The deleterious effects of obesity on health have been well documented. Obesity has been shown to increase mortality, aggravate common medical conditions such as cardiovascular disease and diabetes, and increase health care costs. 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. 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.

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. Obesity and weight gain have been associated with an increased risk of hypertension and dyslipidemia in a number of studies. 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. 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.

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 without diagnosis.
to only 50% of overweight and obese people with dia-
abetes and to 21% of overweight and obese non-diab-
etics.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 natio-
ally representative sample, emphasizing groups at risk
for undiagnosed obesity. Because of the acknowledged
association between obesity and hypertension, hyper-
cholesterolemia, and diabetes, we also describe the
prevalence of undiagnosed hypertension, hypercholes-
terolemia, and diabetes in obese adults.

Methods

Survey Description

We analyzed data from the 1999–2000 National
Health and Nutrition Examination Survey (NHANES
of the National Center for Health Statistics. It is a con-
tinuous, annual survey involving participants from a
nationally representative sample of non-institutionalized
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 re-
presentative 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 sam-
ple size of 49,915,375 obese adults.

The NHANES 1999–2000 consists of detailed house-
hold 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 com-
ponents 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 recom-
mendations from the National Cholesterol Educa-
tion Program (NCEP), which advocates cholesterol testing
starting at age 20, and American Diabetes Association
(ADA) guidelines, which recommend screening for
diabetes starting at age 45.1125 BMI was based on mea-
sured 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 sam-
pling time frame, diagnostic criteria established after
1998 were not used. Undiagnosed obesity was identified
in respondents having a BMI ≥ 30.026 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 stud-
ies.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 toler-
ance 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 choles-
terol. This classification is consistent with 1993 NCEP
guidelines.28 Undiagnosed hypertension was defined
based on an average of three blood pressure measure-
ments 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 be-
ing told they had hypertension or high blood pressure
were classified as having undiagnosed hypertension.
This classification standard is consistent with guide-
lines from the Sixth Report of the Joint National Com-
mittee on Prevention, Detection, Evaluation, and Treat-
ment 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 inconsistenc-
ies 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.

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

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**Table 1**

<table>
<thead>
<tr>
<th></th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Hispanic white</td>
<td>15,049,320 (30.2)</td>
<td>19,192,100 (38.4)</td>
<td>34,241,420 (68.6)</td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>2,039,493 (4.1)</td>
<td>5,140,859 (10.3)</td>
<td>7,180,352 (14.4)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2,186,949 (4.4)</td>
<td>4,757,753 (9.5)</td>
<td>6,944,702 (13.9)</td>
</tr>
<tr>
<td>Other</td>
<td>960,505 (1.9)</td>
<td>588,394 (1.3)</td>
<td>1,548,900 (3.1)</td>
</tr>
<tr>
<td>All</td>
<td>20,236,268 (40.5)</td>
<td>29,679,107 (59.5)</td>
<td>49,915,375 (100.0)</td>
</tr>
</tbody>
</table>

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

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

**Table 3**

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

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. Further, young adults have had the greatest increase in the prevalence of obesity in recent

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

OR—odds ratio
CI—confidence interval
Years. 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. 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. Results based on this strategy are accepted throughout the research community. 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. 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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REFERENCES


