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Nutritional care, time period since diagnosis, demographics and body mass index in HIV/AIDS patients

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ABSTRACT

Background. Nutritional status and nutritional care have long been ignored among HIV/AIDS patients. Furthermore, in Mexico there is no information on potential factors favoring weight increase in such population. **Objective.** To assess the association between the time period since diagnosis, demographics and BMI in different categories of patients with HIV/AIDS in Monterrey, Mexico. In addition, to provide information on overweight/obesity prevalence and nutritional care referral. **Material and methods.** This was a cross-sectional study of HIV/AIDS positive patients receiving outpatient secondary care (n = 231). Nutritional care referral, time period since diagnosis and demographic data were obtained by interview. A standardized and registered dietitian collected anthropometrics measures. Binary multiple logistic regression was used to evaluate the association between increasing BMI categories and variables of interest. **Results.** Mean patient age was 40.6 ± 11.2 years, 87% were male, 79.2% were economically active, 65% were single and 60% had less than a college education. The average time since diagnosis was 6.5 ± 5.4 years. Overweight and obesity prevalence were 35.8% and 12.5%, respectively. Only 18% of patients had ever been referred for nutritional care. The time period since diagnosis, the sum of skinfold measurements and the waist-to-hip ratio, were significantly predictive of the BMI category (normal/underweight vs. overweight/obese), when controlling for nutritional care referral and daily carbohydrate intake; age and marital status were not associated with BMI category. **Conclusions.** Identification of predisposing factors to overweight/obesity among HIV/AIDS patients constitutes a significant step for providing nutritional care, of the same importance as the load or $CD4^+$ count, especially nowadays, with more common

Atención nutricional, tiempo desde el diagnóstico, características demográficas e índice de masa corporal en pacientes con VIH/SIDA

RESUMEN

Antecedentes. *Durante mucho tiempo se han ignorado el estado y la atención nutricional de los pacientes con VIH/SIDA. Además, en México no se cuenta con información sobre factores potenciales para incremento de peso en este tipo de población.* ***Objetivo.*** *Evaluar la asociación entre el diagnóstico, las características demográficas y el índice de masa corporal (IMC) en pacientes con VIH/SIDA en Monterrey, México. Así como proporcionar información sobre la prevalencia del sobrepeso/obesidad y la referencia del paciente al Servicio de Nutrición.* ***Material y métodos.*** *Es un estudio transversal de pacientes con VIH/SIDA tratados en la Consulta Externa de segundo nivel de atención (n = 241). Mediante entrevista se obtuvo información sobre su referencia para atención nutricional, el periodo desde el establecimiento del diagnóstico y datos demográficos. Una dietista capacitada obtuvo las medidas antropométricas. Por regresión logística binaria múltiple se evaluó la asociación entre el incremento en las categorías de IMC y las variables de interés.* ***Resultados.*** *La media de edad de los pacientes fue de 40.6 ± 11.2 años, 87% del sexo masculino, 79.2% económicamente activos, 65% solteros y 60% tenían una educación inferior a la universitaria. El tiempo promedio desde el establecimiento del diagnóstico fue de 6.5 ± 5.4 años. La prevalencia de sobrepeso y de obesidad fue de 35.8 y 12.5%, respectivamente. Solamente 18% de los pacientes fueron referidos al Departamento de Nutrición para su atención. El periodo desde el diagnóstico, la suma de las medidas de pliegues cutáneos y el índice cintura-cadera predijeron significativamente la categoría del IMC (normal/bajo peso vs. sobrepeso/obesidad),*

increased survival rates and consequently, longer lives with the disease.

al controlar por referencia a la atención nutricional e ingesta de carbohidratos; la edad y estado civil no se asociaron con las categorías del IMC. ***Conclusiones.*** *La identificación de factores predisponentes al sobrepeso/obesidad en pacientes con VIH/SIDA constituye un primer esfuerzo para cuidar la atención nutricional, tanto como la carga viral o la cuenta de células CD4+, particularmente ahora que la tasa de supervivencia es más alta y por consecuencia es mayor el tiempo de vida con la enfermedad.*

Key words. Nutritional care, body mass index, HIV/AIDS.

Palabras clave. *Atención nutricional, índice de masa corporal, VIH/SIDA.*

INTRODUCTION

In 2011, 34 million people were living with HIV around the world. On a daily basis, 7,000 individuals were newly infected and a total of 1.7 million died because of HIV/AIDS. Latin America registered 1.4 million cases and 54,000 deaths due to AIDS.[1] Certainly, antiretroviral therapy (ART) has become more readily available, but nutritional status and nutritional care have long been ignored among HIV/AIDS patients despite the fact that malnutrition is frequently associated with the disease. Furthermore, overweight or obesity may actually coexist with micronutrient deficiencies.

ART positively impacts nutritional status because it may increase appetite and strengthen the immune system, which in turn decreases opportunistic infections, especially those contributing to diarrhea and malabsorption; this prevents weight loss and in many cases, leads to weight gain.[2] Additionally, fat mass may increase more than fat-free mass in patients on ART, especially in non-wasted patients; consequently, care should be taken to avoid the development of obesity once a target weight has been reached. This is particularly important in the long term, because ART is a lifelong treatment.[3] Studies such as that of Amorosa, *et al.*,[4] have revealed that 45% of the HIV-infected population is overweight or obese, whereas Mulligan, *et al.,* reported a prevalence above 40%, regardless of the type of ART.[5] In fact, Crum, *et al.,*[6] observed that 62% of patients gained weight during HIV infection, an average of 1.71 Kg per year (mean follow-up 6.2 years) and Tate, *et al.,*[7] documented that 20% of patients progressed from normal to overweight/obese or from overweight to obese.

Both HIV infection and its therapies are known to contribute to metabolic and morphologic alterations that may increase the risk of cardiovascular disease.[4,8,9] A typical pattern includes hypertriglyceridemia, hypercholesterolemia, lipodystrophy and alterations of glucose metabolism as a result of adverse lipid changes and vascular damage caused by viral replication, ART and other traditional risk factors.[10,11] On the other hand, evidence from Kenya and Cambodia has shown that weight gain in adults after 3 months on ART was highly predictive of survival.[12] The World Health Organization recognized the role of nutritional abnormalities and the benefits of timely nutritional care in disease progression among patients with HIV/AIDS.[13] Researchers argue that nutrition should be given the same attention as viral load or $CD4^+$ count.[14,15] Crum-Cianflone, *et al.*,[6] reported that inflammatory biomarkers and abnormal cytokine production negatively affected $CD4^+$ T-lymphocyte recovery. The opposite was found by Palermo, *et al.*,[16] who observed that a high baseline body mass index (BMI) predicted greater increases in $CD4^+$ T-lymphocyte counts at weeks 96 and 144. In spite of such an impact, few studies have focused on overweight and obesity as predisposing factors among HIV patients. In the United States, it has been reported that older age, African-American race, early Walter Reed stage and a more recent diagnosis were associated with a higher BMI at HIV diagnosis.[6] In Brazil, an increased risk was documented with older age and a decreased risk with the lack of a steady partner. Three years after diagnosis, the possibilities of overweight/obesity increased 16% when compared to less than one month since the diagnosis was established.[17] Another Brazilian study showed a direct and significant relationship between the BMI on admission and being overweight/obese by the end of the study, in individuals admitted with normal weight.[18] In Mexico, there are no reports on potential factors favoring weight increase and obesity in HIV/AIDS patients.

This study provides information not only on the prevalence of overweight and obesity as well as nutritional care referral, but also evidence of the association between the time period since diagnosis, demographics (marital status and age), and BMI in

different categories of patients with HIV/AIDS in Monterrey, Mexico.

MATERIAL AND METHODS

This cross-sectional study took place from April 2011 to November 2011. Participants were HIV/AIDS positive patients receiving outpatient secondary care at the Instituto Mexicano del Seguro Social (IMSS) in Monterrey, México (n = 241). Only patients aged 18 years old or more were included. Approval was obtained from the IMSS Research Ethics Committee and informed consent was obtained from each individual.

A third year medical epidemiology resident invited study participants by consecutive sampling, after they had completed their periodic medical doctor consultation. She interviewed them on nutritional care referral (have you ever been referred to the nutrition department? If so, have you ever used these nutrition services?); time period since diagnosis (date of diagnosis); and demographic variables (age, gender, marital status, education level, employment). She also obtained clinical and biochemical markers from the medical chart:

- ART usage (yes/no).
- $CD4^+$ cell counts (cells/mm^3, value range 500 and 1,450; recommended value for initiating ART < 350 cell/mm^3).
- Viral load (copies/mL, undetectable value < 50).
- Fasting glucose (mg/dL, value range 60-100).
- Cholesterol (mg/dL, value range 130-200).
- Proteins (g/dL, value range 10-15).
- Albumin (g/dL, value range 3.0-5.2).
- Globulins (g/dL, value range 1.5-3.3).
- Triglycerides (mg/dL, recommended value < 150).
- Urea (mg/dL, value range 19-44).
- Creatinine (mg/dL, 0.4-1.25).
- Uric acid (mg/dL, value range 3.5-7.2).
- Hemoglobin (mg/dL, value range for men: 13.8-17.2 g/dL and for women 12-15.1 g/dL).

The resident then accompanied the patient to the nutrition department, where a specifically trained and registered dietitian collected data on weight (kg) with minimum clothing and always using the same digital Tanita scale with a precision of 100 mg (IRONMAN® 533), and calibrated periodically. Height (cm) was measured with the patient standing barefoot against a non-extending vertical shaft, with the neck, buttocks and heels touching the shaft. BMI was calculated (weight/height^2) and classified according to WHO criteria: underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9) and obese (≥ 30.0). The dietitian also measured waist and hip circumferences to the nearest 0.1 cm using a non-stretching tape (SELANUSA®); waist circumference was obtained by measuring the distance around the smallest area below the rib cage just above the umbilicus, and hip circumference was obtained at the point yielding the maximum circumference over the buttocks with the tape in a horizontal plane. The waist-to-hip ratio was estimated and defined as central obesity if the value was > 0.95 for men and > 0.85 for women. Peripheral and central subcutaneous fat were evaluated by biceps, triceps, subscapular and abdominal skinfold measurement using HARPENDEN® skinfold calipers, with a precision of 1.00 mm. Three assessments were measured at each skinfold site, averaged and added (mm, value range for men 15-25 and for women, 15-30). The obtained values were translated into percentage of fat according to sex and age (value range for men 12.2-15.6% and for women, 17-26.6%).[19] Finally, the participant was instructed on how to describe his diet within the previous 24-hour period, excluding weekends.

Once the data was collected, food registries were entered into the NUTRIS® software 20 program in order to quantify gr., mg or mcg obtained from each nutrient and the percentage of total energy in the case of macronutrients. Later, food intake was assessed in terms of its adequacy when compared with the recommended dietary allowances in the Mexican population and according to the following values: 21 carbohydrates 60%, proteins 15%, lipids 25%, fiber 25 g, folic acid 200 mcg, vitamin A 400 mcg, vitamin C 60 mg, iron 20 mg, potassium 2,000 mg, sodium 500 mg, calcium 1,200 mg, and cholesterol 300 mg.

Statistical analysis

Results were analyzed with descriptive statistic techniques, percentages or means and standard deviations, as appropriate. Malnutrition point prevalence was estimated, including 95% confidence intervals. Univariate associations between independent variables and BMI category were evaluated with Chi-square tests (or Fisher's exact test, if appropriate) for categorical variables, or ANOVA and Kruskal-Wallis tests for continuous variables. Binary multiple logistic regression evaluated the association between increasing BMI categories (the dependent variable) and the time period since

diagnosis, age, marital status and those variables that were significantly associated with increasing BMI by univariate analysis ($p < 0.05$): nutritional care referral, waist-to-hip ratio, percentage of fat and daily carbohydrate intake. The percentage of fat and the skinfold measurements were found to be co-linear, and only the latter were considered. The multivariate model was built by manual backward elimination techniques (using a p-value cutoff of 0.05). Due to the small sample size of underweight participants, underweight and normal patients were grouped for the purpose of analysis. Data analysis was conducted with SPSS, version 15.

RESULTS

Mean patient age was 40.6 ± 11.2 years, and 87% were male. Most participants were economically active (79.2%), single (65%), and had less than a college education (60%).

Clinical status

The average time since the confirmed HIV/AIDS diagnosis was 6.5 ± 5.4 years and 90% of patients were on ART. Their mean $CD4^+$ T cell count was 335 ± 299.6 cells/mm^3 (median = 255; 40.7% had < 350 cells/mm^3) and the mean viral load was 13,875 ± 80,699 (median = 40 copies/mL; 69.3% had > 1,000 copies/mL). The time period since diagnosis did not differ according to the $CD4^+$ T cell count (5.9 ± 5.2 years in patients with < 350 cells/mm^3 *vs.* 6.8 ± 5.2 years in patients with ≥ 350 cells/mm^3, $p = 0.20$) or viral load (6.9 ± 5.5 years in patients with < 1,000 copies/mL *vs.* 6.2 ± 5.2 years in patients with ≥ 1,000 copies/mL, $p = 0.40$).

Biochemical markers were as follows:

- Fasting glucose 99.9 ± 21.8 mg/dL.
- Cholesterol 178.7 ± 44.3 mg/dL.
- Total protein 7.9 ± 4.9 g/dL.
- Albumin 4.0 ± 0.45 g/dL.
- Globulins 1.2 ± 0.45 g/dL.
- Triglycerides 238.1 ± 160.9 mg/dL.
- Urea: 27.7 ± 17.9 mg/dL.
- Creatinine: 0.92 ± 0.39 mg/dL.
- Uric acid: 5.6 ± 1.4 mg/dL.
- Hemoglobin: 14.3 ± 1.6 mg/dL.

There was no significant correlation between the time period since diagnosis and any biochemical markers, including triglycerides.

Nutritional care and nutritional status

Only 18% of patients had ever been referred to the Department of Nutrition by their physician, and among those, only 29% received nutritional care after referral. Mean BMI was 25.1 ± 4.4 kg/m^2. BMI categories were as follows: underweight 1.3% (CI95% 0.4-3.6), normal 50.4% (CI95% 41.9-54.4), overweight 35.8% (CI95% 28.7-40.6) and obese 12.5% (CI95% 12.1-21.4). The mean waist-to-hip ratio was 0.92 ± 0.06 (41.7% central obesity prevalence), the mean skinfold measurements were 74.2 ± 24.1 mm and the mean percentage of fat was 53.4 ± 26.3%. On the other hand, average intake of

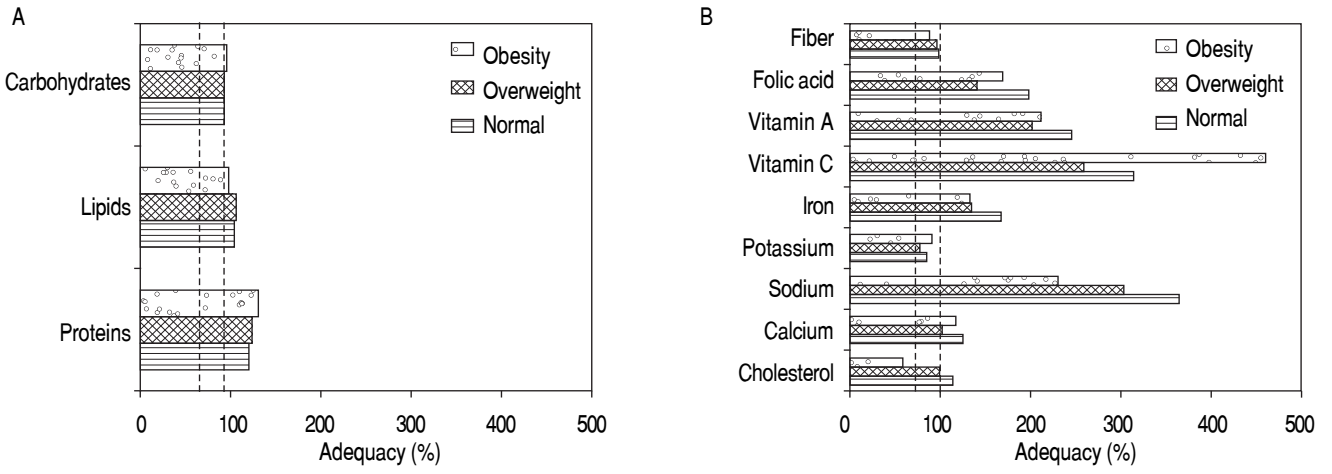

Figure 1. Macro- and micronutrients adequacy percentage of HIV/AIDS patients within the IMSS, Nuevo León, 2011. Ideal percentage of adequacy = 90 and 100%. A. Macronutrients B. Micronutrients.

carbohydrates was 384.2 ± 165.3 g, average protein intake was 110.9 ± 51.0 g and average lipid intake was 75.8 ± 60.2 g. Whereas, average fiber ingestion was 23.8 ± 16.8 g, folic acid was 348 ± 313.3 mg, vitamin A intake was 1,348.52 ± 3,568.4 mcg and vitamin C was 897.9 ± 5,959.3 mg. Additionally, average iron intake was 42.0 ± 97.0 mg, average potassium 1,519.6 ± 1,382.2 mg, average sodium 1,859.8 ± 1,712.6 mg and average cholesterol 438.0 ± 1,502.9 mg. Figure 1 shows the percentage of adequacy of macro and micronutrients, respectively.

Predisposing factors for overweight weight/obesity

Age, marital status and other patient demographic factors were not significantly different according to the BMI group. The average time since the HIV/AIDS diagnosis was significantly different according to the BMI group whereas those with a higher BMI had been diagnosed for a longer period of time: 6.2 ± 5.4 years in the normal/underweight group, 5.9 ± 5.3 years in the overweight group and 9.4 ± 5.0 years in the obese group ($p = 0.006$). Obese patients were most frequently referred for nutritional care ($p = 0.03$). There were no differences according to the type of ART, $CD4^+$ cell count or viral load across BMI categories (Table 1). Conversely, all anthropometric measures, carbohydrate and sodium intake were significantly different according to the BMI group (Table 2). The binary multivariate logistic regression model showed that the time period since diagnosis, the sum of skinfold measurements and the waist-to-hip ratio, were significantly predictive of the BMI category (normal/underweight *vs.* overweight/obesity), when controlling for nutritional care referral, age, marital status and daily carbohydrate intake (Table 3).

DISCUSSION

The study population consisted mainly of single male patients, typically young and with no more than a high school education. Their median viral load and $CD4^+$ T cell count were either undetectable or within lower limits, respectively; most were undergoing ART. We established the following facts regarding their nutritional status and nutrition care referral.

The prevalence of thin patients was minimal but that of overweight and obese patients was nearly 50%. Other studies have also found that wasting is less common than heaviness. In Latin America, Mariz, *et al.*,[17] reported these states in 8.8% and 32.1% of patients, respectively; Jaime, *et al.*,[22] reported a prevalence of 3.6 and 30.5%, respectively. Increasing rates of obesity among HIV/AIDS positive individuals have been also identified in the US.[4,6] Data

Table 1. Nutritional care, clinical status and body mass index category of HIV/AIDS patients within the IMSS, Nuevo León, 2011.

	Body mass index category			
	Normal/underweight (n = 119) n (%)	Overweight (n = 83) n (%)	Obese (n = 39) n (%)	p-value*
Ever been referred to nutritional service unit				
Yes	21 (17.6)	8 (9.6)	11 (28.2)	0.03
No	98 (82.4)	75 (90.4)	28 (71.8)	
Received nutritional care				
Yes	8 (6.7)	2 (2.4)	3 (7.7)	0.32
No	111 (93.3)	81 (97.6)	36 (92.3)	
Use of antiretroviral drugs				
Yes	107 (90.0)	74 (89.0)	37 (95.0)	0.58
No	12 (10.0)	9 (11.0)	2 (5.0)	
CD4 count (cells/mm^3)				
< 350	49 (40.3)	37 (44.6)	13 (33.3)	0.49
≥ 350	71 (59.7)	46 (55.4)	26 (66.7)	
Viral load (copies/mL)				
Indetectable (< 50 copies)	38 (31.9)	24 (29.0)	12 (31.0)	0.90
Present (≥ 50 copies)	81 (68.1)	59 (71.0)	27 (69.0)	

Categories may not add up totals due to missing values. *2-sided p values from χ^2 or Fisher's exact test.

Table 2. Nutritional care, clinical status and body mass index category of HIV/AIDS patients within the IMSS, Nuevo León, 2011.

	Body mass index category			
	Normal/underweight (n = 119) Mean (SD)	Overweight (n = 83) Mean (SD)	Obese (n = 39) Mean (SD)	p-value*
Anthropometric measures				
Sum of four skin fold measures (mm)				
Male	67.7 (19.5)	78.3 (27.5)	76.9 (31.2)	0.04
Female	84.5 (22.3)	101.7 (13)	84.4 (45.2)	
Waist-to-hip ratio				
Male	0.89 (0.04)	0.93 (0.03)	0.94 (0.05)	
Female	0.89 (0.05)	0.91 (0.06)	0.96 (0.03)	< 0.0001
Percentage of fat				
Male	44.4 (19.5)	59.2 (25.6)	67.2 (37.8)	< 0.0001
Female	48.3 (21.2)	60.7 (28.5)	68.7 (31.9)	
Biochemical characteristics				
Fasting glucose (mg/dL)	102.2 (27)	97.7 (18.4)	100.5 (13.3)	0.52
Cholesterol (mg/dL)	180.6 (46.8)	181.8 (41.7)	166.2 (43.1)	0.31
Proteins (g/dL)	8.4 (7.3)	7.6 (0.7)	7.5 (0.9)	0.62
Albumin (g/dL)	4.1 (0.4)	4.1 (0.5)	4 (0.4)	0.65
Globulin (g/dL)	1.3 (0.5)	1.3 (0.4)	1.2 (0.4)	0.51
Triglycerides (mg/dL)	256.4 (166.9)	212.2 (119.4)	210.4 (172.3)	0.19
Urea (mg/dL)	27.4 (10.3)	25.8 (12.8)	33.9 (36.9)	0.16
Creatinine (mg/dL)	1.0 (0.5)	0.9 (0.3)	0.8 (0.2)	0.4
Uric acid (mg/dL)	5.4 (1.4)	5.8 (1.5)	5.6 (1.4)	0.33
Hemoglobin (mg/dL)				
Male	14.5 (1.5)	14.3 (1.7)	14.2 (1.5)	0.98
Female	12.8 (0.91)	12.3 (1.5)	13.1 (1.5)	0.98
Daily dietary intake				
Carbohydrates (g)	396.7 (159.6)	327.2 (143.2)	295.7 (82.3)	0.01
Proteins (g)	120.2 (49.2)	103.4 (55.8)	100.7 (24.1)	0.55
Lipids (g)	77.8 (31.4)	68.5 (31.7)	131.8 (103.3)	0.13
Fiber (g)	24.4 (13.7)	24.2 (18.3)	21.2 (7.9)	0.31
Folic acid (mg)	396.8 (361.9)	281.1 (194.5)	338.6 (268.8)	0.31
Vitamin A (mcg)	985.2 (924.6)	809.8 (844.4)	871.2 (846.5)	0.41
Vitamin C (mg)	190.8 (188.8)	156.4 (122.6)	276 (298)	0.18
Iron (mg)	33.6 (42.3)	26.9 (16.4)	26.5 (13.3)	0.89
Potassium (mg)	1,698.90 (1,096.0)	1,570.1 (1,059.00)	1,832.9 (1,111.70)	0.55
Sodium (mg)	1,828.40 (1,047.50)	1,516.7 (967.3)	1,155.60 (633.7)	0.03
Calcium (mg)	1,512.0 (705.2)	1,236.6 (780.9)	1,409.9 (833.7)	0.36
Cholesterol (mg)	340.9 (262.1)	293.6 (281.3)	178 (95.29)	0.89

Categories may not add up totals due to missing values. *2-sided p values from ANOVA or Kruskal-Wallis test .

Table 3. Multivariate binary logistic regression analysis of time since diagnosis, anthropometric measures and body mass index (overweight/obesity) of HIV/AIDS patients within the IMSS, Nuevo León, 2011.

	Odds ratio*	95% CI	p-value
Time since diagnosis			
> 5 years	1.8	1.01-3.3	0.03
≤ 5 years	Reference	Reference	
Sum of four skinfold measure (mm)	1.02	1.00-1.03	< 0.001
Waist-to-hip ratio			
> 0.95 for men; > 0.85 for women	4.2	2.3-7.5	< 0.0001
≤ 0.95 for men; ≤ 0.85 for women	Reference	Reference	

*Adjusted by nutritional care referral, age, marital status and daily carbohydrates intake. Hosmer and Lemeshow model fit test, p = 0.67.

may vary depending on the time period since HIV/AIDS diagnosis and treatment initiation, socioeconomic status (food availability/adequate food supplies) and access to medical care. Our patients had on average, 6 years of disease since first diagnosed, most did not have a university education and they were employed. Fortunately, all were either on social security or beneficiaries, which guarantees medication and access to specialized health services. Weight gain may reflect the rising prevalence of excess weight in the general population.[23] Actually, the Mexican National Health and Nutrition Survey revealed a 71% prevalence of overweight and obesity for northern states in 2006, which changed to 73.1% in 2012.[24,25] This switch from wasting to increasing weight may also be a consequence of appropriate ART administration that may foster adequate control of disease progression with consequent changes in the nutritional profile of individuals with HIV/AIDS. Precisely, this is one of the reasons that supported the premise that a lengthier disease could lead to increased weight, due to longer exposure to ART. We hypothesized that a longer time period since diagnosis constituted a predisposing factor for overweight/obesity. Our results showed that over 5 years with an HIV/AIDS diagnosis was associated with an increasing BMI, independently of other anthropometric markers such as waist-to-hip ratio, percentage of fat and skinfold measurements. Mariz, *et al.,*[17] reported that 3 or more years since diagnosis, increased the possibilities of being overweight or obese by 16%, compared to less than one month since diagnosis. Other authors such as Crum-Cianflone, *et al.,*[6] found that HIV duration was associated with weight gain. As previously mentioned, this is of particular interest since in the past, long-term HIV infection was associated with low weight.[6] In our study, most patients had never been referred to or had not received nutritional care in order to help them integrate a proper diet and favor disease management. Nutritional care coupled with long-term nutritional maintenance not only preserves the immune system, but also improves drug therapy and patient quality of life. Actually, the IMSS recognizes this issue as a cornerstone, but nutrition services still remain underutilized.[26]

We also explored age and marital status as risk factors for increased weight/obesity, but neither was associated with increasing BMI. Mariz, *et al.,*[17] documented that patients aged 40 or above, were at an increased risk of being overweight/obese by 30% compared to those between 18-39 years of age. On the other hand, the lack of a steady partner decreased the risk in terms of BMI category, a variable considered by the authors as a proxy variable of social support. In our study, most of our patients were younger than 50 years old, so future research needs to take into account longer follow-up periods before reaching any final conclusions. Although companionship was not associated with nutritional status, it is essential to closely watch single individuals since they are prone to depression due to the lack of social support that in turn, has been associated with malnutrition and lipodystrophy.[27] Skinfold measurements, central adiposity and fat percentages differed by BMI category and showed significant association with overweight/obesity; all are indicators of localized adiposity. Participants had mean skinfold measurements and fat percentages well above the normal range and 41.7% had central obesity. Redistribution of body fat has been increasingly recognized among HIV-infected individuals. Jaime, *et al.,*[22] documented central adiposity in 45.7% of patients with a high BMI as well as high waist-to-hip ratios, waist circumference and subscapular skinfold measurement means. Lipodystrophy-associated fat deposition results in an abnormal accumulation of body fat, primarily as visceral fat and sometimes as a dorso-cervical fat pad. While this event is likely multifactorial, exposure to protease inhibitors and more recently, to reverse transcriptase inhibitors, as well as HIV and ART duration, age and high BMI, have all been implicated in the etiology of this morphological abnormality.[28,29]

With respect to biochemical markers, it was noteworthy that triglycerides were higher than normal in all BMI groups. Particularly in Mexico, Sierra-Madero, *et al.*,[30] reported adverse outcomes related to metabolism of lipids in patients receiving ART; 20.5 to 32.3% frequency depending on therapeutic drug. Other studies from African, European and Latin-American countries have also shown the impact of ART on triglycerides.[31-34] This is relevant, because hypertriglyceridemia is a strong marker of disease progression and the patients' course, regardless of the effects of ART.[35] Leite, *et al.,*[18] found that greater weight gain negatively contributed to the presence of dyslipidemias. Nutrient averages determined with the 24-h dietary survey, were not significantly different by BMI group except in terms of carbohydrate and sodium intake, which were lower in overweight/obese patients. This point and the excessive percentage of macro and micronutrients adequacy imply a lack of orientation/education in the prevention of nutritional disorders.

Limitations

An important limitation to this study was the low number of females in the cohort since only 1 out of 10 patients was a woman. Therefore, caution is needed in generalizing and applying results to the female population. Unlike a longitudinal study, the cross-sectional nature of our data could have precluded demonstrating the true effects of older age on malnutrition. It was also not possible to determine increasing weight gain rates over time. Additionally, the method used to determine body fat percentages was not ideal in people with obesity, so results could have underestimated the total value.

In conclusion, we found a one-to-one ratio between increased weight and normal weight patients in our study group and nearly half of all participants presented central obesity. Paradoxically, less than 20% of those with overweight/obesity were referred for nutritional care. Dietary modifications are recommended not only to decrease BMI but secondarily, to diminish the inherent risk for cardiovascular disease, dyslipidemia, altered glucose metabolism and metabolic syndrome.

This study identifies predisposing factors to overweight/obesity among HIV/AIDS patients, which constitutes a significant step for providing nutritional care. Accordingly, the time since diagnosis but not marital status and age, was associated with increasing BMI, independently of other anthropometric markers such as central obesity, percentage of fat or skinfold measurements. Nutritional care should be provided the same attention as viral load or $CD4^+$ count, especially nowadays, with more common increased survival rates and consequently, longer lives with the disease.

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