Clinical Research and Methods

Undiagnosed Obesity: Implications for Undiagnosed Hypertension, Diabetes, and Hypercholesterolemia

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Background and Objectives: *Since obesity is a risk factor for hypertension, diabetes, and hypercholesterolemia, health care providers should screen obese individuals for these common diseases. It is possible that obese adults are not receiving appropriate screening for these diseases. This study's objective was to describe the prevalence of undiagnosed obesity, diabetes, hypertension, and hypercholesterolemia, in a nationally representative sample of obese US adults, by patients' recollection of whether they had received such a diagnosis.* Methods: *The prevalence of undiagnosed disease was obtained by identifying respondents in the 1999–2000 National Health and Nutrition Examination Survey (NHANES) who had findings consistent with a condition but who did not report being told they had that condition by a health care provider.* Results: *The prevalence of undiagnosed obesity, diabetes, hypertension, and hypercholesterolemia in currently obese US adults is 22.9%, 11.3%, 16.1%, and 37.7%, respectively. Significant predictors of undiagnosed obesity include black race and younger age. In addition, obese adults with excellent self-reported general health condition and lower body mass index are less likely to have diagnosed obesity.* Conclusions: *Health care providers are missing valuable opportunities to address obesity and diagnose diabetes, hypercholesterolemia, and hypertension in obese adults. An emphasis on screening obese individuals for these diseases is needed to improve health promotion.*

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The deleterious effects of obesity on health have been well documented. Obesity has been shown to increase mortality,[1-3] aggravate common medical conditions such as cardiovascular disease[4,5] and diabetes,[6] and increase health care costs.[7] Obesity is also common, with its prevalence in the US population continuing to rise despite the growing evidence that it is unhealthy and costly. A recent study showed increased prevalence of obesity to 30.5% of the US population in 1999–2000 from 22.9% in 1994–1998, with a concomitant increase in overweight individuals and extreme obesity.[8] This demonstrates the continuation of a trend that began in the 1980s, given that the prevalence of obesity had been relatively stable from 1960 to 1980.[9,10]

Diabetes mellitus, hypertension, and dyslipidemia are prevalent diseases that are linked to obesity. The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus identified being overweight or obese, defined as a body mass index (BMI) ≥ 27 in 1997, as a major risk factor for type 2 diabetes.[11] Obesity and weight gain have been associated with an increased risk of hypertension and dyslipidemia in a number of studies.[12-16] Currently, the US Preventive Services Task Force states that obesity is a risk factor for diabetes, hypertension, and hypercholesterolemia. However, the time interval between screenings and the age to begin screening for obese patients has not been well-defined.[17] This is an important issue, considering that hypertension, diabetes, and hypercholesterolemia lead to considerable morbidity and mortality, which can be mitigated through early recognition and treatment, with weight loss being a key management goal.[18-22]

The recognition of obesity by physicians is a crucial initial step to health promotion. However, the prevalence of physician-diagnosed obesity is less than optimal, even for patients with comorbid diseases that are linked to weight. For instance, a study using the 1999 Behavioral Risk Factor Surveillance System reported that health providers had given weight loss counseling

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to only 50% of overweight and obese people with diabetes and to 21% of overweight and obese nondiabetics.[23] This failure to deal with obesity in those with weight-related conditions suggests that the obese may also receive inadequate screening for weight-related conditions.

This study describes the patient-reported prevalence of physician-diagnosed obesity using a recent nationally representative sample, emphasizing groups at risk for undiagnosed obesity. Because of the acknowledged association between obesity and hypertension, hypercholesterolemia, and diabetes, we also describe the prevalence of undiagnosed hypertension, hypercholesterolemia, and diabetes in obese adults.

Methods

Survey Description

We analyzed data from the 1999–2000 National Health and Nutrition Examination Survey (NHANES 1999–2000).[24] The NHANES 1999–2000 is a product of the National Center for Health Statistics. It is a continuous, annual survey involving participants from a nationally representative sample of noninstitutionalized residents of the United States. Minority groups were oversampled to ensure adequate numbers for analysis, and samples are weighted so they are representative of the US population. Sampling weights were calculated taking into account unequal probabilities of selection due to sample design and planned oversampling, then matched to known population control totals to be representative of the US population. The number of unweighted adult respondents, defined as those ≥ 20 years old, is 4,880, with 1,247 of these being obese, defined as a BMI ≥ 30. This results in a weighted sample size of 49,915,375 obese adults.

The NHANES 1999–2000 consists of detailed household interviews and physical examinations that include lab work in mobile examination centers. If respondents are unwilling or unable to receive the full examination, home examinations consisting of a subset of exam components are offered. Nonresponse/refusal rates undergo statistical adjustment by using appropriate sampling weights.

Demographic Data

The respondents were divided into groups based on race, age, gender, and BMI. Race was self-reported. Age groups were formed based on screening recommendations from the National Cholesterol Education Program (NCEP), which advocates cholesterol testing starting at age 20, and American Diabetes Association (ADA) guidelines, which recommend screening for diabetes starting at age 45.[11,25] BMI was based on measured weight and height. BMI categories are consistent with 1998 National Heart, Lung, and Blood Institute guidelines, which classify obesity as a BMI ≥ 30.0.[26]

Definition of Disease

Because physician-diagnosed disease is dependent on seeing a physician, only individuals with at least one visit to a health care provider over the past year were included in the analysis. Individuals who reported never having been told by a health care provider that they have a condition, but who have a laboratory or examination result that is consistent with the condition, are classified as having undiagnosed disease. We would only expect physicians to diagnose disease based on guidelines already in place prior to the survey, which began in 1999. Thus, to remain consistent with the sampling time frame, diagnostic criteria established after 1998 were not used. Undiagnosed obesity was identified in respondents having a BMI ≥ 30.0[26] who did not report ever being told they were "overweight" or that they should "lose weight." A fasting plasma glucose level >126 mg/dL was used to establish a diagnosis of diabetes, which is consistent with the level proposed in the 1997 ADA guidelines for use in epidemiologic studies.[11] This approach, using one fasting plasma glucose level, may actually lead to slightly lower estimates of prevalence than would be obtained from the combined use of fasting plasma glucose and an oral glucose tolerance test.[27] Respondents who met the criteria were defined as having undiagnosed diabetes if they did not report ever being told by a health care provider they had diabetes or sugar diabetes.

Undiagnosed hypercholesterolemia was defined as those with total serum cholesterol >200 mg/dL who did not report ever being told they had elevated cholesterol. This classification is consistent with 1993 NCEP guidelines.[25] Undiagnosed hypertension was defined based on an average of three blood pressure measurements performed on the same day. Respondents with a mean systolic blood pressure >140 mmHg or diastolic blood pressure >90 mmHg who did not report ever being told they had hypertension or high blood pressure were classified as having undiagnosed hypertension. This classification standard is consistent with guidelines from the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.[18]

Control Variables

Health care utilization was defined using the self-reported number of outpatient visits over the prior year to a health care provider. Education level was based on the highest education level completed. General health condition was self-reported, with respondents asked to characterize their health as excellent, very good, good, fair, or poor. We were not able to include income in our analysis due to its withdrawal from the NHANES 1999–2000 data set in March 2003 as a result of inconsistencies in the data.

Analysis

Because of the complex survey design used in the NHANES 1999–2000, we accounted for the sampling design and appropriate weights in the analysis using SUDAAN (Research Triangle Institute, Research Triangle Park, NC). This strategy allows for the computation of nationally representative estimates. Population characteristics of obese adults were calculated. Subgroup analysis on the prevalence of unrecognized obesity was performed using a chi-square test for independence. A logistic regression with undiagnosed obesity as the dependent variable was performed. Forced inclusion of the predictor variables was used for this logistic regression model.

Results

The demographic composition of the population of obese adults is shown in Table 1. No analysis was performed on the "other" racial category due to heterogeneity of the group and the small sample size, which may not yield a reliable estimate.

The prevalence of undiagnosed disease in obese adults is shown in Table 2. These prevalences represent undiagnosed disease in patients with an easily identifiable risk factor—obesity—that should lead to screening for these conditions. Further analysis shows a large proportion of individuals with unrecognized hypertension, hypercholesterolemia, and diabetes have the acknowledged risk factor of obesity. Among individuals with unrecognized hypercholesterolemia, 28.4% were obese. Similarly, among individuals with undiagnosed hypertension and undiagnosed diabetes, 28.2% and 53.7%, respectively, were obese.

The prevalence of undiagnosed obesity stratified by race/ethnicity is presented in Table 3. To account for the possibility of differential health care utilization based on race/ethnicity, the prevalences in Table 3 are based on respondents who had at least one visit to a health care provider over the last year, although diagnosis could have occurred at any time, not just over the last year. Unadjusted relationships between race/ethnicity and obesity that are initially significant drop out when stratified by age and gender. There also appears to be an effect modification by gender, with women being more likely to have significant differences based on race/ethnicity, especially in the younger age group.

Results from a logistic regression using predictors for the diagnosis of obesity are shown in Table 4. As expected, BMI is an important predictor, with respondents with higher BMIs being more likely to have diagnosed obesity. Race and age were also important predictors, with younger subjects and blacks exhibiting a higher likelihood of having undiagnosed obesity, even after controlling for other variables. Respondents with worse general health condition have a lower prevalence of undiagnosed obesity. There appeared to be no effect based on health care utilization, since there was no significant difference in the diagnosis of disease for respondents with only one visit when compared to those with more than one visit over the last year.

Table 1

Population Characteristics for Obese Adults (Age ≥ 20, BMI ≥ 30) in the US Population*

	Male (%)	*Female (%)*	*Total (%)*
Non-Hispanic white	15,049,320 (30.2)	19,192,100 (38.4)	34,241,420 (68.6)
Non-Hispanic black	2,039,493 (4.1)	5,140,859 (10.3)	7,180,352 (14.4)
Hispanic	2,186,949 (4.4)	4,757,753 (9.5)	6,944,702 (13.9)
Other	960,505 (1.9)	588,394 (1.3)	1,548,900 (3.1)
All	20,236,268 (40.5)	29,679,107 (59.5)	49,915,375 (100.0)
Mean age (SD)	50.9 (16.8)	48.9 (17.4)	50.7 (17.2)
Mean BMI (SD)	34.5 (4.2)	36.0 (5.5)	35.5 (5.2)

* n=49,915,375
SD—standard deviation
BMI—body mass index

Table 2

Prevalence of Unrecognized Disease in Obese Adults in the US Population

	Unrecognized Obesity	*Undiagnosed Diabetes*	*Undiagnosed Hypertension*	*Undiagnosed Hypercholesterolemia*
Male (%)	4,587,632 (23.8%)	2,062,507 (10.7%)	3,797,325 (19.7%)	6,226,071 (32.3%)
Female (%)	6,574,501 (22.6%)	3,432,704 (11.8%)	3,985,428 (13.7%)	12,159,918 (41.8%)
Total (%)	11,162,133 (22.9%)	5,495,211 (11.3%)	7,782,753 (16.1%)	18,385,989 (37.7%)

Discussion

Diagnosis of obesity in this study was based on patient recollection. It was defined as patients reporting that their health care provider told them they were overweight or advised them to lose weight. Many factors, such as the perceived ineffectiveness of interventions, lack of

Table 3

Prevalence of Unrecognized Obesity in US Adults with BMI ≥ 30

	NHW	*NHB*	*Hisp*	P *Value*
Race total	19.7%	31.0%	30.9%	.006
Age				
20–45 years	25.5%	36.1%	41.6%	.077
>45 years	15.1%	22.1%	15.5%	.323
Male total	21.5%	30.2%	34.6%	.124
Age				
20–45 years	30.3%	32.4%	42.8%	.484
>45 years	15.4%	25.7%	20.8%	.487
Female total	18.2%	31.4%	29.2%	.007
Age				
20–45 years	22.3%	37.7%	41.0%	.066
>45 years	14.8%	20.9%	13.4%	.303

NHW—Non-Hispanic whites
NHB—Non-Hispanic blacks
Hisp—Hispanics

time, lack of reimbursement, and patient indifference, may be associated with no or ineffective counseling, leading to patients reporting that they were not identified as overweight by a physician. Either scenario can emphasize groups at high risk for undiagnosed obesity that need to be targeted for more aggressive counseling by physicians. Obtaining a current estimate is significant since we expect there might be a change in the prevalence of diagnosed obesity in comparison to previous studies due to the ongoing emphasis on weight issues by the medical literature and media.

The diagnosis of obesity by health care providers is also important due to the association of obesity with diabetes, hypertension, and hypercholesterolemia. By including only those respondents with a BMI ≥ 30, we expected respondents would be easily identifiable as obese by health care providers based on visual inspection and that this would lead to screening even if it did not lead to extensive weight loss counseling. Instead we found there was a significant prevalence of unrecognized diabetes, hypertension, and hypercholesterolemia in obese adults, ranging from 11.3% to 37.7%. This is a large proportion considering that the presence of an obvious risk factor that should lead to screening and that these diseases have considerable morbidity and mortality preventable with early diagnosis and treatment. This shows providers are missing opportunities to diagnose these treatable diseases in obese patients. This suggests it might be warranted to decrease the time interval between screenings and start screening at a younger age in the obese population. However, further evidence is necessary before specific recommendations can be made.

Table 4

Logistic Regression for Probability of Undiagnosed Obesity in Obese US Adults

Predictor Variables	*OR*	*95% CI*	*Beta*
Gender			
Male	1.000		0.000
Female	1.086	(0.716–1.649)	0.083
Body mass index (kg/m2)	0.819	(0.770–0.872)	-0.200
Age Group (years)			
20–45	2.270	(1.414–3.645)	0.820
46+	1.000		0.000
Race/ethnicity			
White	1.000		0.000
Black	2.048	(1.278–3.284)	0.717
Hispanic	1.273	(0.792–2.044)	0.241
Utilization (# of outpatient visits in previous year			
1	1.000		0.000
> 1	0.815	(0.459–1.448)	-0.204
General health condition			
Excellent	1.000		0.00
Very Good	0.555	(0.305–1.010)	-0.561
Good	0.460	(0.239–0.883)	-0.674
Fair	0.338	(0.152–0.751)	-0.783
Poor	0.257	(0.083–0.794)	-0.871
Educational level			
< high school	1.000		0.000
High school graduate	0.736	(0.393–1.376)	-0.307
College	0.643	(0.382–1.083)	-0.442

OR—odds ratio
CI—confidence interval

Results from the logistic regression highlight subgroups at higher risk of having undiagnosed obesity. Younger people will obtain the most benefit from weight reduction, based on years of life remaining.[3] Further, young adults have had the greatest increase in the prevalence of obesity in recent

years.[28] Blacks, on the other hand, are also less likely to be diagnosed as obese. Although many factors are probably involved, this may be in part due to cultural differences that lead to greater acceptance of obesity by black patients as well as by their providers.[29] As a result, health care providers should emphasize culturally appropriate weight counseling for this subgroup to overcome barriers to achieving a healthy weight. Finally, we see that obese patients with lower BMIs are more likely to have undiagnosed obesity. It is in this early stage of obesity where weight loss sufficient to reach normal weight may seem more attainable, and patients may thus be more receptive to weight loss methods than if counseled once they are already far above normal weight and suffering from weight-associated conditions, such as osteoarthritis, that interfere with exercise. Therefore, it is important to diagnose obesity early to institute appropriate interventions sooner in an attempt to control the condition.

Limitations

Several limitations must be considered when interpreting these results. First, due to the NHANES 1999–2000 survey design based on one examination, our criteria for the diagnosis of diabetes and hypercholesterolemia are based on one blood measurement rather than the more stringent definitions requiring follow-up measurements.

Also due to the NHANES 1999–2000 design, our criteria for hypertension diagnosis, although an average of three measurements, is based on measurements taken on 1 day. This is the strategy the National Center for Health Statistics uses to make population estimates, which are reasonably valid and reliable.[27,30,31] Results based on this strategy are accepted throughout the research community.[32-35] While the use of this strategy is unlikely to add a systematic bias to our results, it may lead to some lack of precision.

Further, elevated cholesterol is a screening test that should lead to further evaluation of LDL levels. We did not use LDL to make population estimates in this study since only one third of our sample had this test done, and such a small sample size would lead to unstable population estimates.

We were not able to use income in this study due to its withdrawal from the NHANES 1999–2000 at the time of this analysis. We doubt this will affect our analysis substantially, since a recent study shows that associations with the prevalence of weight loss counseling are not affected by adjustment for income.[23] In addition, much of the effects of income may be due to differences in access to care, which are controlled in our study by a measure of health care utilization. Our results are based on self-reported data, which are prone to recall bias. However, in this instance, using self-report is valid since we are interested in the patients' awareness of their condition, based on their interpretation of dialogue with their health care provider. Even if the issue was discussed, if the patient has no recollection of it, it still signifies a need for further recognition and counseling. Finally, a major strength of this study is its use of a nationally representative sample from a large database, which enables us to make estimates for the US population.

Conclusions

Health care providers are missing valuable opportunities to identify obesity and diagnose diabetes, hypercholesterolemia, and hypertension in obese adults. Emphasizing obesity as a risk factor for these conditions, with further emphasis on screening the obese population, is needed to improve health promotion.

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