Austin Journal of HIV/AIDS Research

Open Access

Austin Publishing Group

Research Article

Influence of Antiretroviral Therapy in the Anthropometric and Biochemical Profile of Persons with HIV/AIDS

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Received: April 13, 2015; **Accepted:** September 10, 2015; **Published:** September 25, 2015

Abstract

Antiretroviral Therapy (ART) triggers biochemical changes and in body composition in individuals with HIV who use it. The aim of the present study was to assess the changes caused by the ART in the anthropometric and biochemical profile of persons with HIV/AIDS in the province of Pinar del Rio, Cuba, we conducted an observational, analytical and cross-sectional study on 217 adults with HIV/AIDS (men: 72.4 %; mean age of the studied population: 32.7 ± 8.4; antiretroviral therapy: 33.2 %). The nutritional evaluation was performed by using anthropometric measures and indicators (weight, height, arm circumference, triceps skin fold, body mass index, arm muscle circumference and arm fat area), and biochemical (albumin, total protein, transferrin; creatinine, triglycerides, total cholesterol and lipoproteins). The test to compare proportions for independent samples and the Mann-Whitney U-test were used. A greater affectation of the perimeter of the waist, waist/hip ratio and HDL-c in women was found, regardless of the therapy. ART caused a significant increase in the perimeter of the waist (Z= -2.317; p= 0.02) waist/hip ratio (Z= -2.266; p= 0.02), total cholesterol (Z= -2.984; p= 0.003), triglycerides (Z= -3.865; p<0.001) and VLDL-c (Z=-3.804; p <0,001); the other evaluated variables did not differ as treated and untreated groups were compared. Men with HIV and ART had a greater risk of morbidity from central adiposity and hyper triglyceridemia. To conclude, it is evident from our study that ART caused alterations in the anthropometric and biochemical profile, mainly in indicators of central adiposity and markers of lipid metabolism in men with HIV.

Keywords: HIV/AIDS; Antiretroviral therapy; Anthropometric profile; Biochemical profile; Lipid; Lipoprotein

Abbreviations

S: Standard Deviation; BMI: Body Mass Index; AC; Arm Circumference; TS: Triceps Skin fold; AMC: Arm Muscle Circumference; AFA: Arm Fat Area; WC: Waist Circumference; TC: Total Cholesterol; TG: Triglyceride; HDL-C: High Density Lipoprotein Cholesterol; LDL-C: Low Density Lipoprotein Cholesterol; VLDL-C: Very Low Density Lipoprotein Cholesterol

Introduction

At the end of 2011, 34 million people were living with HIV worldwide and 1.7 million had died of AIDS-related causes. After sub-saharan Africa, the Caribbean region is one of the most affected [1]. The accumulated data in Cuba until September 2013 reported one of the lowest prevalence rates estimated in the sexually active population of the world [2], and in the province of Pinar del Rio the number of cases equaled 3.0 % of the total of the country [3].

Despite the progress achieved in the last years in connection with the epidemiological trend of HIV infection, the number of people contracting the infection still continues to increase, and also those who progress from asymptomatic phase to clinical AIDS, so that, in the same way, the immune and nutritional deterioration that accompany the progression of HIV disease continues, now with new peculiarities from the introduction of the Antiretroviral Therapy (ART). The changes in the nutritional profile triggered by antiretroviral involve anthropometric alterations and changes in biochemical markers such as triglycerides, total cholesterol and serum lipoprotein fractions [4], so that the ART can endanger people's lives, not through the immunodeficiency caused by the virus and the concomitant opportunistic diseases but through their side effects, which put the individual at risk of cardiovascular disease [5,6]. It is easy to understand then, that the elaboration of a systematic anthropometric and biochemical profile in people with HIV/AIDS can be useful not only for the alertness of the progression of the disease, but also in the monitoring of the response to anti-retrovirals. Precisely the current research aims to assess the changes caused by the ART in the nutritional profile of persons with HIV/AIDS of Pinar del Rio province, Cuba.

Material and Method

An observational, analytical and cross-sectional study was conducted on 217 PVIH/aids domiciled in the province of Pinar del Rio (Cuba), between November 2006 and May 2010.

The series of study included adults of both sexes with a confirmed

Citation: Guerra EML, Porbén SS, Fornés OC, Núñez NA, Cruz AP, et al. Influence of Antiretroviral Therapy in the Anthropometric and Biochemical Profile of Persons with HIV/AIDS. Austin J HIV/AIDS Res. 2015; 2(1): 1012.

diagnosis of HIV, outpatients who attended at least once during the viewing of the study window the appointments made by the Department of Attention to STI/HIV/AIDS in the province, for the count of lymphocytes T CD4, and who agreed to participate voluntarily in the study.

Children under 19 years of age, pregnant women, and adults with concurrent metabolic disease, or subject to anabolic steroids, were excluded. As data in the present series of study were: gender (masculine/feminine), age at the time of diagnosis, time of evolution with the infection, and state of the Antiretroviral Therapy (ART): No Treaty/Treaty. Patients treated with antiretroviral used drugs of first generation of national production [7]. Second or third-generation drugs were used only in selected cases.

Nutritional evaluation

Anthropometric measurements: The general requirements and recommendations of the anthropometric technique described by Diaz Sanchez [8] were met for measurements of weight, height; Arm Circumference (AC) and Triceps Skin fold (TS).

The Body Mass Index (BMI) was calculated from the actual weight in kg and height in meters, through the formula [9]:

$BMI, kg.m^{-2} = weight, kg / (height, m)^2$

The Arm Muscle Circumference (AMC) and Arm Fat Area (AFA) were calculated from the current values of the Triceps Skin fold (TS) and Arm Circumference (AC) by the formulas described below [9].

- $AMC, cm = AC - 0.314 * TS$
- $AFA, cm^2 = [(TS^*AC)/2]-[(\pi^*TS^2)/4]$

The waist/hip ratio was calculated from the values for waist circumference (cm) and hip (cm) using the formula [9]:

- waist/hip = circumference of the waist / hip circumference

Biochemical evaluation: The following serum determinations were made: albumin (g.L-1); total protein (g.L-1); triglycerides (mmol.L-1); total cholesterol (mmol.L-1); transferrin (g.L-1); and creatinine (µmol.L-1), using the computerized chemical analyzer, model HITACHI 902, located in the clinical laboratory service of the General Hospital "Abel Santamaría Cuadrado" of Pinar del Rio province, and were carried out following the instructions supplied by the manufacturer on the instructions for use of reagent kits . For the determination of HDL-c (mmol.L-1) the previous precipitation of the rest of lipoproteins with phosphotungstic acid and chloride magnesium [10] was necessary, as well as the subsequent determination of cholesterol in the supernatant by the same enzymatic colorimetric test of determination of the total cholesterol.

LDL was determined according to the formula of Friedewald [11]:

LDLc (mmol.L-1)=TC - (HDLc+ TG/2.21) in mmol.L-1 where TG/2, 21 = VLDL-c.

Statistical Processing of the Results

Demographic and clinical data obtained from persons with HIV/AIDS, and results of anthropometric and biochemical determinations were stored in an automated base in Excel of OFFICE for WINDOWS (Microsoft, Redmond, Virginia, United States). The data were reduced by indicators of location (mean), dispersion (standard deviation) and aggregation (percentages), depending on the type of the variable in the study. The normality of variables was verified by the Kolmogorov-Smirnov test.

The population of the study was distributed according to the state of the ART. The existence of differences between subpopulations was explored through the tests of comparison of proportions for independent samples and the non-parametric Mann-Whitney U test. The statistical analysis of the results obtained was performed with the systems SPSS version 11.5 (SPSS Inc., New York, United States) and EPIDAT version 3.1 (CDC centers for Disease Control, Atlanta, United States), depending on the needs of calculation. For all statistical tests, 95% certainty was considered to denote the events of interest as significant [12].

Results and Discussion

Sociodemographic and clinical characteristics of people with HIV/AIDS who participated in the study

As shown in (Table 1), the study involved 217 people with HIV/AIDS of Pinar del Rio province, Cuba. Males predominated (men: 72.4 % vs women: 27.6 %; $p < 0.05$), which reflects the behavior of the Cuban epidemic [13]. On the other hand, the average age did not exceed 35 years of age in both sexes, which minimizes the natural effects of advanced age in relation to the metabolic alterations of

Table 1: Demographic and clinical characteristics of people with HIV/AIDS. Pinar del Río, Cuba.

Characteristics	Number [%]
Sex	Male: 157 [72,4]
	Female: 60 [27,6]
Residence	Pinar del Río: 117 [53,9] ¶
	Others municipalities: 100 [46,1]
Age at the confirmatory diagnosis of HIV (years)	< 30: 135 [62,2]
	≥ 30: 82 [37,8]
Years since the confirmation of the diagnosis of HIV	≤ 5: 136 [62,7]
	> 5: 81 [37,3]
With ART	Yes: 72 [33,2]
	Men:48[30,6]
	Women:24[40,0]
	No: 145 [66,8]
	Men:109[69,4]
	Women:36[60,0]
Years with ART	≤ 2 years: 23 [31,9]
	> 2 years: 49 [68,1]
Antiretroviral drugs used in the ART	Nucleoside Reverse Transcriptase
	Inhibitors: 72 [100,0]
	Non-nucleoside Reverse Transcriptase
	Inhibitors: 25 [34,7]
	Protease inhibitors: 46 [63,9]

¶ Includes the provincial capital city.
Size of the series: 217.
Source: Records of the study.

Table 2: Anthropometric profile of persons with HIV/AIDS. Pinar del Río, Cuba.

Anthropometric variables		Results
Height, cm	(mean ± s) ¶	167,5 ± 8,5
		men: 170 ± 0,06
		women: 157±0,06
Weight, kg	(mean ± s) ¶	66,1 ± 11,5
		men: 68,0 ±11,1
		women:63,1±12,9
BMI,kg.m^{-2}	(mean ± s) ¶	23,6 ± 3,7
		men: 23,2±3,2
		women: 25,3±4,9
< 18,5	A F [%]	8 [3,7]
Arm circumference, cm	mean ± s	28,3 ± 3,3
Men: ≤ 25, 1	A F [%]	men: 25[15,9]
Women: ≤ 22,4		women: 4 [6,8]
Triceps Skinfold, mm	(mean ± s) ¶	14,9 ± 9,2
		men: 11,4 ±12,4
		women: 24,1±9,1
Men: ≤ 4,9	A F [%]	men: 8 [5,1] women: 3 [5,1]
Women: ≤ 9,3		
Arm Fat Area, cm^2	(mean ± s) ¶	19,3: ±12,2
		men: 15,3±8,9
	A F [%]	women: 29,9±13,4
Men: ≤ 6,3		men: 5[3,2]
Women: ≤ 10		women: 3 [5,1]
Arm Muscle Circumference, cm	(mean ± s) ¶	23,6 ± 3,2
		men: 24,7±2,5
Men: < 23,6	A F [%]	women: 20,5±2,2
Women: < 19,5		men: 57 [36,3]
		women: 23 [38,3]
Waist Circumference (cm)	mean ± s	83,5±10,2
Men: ≥ 94	A F [%]¶	men: 26 [16,6]
Women: ≥80		women: 34 [57,6]
Waist/hip ratio	(mean ± s) ¶	0,89±0,06
		men: 0,90±0,06
	A F [%]¶	women: 0,85±0,06
Men: ≥ 0,95		men: 41 [26,1]
Women: ≥ 0,80		women: 49[83,1]

A F: Absolute Frequency
¶ Significance of observed differences: p < 0.05.
Size of the series: 217.
Source: Records of the study.

the individual in the population studied [14]. Neither sex nor the state of the antiretroviral therapy influenced the age of the people: men = 32.5 ± 8.4 years vs. women = 33.1 ± 8.2 years; with a Mann-Whitney U test = 4549.5; Z = -0,388; p = 0.69); ART installed: 33.6 ± 5.8 years vs. without ART: 32.2 ± 9.3 years (Mann-Whitney U = 4433.0; Z = -1,784; p = 0.07). 38 % of the evaluated were diagnosed in a time under a year with regard to the date of completion of the study.

Table 3: Biochemical profile of people with HIV/AIDS. Pinar del Río, Cuba.

Biochemical variables		Results
Transferrine, g.L^{-1}	mean±s	3,1±0,6
< 2,0	A F [%]	9 [4,2]
Serum Albumin, g.L^{-1}	mean±s	44,3±5,6
< 35	A F [%]	8 [3,7]
Total Protein, g.L^{-1}	mean±s	85,9±8,4
<60	A F [%]	3[1,4]
>80	A F [%]	77[35,6]
Creatinine, µmol/L	(mean±s) ¶	73,8 ±13,4
		men: 76,7±12,2
		women:66,3±13,6
<44	A F [%]	men: 15 [9,6]
		women: 1 [1,7]
Total Cholesterol, mmol. L^{-1}	(mean±s) ¶	4,17 ±1,08
		men: 4,03±1,07
		women:4,57±1,03
< 3,5	A F [%]¶	men: 46 [29,3]
		women: 7 [11,9]
> 6,5	A F [%]	men: 5[3,2]
		women: 2 [3,4]
Triglyceride, mmol. L^{-1}	mean±s	1,56: ±1,18
Men: < 0,68 and Women: < 0,46	A F [%]¶	men: 23 [14,6]
		women : 3 [5,1]
Men: > 1,88 and Women: > 1,6	A F [%]	men 45[28,7]:
		women: 14 [23,7
VLDL-c, mmol. L^{-1}	mean±s	0,71 ±1,08
> 0,8	A F [%]	63[29,0]
LDL-c, mmol. L^{-1}	mean±s	2,76 ±0,99
> 4,9	A F [%]	4[1,8]
HDL-c, mmol. L^{-1}	mean±s	0,71 ±0,28
		men: 0,69±0,28
		women:0,75±0,25
Men: < 1,16 and Women: < 0,9	A F [%]¶	men: 125 [79,6]
		women: 58 [96,7]

A F: Absolute Frequency
¶ Significance of observed differences: p < 0.05.
Size of the series: 217.
Source: Records of the study.

The average time of HIV diagnosis for all people regardless of sex and of using or not using antiretroviral drugs was 4.1 ± 4.4 years. Little more than a third of them had accumulated more than 5 years of evolution since the time of confirmation of the diagnosis.

With regard to antiretroviral therapy, 72 PVIH/aids (33.2 %) were receiving some kind of combination of antiretroviral drugs, and 68.1% had been exposed to the therapy. for more than 2 years.

Anthropometrical and biochemical profile of persons with HIV/AIDS who were part of the studied population

An anthropometric and biochemical profile of people with HIV who participated in this study is shown in (Tables 2 and 3) respectively. The values of mean and deviation standard of each nutritional variable are reported, both globally and by gender, when the comparison of the averages according to U of Mann-Whitney nonparametric test attributed statistical significance to the differences observed. Absolute frequencies and percentages of involvement by individual sexes are also reported.

In relation to anthropometric variables men were heavier and taller than women, while the latter showed a higher BMI, which could be consistent with a significantly lower size in the female sex. Almost a fifth of the HIV/AIDS persons reported a weight loss. The values of the arm circumference were independent of sex, while the arm muscle circumference was significantly higher in men, being the most affected anthropometric indicator in both sexes. On the other hand we found higher values of indicators of body fat in women (triceps skin fold and arm fat area) and muscle mass in men (arm muscle circumference), these differences in body composition between men and women correspond to the already known consequences of sexual dimorphism [15]. AIDS patients consume more quickly the muscle protein than its reserves of fat, altering their body composition [16], so the lean compartment is much more seriously affected. The results of the present study reflect the above, in conjunction with other nutritional evaluation studies performed in people with HIV/AIDS [17,18]. Protein catabolism in AIDS increases with the progress of the disease and can primarily reflect the increase of energy needs of people infected and the lower levels of testosterone in the circulation [19], which at least partially accounts for the loss of muscle protein suffered by men with HIV. However, no differences were found between the sexes with regard to the depletion of muscle mass according to the AMC. The reason may be the initiation of ART. Although no statistical significance was obtained for the observed differences in AC affectation percentages in both sexes, it was higher in men (15.9 % men vs 6.8 % women), which could explain the similar average values of such anthropometric measurement for both sexes.

The anthropometric indicators of central adiposity (waist circumference and the waist/hip ratio) showed a significantly higher involvement in women. It is known that the abdominal fat varies between the sexes, with a tendency in women to accumulate in the peripheral regions such as the hips, whereas in men there is an increased accumulation in the abdominal area [20]. In this study, the average values of the waist circumference showed no differences between the sexes, which could be the result of the higher proportion of women with a waist circumference above the value set as optimal in relation to men, which may be placing HIV/AIDS women participating in the study at a higher risk for cardiovascular disease [21], without overlooking the fact that the cutoff point used in this study for the waist circumference (80 cm) , which is also recommended by Berdasco for the Cuban population [22], is lower than the one used by other researchers [23], and the one used as a determinant of risk of metabolic syndrome (≥ 88 cm) as reported by Wijk and Castro, 2012 [24]. However, the average value of the waist/hip ratio was higher in men, therefore we can infer that in spite of the changes in the circumference of the waist experienced by women with HIV, the waist/hip ratio maintains the pattern of human sexual dimorphism for this body dimension [15] in the studied population.

In relation to the biochemical variables, the average total cholesterol values were higher in women, with a frequency of hypocholesterolemia significantly higher than in men. Although the hypercholesterolemia represents an important risk factor for cardiovascular disease, hypocholesterolemia represents an indicator of malnutrition and is associated with a high risk of mortality [25].

Hypertriglyceridemia prevailed in a little more than a fifth of the men and women, becoming independent of sex. The HDL-c were the most affected lipoprotein, 79.6 % of the men had values below 0.9 mmol.L-1 and 96.7 % of women below 1.16 mmol.L-1.The female sex was significantly more affected ($p<0.001$). Taking into account the association between low levels of High-Density Lipoprotein Cholesterol (HDL-C) and an increased risk for cardiovascular disease established through the various epidemiological and clinical studies [26], the high percentage of people in the present study with decreased HDL-c levels is worrying..

The serum creatinine values showed higher mean values for the men, with a higher frequency of involvement in this sex in relation to women. The rest of the variables were independent of sex ($p>0.05$). Observe a minimum involvement of transfer in, serum albumin and total protein. With the exception of total proteins, whose mean value, both general and by gender, was above the upper limit (reference range: 60-80 gr.L-1), the mean values obtained in a comprehensive manner and by individual gender from the rest of the biochemical variables, are in the range of reference established for seronegative and supposedly healthy individuals [27,28].

Influence of antiretroviral therapy in the anthropometric and biochemical profile of persons with HIV/AIDS that formed the studied population

(Tables 4 and 5) show the comparison of the core values of anthropometric and biochemical variables, obtained from members of the study series when they were segregated according to the state of ART.

A significant increase was shown in the WC, waist/hip ratio, TC, TG and VLDL-c in the group of people with HIV/AIDS who joined the study while using some kind of combination of antiretroviral drugs. On the other hand, the mean total protein and serum creatinine were higher in the group exposed to ART. The rest of the nutritional variables did not differ from each other on comparing the groups treated and not treated with antiretrovirals at the time of admission to the study.

The indicators of central adiposity such as the WC and the waist/hip ratio may be altered by effect of HIV, ART or both factors. ART especially causes subcutaneous loss and accumulation of central adipose tissue in those who receive it [29], which increases the risk of cardiovascular disease in this population [30,31]. In the present study, we found higher mean values for both indicators of central adiposity in the group exposed to antiretroviral; this is consistent with previous studies [32].

A comparison of the frequency of involvement within the same sex for those variables that showed significant differences when comparing the means of the groups with and without ART and that

Table 4: Influence of antiretroviral therapy on the anthropometric profile of persons with HIV/AIDS. Pinar del Río, Cuba.

Anthropometric profile	ART		Mann-Whitney Test		
	With Therapy	Without Therapy	U	Z	p
	mean±s	mean±s			
	median[minimum-maximum]	median[minimum-maximum]			
Weight (kg)	67,3±12,0	66,3±11,7	5018,5	-0,299	0,76
	65,5[48,0-112,0]	65,5[43,5-113,0]			
BMI (kg.m^{-2})	24,2±4,0	23,5±3,8	4497,5	-1,507	0,13
	23,9[16,0-36,6]	22,9[17,2-43,5]			
TS(mm)	15,6±9,8	14,5±8,6	4979,5	-0,389	0,70
	13,0[4,5-42,0]	11,6[4,1-40,0]			
AC (cm)	28,5±3,1	28,2±3,2	4927,5	-0,511	0,61
	28,0[22,0-37,5]	28,0[21,5-39,5]			
AMC(cm)	23,5±3,2	23,6±3,1	5101,5	-0,107	0,92
	23,6[17,9-30,9]	23,5[15,2-35,3]			
AFA (cm^2)	20,3±13,2	18,8±11,6	4927,5	-0,51	0,61
	16,2[5,0-64,9]	15,3[5,4-65,4]			
WC	85,4±9,9	82,6±10,3	4148,5	-2,317	0,02
	83,0[68,0-119,0]	80,0 [61,0-116,0]			
Waist/hip ratio	0,90±0,06	0,88±0,06	4171,0	-2,266	0,02
	0,91[0,75-1,04]	0,88[0,71-1,04]			

Size of the series: 217.
Source: Records of the study.

Table 5: Influence of antiretroviral therapy on the biochemical profile of persons with HIV/AIDS. Pinar del Río, Cuba.

Biochemical profile	ART		Mann-Whitney Test		
	With Therapy	Without Therapy	U	Z	p
	mean±s	mean±s			
	median[minimum-maximum]	median[minimum-maximum]			
Transferrine, g.L-1	3,1±0,6	3,1±0,7	4802,0	-0,564	0,57
	3,02[1,2-4,7]	3,06[1,1-5,5]			
Serum albumin,	44,3±4,5	44,3±6,1	5119,5	-0,231	0,82
g.L-1	44,8[29,7-65,6]	44,4[17,1-69,1]			
Total Protein, g.L-1	83,0±5,7	87,6±6,4	3810,5	-3,996	<0.001
	84,0[62,0-95,6]	87,0[63,1-106,9]			
Creatinine,	71,8±13,6	74,8±13,3	4199,5	-2,343	0,02
µmol.L^{-1}	70,2[36,0-108,0]	75,7[42,4-106,0]			
Total Cholesterol,	4,5±1,1	4,0±1,1	3921,5	-2,984	0,003
mmol. L^{-1}	4,3[2,4-7,4]	4,0[0,7-7,2]			
Triglyceride, mmol. L^{-1}	2,0±1,4	1,4±1,0	3537	-3,865	<0.001
	1,59[0,4-8,3]	1,04[0,1-5,9]			
VIDL-c	0,90±0,64	0,62±0,46	3428,0	-3,804	<0.001
mmol. L^{-1}	0,74[0,16-3,75]	0,47[0,05-2,67]			
LDL-c	2,84±1,03	2,71±0,97	4780,0	-0,616	0,53
mmol. L^{-1}	2,79[0,22-5,79]	2,65[0,12-5,90]			
HDL-c	0,76±0,37	0,68±0,21	4592,0	-1,059	0,29
mmol. L^{-1}	0,70[0,09-2,65]	0,67[0,13-1,34]			

Size of the series: 217.
Source: Records of the study.

Table 6: Frequency of involvement for the anthropometric and biochemical variables related to the risk of cardiovascular disease in persons with HIV/AIDS. Pinar del Río, Cuba.

Nutritional Variables	Absolute Frequency [%]
Waist Circumference (cm)	men with therapy: 11[22,9]
Men: ≥ 94	men without therapy: 15[13,8]
	women with therapy: 15 [65,2]
Women: ≥ 80	women without therapy:19[52,8]
Waist/hip ratio	men with therapy: 21[43,8]
Men¶: ≥ 0,95	men without therapy: 20[18,3]
Women: ≥ 0,80	women with therapy: 20[87]
	women without therapy: 29[80,6]
Total Cholesterol, mmol. L^{-1}	men with therapy: 2[4,2]
Men: > 6,5	men without therapy: 3[2,8]
Women: > 6,5	women with therapy: 1[4,3]
	women without therapy: 1[2,8]
Triglyceride, mmol. L^{-1}	men with therapy: 24[50]
Men¶: > 1,88	men without therapy: 21[19,3]
Women: > 1,6	women with therapy: 5[20,8]
	women without therapy: 9[25]
HDL-c < Punto de corte (Hombres)	men with therapy: 36[75]
	men without therapy: 89[81,6]
	women with therapy: 22[91,7]
HDL-c < Punto de corte¶ (Mujeres)	women without therapy: 36[100]

¶ Significance of observed differences: $p < 0.05$.
Size of the series: 217.
Source: Records of the study.

are also related to the risk of cardiovascular disease is presented in (Table 6). The comparison of proportions for independent samples showed an increased risk of morbidity values increased by the waist/hip ratio (Z=3.14 p=0.0017) and hyper triglyceridemia (Z=3.73 p=0.0002) in men with ART installed. On the other hand, the hypercholesterolemia was virtually undetectable in both genders, regardless of the art, while the measurement of the WC and the waist/hip ratio in women was not dependent on exposure to antiretroviral.

Although the present study does not assess the coexistence in men of a high waist/hip ratio and hypertriglyceridemia, it would be important to do so in future research work, taking into account that other studies have shown that VIH+ men with high triglycerides have a higher visceral adipose tissue, with a higher prevalence of metabolic syndrome, hypertension and type 2 diabetes [33]. Hypertriglyceridemia described in individuals with HIV/AIDS was due both to a direct effect of the virus as to the side effects of antiretroviral drugs, with a reported combination of a hepatic overproduction of VLDL and its reduced elimination [24]. Hypertriglyceridemia is also related to a bad virological control and increased levels of TNF-α [24].

The natural course of HIV infection is characterized by reductions in HDL and LDL cholesterol and an increase in TG [24]. After the introduction of antiretroviral therapy, greater changes have been observed in the atherogenic lipid profile, including increases in TG and LDL-c and a decrease in HDL-c [34]. It is interesting that the study population did not show any increase in LDL-c, as reported by other investigators [34] and despite the fact that low HDL-c levels were the most frequent alteration in the lipoprotein profile, it was independent of antiretroviral treatment. This result is consistent with a recent study by Kuti and collaborators on 1316 HIV-infected people without antiretroviral treatment, where decreased HDL-c was the most frequent alteration observed [35].

On the other hand, the mean value found for triglycerides in the group with ART represents a slight hypertriglyceridemia for both sexes, and the increase in the total cholesterol does not even allow it to be considered as hypercholesterolemia, since although its mean value was significantly higher in the group with ART when compared with those not treated, it is in the normal range established for HIV-negative, supposedly healthy individuals. The possible explanation for this might have been due to the fact that in the early stages of HIV -infection levels of cholesterol tend to be low as a result of a reduced catabolism of the TG as a response to an altered profile of cytokines [36], consequently the increase it shows, associated with the treatment, takes its values to the range of normality, However, the extension of the infection could lead to high blood cholesterol in those who use anti-retrovirals, therefore it would be advisable to monitor this biochemical marker in the PVIH/aids with ART, as the time of exposure to the drugs increases.

What has been described above allows us to infer that at the time the persons with HIV/AIDS are admitted into the study, the antiretroviral therapy is not associated with a high risk of cardiovascular disease at least in terms of the serum levels of lipids and lipoproteins. These findings are consistent with a previous report of our research team to study the changes caused by the ART on biochemical indicators of nutritional status in 142 HIV/AIDS individuals; 53 of them exposed to antiretroviral; [37] and with other studies that claim that the use of antiretroviral drugs is associated with an increase in the blood triglycerides and total cholesterol [38].

In addition to the lipid indicators, there are other biochemical tests that can be used to evaluate nutritional imbalances; such is the case of proteins that assess the degree of preservation of the visceral compartment, such as albumin and transferring. In the present study no variation was found with sex or with the exposure to antiretrovirals in none of these proteins. In addition, the mean values obtained are in the normal range in both the general population and the groups segregated according to gender and the state of ART. On the other hand both proteins showed a minimum impact, which allows us to infer the conservation of the visceral compartment in these individuals, possibly by the introduction of ART before they reached the most advanced stage of the disease, which is precisely where a significant decrease in both serum proteins has been observed [39].

In HIV-infection normal serum levels of total protein have been described, accompanied by a significant decrease in serum albumin and an increase of the globulins [36]. According to the results found in this research, a little more than a third of the participants in the study showed a high value of the total protein. If we take into account the low alteration in serum albumin, then we can infer that this increase may be due to an increase of the globulins and more specifically of the gamma globulin fraction due to the immune response of humoral type in the early stages of infection, where a polyclonal activation of B lymphocytes has been reported that brings about a

hypergammaglobulinemia, also of polyclonal type. These alterations that HIV causes in B cells appear to be related to the magnitude of the viral load or viral replication, so that the antiretroviral treatment, as it causes a decrease in viral load and an increase and reconstitution of the functions of CD4 T lymphocytes, brings down the markers of immune activation and induces a reduction of the polyclonal activation of B cells. The above explains why in the present study the persons with HIV/AIDS not exposed to antiretroviral had significantly higher mean values of total protein in relation to the group with installed ART.

Creatinine is the product of the catabolism of muscle phosphocreatine, the values being higher in men than in women. This variation according to sex became evident in the present study. The alteration of serum creatinine below the cut-off point, though it did not achieve statistical significance, turned out to be slightly higher in the men of the studied population (9.6 % in men vs 1.7 % in women). In a study where we compared the mean values of serum creatinine in different clinical stages of HIV disease, and in HIV-negative individuals, a decline was found with statistical significance in all the clinical groups of the infection in relation to the seronegative individuals. In it the comparison by gender specifically demonstrated a reduction in men [36], which is consistent with the present work. However, despite the fact that from the statistical point of view there were significant differences between the mean values of the groups treated and not treated with antiretrovirals, both values are in the range set as normal for the supposedly healthy subjects, so that neither the decrease of the serum creatinine by the action of the virus on the muscle mass or its elevation in response to the renal toxicity of antiretroviral drugs is apparent in the persons with HIV/AIDS included in the present investigation.

Conclusion

Women with HIV showed a greater risk of cardiovascular disease than infected men, regardless of the use of ART. The alterations brought about by ART in the anthropometric and biochemical profile of people with HIV/AIDS studied focused on indicators of central adiposity and markers of lipid metabolism, specifically in the male sex. The declining trend of the HDL-c and the increase of anthropometric and biochemical markers, associated with the metabolic syndrome and the atherosclerotic risk, suggests the need for a systematic monitoring of such markers and the importance of a healthy lifestyle in those persons with HIV and antiretroviral treatment.

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Austin J HIV/AIDS Res - Volume 2 Issue 1 - 2015
ISSN : 2380-0755 | www.austinpublishinggroup.com

Citation: Guerra EML, Porbén SS, Fornés OC, Núñez NA, Cruz AP, et al. Influence of Antiretroviral Therapy in the Anthropometric and Biochemical Profile of Persons with HIV/AIDS. Austin J HIV/AIDS Res. 2015; 2(1): 1012.