDL 15 (65.2%) were female and 8 (34.8%) were male. Of those who showed hypertriglyceridemia 17 (45.9%) were female and 20 (54.1%) were male. Those who showed high fasting blood sugar were female 19 (39.6%) while 29 (60.4%) were male. Of those who showed hypertension 7 (24.1%) were female while 22 (75.9%) were male, and of those indicated central obesity 33 (60.0%) were female while 22 (40.0%) were male.



CONCLUSION

The prevalence of metabolic syndrome among inmates on HAART was 14.3%.

RECOMMENDATIONS

These findings prompt further studies to be conducted to evaluate the prevalence of MS among inmates in other prison facilities in the country.

Keywords: *Fasting Blood Sugar, Total Cholesterol, Low-Density Lipoprotein, High-Density Lipoprotein, Triglyceride*

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Introduction

Metabolic syndrome (MS) is an accumulation of metabolic abnormalities and central obesity that present an increased risk of cardiovascular disease and type 2 diabetes mellitus, (Jericó *et al.*, 2005). It consists of a cluster of metabolic risk factors which include but are not limited to dyslipidemia, impaired carbohydrate metabolism, obesity and high blood pressure [1]. HIV infected patients are put on antiretroviral therapy (ART)/highly active antiretroviral therapy (HAART) to live longer and also reduce the viral load thereby increasing their health status. There are increased reports of high levels of lipodystrophy, obesity and hypercholesterolemia among patients on ART [2].

Despite the success of HAART, the prevalence of diabetes mellitus (DM), fat redistribution, blood pressure and mainly dyslipidemia have considerably increased after its global scaling up [3]. The inclusion of protease inhibitors (PIs) and nucleoside reverse transcriptase inhibitors (NRTIs) has been linked to the development of lipodystrophy and metabolic abnormalities. The increased rate of MS in the HIV infected population has placed it in a high-risk cardiovascular disease (CVD) category turning MS into an important public health concern [4]. HIV patients who have MS are more likely to develop subclinical carotid artery atherosclerosis, a surrogate marker of cardiovascular disease than those without MS [5]. Nucleoside reverse transcriptase inhibitors

(NRTIs) are the most cited antiretroviral drugs associated with MS and HIV related fat accumulation [6]. There is also a link between patients infected with HIV and elevated lipid levels even in those who have not yet been put in ART [7]. In patients with AIDS, very low-density lipoprotein cholesterol (VLDL-C) and triglycerides (TGs) increase [8]. Cardiovascular [8] diseases (CVD) may become an important clinical problem for HIV infected patients mainly because the cluster of risk factors defining the metabolic syndrome increases cardiovascular risk more than every single component [9]. The prevalence of MS among HIV –infected patients globally ranges from 17.0% to 45.4%, with most reports produced in developed nations [10]. A recent study by (Kiama *et al.*, 2018) showed a prevalence of 19.2%, higher in females at 20.7% than in males at 16.0% in an urban population of adults living with HIV in Kenya.

There is evidence that protease inhibitor (PI) directly inhibit the uptake of glucose in insulin-sensitive tissues such as skeletal muscle and fat tissue by inhibiting glucose transporter Glut [12]. The relationship between levels of insulin resistance and soluble type 2 tumour necrosis factor α receptors indicate an inflammatory stimulus that contributes to the development of HIV associated lipodystrophy [13]. Multiple antiretroviral drugs, stavudine, lamivudine, efavirenz, zidovudine and most of the PIs have been found to influence glucose metabolism through different mechanisms with some not yet fully understood. There is



documented evidence that endothelial dysfunction has been recently described in PIs recipients, supporting the increased risk of cardiovascular diseases [14].

Metabolic syndrome is associated with an increased risk of both diabetes and cardiovascular disease. It is a manageable condition when detected early but if not, it may lead to the development of Diabetes and CVD. Metabolic syndrome is a major global healthcare challenge affecting 7% - 47% of the global population, among the patients on HAART it affects 17.0% to 45.4%, with most reports produced in developed nations. Kenya has a prevalence of 19.2%, higher in women at 20.7% while men at 16% but no data on the prevalence of inmates on HAART. The health of inmates' is important because when they are released, they are integrated into the general population.

Metabolic syndrome is associated with increased fasting blood sugar, increased triglycerides, reduced HDL and increased blood pressure. In 2005, the major chronic, non-communicable diseases accounted for 60% of all deaths and 47% of the global burden of disease. 80% of chronic disease deaths are already occurring in low and middle-income countries, (WHO 2005). The prevalence of MS among HIV –infected patients globally ranges from 17.0% to 45.4%, with most reports produced in developed nations. A study by Madison *et al* on the impact of incarceration on obesity, found that due to the sedentary lifestyle of inmates they were at a higher risk of developing obesity, these individuals may develop hypertension and type 2 DM. The fact that they are incarcerated and in HAART necessitated the need to establish the prevalence of MS among the prison population in Kenya. The health of inmates has an impact on public health when they are integrated into the general population; they ultimately affect public health resources and communities they return to. The objective of the

study was to determine the serum concentration of fasting blood sugar, TC, LDL-C, HDL-C and triglyceride.

Materials and Methods

This was a hospital-based descriptive cross-sectional study aimed at establishing the prevalence of metabolic syndrome among patients on HAART for at least six months and attending Embu prison Dispensary. The study employed the consecutive sampling method on the inmates attending the CCC clinic until the sample size was reached. Blood samples were collected and analyzed at the Embu teaching and referral hospital laboratory, biochemistry department. Research results were disseminated to the department of human pathology UoN, KNH to be published in a reputable peer-reviewed journal.

On Inclusion criteria all inmates on HAART for at least six months, Only those inmates who give informed consent will be included in the study and all inmates incarcerated for 6 months or more and on HAART while exclusion criteria involved all inmates on HAART for less than 6 months, Inmates in remand but on HAART, Those that do not give consent and Inmates on HAART but jailed for less than 6 months. The Cochran equation (1977) below will be used to estimate the sample size:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where n_0 is the sample size, Z^2 is the abscissa of the normal curve that cuts off an area α at the tails; $(1 - \alpha)$ equals the desired confidence level, e.g., 95%; e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p. The value for Z is found in statistical tables which contain the area under the normal curve. E.g. $Z = 1.96$ for 95 % level of confidence



Therefore:

$n=1.96^2*0.17*0.83/0.05^2$, $n=216.819$,
 $n= 217$

the p-value was obtained from a study done by Worm *et al.*, 2010, where p is the prevalence of Ms in the study.

The blood samples were left to clot then centrifuged at 2000rpm for 3 minutes. The serum was then be aspirated and transferred to serum vials, labelled appropriately and stored at 4°C, in a fridge, awaiting transportation. Samples were transported to Embu Teaching and Referral Hospital in a cool box for analysis.

Specimen Collection for laboratory analysis: Blood samples

The clinical officer obtained signed consent from the patient then explained the procedure, assured and placed the patient in a comfortable position for sample collection. 4 ml of venous blood was collected using an aseptic technique and transferred into a plain tube and labelled appropriately. A questionnaire was filled with the help of the clinical officer.

A 12-14 hours fasting blood sample was obtained through a needle prick in the morning and the levels of Fasting Blood Sugar were estimated. This was done by the research assistant, nurse. The fasting blood sample was collected just before they had their breakfast.

The blood samples were left to clot for 30 minutes then centrifuged at 2000rpm for 3 minutes. The serum was then be aspirated and transferred to serum vials, labelled appropriately and stored at 4°C awaiting transportation.

Data management

Data were collected and stored in file maker software. Quantitative data was summarized as a mean standard deviation. Chi-square was used to test for statistical significance

The following criteria were used for identifying MS using NCEP/APT III,

1. Raised triglycerides >1.69 mMol/l
2. Reduced HDL <1.03mmol/l (males), <1.29 mMol/l (female)
3. Raised blood pressure: systolic >130 mm Hg or diastolic >85 mm Hg
4. Raised fasting blood glucose >5.6 mMol/l
5. Body mass index > 30 kg/m²

Ethical consideration

Ethical clearance was sought from UoN/KNH ethical review committee. Research results were disseminated to the department of human pathology UoN, to be published in a reputable peer-reviewed journal.

Data analysis

Data were collected and stored in file maker software and later analyzed using statistical tools which include SPSS version 20.

Results

Response rate

This cross-sectional study evaluated the prevalence of metabolic syndrome in a cohort comprising of two hundred and seventeen HIV-infected patients at the Embu GK prison. The research comprised data from Jan 2020 to Jun 2020. Of the 217 samples, 64.5% ($n=140$) were male and 35.5% ($n=77$) were female. The age ranged from 23 to 83 years with a mean age of 39.8, the weight ranged from 40-105 kg with the mean of 61.9 Kg and height ranged from 1.4 – 1.9 m with a mean of 1.7 m. Out of the total study subjects, 28.1% ($n=61$) were under AF2B regimens with 71.9% ($n=156$) under AF2E regimens.

Among the sampled study, 13.4% ($n=29$) showed hypertension, 10.6% ($n=23$) had low HDL, 17.1% ($n=37$) had hypertriglyceridemia, 22.1% ($n=48$) showed high fasting blood sugar, and 25.4% ($n=55$) indicated central obesity. The most frequent component observed was central obesity



(25.4%) and the lowest was hypertension (10.6%). The study went further to investigate the distribution of the risk factors against gender. It was established that of those indicated with low HDL 15 (65.2%) were female and 8 (34.8%) were male. Of those who showed hypertriglyceridemia 17 (45.9%) were female

and 20 (54.1%) were male. Those who showed high fasting blood sugar were female 19 (39.6%) while 29 (60.4%) were male. Of those who showed hypertension 7 (24.1%) were female while 22 (75.9%) were male, and of those indicated central obesity 33 (60.0%) were female while 22 (40.0%) were male.

Table 1: Fasting blood sugar (FBS) levels

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Normal	169	77.9	77.9	77.9
	Raised	48	22.1	22.1	100.0
	Total	217	100.0	100.0	

Table 2: Distribution of FBS levels against Age

	Age	FBS		Total
		Normal	Raised	
	20-29	22	10	32
	30-39	72	16	88
	40-49	53	8	61
	50-59	18	8	26
	60 and above	4	6	10
Total		169	48	217

Table 3 Distribution of HDL levels

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Normal	193	88.9	89.4	89.4
	Reduced	23	10.6	10.6	100.0
	Total	216	99.5	100.0	
Missing	System	1	.5		
Total		217	100.0		

Table 4 Distribution of TG levels

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Normal	180	82.9	82.9	82.9
	Raised	37	17.1	17.1	100.0
Total		217	100.0	100.0	

Table 5 Distribution of TG levels against Age

	Age	TG		Total
		Normal	Raised	
	20-29	24	8	32
	30-39	80	8	88
	40-49	53	8	61
	50-59	17	9	26
	60 and above	6	4	10
Total		180	37	217



Discussion

The study had a sample size of 217 participants of whom 64.5% were males while 35.5% were females. From this population, it was estimated that the prevalence of metabolic syndrome was 14.3% which compares to the global prevalence that ranges from 17.0% to 45.4% with most reported cases in developing nations [15]. The prevalence of MS was higher in females at 54.8% while that of males was 45.2% which is in line with a study done in Kenya by Kiama [16,17] that showed females had a higher prevalence than males. It also corresponds to a study done by [16] that MS was more common in females than males in Africa. From the study, ANOVA was used and it estimated that there was a significant difference between sexes on the prevalence of metabolic syndrome in patients on HAART.

It was established that the distribution of MS by age among participants who were aged 20-29, 30 – 39, 40 – 49 had a prevalence of 21.6%. Of the cases, ages 50 – 59 had the highest prevalence at 24.3% which suggests an increase in the prevalence of MS with age. This is in line with studies conducted by [18,19,20]. Available data from the study shows that despite the increasing trend in the prevalence of MS with an increase in age, adults classified as middle-aged 40 – 59 years are predominantly affected. In the prison setup, this can be attributed to the sedentary lifestyle due to reduced activities and movement.

The study further investigated the correlation between the variables, TC, FBS, BMI, LDL-C and HDL-C, presence of metabolic syndrome and ART used, it was established that there was a weak positive correlation between the variables with $R= 0.073$ and $p= 0.649$.

The study established that among those with metabolic syndrome, females had the highest percentage of low HDL-C at 65.2% and central obesity a 60.0% which corresponds to

studies done recently [17,18]. Males had a higher prevalence of hypertriglyceridemia at 54.1%, elevated fasting blood sugar at 60.4% and hypertension at 75.9%. In terms of age, the middle-aged had a higher prevalence of hypertension that is 40-49 years 43.4% while those aged 50 – 59 at 27.6%. A study by Madison [20] on the impact of incarceration on obesity found that due to the sedentary life of inmates, they were at a higher risk of developing obesity, DM and hypertension. The elevated levels correspond to a study done on prisoners in India [20].

Conclusion

This study estimated the prevalence of metabolic syndrome among inmates on HAART was 14.3%.

Recommendations

Laboratory tests should be conducted on all patients in active antiretroviral therapy (HAART) to improve the quality of health and life.

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Authors' contribution to the study

Mutinda M.L. - Principal investigator

Maina F.M - supervisor and advisor.

Wandolo G. - supervisor and advisor.

Evah M. M. – Data collection and review of manuscript

Data availability

Data will be available upon request.

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