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# Progression to overweight, obesity and associated factors after antiretroviral therapy initiation among Brazilian persons with HIV/AIDS

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## Abstract

**Objectives:** To assess body weight changes, progression to overweight/obesity and investigate the associated factors among HIV/AIDS patients.

**Methods:** A retrospective study was conducted involving a sample group of 203 adults with HIV/AIDS. Medical records were used to gather demographic, clinical and anthropometric information. The variables were compared by Chi-square tests, Student's t tests and One-way analysis of variance.

**Results:** The majority of the individuals studied were men (72.4%) with an average age of  $34.68 \pm 8.3$  years, and time of HIV infection of  $4.12 \pm 1.8$  years. 63% of the patients gained weight. The greatest weight gain was observed among patients with lower CD4 cell count on admission ( $8.45 \pm 6.6$  vs.  $5.97 \pm 4.97$ )  $p = 0.019$ . 39/203 new cases of overweight/obesity were identified, with a progression rate of 19%. Men were more likely to progress to overweight ( $p < 0.001$ ) and women to obesity ( $p < 0.001$ ). A direct and significant relationship was observed between the BMI level on admission and being overweight/obese at the end of the study for individuals admitted with normal weight.

**Conclusions:** The results of the study show that in the course of HIV infection overweight/obesity affected men and women admitted with normal weight, although a greater proportion of women progressed to obesity. A higher weight gain contributed in a negative manner to the presence of dyslipidemias in these patients. These data show the importance of monitoring body weight in the course of HIV/AIDS treatment, even in those individuals who present normal body weight.

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Key words: *Overweight. Obesity. Body weight. HIV. AIDS.*

## PROGRESIÓN PARA EL SOBREPESO, OBESIDAD Y LOS FACTORES ASOCIADOS DESPUÉS DE LA INICIACIÓN DE LA TERAPIA CON ANTIRRETROVIRALES EN PERSONAS BRASILEÑAS CON VIH/SIDA

### Resumen

**Objetivos:** Evaluar los cambios del peso corporal, la progresión al sobrepeso/obesidad e investigar los factores asociados a ellas en pacientes con VIH/SIDA.

**Métodos:** Se realizó un estudio retrospectivo en una muestra de 203 adultos que viven con VIH/SIDA. Se utilizaron historias clínicas para recoger informaciones demográficas, clínicas y antropométricas. Se compararon las variables por medio de pruebas Qui cuadrado, pruebas t de Student y análisis de la varianza ANOVA one way.

**Resultados:** La mayoría de los individuos estudiados eran hombres (72,4%) con edad promedio de  $34,68 \pm 8,3$  años, y tiempo de infección por VIH de  $4,12 \pm 1,8$  años. El 63% de los pacientes ganaron peso. La mayor ganancia de peso se observó entre los pacientes con menor recuento de células CD4 a la admisión ( $8,45 \pm 6,6$  vs.  $5,97 \pm 4,97$ )  $p = 0,019$ . En los 203 adultos estudiados se identificaron 39 nuevos casos de sobrepeso/obesidad, con una tasa de progresión del 19%. Los hombres presentaron mayor tendencia al sobrepeso ( $p < 0,001$ ) y las mujeres a la obesidad ( $p < 0,001$ ). Se observó una relación directa y significativa en los individuos admitidos con peso normal entre el nivel del IMC al momento de admisión y el sobrepeso alcanzado/obesidad al fin del estudio.

**Conclusiones:** Los resultados del estudio muestran que durante la infección por VIH hombres y mujeres admitidos con peso normal alcanzaron sobrepeso o se convirtieron en obesos, aunque una proporción mayor de mujeres haya progresado a la obesidad. Una mayor ganancia de peso ha contribuido negativamente a la presencia de dislipidemias en estos pacientes. Estos datos muestran la importancia de controlar el peso corporal a lo largo del tratamiento contra el VIH/SIDA, incluso en los individuos con peso normal.

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Palabras clave: *Sobrepeso. Obesidad. Peso corporal. VIH. SIDA.*

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## Introduction

There is a complex interaction between nutritional status and Acquired Immunodeficiency Syndrome (AIDS). Although gaining weight benefits the immune system and extenuates the impact of opportunistic infections, excessive weight gain can also aggravate the metabolic abnormalities associated to antiretroviral therapy.<sup>1,2</sup> The current challenge has been to find a combination of good nutrition with the maintenance of a healthy weight throughout HIV infection.<sup>3</sup>

Recent research has shown that in the HAART (Highly active antiretroviral therapy) era there has been a growing overweight and obesity problem amongst the HIV-positive population, both in the developed world<sup>4,6</sup> and in developing countries like Brazil<sup>7</sup>. The nutritional profile of HIV-positive patients often includes dyslipidemia, insulin resistance, overweight and Metabolic Syndrome (MS), which results in a more atherogenic and high risk condition for the development of cardiovascular diseases and type 2 diabetes.<sup>8</sup>

The majority of studies available regarding the nutritional profile of the HIV/AIDS population have only measured the prevalence of overweight/obesity in those individuals, with very little information about the determining factors or factors associated to progression to overweight in the course of HIV infection.<sup>9</sup> Such information could help in identifying the risk groups and potential target groups for health education about healthy dietary habits and lifestyle changes.

Tracking body weight is one of the most important measures which can be easily adopted in clinical practice for the primary prevention of cardiovascular risk, recommended both for the general population and for HIV-positive patients.<sup>10,11</sup>

The objectives of this study were to assess the changes in body weight, progression to overweight/obesity and to investigate the associated factors after the initiation of antiretroviral treatment among HIV/AIDS patients.

## Methods

A retrospective study was conducted to assess body weight changes, progression to overweight/obesity and the associated factors in a sample group of 203 adults with HIV/AIDS, admitted to a university hospital in Rio de Janeiro, Brazil, between 2000 and 2007. Probability sampling was performed considering a population size of 800 registered individuals under regular observance, a expected frequency of overweight/obesity in the Brazilian population with HIV/AIDS of 30%, according to Jaime et al.<sup>7</sup> a 95% confidence level and a worst acceptable of 5%.

A random selection of 244 patients was made to form the sample group, excluding 41 individuals who did not meet the study inclusion criteria, in other words

children, pregnant women, over 65 years old and those who submitted incomplete details.

Medical records were used to gather the following information: Demographic data: age, gender; clinical data: length of time of HIV diagnosis (years), use of HAART, HIV viral load (copies/ml), T-CD4 lymphocyte count (cells/ml); Biochemical data: Fasting glucose (mg/dl), total cholesterol (mg/dl), triglycerides (mg/dl), High density lipoprotein (HDL-cholesterol) (mg/dl), Low density lipoprotein (LDL-cholesterol) (mg/dl), and anthropometric data: weight (kg), Body Mass Index (BMI) (kg/m<sup>2</sup>), weight gain (kg) and weight loss (kg). The anthropometric and biochemical information was gathered at two instants: upon hospital admission (T0) and at the end of the study (T2), between 1 and 7 years after admission.

Weight was categorized using the World Health Organization (WHO) definitions: BMI < 18.5 kg/m<sup>2</sup>: underweight; BMI 18.5-24.9 kg/m<sup>2</sup>: normal weight; BMI 25-29 kg/m<sup>2</sup>: overweight and BMI >30 kg/m<sup>2</sup>: obese. The prevalence of underweight, normal weight and overweight/obesity were calculated as percentages. Analyses of the men's and women's groups were carried out separately.

The outcome variable was new cases of overweight or obesity in the course of HIV infection. Overweight or obesity status (dichotomous) defined as BMI  $\geq$  25 kg/m<sup>2</sup> compared with BMI < 25 kg/m<sup>2</sup> based on measured height and weight. Body weight changes were defined in terms of weight gain in kg and BMI variations (kg/m<sup>2</sup>). Progression to overweight and obesity was defined as the percentage of the individuals who presented normal weight or overweight on admission and progressed to overweight/obesity during the course of HIV infection.

All the information was stored in a database and analyzed using SPSS 11.0 software (SPSS Inc., Chicago, IL, U.S.A.). Category variables were compared using the Chi-square test and continuous variables were compared using the Student's t test and One-way analysis of variance ANOVA. The binomial probability test was used to compare the weight of overweight/obesity by gender at the end of the study.

To evaluate the relation between overweight or obesity and different variables, weighted logistic regression models were used, with the prevalence of overweight or obesity as the outcome, and different factors as predictors including: age, sex, naïve status, HAART use, current PI use, HIV viral load, CD4 cell count and BMI on admission were included in this analysis. A p value < 0.05 was considered statistically significant.

The study was analyzed and approved by the committee of ethics of the Federal University of Rio de Janeiro, report number 082/2006.

## Results

The study involved 203 adult patients, predominantly male 147 (72.4%), with an average age of 34.68

**Table I**  
Demographic, clinical and anthropometric characteristics of HIV-positive patients admitted to a University Hospital in Rio de Janeiro, Brazil, between 2000 and 2007

Characteristics*	%
<i>Gender</i>	
Female	27.6
Male	72.4
<i>Age (years)</i>	
18-25	14.3
26-39	59.1
40-59	25.6
> 60	1.0
<i>HIV viral load (copies/ml)</i>	
< 400	23
<i>T-CD4 lymphocyte count (cells/mm<sup>3</sup>)</i>	
< 200	31
200-499	44
> 500	25
<i>mean ± standard deviation</i>	
Duration of HIV diagnosis (years)	4.12 ± 1.8
BMI (Kg/m <sup>2</sup> )	23.25 ± 3.81
Fasting glucose (mg/dl)	86.90 ± 10.7
Total Cholesterol (mg/dl)	163.3 ± 33.0
Triglycerides (mg/dl)	127.7 ± 79.0
HDL-cholesterol (mg/dl)	38.4 ± 11.9
LDL-cholesterol (mg/dl)	100.2 ± 29.9

\*Values relative to the admission period (T0); BMI: Body Mass Index.

± 8.3 years, an average length of time since HIV infection of 4.12 ± 1.8 years (1-11 years) and 80% were undergoing antiretroviral therapy. The demographic, clinical and anthropometric information upon admission is summarized in table I.

The prevalence of overweight/obesity on admission was 35.9%. Only 8.4% were underweight. A more significant quantity of women had overweight/obesity on admission compared to men (51.8% vs. 30.0%)  $p = 0.004$ . At the end of the study the prevalence of overweight/obesity among women and men was similar, with no significant difference (51.8% vs. 41.5%)  $p = 0.10$ , however a higher proportion of women progressed to obesity (table II).

Over the course of HIV infection (average of 4.12 ± 1.8 years), 127 (63%) of the individuals gained weight (average 6.95 ± 5.7 kg) and 59 (27%) lost weight (average 3.74 ± 3.1 kg).

We performed stratified analyses to determine factors associated with weight gain during HIV infection. In an univariate analysis, a tendency of a higher weight gain was observed among men than women, in the group with > 5 years of HIV diagnosis (7.23 ± 5.49 vs. 6.71 ± 6.32 kg)  $p = 0.63$ . There was no correlation between BMI and specific antiretroviral therapy regimens. On the other hand, the weight gain was significantly associated to the lowest CD4 nadir (< 200 cells count)  $p = 0.019$ .

In relation to nutritional evolution according to BMI ranges on admission, 64.7% of the individuals underweight reached normal BMI levels and none of those individuals progressed to overweight/obesity. Among those admitted with normal weight 113 (24.7%) progressed to BMI levels of overweight/obesity and 64 (17.2%) to overweight. A total of 39/203 new cases of overweight/obesity were observed. The progression rate to BMI > 25 kg/m<sup>2</sup> was 19% in an average of 4.12 ± 1.8 years. Binomial probability testing showed men were more likely to progress to overweight (69.0% vs. 31.0%)  $p < 0.001$  and women more likely to progress to obesity in the course of HIV infection (96.0% vs. 0.04%)  $p < 0.001$ .

We also evaluated the weight loss over the course of HIV infection. Among overweight patients 11 (17.2%) reached normal BMI and 3 (33.3%) into obese group lost weight but not meet the normal ranges of BMI.

Comparing the group of individuals who were admitted with normal weight, being overweight/obese at the end of the study were associated significantly higher levels of cholesterol ( $p = 0.02$ ) and of triglycerides ( $p = 0.002$ ) (table III).

The multivariate models for overweight/obesity included factors such as age, sex, naïve status, HAART use, current PI use, HIV viral load, CD4 cell count and BMI on admission. The results showed that being overweight/obese at the end time of the study was inversely associated with a younger age (< 40 years) ( $b = -0.057 ± 0.05$ ) ( $p = 0.04$ ) and positively associated with higher BMI on admission ( $b = 0.0589 ± 0.09$ ) ( $p < 0.001$ ).

## Discussion

The results of this study showed that a substantial proportion of HIV/AIDS patients presented some level of overweight after an average of 4.12 ± 1.8 years, and only a minority were underweight. These data are in agreement with previous studies which showed that in the HAART era, overweight/obesity is frequent among the HIV-positive population, both in the developed world<sup>4,9</sup> and in developing countries like Brazil.<sup>7,12</sup>

Among the patients that were already overweight at the time of admission, the prevalence of overweight/obesity was higher in women. Other studies conducted in HIV-positive populations also found a greater proportion of women in the obesity range compared to men.<sup>5,6,13</sup> This high proportion of overweight may be a reflection of the epidemic trend of overweight/obesity in the Brazilian population, currently standing at roughly 40.6% of the adult population.<sup>14</sup>

This study provides evidence regarding the factors associated to progression to overweight and obesity following the initiation of antiretroviral therapy in HIV-positive Brazilians.

The effects of body weight and the AIDS prognosis have been investigated over the years. Unintentional weight loss would seem to be an independent predictor of progression to more advanced states of AIDS, with a

**Table II**  
Changes in the Body Mass Index of HIV-AIDS patients monitored in the period from 2000 to 2007

BMI (kg/m <sup>2</sup> )	Nutritional outcomes over time (2000-2007)					
	General (n = 203)		Women <sup>t</sup> (n = 56)		Men <sup>t</sup> (n = 147)	
	T0	T2	T0	T2 N (%)	T0	T2
< 18.5	17 (8.4)	7 (3.4)	2 (3.6)	1 (1.8)	15 (10.2)	6 (4.1)
18.5-24.9	113 (55.7)	106 (52.2)	25 (44.6)	26 (46.4)	88 (59.9)	80 (54.4)
25-29	64 (31.5)	71 (35.0)	26 (46.4)	20 (35.7)	38 (25.9)	51 (34.7)
> 30	9 (4.4)	19 (9.4)	3 (5.4)	9 (16.1)	6 (4.1)	10 (6.8)
Σ overweight/obesity	73 (35.9)	90 (44.4)	29 (51.8)	29 (51.8)	44 (30.0)	61 (41.5)
BMI (kg/m <sup>2</sup> ) (mean ± SD)	23.25 ± 3.8	25.49 ± 15.7	24.18 ± 4.0 <sup>tt</sup>	25.45 ± 4.3	22.90 ± 3.6	25.51 ± 18.3

T0: Values relative to the admission period.

T2: Values relative to end time of the study (between 1 and 7 years after admission).

<sup>t</sup> The calculations for the men's and women's groups were made separately.

<sup>tt</sup> Student's *t* test. P < 0.05; BMI: Body Mass Index.

negative association to survival,<sup>15</sup> while individuals who present greater body weight, even in the overweight range would be less likely to develop opportunistic infections.<sup>16</sup>

During the period of the study, the majority of the patients gained weight. The greatest averages weight gain was observed among patients with lower CD4 nadir (< 200 cells count) on admission. These data suggests that the greatest weight gain occurred in groups that experienced the most severe states of AIDS.

Throughout the years, AIDS has been highly associated with states of severe malnutrition, with a public

perception that people infected with HIV are thin and therefore that gaining weight may hide the condition of being HIV-positive.<sup>15</sup>

The results found in this study show that despite individuals with low weight and lower CD4 rates upon admission having presented higher averages of weight gain, these were not the most likely candidates for progression to overweight and obesity. Similar data were described in the HIV-positive population of the USA by Crum-Cianflone et al.<sup>9</sup>

A total of 39/203 new cases of overweight/obesity were observed, of which the majority had been admit-

**Table III**  
Characteristics of HIV/AIDS patients admitted with normal body weight progressed to overweight/obesity in the period 2000-2007

Characteristics	< 25 (n = 85)	> 25 (n = 28)	P-value**
Age (years)	34.29 ± 9.84	32.86 ± 7.4	0.32
Duration HIV infection (years)	4.07 ± 1.76	4.23 ± 1.65	0.65
HAART exposure (years)	3.10 ± 2.12	3.29 ± 2.0	0.68
Body Weight (on admission) (kg)	62.23 ± 8.2	64.18 ± 9.5	0.30
Body Weight (T2) (kg)	64.19 ± 8.63	75.43 ± 8.7	< 0.001
BMI (on admission) (kg/m <sup>2</sup> )	21.51 ± 1.61	22.36 ± 1.59	0.017
Average weight gain (kg)	5.35 ± 4.35	10.96 ± 7.19	< 0.001
Fasting glucose (mg/dl)	88.82 ± 9.7	90.74 ± 14.52	0.51
Total Cholesterol (mg/dl)	171.53 ± 38.89	192.64 ± 45.32	0.02
Triglycerides (mg/dl)	134.88 ± 85.61	211.25 ± 165.04	0.002
HDL-cholesterol (mg/dl)	40.98 ± 10.98	41.32 ± 11.21	0.88
LDL-cholesterol (mg/dl)	110.0 ± 38.32	104.58 ± 41.41	0.54

\*T0: on admission; T2: End time of the study (between 1 and 7 years after admission).

HAART: Highly Active Antiretroviral Therapy.

BMI: Body Mass Index.

\*\*Student's *t* test.

ted with normal weight. The progression rate to overweight/obesity was 19.2% in an average of  $4.12 \pm 1.8$  years. The factors that influence overweight/obesity include a combination of behavioural factors (ingesting more calories and not practicing physical exercise); environmental elements (school, work, etc), genetic characteristics (hereditary features) and other cultural factors, ethnic differences and others.<sup>4</sup>

Previous studies conducted in different countries have shown that individuals with HIV/AIDS present inadequate dietary patterns, favouring diets rich in saturated fats and poor in fibres, associated to an unsatisfactory level of physical activity,<sup>17-20</sup> and this trend is repeated in Brazil.<sup>21,22</sup>

In this study, it was not assessed data regarding dietary consumption and lifestyle. We were unable to confirm any association between progression to overweight/obesity and changes in lifestyle during the course of HIV infection.

Interestingly, the research data show that men admitted with normal body weight were more likely to progress to overweight and women more likely to progress to obesity. Over the years the results of other studies have indicated that men and women with HIV/AIDS have a poor body image related to weight loss and the presence of lipodystrophy,<sup>23</sup> and the fear of losing weight is constantly present causing emotional problems.<sup>24</sup> Moreover, in general, women with HIV/AIDS show a preference for body images which represent greater body weight,<sup>25</sup> dissatisfaction with their body weight may have influenced the weight gain amongst individuals admitted with normal BMI.

No significant association was observed in this study between the use of specific antiretroviral therapy regimens and progression to overweight and obesity, although patients who used antiretroviral therapy presented with a tendency to higher average weight gain compared to naïve group.

Progression to overweight and obesity in the course of HIV infection contributed in a negative manner to the presence of dyslipidemias. Although no causality assessment has been performed, excessive weight at the end of the study correlated to significantly higher levels of cholesterol and triglycerides, which may result in a more atherogenic and high risk profile as regards cardiovascular disease.<sup>26-28</sup>

To our knowledge this is the first study which has assessed progression to overweight/obesity and associated factors among a Brazilian population with HIV/AIDS, with the aim of identifying high risk patients and potential targets for specific clinical and dietary advice.

This study has potential limitations and the findings must be interpreted with caution. The study population was male individuals in majority and risks factors for weight gain may be gender specific. Furthermore, the cross-sectional design and the use of data from medical records do not allow the assessment of risk associations, and the cause-effect association could not be established due to the retrospective design. The perfor-

mance of longitudinal research could help to clarify the association between overweight and other related factors, such as specific antiretroviral regimes and lifestyle changes during the course of HIV infection.

## Conclusions

This study provides evidences that overweight/obesity is highly prevalent among HIV-positive patients in the HAART era. The greatest weight gain occurred in the groups that experienced the most severe states of AIDS.

Overweight/obesity affected men and women admitted with normal weight, although a greater proportion of women progressed to obesity. A higher weight gain contributed in a negative manner to the presence of dyslipidemias in these patients. These data show the importance of monitoring body weight in the course of HIV/AIDS treatment, even in the individuals who presents normal body weight.

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