Obesity Among Chronically Homeless Adults: Is It a Problem?

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ABSTRACT

Objective. We examined rates of obesity and associated characteristics in the chronically homeless population to explore how a range of factors, including sociodemographics, housing, food source, physical and mental health, and health service use, were related to being overweight or obese.

Methods. We conducted multivariate regression analyses on a community sample of 436 chronically homeless adults across 11 U.S. cities to examine the prevalence of obesity.

Results. The majority (57%) of chronically homeless adults were overweight or obese. Chronically homeless adults who were female or Hispanic appeared to be at particular risk for obesity. There were few differences on physical and mental health by weight group. Although overweight and obese chronically homeless adults were more likely to discuss exercise with a health-care provider, they reported engaging in less exercise than those who were underweight or normal weight.

Conclusion. These findings underscore the need for greater attention to obesity in chronically homeless adults and demonstrate a food insecurity-obesity paradox or poverty-obesity link.

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Obesity has become a worldwide epidemic.¹⁻³ In the United States, 34% of adults are obese and 34% are overweight, meaning 68% are either overweight or obese.⁴ Obesity has been linked to various health problems, many of which have high morbidity and mortality, including diabetes, musculoskeletal disorders, cardiovascular disease, pulmonary disorders, and cancer.^{3,5} Thus, identifying and intervening with people who are overweight or obese has become important for primary and secondary prevention.⁶⁻⁸

There has been little study of obesity among chronically homeless adults. Homeless adults represent a marginalized, neglected segment of the population and are known to experience poorer physical health than the general population.^{9,10} Because adults who are chronically homeless lack a stable, secure residence and often cannot afford regular, healthy meals,¹¹⁻¹³ they are presumed to be underweight. However, this assumption has not been empirically examined, and there is evidence to suggest there may be an obesity problem among the homeless.

A nationally representative survey of 1,704 homeless adults and 400 soup kitchens and shelter providers in 20 cities found that 63% of homeless adults reported obtaining meals from soup kitchens and 51% from shelters in a one-week period.¹⁴ Only 17% of soup kitchens, food pantries, and shelters surveyed were working with a nutritionist or dietician. The nutritional value of food served in many soup kitchens and shelters has been found to be low in vitamins and to exceed fat, energy, and protein content recommendations.^{15,16}

A growing literature in the past decade has reported on a food insecurity-obesity paradox, whereby food insecurity, which often results from inadequate economic resources to purchase food, is associated with obesity, which is a consequence of overconsumption of food.^{17,18} Many theories have been proposed to explain this correlation, including the low cost of energy-dense foods, binge eating habits as an adaptive physiological response to food scarcity, and childhood poverty leading to obesity in adulthood.^{17,19} Related literature has also suggested a poverty-obesity link, finding that populations with high poverty rates and low education levels have the highest obesity rates.^{1,20-22}

Yet the question remains whether there is an obesity problem among chronically homeless adults, and no prior study could be found directly addressing this question. Thus, this study aimed to examine the prevalence of obesity in a multisite community sample of chronically homeless adults and explore how a range of variables known to be related to weight, including sociodemographics, income and insurance, housing,

food source, physical and mental health, and health service use, may be related to being overweight or obese.

METHODS

Data source

We conducted secondary analyses on data from the Collaborative Initiative to Help End Chronic Homelessness (CICH).²³ CICH was initiated by the U.S. Interagency Council on Homelessness and implemented in 11 cities from 2004 to 2009 to provide adults who are chronically homeless with permanent housing and primary health-care and mental health services. Criteria for eligibility as being chronically homeless were defined as an unaccompanied homeless individual with a disabling condition who has either been continuously homeless for one year or more or has had at least four episodes of homelessness in the past three years. A disabling condition included a physical and/or psychiatric disability.

Sample

Of 734 clients who consented to be evaluated in CICH, 436 (59.4%) provided information about their height and weight at baseline to be included in this study. This study focused on participants at baseline upon enrollment in CICH to examine chronically homeless adults before they received primary health-care and mental health services. Compared with clients who were excluded because they did not provide height and weight information, participants were more likely to be married, report poorer mental health, and have fewer years of lifetime homelessness.

Measures

Body mass index (BMI). We obtained height and weight from participant self-report to calculate BMI. As defined by international standards,²⁴ a BMI >25 kilograms per meter squared (kg/m^2) was classified as overweight and a BMI >30 kg/m^2 was classified as obese.

Housing. We derived the number of nights participants reported spending in different places during the three months before baseline and categorized them as follows: nights in own place (e.g., own apartment, room, or house), nights in someone else's place, nights in a hotel/boarding home, nights in an institution (e.g., transitional housing, hospital, or jail), or nights homeless (e.g., shelters, outdoors, or in vehicles).

Food source. Participants were asked whether they obtained food from any of the following places in the past month: soup kitchen; food pantry; or a mobile van, wagon, or program providing free food.

Physical and mental health. We assessed physical health using the Short Form-12 (SF-12)²⁵ and a list of 19 medical diseases/conditions, which were summed for a total score. These diseases/conditions included high blood pressure/heart condition, asthma/lung trouble, cancer, stroke, kidney/bladder trouble, arthritis/rheumatism, human immunodeficiency virus/acquired immunodeficiency syndrome, tuberculosis, hepatitis, diabetes, stomach/digestive disorder, liver trouble, seizures/epilepsy, walking problems, dental problems, chest infection/bronchitis, back/neck pain, skin problems, and foot problems.

Mental health diagnoses were self-reported by participants. Mental health was also assessed by the mental health component of the SF-12, three subscales of the Brief Symptom Inventory,²⁶ an observed psychotic behavior rating scale,²⁷ and the Addiction Severity Index (ASI).²⁸

Unhealthy behaviors. Participants were asked the extent to which they engaged in four health behaviors, derived from the Health-Promoting Lifestyle Profile,²⁹ which included use of cigarettes, consumption of alcohol, consumption of fatty foods, and level of exercise. These behaviors were rated on a four-point scale, with higher scores indicating less healthy behaviors.

Health service use. Participants were asked about the total number and type of medical and mental health (including substance abuse) treatment visits they made during the past three months. Inpatient and outpatient treatment visits were differentiated.

Discussions with health-care professional. Adapted from items from the Adult Primary Care Assessment Tool,³⁰ questions for participants included whether a health-care professional had discussed any of the following with them in the past year: exercise, alcohol use, drug use, emotional or mental problems, nutrition or diet, or smoking.

Data analysis

First, we conducted frequency analyses to summarize participants in each weight group. Second, we conducted bivariate analyses using analysis of variance and Chi-square tests to compare participants who were underweight/normal weight, overweight, or obese on various characteristics, including sociodemographics, income and health insurance, food source, physical and mental health, unhealthy behaviors, health service use, and discussions with health-care professionals. Post-hoc analyses were conducted using Fisher's least significant difference test and pairwise Chi-square tests. Third, we included significant variables found in the bivariate analyses in a forward stepwise multinomial

logistic regression to examine independent associations with each weight group, with the underweight/normal weight group serving as the reference group for the overweight and obese groups. We calculated odds ratios (ORs) and 95% confidence intervals.

RESULTS

Of the 436 participants, 42.7% were underweight or in the normal range (7.6% were underweight), 24.8% were overweight, and 32.5% were obese. Thus, 57.3% of all participants were either overweight or obese, and the mean BMI of the sample was 27.3 kg/m² (standard deviation [SD] = 7.22).

Among the 327 men in the study, 48.3% were underweight/normal weight, 25.1% were overweight, and 26.6% were obese. Among the 109 women in the study, 25.7% were underweight/normal weight, 23.9% were overweight, and 50.5% were obese.

Bivariate analyses of the total sample determined that participants who were obese were significantly more likely to be female and Hispanic, and to have spent more days in a hotel/boarding home than those who were underweight/normal weight. There were no significant group differences in any other housing variables or in income, health insurance, or food source variables. The total sample reported a total mean income of \$335.10 (SD=\$332.57) in the past month, which equates to \$4,021.20 annually. Of the total sample, 226 of 435 participants (52.0%) reported eating from a soup kitchen, 105 of 434 participants (24.2%) reported eating from a food pantry, and 136 of 435 participants (31.3%) reported eating from a mobile food van in the past month (Table 1).

There were no significant differences on any measures of physical and mental health, except that participants who were overweight had significantly higher ASI-Drug scores than those who were obese, and examination of individual medical diseases/conditions found that participants who were obese were significantly more likely to report high blood pressure or a heart condition than those who were underweight/normal weight.

In comparing unhealthy behaviors, participants who were obese reported greater efforts to smoke fewer cigarettes than those who were underweight/normal weight, and those who were obese or overweight reported a lower level of exercise (OR = 1.22 for obese and 1.34 for overweight) than those who were underweight/normal weight. Participants who were obese were more likely to discuss exercise with a health-care provider (OR=2.74) than those who were underweight/normal weight.

Table 1. Bivariate analyses of characteristics associated with weight group among chronically homeless adults enrolled in an 11-site supported housing initiative: U.S., 2004–2009

Characteristic	Underweight/normal weight		Overweight		Obese		Test of difference	Group difference ^b
	(n = 186) ^a	N (percent) or mean (SD)	(n = 108)	N (percent) or mean (SD)	(n = 142)	N (percent) or mean (SD)		
Sociodemographics								
Age in years	46.5 (8.1)		44.5 (8.8)		44.7 (9.0)		F(2,433) = 2.65	NS
Gender: female	28 (15)		26 (24)		55 (39)		$\chi^2(2) = 24.15^c$	1,2>3
Race/ethnicity								
White	66 (36)		35 (33)		55 (40)		$\chi^2(6) = 14.01^d$	3>1
Black	105 (57)		55 (51)		64 (46)			
Asian/American Indian/Pacific Islander	10 (5)		10 (9)		6 (4)			
Hispanic	4 (2)		7 (7)		14 (10)			
Years of education	11.9 (2.3)		12.0 (2.0)		11.7 (2.3)		F(2,433) = 0.76	NS
Income and health insurance								
Employment income, past month	\$64.34 (\$198.94)		\$44.68 (\$166.90)		\$39.67 (\$137.55)		F(2,433) = 0.93	NS
Public support income, past month	\$264.77 (\$305.07)		\$267.93 (\$291.39)		\$277.45 (\$314.00)		F(2,433) = 0.07	NS
Total income, past month	\$346.55 (\$345.85)		\$322.81 (\$301.86)		\$329.45 (\$338.84)		F(2,433) = 0.20	NS
Medicaid	37 (20)		22 (20)		33 (23)		$\chi^2(2) = 0.69$	NS
Medicare	13 (7)		7 (6)		9 (6)		$\chi^2(2) = 0.05$	NS
State or local medical assistance	74 (40)		36 (33)		56 (40)		$\chi^2(2) = 1.37$	NS
Private insurance	3 (2)		2 (2)		1 (1)		$\chi^2(2) = 0.72$	NS
No health insurance	40 (22)		18 (17)		23 (17)		$\chi^2(2) = 1.75$	NS
Housing								
Lifetime years homeless	7.7 (5.7)		7.3 (5.5)		7.9 (6.8)		F(2,433) = 0.24	NS
Age first homeless	34.2 (11.5)		34.2 (11.0)		32.3 (12.3)		F(2,433) = 1.24	NS
Nights in own place, past three months	4.5 (13.6)		7.0 (19.4)		5.6 (16.1)		F(2,433) = 0.85	NS
Nights in a hotel/boarded home, past three months	1.2 (5.9)		3.9 (15.1)		6.0 (19.0)		F(2,433) = 4.85 ^e	3>1
Nights homeless, past three months	59.8 (35.9)		57.5 (38.5)		54.7 (37.1)		F(2,433) = 0.75	NS

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Table 1 (continued). Bivariate analyses of characteristics associated with weight group among chronically homeless adults enrolled in an 11-site supported housing initiative: U.S., 2004–2009

Characteristic	Underweight/normal weight (n=186) ^a N (percent) or mean (SD)	Overweight (n=108) N (percent) or mean (SD)	Obese (n=142) N (percent) or mean (SD)	Test of difference	Group difference ^b
Food source					
Used soup kitchen, past month	97 (52)	61 (57)	68 (48)	$\chi^2(2) = 2.04$	NS
Used food pantry, past month	50 (27)	24 (22)	31 (22)	$\chi^2(2) = 1.29$	NS
Used mobile food program providing free food, past month	60 (32)	33 (31)	43 (30)	$\chi^2(2) = 0.16$	NS
Unhealthy behaviors ^f					
Use of cigarettes, past three months	2.9 (1.2)	2.7 (1.2)	2.6 (1.2)	$F(2,432) = 4.19^d$	1>3
Consumption of alcohol, past three months	2.2 (1.3)	2.0 (1.3)	1.9 (1.2)	$F(2,432) = 2.04$	NS
Consumption of fatty foods, past three months	2.4 (0.8)	2.3 (0.8)	2.4 (0.7)	$F(2,432) = 0.25$	NS
Low level of exercise, past three months	1.9 (1.2)	2.4 (1.3)	2.2 (1.3)	$F(2,432) = 4.85^e$	2,3>1
Discussed with health-care professional in past year ^g					
Exercise	60 (32)	47 (44)	71 (50)	$\chi^2(2) = 10.92^a$	3>1
Alcohol use	105 (56)	67 (62)	70 (49)	$\chi^2(2) = 4.15$	NS
Drug use	93 (50)	60 (56)	75 (53)	$\chi^2(2) = 0.87$	NS
Emotional or mental problems	117 (63)	76 (70)	100 (70)	$\chi^2(2) = 2.72$	NS
Nutrition or diet	80 (43)	56 (52)	73 (51)	$\chi^2(2) = 3.16$	NS
Smoking	111 (60)	64 (59)	85 (60)	$\chi^2(2) = 0.01$	NS

^aFive participants were missing data on race/ethnicity, four were missing data on use of state or local assistance or having no health insurance, three were missing data on Medicaid, two were missing data on the use of a food pantry or use of Medicare, and one was missing data on use of soup kitchens and mobile food vans, use of private insurance, and health behaviors.

^b1 = underweight/normal weight, 2 = overweight, 3 = obese. Reference groups for categorical variables included female, white, and discussed exercise with health-care professional.

^c $p<0.001$

^d $p<0.05$

^e $p<0.01$

^fUnhealthy behaviors were rated on a four-point scale, with higher scores indicating more unhealthy behaviors.

^gPercentages do not add up to 100% because participants could select more than one.

SD = standard deviation

NS = not significant

Using multivariate analyses, including only significant variables in a forward stepwise multinomial logistic regression model, we found that the strongest associations with being obese were being female (OR=3.85), discussing exercise with a health-care provider (OR=2.74), and reporting a low level of exercise (OR=1.22). The strongest associations with being overweight included discussing exercise with a health-care provider (OR=1.87), having higher ASI-Drug scores (OR=1.63), being female (OR=1.60), and reporting a low level of exercise (OR=1.34) (Table 2).

DISCUSSION

The majority (57%) of chronically homeless adults were overweight or obese, which is less than the 68% of obese or overweight individuals in the general U.S. population.⁴ However, given that this was a sample of homeless adults who reported an annual income (\$4,021.20) that is less than half of the 2010 national poverty threshold³¹ for adults younger than 65 years of age (\$11,344), and that the majority (52%) reported

eating from a soup kitchen in the past month, this finding suggests that there is an unexpected obesity problem in this population, in line with the food insecurity-obesity paradox^{17,18} and the poverty-obesity link.^{1,20,22}

Various theories have been proposed about the association among food insecurity, poverty, and obesity,¹⁷ and the development of obesity is likely multifactorial, involving environmental, behavioral, and genetic factors.^{5,32} But one likely contributing factor to obesity among chronically homeless adults is their primary food source—i.e., soup kitchens and shelters, many of which have been found to serve foods that are high in fat and energy-dense.^{15,16} Despite no association between food source and obesity observed in this study, with the majority of homeless adults being obese, dietary education and improved access to nutritious, healthy food is imperative.¹¹

Obesity was especially prevalent among chronically homeless women, with 74% of homeless women compared with 52% of homeless men being either overweight or obese, which is a reverse gender trend

Table 2. Forward stepwise multinomial logistic regression of variables associated with weight group among chronically homeless adults enrolled in an 11-site supported housing initiative: U.S., 2004–2009

Variable	OR (95% CI)
Overweight	
Days in hotel/boarded home	1.03 (1.00, 1.06) ^a
Use of cigarettes	0.80 (0.65, 0.99) ^a
Race/ethnicity: white	0.30 (0.08, 1.13)
Race/ethnicity: black	0.25 (0.07, 0.94) ^a
Race/ethnicity: Asian/American Indian/Pacific Islander	0.53 (0.11, 2.57)
ASI-Drug score	1.63 (1.16, 2.29) ^b
Low level of exercise	1.34 (1.10, 1.63) ^b
Discussed exercise with health-care provider	1.87 (1.11, 3.16) ^a
Female	1.60 (0.84, 3.06)
Obese	
Days in hotel/boarded home	1.03 (1.00, 1.06) ^c
Use of cigarettes	1.03 (1.00, 1.06) ^a
Race/ethnicity: white	0.23 (0.07, 0.80) ^a
Race/ethnicity: black	0.15 (0.04, 0.53) ^b
Race/ethnicity: Asian/American Indian/Pacific Islander	0.14 (0.03, 0.72) ^a
ASI-Drug score	1.17 (0.80, 1.72)
Low level of exercise	1.22 (1.01, 1.48) ^a
Discussed exercise with health-care provider	2.74 (1.65, 4.54) ^c
Female	3.85 (2.16, 6.87) ^c

Note: The underweight/normal weight category is the reference group. Race/ethnicity categories are compared with Hispanic as the reference group. ORs for ASI-Drug scores represent odds with every increase of 0.1 in scores.

^ap<0.05

^bp<0.01

^cp<0.001

OR = odds ratio

CI = confidence interval

ASI = Addiction Severity Index

in the general population, in which 64% of women vs. 72% of men are overweight or obese.⁴ This increased risk for overweight/obesity among homeless women is consistent with the literature on the food insecurity-obesity paradox. Additionally, after adjusting for other sociodemographic factors, being Hispanic also increased the risk for obesity and suggests that obesity may be particularly related to food insecurity in some racial/ethnic groups.¹⁷ Special attention may need to be given to the weight status of chronically homeless adults who are female and/or Hispanic; further research is needed on the diets and eating habits of these groups.

There were few differences on physical and mental health by weight group. We speculate the reason is that chronically homeless adults are an unhealthy population group in general, so obesity was not necessarily associated with worse health. Another reason may be that chronically homeless adults may be unaware of their medical conditions, and better outreach and screening procedures may be needed.^{9,10} Even though overweight and obese homeless adults were more likely to discuss exercise with a health-care provider, both groups reported a lower level of exercise than those who were not overweight or obese. This finding suggests that there are missed opportunities for intervention and prevention because obesity is not a common target outcome in this population.

Limitations

This study had several limitations. First, this study involved multiple comparisons, which were largely exploratory, so no causal conclusions could be made. Second, data were based on participant self-report, which may be susceptible to various response biases. Third, diet and food insecurity were not specifically measured, although it can be expected that homeless adults lack regular access to nutritional food. Detailed information on diets of this population will need to be collected in future research. Future research should also examine the timing of when obesity and homelessness occur, as this study was not able to rule out the possibility that obesity preceded homelessness. Lastly, this study was limited to participants who provided information about their height and weight, and the findings may not be generalizable to all chronically homeless adults.

CONCLUSIONS

There may be an obesity problem among chronically homeless adults, and women and Hispanic people appear to be particularly at risk. Given clear findings that obesity contributes to morbidity and mortality,

and that there are few weight interventions for homeless adults, more attention and research in this area is needed.

The Collaborative Initiative to Help End Chronic Homelessness Funder's Group representing the Departments of Housing and Urban Development, Health and Human Services, and Veterans Affairs provided essential support and guidance to this evaluation. The views presented in this article are those of the authors and do not represent the official position of any federal agency or of the U.S. government.

This study was approved by the Institutional Review Boards at VA Connecticut Healthcare System and Yale University.

REFERENCES

1. Popkin BM, Doak CM. The obesity epidemic is a worldwide phenomenon. *Nutr Rev* 1998;56(4 Pt 1):106-14.
2. James PT, Leach R, Kalamara E, Shayeghi M. The worldwide obesity epidemic. *Obes Res* 2001;9 Suppl 4:S228-S33.
3. Li Z, Bowerman S, Heber D. Health ramifications of the obesity epidemic. *Surg Clin North Am* 2005;85:681-701.
4. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. *JAMA* 2010;303:235-41.
5. Pi-Sunyer FX. The obesity epidemic: pathophysiology and consequences of obesity. *Obes Res* 2002;10 Suppl 2:97S-104S.
6. Swinburn B, Gill T, Kumanyika S. Obesity prevention: a proposed framework for translating evidence into action. *Obes Rev* 2005;6:23-33.
7. James PT, Rigby N, Leach R; International Obesity Task Force. The obesity epidemic, metabolic syndrome, and future prevention strategies. *Eur J Cardiovasc Prev Rehabil* 2004;11:3-8.
8. Pearson TA, Blair SN, Daniels SR, Eckel RH, Fair JM, Fortmann SP, et al. AHA guidelines for primary prevention of cardiovascular disease and stroke: 2002 update: consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular disease. *Circulation* 2002;106:388-91.
9. Baggett TP, Singer DE, Rao SR, O'Connell JJ, Bharel M, Rigotti NA. Food insufficiency and health service utilization in a national sample of homeless adults. *J Gen Intern Med* 2011;26:627-34.
10. Gelberg L, Linn LS. Assessing the physical health of homeless adults [published erratum appears in *JAMA* 1989;262:3132]. *JAMA* 1989;262:1973-9.
11. Weicha JL, Dwyer JT, Dunn-Strohecker M. Nutrition and health services needs among the homeless. *Public Health Rep* 1991;106:364-74.
12. Lee BA, Greif MJ. Homelessness and hunger. *J Health Soc Behav* 2008;49:3-19.
13. Whitbeck LB, Chen X, Johnson KD. Food insecurity among homeless and runaway adolescents. *Public Health Nutr* 2006;9:47-52.
14. Burt MR, Cohen BE. Feeding the homeless: does the prepared meals provision help? Report to Congress on the Prepared Meal Provision. Washington: The Urban Institute; 1988.
15. Carrillo T, Gilbride JA, Chan MM. Soup kitchen meals: an observation and nutrient analysis. *J Am Diet Assoc* 1990;90:989-91.
16. Sisson LG, Lown DA. Do soup kitchen meals contribute to sub-optimal nutrient intake & obesity in the homeless population? *J Hunger Environ Nutr* 2011;6:312-23.
17. Dinour LM, Bergen D, Yeh MC. The food insecurity-obesity paradox: a review of the literature and the role food stamps may play. *J Am Diet Assoc* 2007;107:1952-61.
18. Dietz WH. Does hunger cause obesity? *Pediatrics* 1995;95:766-7.
19. Townsend MS, Pearson J, Love B, Achterberg C, Murphy SP. Food insecurity is positively related to overweight in women. *J Nutr* 2001;131:1738-45.
20. McLaren L. Socioeconomic status and obesity. *Epidemiol Rev* 2007;29:29-48.
21. Drewnowski A, Specter SE. Poverty and obesity: the role of energy density and energy costs. *Am J Clin Nutr* 2004;79:6-16.
22. Sobal J, Stunkard AJ. Socioeconomic status and obesity: a review of the literature. *Psychol Bull* 1989;105:260-75.

23. Mares AS, Rosenheck RA. HUD/HHS/VA collaborative initiative to help end chronic homelessness. West Haven (CT): Northeast Program Evaluation Center; 2009.
24. World Health Organization. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. Geneva: WHO; 1995.
25. Ware J Jr, Kosinski M, Keller SD. A 12-item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996;34:220-33.
26. Derogatis LR, Spencer N. The brief symptom index: administration, scoring, and procedure manual. Baltimore (MD): Johns Hopkins University Press; 1992.
27. Dohrenwend B. Psychiatric epidemiology research interview (PERI). New York: Columbia University Social Psychiatry Unit; 1982.
28. McLellan AT, Luborsky L, Woody GE, O'Brien CP. An improved diagnostic evaluation instrument for substance abuse patients. The Addiction Severity Index. *J Nerv Ment Dis* 1980;168:26-33.
29. Walker SN, Sechrist KR, Pender NJ. The health-promoting lifestyle profile: development and psychometric characteristics. *Nurs Res* 1987;36:76-81.
30. Shi L, Starfield B, Xu J. Validating the adult primary care assessment tool. *J Fam Pract* 2001;50:161-75.
31. Census Bureau (US). Poverty thresholds for 2010 by size of family and number of related children under 18 years [cited 2012 Feb 1]. Available from: URL: <http://www.census.gov/hhes/www/poverty/data/threshld/thresh10.xls>
32. Taubes G. As obesity rates rise, experts struggle to explain why. *Science* 1998;280:1367-8.