

# A tale of two epidemics: The intersection between obesity and HIV infection in urban U.S.

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## ABSTRACT

**Background:** Obesity and HIV infection are ongoing epidemics in the U.S. Obesity predisposes to diabetes and cardiovascular disease which are complications also associated with HIV infection or its treatment. We characterized the prevalence and risk factors of overweight (OW) and obesity (OB) within a large urban cohort of HIV infected individuals.

**Methods:** Retrospective cross-sectional study of the 1678 patients enrolled in the University of Pennsylvania Center for AIDS Research Clinical Core Cohort Registry. Demographic, social and medical data on these patients have been collected prospectively since 1999. The usual BMI definitions of OW (BMI between 25-29.9kg/m<sup>2</sup>) and OB (> 30kg/m<sup>2</sup>) were used. Wasting was defined as a BMI less than 20kg/m<sup>2</sup>.

**Results:** Data were available for 1654 (98.6%) subjects. They were 78% men, 60% AA, 46% current smokers, 18% with prior IV drug abuse, 67% with income <\$25,000. The median CD4 was 377 cells/μl (IQR 220-581). 52% had a viral load (VL) <400 copies/mL. 9% of the patients were treatment naive.

OW and OB were much more common than wasting, 31%, 14% and 9% prevalence respectively. While women and men were equally likely to be OW (30% vs. 31%, p = .855), women were significantly more likely than men to be OB (29% vs.11%, p < .001). AA were more likely to be OW or OB than non-AA (49% vs. 42%, p = .012). Current CD4 ≥ 200 (RR 2.0, 1.5 – 2.6) was associated with being OW or OB. Current smoking was protective (RR 0.6, 0.5-0.7).

In a logistic regression model, female sex (RR 2.0, 1.5-2.7), AA race (RR 1.3, 1.0-1.6), smoking (RR 0.6; 0.5-0.8), and current CD4 (for each 100 cells/μl increment, RR 1.11, 1.06-1.16) were independent predictors of obesity. Age, income, employment, education, past or current IVUD, being on HIV treatment and VL were not associated with obesity.

**Conclusion:** Obesity is a much more common problem than wasting in the current therapeutic era. While the combined 45% prevalence of OW and OB within our population is less than the overall 60% population prevalence for the state of Pennsylvania, it is nonetheless of epidemic proportion. Women, particularly those of color are at high risk. Baseline or acquired obesity might be a significant contributor to the metabolic abnormalities associated with HIV or its treatment. As patients with HIV live longer, obesity-related complications may contribute to morbidity. Specific dietary and lifestyle modifications to counter this will be needed in this population.

## INTRODUCTION

- Obesity is continuing its epidemic incidence in the U.S.
- Greater than 20.0% of American adults fulfill the NIH definition of obesity, with a BMI of ≥ 30kg/m<sup>2</sup>, while more than half of U.S. adults are considered overweight, with BMIs ≥ 25kg/m<sup>2</sup>.
- While some HIV-infected patients are still afflicted with wasting, we have observed that obesity is becoming a significant issue in our HIV-infected patients.

## METHODS

### Cohort description:

Enrollment in Univ. of Penn CFAR Clinical Core Cohort Registry (CFAR-CCCR) began in 1999 at the Hospital of Univ. of Penn, two affiliated hospitals and the Philadelphia VA.

- Biyearly patient encounters.
- Patient data self reported. Laboratory data from hospital database.

### Sample size:

- 1678 patient, first encounter prior to 6/1/03. BMI data for 1654 patients.
- Questionnaire modified 10/1/02 to include antiretroviral medications. For antiretroviral variable, 1127 patient sample.

### Definitions:

- BMI {wt (kg) / [height(m)]<sup>2</sup>}. Most recent weight as of 8/1/03. Height recorded at initial encounter.
- Obese (BMI ≥ >30kg/m<sup>2</sup>), overweight (BMI 25-29.9kg/m<sup>2</sup>), HIV wasting (BMI <20kg/m<sup>2</sup>). Normal weight (BMI 20-24.9kg/m<sup>2</sup>).

### Variables included in the analysis:

- Variables correlating with obesity in U.S. population determined by CDC-NHANES: gender, race, age, education, income, employment and tobacco use.
- Other variables included: IV and non-IV drug use, CD4 count (within 4 months of reference weight), viral load, current antiretroviral and protease inhibitor use.
- Age group with highest national prevalence overweight or obesity (44-64 years) used as comparison group.

### Statistical analysis:

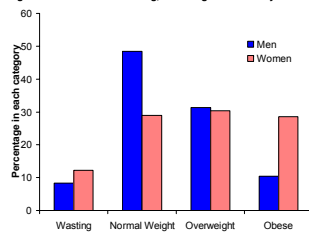
- Prevalence in each category as percentages of cohort.
- Univariate analysis for association with obesity,  $\chi^2$  test to calculate relative risk (RR) and 95% CI for each variable.
- Stratified analyses for men and women.
- Multivariate analysis with forward step-wise multivariate regression model including all variables associated with overweight/obesity with p ≤ 0.05.
- Comparison with overall prevalence of overweight and obesity in Philadelphia adults stratified by race and gender.

## RESULTS

Table 1: Demographics of the Cohort

Factor	Number (%)	Men (%)	Women (%)
Gender	1678	1312(78)	366(22)
Age			
18-29	134(8)	79(6)	56(5)
30-44	776(46)	675(44)	201(16)
44-64	374(43)	62(47)	60(27)
≥65	47(3)	36(3)	11(3)
Race			
Black	1026(56)	719(55)	285(18)
Non-black	670(40)	594(45)	80(2)
Missing	4	3	1
Income			
<\$25,000/year	1126(67)	835(53)	293(18)
>\$25,000	533(32)	473(36)	60(7)
Missing	215(13)	141(11)	72(7)
Education Level			
Less than high school	290(17)	188(14)	102(8)
High school graduate	539(32)	386(29)	153(42)
College/graduate school	847(51)	736(29)	111(30)
Missing	2	2	0
Employed	871(40)	641(41)	130(59)
Current Smoker	774(46)	604(46)	170(47)
Hx IVUD	308(18)	251(19)	57(16)
Hx non-IVUD	1229(73)	959(73)	236(65)
Currently on HAART	805(50)	580(45)	244(67)
Not on HAART	280(16)	247(20)	30(8)
Missing	591(35)	479(36)	72(20)
PI containing regimen	447(27)	324(25)	123(34)
Non PI	672(40)	501(38)	171(47)
Missing	589(35)	483(37)	72(20)
CD4 count (copies)			
<200	311(18)	250(19)	59(16)
≥200 and ≤500	614(44)	444(37)	130(36)
>500	475(4)	381(28)	114(31)
Missing	289(17)	215(16)	69(17)
Viral Load (copies/mL)			
<400	733(44)	589(45)	138(37)
>400	660(39)	496(38)	164(45)
Missing	256(15)	218(17)	67(18)

Figure 1. Prevalence of Wasting, Overweight and Obesity



- Combined prevalence of obesity and overweight in cohort: 46%.
- Combined prevalence in women: 58.8%; men: 42.4% (RR 1.9, 95% CI 1.5-2.5).
- Combined prevalence in African American women: 62.1%.
- Figure 1: Prevalence of obesity in women was 28.5% vs. 10.6% in men (RR 3.6, 95% CI 2.5-4.8).

Table 2. Factors associated with obesity and overweight, univariate analysis. Significant associations highlighted in yellow.

Factor	OR	95% CI of OR
Gender – Female vs. Male	1.94	1.53-2.46
Age – 44-65 vs. other	1.12	0.92-1.36
Race – Black vs. non-black	1.29	1.06-1.57
Income ≤\$25,000 vs. >\$25,000	0.92	0.74-1.13
Education: High school vs. beyond HS	1.1	0.90-1.33
Employed vs. not employed	1.10	0.91-1.35
Smoker vs. non-smoker	0.61	0.50-0.74
Hx IVUD vs. no Hx IVUD	0.92	0.72-1.12
Hx non-IVUD vs. no Hx non-IVUD	0.84	0.68-1.35
Currently on HAART vs. not on HAART	0.99	0.75-1.29
Currently on PI vs. not on PI	0.95	0.74-1.20
CD4 ≥ 200 vs. <200/μl	1.99	1.53-2.60
VL < 400 vs. ≥ 400copies/ml	1.13	0.91-1.40

Table 2: Multivariate model for obesity or overweight including all factors found to be significant in the univariate model in addition to those that were not found to be significant except antiretroviral regimen.

- The pseudo R-squared for the regression model is 0.044 by Cox & Snell. The low pseudo R-squared implies that most of the risk for obesity within our population is due to variables not contained within our model.

Factor	OR	95% CI of OR
Gender- female vs. male	1.99	1.50-2.64
Race – black vs. non-black	1.29	1.01-1.63
Current smoking vs. non-smoking	0.61	0.49-0.77
CD4 – increase per 100 cells/μl increment	1.12	1.08-1.17

Figure 3: Combined prevalence of obesity and overweight stratified by age (A), sex and race (B) within our cohort compared to the city of Philadelphia.

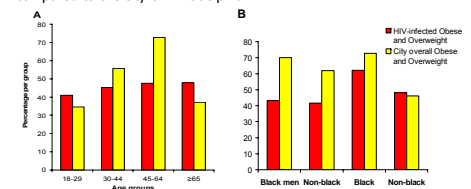


Table 4: Comparison of combined prevalence of obesity and overweight between our population and the city of Philadelphia

Group	City combined prevalence of Overweight and obese (%) <sup>1</sup>	Cohort combined prevalence of Overweight and obese (%)	Significance of the difference
Black men	70.1	43 +/- 1.9	<0.001
Non-black men	62.0	42 +/- 2.0	<0.001
Black women	72.8	62 +/- 2.9	<0.001
Non-black women	46.0	48 +/- 5.7	0.711

<sup>1</sup>City data from the Household health survey data, Philadelphia Health Management Corporation's community health data base 2002, Southeastern Pennsylvania Household Health Survey.

## CONCLUSION

- Obesity is 5 times more common than wasting in the current therapeutic era.
- While the combined 45% prevalence of OW and OB within our population is less than the overall 60% population prevalence for the state of Pennsylvania, it is nonetheless of epidemic proportion.
- Women, particularly those of color are at high risk. Baseline or acquired obesity might be a significant contributor to the metabolic abnormalities associated with HIV or its treatment.
- Further study of the heterogeneous interplay of genetic, behavioral and environmental factors responsible for obesity and not fully explored in this model is warranted.
- As patients with HIV live longer, obesity-related complications may contribute to morbidity. Specific dietary and lifestyle modifications to counter this will be needed in this population.