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The Hunger–Obesity Paradox: Obesity in the Homeless

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ABSTRACT *Despite stereotypes of the homeless population as underweight, the literature lacks a rigorous analysis of weight status in homeless adults. The purpose of this study is to present the body mass index (BMI) distribution in a large adult homeless population and to compare this distribution to the non-homeless population in the United States. Demographic, BMI, and socioeconomic variables from patients seen in 2007–2008 were collected from the Boston Health Care for the Homeless Program (BHCHP). This population was compared to non-homeless adults from the National Health and Nutrition Examination Survey (NHANES). Among 5,632 homeless adults, the mean BMI was 28.4 kg/m^2 and the prevalence of obesity was 32.3 %. Only 1.6 % of homeless adults were underweight. Compared to mean BMI in NHANES (28.6 kg/m^2), the difference was not significant in unadjusted analysis ($p=0.14$). Adjusted analyses predicting BMI or likelihood of obesity also showed that the homeless had a weight distribution not statistically different from the general population. Although underweight has been traditionally associated with homelessness, this study suggests that obesity may be the new malnutrition of the homeless in the United States.*

KEYWORDS *Homeless, Obesity, Body mass index, Malnutrition*

INTRODUCTION

Stereotypes and the media have generally portrayed the homeless as starving and underweight.[1] However, few studies have documented their weight status or compared their weight distribution to that of the general population. The homeless represent one of the most socially and economically disadvantaged groups in the United States.[2,3] Homelessness is a particularly extreme form of material deprivation that is considered even lower-income than the low-income populations typically studied in obesity research.[3]

The estimated 2.3 to 3.5 million homeless individuals in America each year are at risk for nutritional problems,[2] yet they are usually excluded from national health and nutrition surveys because the homeless are inaccessible or ineligible by conventional sampling methods which define sampling units as households.[4] Nutrition is a daily challenge for homeless individuals; many experience food

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insufficiency and struggle to meet even basic nutritional needs.[5–7] The diets of homeless individuals are reported to have a high prevalence of inadequate or imbalanced nutrient, vitamin, and mineral content.[8]

Despite attention to other ailments of the homeless such as substance abuse and mental illness,[9] there is a dearth of research on obesity prevalence. The literature on overweight and obesity in homeless adults consists of only a few studies (Table 4 in the Appendix), which consist of several limitations. Though providing valuable groundwork, these studies have tended to contain small sample sizes, do not include direct comparisons with the general population, and lack information on subgroups and weight categories.[3,8,10–12]

To address this need, we sought to provide a more rigorously conducted, comprehensive, and up-to-date assessment of weight distribution among homeless adults. To improve upon prior research, we aimed to characterize obesity in the homeless by analyzing one of the largest adult homeless study populations reported to date. We also provide one of the first comparisons of body mass index (BMI) between the homeless and general populations.

METHODS

Data and Subjects

We conducted a retrospective chart review of electronic medical records of all patients seen in a clinical context by Boston Health Care for the Homeless Program (BHCHP) between January 1, 2007 and December 31, 2008 with recorded Body Mass Index (BMI) data. For patients who had multiple weights recorded in 2007–2008, the weight recorded closest to the date at the mid-point of study frame was selected for analysis. We then compared BMI and obesity status in the homeless group to the non-homeless United States population derived from the National Health and Nutrition Examination Survey (NHANES).

BHCHP services 11,000 individuals each year in a wide range of 80 settings in Boston, Massachusetts, including shelter-based clinics, hospital-based clinics, a medical respite center, and on the streets.[13] With an estimated 15,000 homeless individuals in Massachusetts,[14] BHCHP services greater than 70 % of the state's homeless population each year.[13] While BHCHP does not ask for official proof of homelessness, we considered patients presenting at any BHCHP clinic to be eligible for the study.

BHCHP subjects were male and female homeless adults over the age of 20 years. We excluded from analyses subjects who were pregnant or whose recorded BMI exceeded 100 kg/m^2 or fell below 10 kg/m^2 (n=110). The final sample consisted of 5,632 homeless adults.

The comparison group was drawn from the 2007–2008 NHANES. This survey uses a stratified, multi-stage probability cluster sampling design to obtain a nationally representative sample of the United States civilian non-institutionalized population.[15] NHANES data are gathered from interviews at participants' homes and standardized physical examinations in mobile examination centers.[15] The study protocol was approved by the Institutional Review Board at Boston University and by the Departmental Research Ethics Committee at the University of Oxford.

Variables and Analyses

For our homeless sample, we collected demographic information (sex, age, and ethnicity), BMI, other clinical variables (number of years registered with BHCHP,

total clinical encounters in 2007–2008, seen only in 2007–2008) and socioeconomic variables (education and employment status) using electronic medical records. We classified subjects by age (20–39, 40–59, and 60 years or older) and ethnicity (non-Hispanic White, non-Hispanic Black, and Hispanic, other, and unspecified). Following the World Health Organization guidelines, we also classified subjects by weight status: BMI$<$18.5 kg/m^2 (underweight), BMI 18.5–24.9 kg/m^2 (normal weight), BMI$\geq$25 kg/m^2 (overweight), and BMI$\geq$30 kg/m^2 (obese).[15] BMI is often used as a surrogate for adiposity, which is difficult to measure in routine examinations.[16] An inexpensive and easy-to-perform method of screening for weight categories, BMI is correlated with obesity-related health consequences.[17]

In descriptive analyses of the homeless, means or percentages were computed for all demographic, clinical, and socioeconomic variables. Furthermore, we calculated the percentage of individuals in each weight category and compared weight categories by sex. In comparative analyses, we examined differences in baseline characteristics and the percent of individuals in each weight category between homeless and non-homeless adults. We also compared mean BMI and the distributions of BMI between the homeless and non-homeless populations. In subgroup analyses, we compared prevalence of obesity between homeless and non-homeless by sex, age, and ethnicity.

We conducted multivariate analyses to determine the association between homelessness and weight status. In the model with BMI as the dependent variable, we used a propensity-weighted generalized linear model adjusting for demographic and socioeconomic variables. Propensity weights help balance individual traits across the homeless and non-homeless populations. Propensity weights were calculated with the use of data on age, sex, ethnicity, and obesity status. In the model with obesity as the dependent variable, we analogously used a propensity-weighted logistic regression model adjusting for similar covariates. Independent variables included categories for age, sex, interactions between age and sex, ethnicity, education, and an indicator for homelessness. The coefficient on the homelessness variable, which indicates the association between homelessness and BMI holding all other covariates constant, was the primary parameter of interest. Statistical analyses were performed using STATA software, version 11.

RESULTS

Homeless Population

From 2007–2008, 5,632 homeless adults received BMI measurements while seeking care from BHCHP. Mean age was 47.8 years (standard deviation (SD)=11.3) and 80.5 % were male (Table 1). The distribution of ethnicity was 46.7 % white, 32.1 % black, 13.8 % Hispanic, and 7.4 % were other/unspecified. The mean number of years registered with BHCHP was 3.5 (SD=3.4) and the mean number of total clinical encounters per person was 20.7 (SD=33.2). For education level, 76.1 % had a highest educational attainment at or below high school graduate/GED, while only 7.6 % had graduated from college. For employment status, 67.3 % were unemployed, 26 % were disabled, 3.6 % were part time, and 2.1 % were full time.

The mean BMI of homeless participants was 28.4 kg/m^2 (SD=6.5) with a range of 13.8 to 68.6 kg/m^2. By weight category, 1.6 % of homeless individuals were underweight, 32.6 % were normal weight, 65.7 % were overweight, and 32.3 % were obese. A more precise breakdown of the obesity category revealed that 18.4 %

TABLE 1 Characteristics of the study population (plus-minus values are means ± standard deviation)

	Homeless group ($N=5,632$)	Comparison group ($N=5,555$)	P value
Demographics			
Age (years)	47.8±11.3	50.7±17.7	<0.001
Female sex (%)	19.5	50.5	<0.001
Ethnicity (%)			
White	46.7	47.1	0.65
Black	32.1	20.6	<0.001
Hispanic	13.8	28.2	<0.001
Other/unspecified	7.4	4.1	<0.001
Education (%)			
Less than 9th grade	10.9	13.3	0.01
9–11th grade	42.9	17.5	<0.001
High school graduate/GED	22.3	24.8	0.04
Some college	16.3	25.7	<0.001
College graduate	7.6	18.6	<0.001
Weight category (%)			
Underweight (BMI<18.5 kg/m^2)	1.6	1.6	0.97
Normal weight (BMI 18.5–24.9 kg/m^2)	32.6	30.3	0.02
Overweight (BMI≥25 kg/m^2)	65.7	68.1	0.02
Obese (BMI≥30 kg/m^2)	32.3	33.7	0.16
Grade 1 (BMI 30–34.9 kg/m^2)	18.4	19.6	0.15
Grade 2 (BMI 35–39.9 kg/m^2)	8.3	8.5	0.72
Grade 3 (BMI≥40 kg/m^2)	5.6	5.6	0.99

exhibited grade 1 obesity (BMI 30–34.9 kg/m^2), 8.3 % exhibited grade 2 obesity (BMI 35–39.9 kg/m^2), and 5.6 % exhibited grade 3 obesity (BMI≥40 kg/m^2) (Table 1). In the homeless population, females were more likely to be obese than males (42.8 % versus 29.7 %, $p<0.001$) (Table 2).

Homeless Compared to NHANES

Table 1 compares the characteristics of the homeless and NHANES populations. The homeless group was younger and disproportionately male, a common finding in homeless demographics.[13] A greater percentage of the homeless population was

TABLE 2 Comparison of weight status by sex in the homeless population

Weight category (%)	Males ($N=4,535$)	Females ($N=1,097$)	P value
Underweight (BMI <18.5 kg/m^2)	1.3	2.9	<0.001
Normal weight (BMI 18.5–24.9 kg/m^2)	33.4	29.4	0.01
Overweight (BMI ≥25 kg/m^2)	65.2	67.7	0.12
Obese (BMI ≥30 kg/m^2)	29.7	42.8	<0.001
Grade 1 (BMI 30–34.9 kg/m^2)	18.1	19.2	0.40
Grade 2 (BMI 35–39.9 kg/m^2)	7.3	12.3	<0.001
Grade 3 (BMI ≥40 kg/m^2)	4.3	11.2	<0.001

black and a smaller percentage was Hispanic. More than 50 % of the homeless population did not graduate from high school, in contrast to 31 % in the comparison group. The percentages of the population in each weight category were largely similar between the groups (Table 1).

Mean BMI for the homeless and non-homeless populations were similar (28.4 kg/m^2 (SD=6.5) versus 28.6 kg/m^2 (SD=6.6)). In an unadjusted analysis using a *t* test, this difference was not statistically significant ($p=0.14$). Figure 1 displays the frequency histograms of BMI in the homeless and non-homeless populations, suggesting that the distributions of BMI were similar across the groups.

Adjusted analysis was consistent with this finding. Our propensity-weighted multivariate linear model demonstrated that the difference in BMI between the two groups is small and not statistically significant (–0.36 kg/m^2, $p=0.11$, 95 % confidence interval (CI) –0.82 to 0.09 kg/m^2) (Table 3). The model also showed that older age and female sex were positively associated with BMI, as were black and Hispanic ethnicity ($p \leq 0.001$). An analogous logistic model predicting the likelihood of being obese (versus not obese) showed that the non-homeless were no more likely to be obese than the homeless (odds ratio 0.93, $p=0.34$, 95 % CI 0.81 to 1.07). Associations of other covariates with obesity were in the same direction and of similar statistical significance as the results of the BMI model (not shown).

Subgroup Analyses

In subgroup analyses, homeless women had a significantly higher percentage of obesity (42.8 %) than non-homeless women (35.3 %), $p<0.001$. However, homeless men had

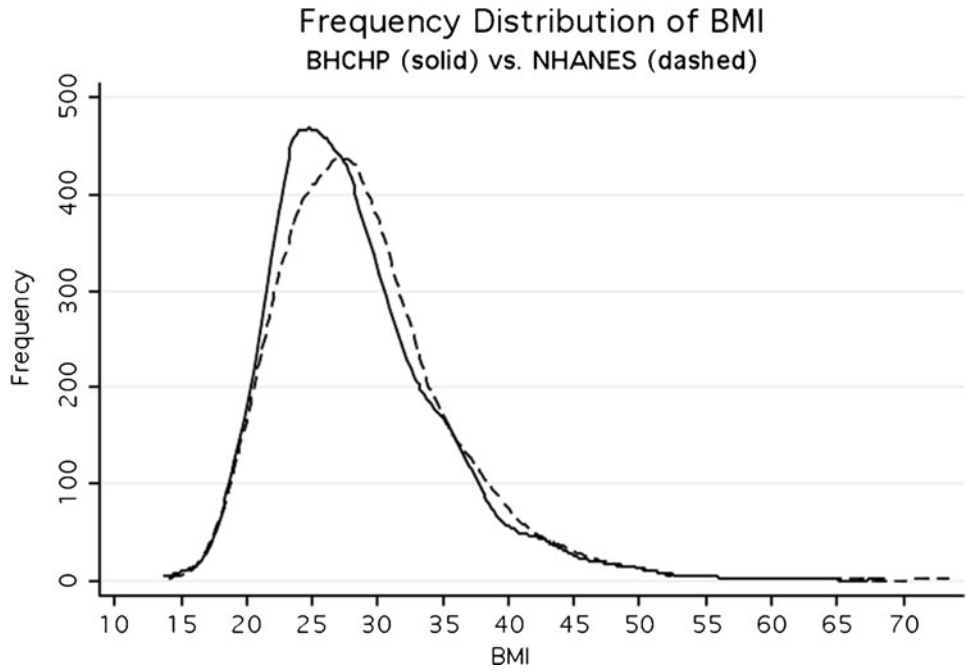

FIGURE 1. Distribution of BMI in BHCHP and NHANES subjects*. * Frequency distribution of the number of subjects by BMI (*BHCHP* Boston Health Care for the Homeless Program, *NHANES* National Health and Nutrition Examination Survey).

TABLE 3 Factors associated with body mass index (BMI)

Independent variables	Model estimate (95 % CI)		*P* value
Age			
Age 20–39 years	Reference		
Age 40–59 years	0.93	(0.42 to 1.44)	<0.001
Age ≥60 years	0.86	(0.33 to 1.38)	0.001
Female	1.08	(0.43−1.74)	0.001
Ethnicity			
White	Reference		
Black	1.01	(0.57 to 1.46)	<0.001
Hispanic	0.69	(0.27 to 1.10)	0.001
Other	−1.92	(−2.60 to −1.25)	<0.001
Education			
Less than 9th grade	Reference		
9–11th grade	0.49	(−0.05 to 1.03)	0.08
High school/GED	0.61	(0.09 to 1.14)	0.02
Some college	0.84	(0.30 to 1.37)	0.002
College graduate	−0.21	(−0.75 to 0.34)	0.46
Homeless	−0.37	(−0.82 to 0.087)	0.11

Estimates are from a propensity-weighted multivariate linear model adjusting for age categories, sex, age–sex interactions, ethnicity, education levels, and homelessness. The dependent variable was BMI. Estimates for age–sex interactions are not shown; none were statistically significant at the $p<0.05$ level

CI confidence interval

a lower percentage of obesity (29.7 %) than non-homeless men (32.0 %), $p=0.08$ (Figure 2 in the Appendix).

Among 20- to 39-year-olds, homeless and non-homeless were equally likely to be obese (33.4 % versus 30.5 %, $p=0.11$). However, homeless 40- to 59-year-olds were significantly less likely to be obese than their non-homeless counterparts, (32.5 % versus 36.0 %, $p=0.03$). Finally, homeless adults 60 years of age and older were also significantly less likely to be obese than non-homeless 60-year-olds (29.1 % versus 34.9 %, $p=0.006$) (Figure 3 in the Appendix).

In subgroup analyses by ethnicity, homeless and non-homeless whites were equally likely to be obese (30.7 % versus 32.5 %, $p=0.18$). Among blacks, the homeless population had significantly lower obesity rates than the non-homeless (36.3 % versus 43.8 %, $p<0.001$). Finally, among Hispanics, the homeless were less likely to be obese than non-homeless (31.7 % versus 37.5 %, $p=0.007$) (Figure 4 in the Appendix).

DISCUSSION

This study suggests that obesity is highly prevalent in the adult homeless population. We documented obesity prevalence in homeless adults that exceeded 30 % overall as well as in most subgroups categorized by sex, age, and ethnicity. The mean BMI of homeless adults was at the level of overweight (28.4 kg/m^2), with individual BMIs as high as 68.62 kg/m^2. Homeless women were more likely to be obese than non-homeless women, with prevalence of obesity over 50 % in certain ethnicity groups. This observation is consistent with the

inverse relationship between socioeconomic status and obesity among women nationally.[17]

Notably, the prevalence of underweight in this population was very small (1.6 %). Rather, morbid obesity appears to be of substantial concern: the prevalence of BMI equal to or greater than 40 kg/m^2 was 5.6 %, exceeding the underweight prevalence by over threefold. Unadjusted and adjusted analyses consistently found that the homeless did not have significantly lower BMI or lower likelihood to be obese. This study generates two main findings: (1) obesity may be a serious problem in the homeless and (2) the prevalence of obesity may be just as high in the homeless as in the general population.

The recently described hunger–obesity paradox, which describes the co-existence of hunger and obesity in the same person, may help explain our findings. This paradigm is counterintuitive because a common misconception is that obesity results from overeating and, by that logic, a lack of access to food must result in being underweight.[18] Nevertheless, the hunger–obesity paradox has been documented in developing countries where undernutrition, traditionally a major public health problem, has been complicated by the rise of obesity.[19] In the United States, the current literature demonstrates that the highest prevalence of obesity now exists in low-income groups.[20]

The results of our study suggest that this paradox may affect the homeless population, for several potential reasons. First, limited economic resources may lead individuals toward cheap and energy-dense but low-nutrient dense foods, in order to avoid hunger.[18] These foods are also more palatable and lead to higher energy intake.[20] Second, some speculate that obesity can be an adaptive response when people do not consistently have enough to eat. Chronic variations in food availability may cause people to eat more when food is available than they normally would, ultimately resulting in weight gain.[21] Finally, when diets are not consistently adequate, physiological changes may occur to help the body conserve energy. The body may compensate for periodic food shortages by becoming more efficient at storing more calories as fat.[21] Other factors associated with the homeless, such as a largely sedentary lifestyle, sleep debt, and stress, may also contribute to the high prevalence of obesity.[22] Though all these reasons are plausible explanations, the exact mechanism for the existence of the hunger–obesity paradox remains unclear. Several studies have questioned the relationship between food insecurity and weight gain, but the literature examining this association is inconclusive and does not focus on the homeless population.[23] Precise risk factors for and mediators of obesity in the homeless are beyond the scope of this study but remain an important area for future research.

We believe the design of this study has several strengths. Due to the mobile lifestyle patterns of the homeless, establishing rigorous samples of homeless individuals has been difficult in prior research.[24] Disadvantaged populations often distrust researchers, rendering them difficult to enroll and retain in studies.[9] Common criticisms of homelessness studies are self-report, small sample size, and sampling at one particular shelter or location, none of which are a concern in this study. Specifically, while most previous studies on the health of the homeless have been conducted in single shelters, this study used electronic medical records representing 80 hospital and shelter sites in Boston. The large sample of over 5,000 individuals represents approximately 37 % of the homeless population in

Massachusetts. In addition, we compared subjects to the nationally representative NHANES population, whereas most previous studies have not used a comparison group. We selected NHANES as the comparison group over alternatives such as a non-homeless Massachusetts patient population or a non-homeless Massachusetts general population. Non-homeless patients have a higher disease burden and are not representative of the non-homeless general population. Additionally, BMI data on the Massachusetts general population are available only through self-report, which have been shown to produce underestimates of BMI compared to surveys that use measurements from physical examinations.[25]

We believe the quality of data also strengthens the findings in this study. In particular, BMI was based on physical examinations, avoiding bias from self-report. We used a standard protocol to account for multiple BMI measurements in a given time period, reducing potential biases due to seasonality when analyzing BMI and obesity prevalence. Improving on prior research that used only qualitative comparisons of NHANES data to study homelessness,[26] we used propensity-weighted regression analyses that included 2007–2008 NHANES data to control for potential demographic and socioeconomic confounders that may have affected comparisons of averages.

Nevertheless, our study is subject to several limitations. First, the BHCHP population may not be generalizable to other homeless individuals in Massachusetts who did not seek medical care. For example, homeless individuals treated by BHCHP may be sicker than those who did not seek care. However, evidence suggests that disease is prevalent among the homeless population whether cared for or not, and thus using a sample of people who sought care may not necessarily be unrepresentative.[10] Second, the homeless population in Massachusetts may not generalize to the broader national homeless population. This introduces potential bias, as our comparison group was the national non-homeless population. However, the Massachusetts homeless are similar to the national homeless population in terms of geographic distribution (e.g., the percentage of people from urban backgrounds) and prevalence (e.g., the percentage of chronic homelessness, percent of homeless population unemployed, and percent of homeless per 10,000 population).[14]

A related issue to the generalizability is that overall rates of obesity in Massachusetts are lower than the national average.[27] Therefore, it is possible that the Massachusetts homeless have, on average, lower BMI than the national homeless population. Interestingly, this possibility suggests that if comparisons of weight between national homeless and national non-homeless populations are conducted, the homeless may have an even higher mean BMI relative to non-homeless than this study demonstrated. This area is ripe for future research.

This study points to several additional directions for further investigation. First, a longitudinal study of homeless individuals to track weight changes over time would provide insight into the extent to which there is a causal relationship between homelessness and obesity. This study did not have a robust way to assess the duration of homelessness, which is a common problem in homelessness research. Duration of homelessness may be correlated with BMI. Second, it may be worthwhile to investigate clinical variables that are disproportionately associated with homelessness, such as drug status, mental illness, or HIV status, as they may mediate the relationship between homelessness and weight. For ethical and practical

reasons, we were not able to obtain further data pertaining to co-morbidities and lifestyle factors. Third, measures of food and caloric intake would be beneficial to determine the extent to which the eating behavior of the homeless affects weight outcomes. Fourth, examining differences in BMI by different types of homelessness, such as those who are transiently homeless (defined as homeless for 1 month), episodically homeless (defined as homeless for two non-consecutive months), or chronically homeless (defined as homeless for over 1 year) may provide insight into the relationship between homelessness and weight status.[28] Finally, studies of the homeless weight distribution in other countries may offer important information on the prevalence of obesity in homeless populations worldwide.

To our knowledge, this study is the first to offer a comparative rigorous evaluation of weight in United States homeless adults and to provide evidence that obesity is a serious problem in this population. Expanding knowledge of obesity across populations helps inform our understanding of unexplored factors associated with this epidemic. Sound epidemiologic research should continue as interventions aimed at reducing obesity in the homeless, such as improving nutritional standards in shelters or educational efforts at clinical sites, may be considered. Although underweight has been traditionally associated with homelessness, this study suggests that obesity may have replaced underweight as the new malnutrition of the homeless.

APPENDIX

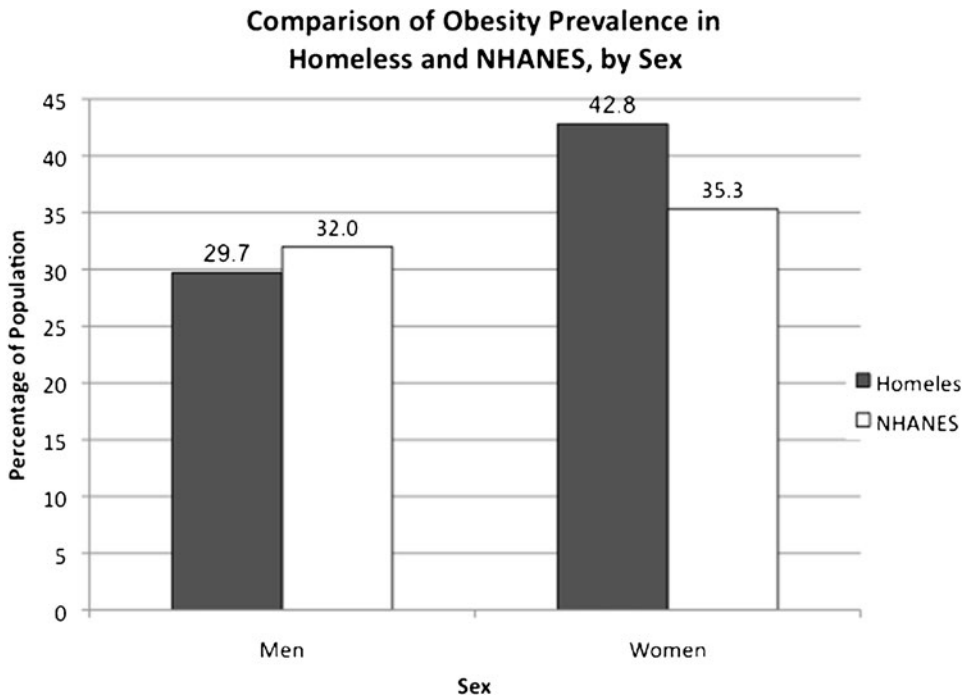

FIGURE 2. Comparison of obesity prevalence in homeless and NHANES, by sex.

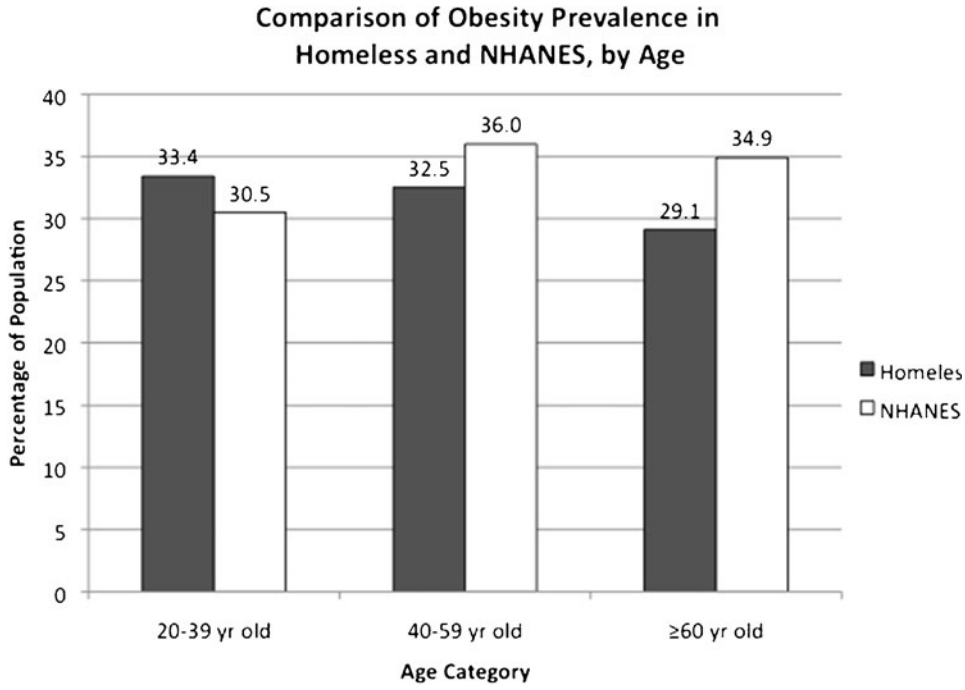

FIGURE 3. Comparison of obesity prevalence in homeless and NHANES, by age.

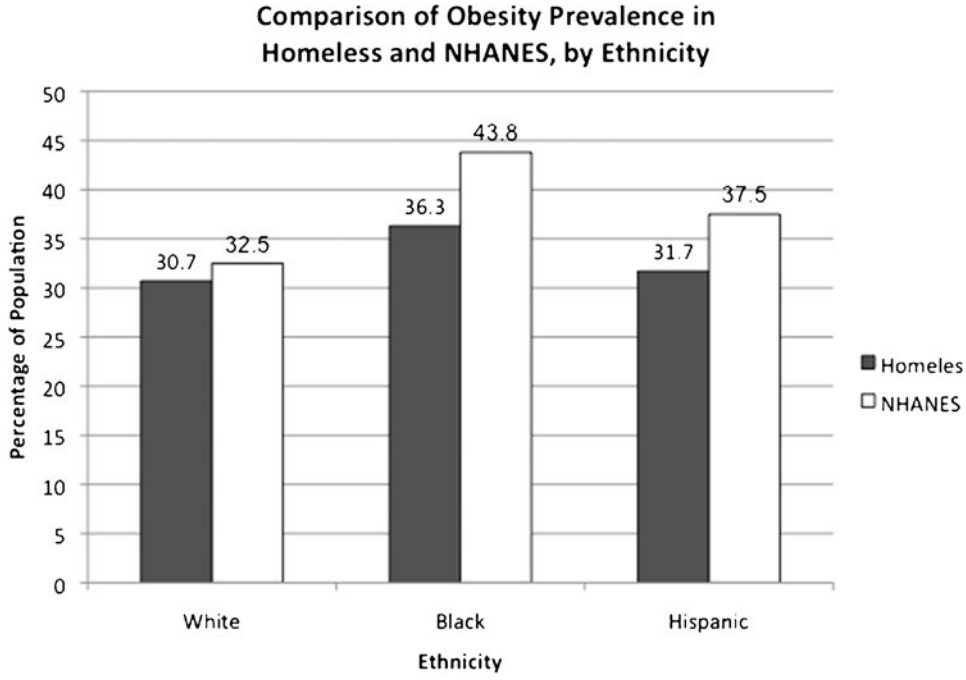

FIGURE 4. Comparison of obesity prevalence in homeless and NHANES, by ethnicity.

TABLE 4 State of the evidence on obesity in the adult homeless population

	Weight category (body mass index)					
Study	Sample	Underweight (<18.5 kg/m^2)	Normal (18.5–24.9 kg/m^2)	Overweight (≥25 kg/m^2)	Obese (≥30 kg/m^n)	Comparison group
Wright and Weber (1987)	11,886 men and women	Not reported	Not reported	Not reported	1.5 %	None
Luder et al. (1989)	55 men and women	Women 6.7 %, men 8 %	Women 30 %, men 48 %	Women 63.3 %, men 44.0 %	Not reported	None
Luder et al. (1990)	96 men and women	Women 7 %, men 5 %	Women 32 %, men 48 %	Women 61 %, men 47 %	39 %	None
Drake (1992)[a]	96 women	Not reported	Not reported	Age 19–24, 29 %, age 25–49, 36 %	Not reported	None
National Health Care for the Homeless (2003)	552 men and women	Not reported	31 %	40 %	29 %	None

[a]Drake (1992) does not use current WHO distinction between overweight and obese

REFERENCES

1. Kusmer KL. *Down and out, on the road: the homeless in American history*. New York: Oxford University Press; 2002: 3.
2. Baggett TP, O'Connell JJ, Singer DE, Rigotti NA. The unmet health care needs of homeless adults: a national study. *Am J Public Health*. 2010; 100(7): 1326–1333.
3. Wright JD, Weber E. *Homelessness and health*. New York: McGraw-Hill; 1987: 114.
4. Gelberg L, Stein JA, Neumann CG. Determinants of undernutrition among homeless adults. *Public Health Rep*. 1995; 110(4): 448–454.
5. Rodriguez RM, Fortman J, Chee C, Ng V, Poon D. Food, shelter and safety needs motivating homeless persons' visits to an urban emergency department. *Ann Emerg Med*. 2009; 53(5): 598–602.
6. Kushel MB, Gupta R, Gee L, Haas JS. Housing instability and food insecurity as barriers to health care among low-income Americans. *J Gen Intern Med*. 2006; 21(1): 71–77.
7. Baggett TP, Singer DE, Rao SR, O'Connell JJ, Bharel M, Rigotti NA. Food insufficiency and health services utilization in a national sample of homeless adults. *J Gen Intern Med*. 2011; 26(6): 627–634.
8. Luder E, Ceysens-Okada E, Koren-Roth A, Martinez-Weber C. Health and nutrition survey in a group of urban homeless adults. *J Am Diet Assoc*. 1990; 90(10): 1387–1392.
9. Vredevoe DL, Brecht ML, Shuler P, Woo M. Risk factors for disease in a homeless population. *Public Health Nurs*. 1992; 9(4): 263–269.
10. Luder E, Boey E, Buchalter B, Martinez-Weber C. Assessment of the nutritional status of urban homeless adults. *Public Health Rep*. 1989; 104(5): 451–457.
11. Drake MA. The nutritional status and dietary adequacy of single homeless women and their children in shelters. *Public Health Rep*. 1992; 107(3): 312–319.
12. National Health Care for the Homeless. Demographic and Other Client Data. 2003. Available at: http://www.nhchc.org/Research/. Accessed May 15, 2010.
13. O'Connell JJ, Oppenheimer SC, Judge CM, Taube RL, Blanchfield BB, Swain SE, Koh HK. The Boston Health Care for the Homeless Program: a public health framework. *Am J Public Health*. 2010; 100(8): 1400–1408.
14. National Alliance to End Homelessness. Homelessness counts: state by state data on homelessness. Available at: http://www.endhomelessness.org/content/article/detail/2673. Accessed March 1, 2010.
15. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999–2008. *JAMA*. 2010; 303(3): 235–241.
16. Caballero B. The global epidemic of obesity: an overview. *Epidemiol Rev*. 2007; 29: 1–5.
17. Wang Y, Beydoun MA. The obesity epidemic in the United States—sex, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiol Rev*. 2007; 29: 6–28.
18. Scheier LM. What is the hunger–obesity paradox? *J Am Diet Assoc*. 2005; 105(6): 83–84. 86.
19. Caballero B. A nutrition paradox—underweight and obesity in developing countries. *N Engl J Med*. 2005; 352(15): 1514–1516.
20. Drewnowski A, Specter SE. Poverty and obesity: the role of energy density and energy costs. *Am J Clin Nutr*. 2004; 79(1): 6–16.
21. Center on Hunger and Poverty. The Paradox of Hunger and Obesity in America. 2003. Available at: http://www.nufs.sjsu.edu/clariebh/Hunger%20and%20Obesity.pdf. Accessed June 15, 2010.
22. Randers MB, Petersen J, Andersen LJ, Krustrup BR, Hornstrup T, Nielsen JJ, Nordentoft M, Krustrup P. Short-term street soccer improves fitness and cardiovascular health status of homeless men. *Eur J Appl Physiol*. [Published online ahead of print Sep 29 2011]. http://www.springerlink.com/content/xwh0014276u72532/fulltext.html. Accessed December 4, 2011.

23. Larson NI, Story MT. Food insecurity and weight status among U.S. children and families: a review of the literature. *Am J Prev Med*. 2011; 40(2): 166–173.
24. Breakey WR, Fischer PJ, Kramer M, Nestadt G, Romanoski AJ, Ross A, Royall RM, Stine OC. Health and mental health problems of homeless men and women in Baltimore. *JAMA*. 1989; 262: 1352–1357.
25. Yun S, Zhu BP, Black W, Brownson RC. A comparison of national estimates of obesity prevalence from the behavioral risk factor surveillance system and the National Health and Nutrition Examination Survey. *Int J Obes (Lond)*. 2006; 30(1): 164–170.
26. Schwarz KB, Garrett B, Hampsey J, Thompson D. High prevalence of overweight and obesity in homeless Baltimore children and their caregivers: a pilot study. *MedGenMed*. 2007; 9(1): 48.
27. Lewis KK. *Overweight and obesity in Massachusetts: epidemic, hype or policy opportunity? Policy Brief: The Massachusetts Health Policy Forum*. 2007: 1–7.
28. Office of the Law Revision Counsel, U.S. House of Representatives. The Public Health and Welfare: Definitions. *United States Code*. 2010 Feb 1. 42 USC Sec. 11360. Available at: http://uscode.house.gov/search/criteria.shtml. Accessed July 30, 2011.