# Socioeconomic characteristics of the population eligible for obesity surgery

**Edward H. Livingston, MD,** *and* **Clifford Y. Ko, MD, MSHS,** *Dallas, Tex, and Los Angeles, Calif*

***Background.*** *Obesity is increasing in the American population in epidemic proportions. Weight reduction surgery results in sustained weight loss for morbidly obese individuals—a group of patients refractory to nonsurgical obesity treatment. Surgical indications were outlined in a National Institutes of Health (NIH) consensus conference published in 1991. Using the NIH criteria, we compared the socioeconomic characteristics of the population eligible for these operations to those receiving them.*
***Methods.*** *The 2000 National Health Interview Survey database was examined to identify how many individuals in the American population were eligible for obesity operations. Socioeconomic characteristics for those individuals were then assessed. The Healthcare Cost and Utility Project and National Hospital Discharge Survey databases were queried to determine how many gastric bypass operations were performed and what the patient's socioeconomic characteristics were.*
***Results.*** *There are 5,324,123 people, or 2.8% of the American population, who are eligible for obesity surgery. Of these, a disproportionate number were black, poorly educated, or impoverished, and 38% rely on Medicare or Medicaid for their health insurance. Of the 28,590 gastric bypass operations performed in 2000, only 13% of patients used Medicare or Medicaid to pay for the operation. Fewer than expected operations were performed on blacks. Regional differences were observed with disproportionately more operations performed in the Northeast and fewer in the Midwest than would be predicted from the surgery-eligible population living in these regions.*
***Conclusions.*** *A significant fraction of the American population could potentially benefit from obesity surgery. However, many of those individuals are black, poorly educated, and impoverished. Public assistance programs need to account for these patients. Centers performing bariatric operations need to accommodate the educational and financial constraints these patients have when planning long-term postoperative care. (Surgery 2004;135:288-96.)*

*From the Division of Gastrointestinal and Endocrine Surgery, University of Texas Southwestern School of Medicine, the VA North Texas Health Care System, and the VA Greater Los Angeles Health Care System, Dallas, Tex, and Los Angeles, Calif*

Subsequent to the 1991 National Institutes of Health (NIH) obesity surgery consensus conference, health care insurers have recognized the value of weight reduction surgery for reducing the disease burden of obese patients. Consequently, most health care plans provide coverage for obesity operations with criteria mimicking those published by the NIH panel. With greater acceptance of the surgical approach to obesity treatment and the rising prevalence of obesity, bariatric operations are being performed in greater numbers that are having significant impact on the health care economy. Patients who have had bariatric operations require close medical follow-up. With more postoperative patients entering the medical community, accommodating their health care requirements will also affect the overall health care system. For the obese, it is known that there is a higher prevalence of poverty and fewer have health care insurance compared to the non-obese. It is unknown how this affects obese individuals' access to health care resources. Similarly, although many obese people might benefit from bariatric surgery, it is not known how much access impoverished obese patients have to this therapeutic modality.

For these reasons we investigated the socioeconomic characteristics of the American population eligible for obesity surgery. We sought to determine, based on the NIH guidelines, the absolute numbers of patients in the population eligible for surgery. We also investigated the ethnicity, educational level, financial and health insurance status, and pattern of health care access and utilization for

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Reprint Requests: Edward H. Livingston, MD, FACS, Professor and Chairman, Gastrointestinal and Endocrine Surgery, UT Southwestern Medical Center, 5323 Harry Hines Blvd Room E7-126, Dallas, TX, 75390-9156.

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individuals who might undergo obesity surgery. Results of this analysis provide a framework for health care resource allocation necessary for management of severe obesity in the American population. This investigation was accomplished with the use of the 2000 National Health Information Survey (NHIS) database. NHIS has been administered annually by the Centers for Disease Control since 1957. Each year 30,000 households are surveyed by trained census takers to determine the health and socioeconomic conditions of the families assessed. Participants are selected by their socioeconomic status, resulting in a population-representative survey. From overall census data, the individual respondents are assigned a statistical weighting factor so that the overall health condition of the United States population can be estimated. NHIS has body weight and height data with body mass indices (BMI) provided for each respondent. BMIs are used to assign health risk categories as established by the World Health Organization[1] and the 1998 National Heart, Lung and Blood Institute's[2] classifications of obesity. We also queried the Agency for Healthcare Research and Quality web site's Healthcare Cost and Utility Project (HCUP) 2000 database and the CDC's National Hospital Discharge Survey (NHDS) to determine how many gastric bypasses were performed in the year of this study. Demographics for patients undergoing surgery were compared to the surgery-eligible population.

## METHODS

The 2000 NHIS database SAMADULT was downloaded from the CDC web site ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Datasets/NHIS/2000/. Data extraction, categorization and statistical analysis were performed using the SAS software package (SAS Institute, Cary, NC).

Respondents were classified into 3 major body size categories: BMI = 18.5 to 34.9, 35 to 39.9, and ≥ 40. BMI = 18.5 to 24.9 is the normal range, 25.0 to 29.9 is defined as overweight, and 30.0 to 34.9 as class I obesity. These size ranges were combined because they are below conventionally accepted thresholds for obesity surgery. Class II obesity, that is, patients with BMIs ranging from 35 to 39.9 can be considered candidates for weight loss surgery if they have concurrent serious obesity-related medical conditions. The NIH consensus statement[3] for this size range states that individuals with severe comorbid conditions related to obesity can be considered for obesity surgery. The NHIS queries individuals regarding their functional abilities and quality of life. We assumed that individuals with obesity-related comorbid conditions that were severe enough to interfere significantly with life functions would have responded affirmatively to the NHIS variable AFLHCA18 (weight problem causes difficulty with activity). Respondents with class II obesity and an affirmative response to AFLHCA18 were considered surgery-eligible. Any person with class III obesity (BMI ≥ 40) can be considered for obesity surgery, and all respondents in this size range were considered potential surgical candidates.

Respondent ethnicity was obtained from NHIS variable HISCOD_I (combined race/ethnicity recode). The highest educational level achieved was derived from the variable EDUC (highest level of school). Poorly educated was defined as having the highest level of education received be 12$^{th}$ grade or less and not receiving a high school diploma. Poverty was defined as having an income below $20,000 annually and is denoted in the variable AB_BL20K (income below $20,000 annually). The ratio of income relative to the poverty level was found in variable RAT_CAT (ratio of family income to the poverty threshold). The type of facility where most health care was received was derived from the NHIS variable APLKIND. Data regarding access and utilization of health care resources was found in the Health Care Access module of the NHIS database.

The HCUPnet website (http://www.ahcpr.gov/data/hcup/hcupnet.htm) was queried for the number of gastric bypasses (ICD-9-CM code 44.31) performed in 2000. Data regarding patients' age, gender, income level, and payer category were obtained. Many states reporting to the HCUP do not provide race. Thus, conclusions regarding the ethnic distribution of patients undergoing surgery are unreliable. To obtain better information regarding ethnicity, we duplicated this analysis with the National Hospital Discharge Survey database obtained from the CDC website (http://www.cdc.gov/nchs/about/major/hdasd/nhds.htm). Discharges assumed to be related to obesity surgery were those coded with a DRG-288 and principle procedure codes of 44.31, 44.39, 44.5, and 44.69. Database entries were weighted to the 1990 United States Population Census facilitating estimation for the annual number of operations performed.

Logistic regression was used to determine the influence that race, educational level, gender, and poverty had on the likelihood that individuals are obesity surgery candidates. The variables were dichotomized, with surgical eligibility used as the dependent variable. Interactions between these variables were determined by factorial ANOVA.

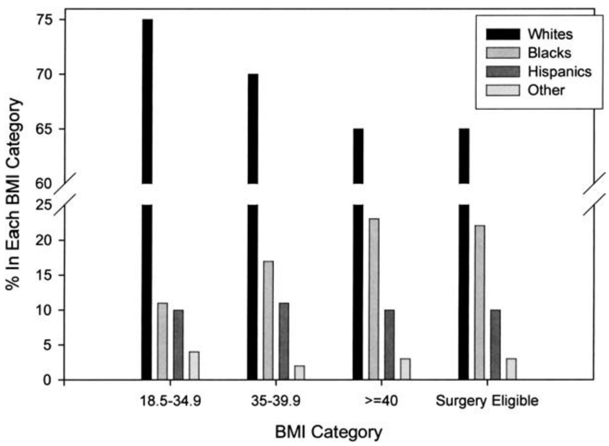


**Fig 1.** Demographic distribution of the US population into the major BMI categories and surgery eligibility. Seventy-five percent of those with BMIs ranging from 18.5 to 34.9 were white, 11% were black, and 10% were Hispanic. For those who were surgery eligible, 66% were white, 21% black, and 10% Hispanic.

## RESULTS

**Numeric estimates.** Of the 32,374 respondents in the NHIS 2000 database, 31,680 had BMIs exceeding 18.5 and were representative of 193,516,724 adult Americans. The remainder, representing 4.3 million people, either were underweight with BMIs less than 18.5 or did not have BMI information in the database.

Of the adult American population in 2000, 179,700,000 (93%) had BMIs ranging from 18.5 to 35. Another 4,646,810 (2.4%) had class III obesity and were eligible for obesity surgery based on size alone.

There were 9,169,914 (4.7%) Americans with class II obesity. We assumed those reporting that "weight problems resulted in functional limitations" represented the population of surgery-eligible patients with class II obesity. Weight problems caused difficulty with activities for 1,144,255 (2.3%) of adults with BMIs between 18.5 and 35. Of those with class II obesity, 677,313 (16.1%) had weight-related activity limitations, and 797,285 (28.5%) of those with class III obesity were limited. Adding the activity-limited class II obese individuals to the class III obese population resulted in 5,324,123, or 2.8% of the American population, that was potentially eligible for obesity surgery. Of these, 36% were male and 64% female. Of the surgery-eligible population, 84% were age 60 or younger, another 6% ranged from age 60 to 65, 5% were age 65 to 70, and the remaining 5% were older than age 70.

**Demographics.** Figure 1 displays demographic information classified by race and BMI category. A greater portion of the obese BMI categories were composed of blacks at the expense of fewer whites. Eleven percent of the non-morbidly obese population is black, yet 17% of all respondents with class II obesity and 23% with class III obesity were black. There were fewer than expected obese whites: 75% of the population is white, whereas 69% of class II and 64% of class III obese subjects were white. Hispanics account for 10% of the total adult American population. Because 10% of each BMI category and surgery-eligible category was Hispanic, no disproportionate amount of obesity was observed in the Hispanic population. The mean age was not affected by BMI class or surgery eligibility; it ranged from 45 to 46 years for each category.

There was a significant trend toward lower educational levels for obese individuals (Table I). The fraction of individuals whose maximal educational level was less than high school level progressively increased with greater degrees of obesity. Approximately 30% of each weight category had obtained a high school diploma or Graduate Equivalency Diploma as their highest level of education. Only about half as many morbidly obese individuals had bachelor or doctorate degrees compared to the non-morbidly obese.

Whereas 19.1% of normal-sized individuals had an income of less than $20,000 annually, 27.6% of morbidly obese respondents were in this low-income category. Poverty was prevalent among the morbidly obese. In contrast 23% of normal-sized and 18% of obese individuals had incomes more than five times the poverty line, yet only 14% of morbidly obese respondents were in the higher income category.

All the groups had similar rates of marriage: 58% for both the normal weight and obese individuals, and 55% for the morbidly obese. The divorce/separation rate was the same for all groups, being 11%.

**Health care access, utilization, and insurance.** Health care access was good (Table II): most respondents had a place to go for their health care needs irrespective of their BMI. Many received their care in a doctor's office, HMO, clinic, or health center. Few relied on hospital emergency rooms or clinics for their routine care. Obese individuals utilized health care resources more than their non-obese counterparts. Consistent with high poverty levels in the obese population, greater numbers of obese individuals than non-obese individuals could not afford medications, eyeglasses, or mental health or dental care. Obesity was associated with greater numbers of provider office visits and more specialty care usage. Fewer obese women

**Table I.** Highest educational level and income classified by BMI category

| | *BMI* | | | |
|---|---|---|---|---|
| | *18.5–34.9* | *35.0–39.9* | *≥ 40* | *Surgery eligible* |
| Grade school | 15,060 (8.4) | 884 (9.6) | 488 (10.5) | 562 (10.6) |
| High school or less | 16,450 (9.2) | 1,060 (11.6) | 622 (13.4) | 680 (12.8) |
| High school graduate or GED | 53,910 (30.0) | 2,987 (32.6) | 1,444 (31.1) | 1634 (30.7) |
| Some college or AA | 50,480 (28.1) | 2,993 (32.6) | 1,440 (31.0) | 1716 (32.2) |
| BS, BA degree | 27,860 (15.5) | 838 (9.1) | 377 (8.1) | 425 (8.0) |
| MS, MA degree | 10,580 (5.9) | 310 (3.4) | 215 (4.6) | 227 (4.3) |
| Doctorate | 4,149 (2.3) | 74 (0.8) | 34 (0.7) | 53 (1.0) |
| Unknown | 1,246 (0.7) | 23 (0.3) | 27 (0.6) | 27 (0.5) |
| Income | | | | |
| > 20,000 | 136,300 (75.8) | 6,787 (74.0) | 3,019 (65.0) | 3,559 (66.8) |
| < 20,000 | 34,260 (19.1) | 1,899 (20.7) | 1,381 (29.7) | 1,518 (28.5) |
| Unknown | 9,175 (5.1) | 483 (5.3) | 247 (5.3) | 247 (4.6) |

The total population for each category is value listed in the table ×1000. Numbers in parentheses are the column percentages for each BMI category. *GED*, Graduate equivalency degree.

had Pap smears and more obese men had prostate-specific antigen tests compared to the non-obese.

Approximately 15% of the population had no health insurance (Table II). Of the total American population, 65% to 75% had private health insurance and another 17% relied on Medicare. More surgery-eligible individuals relied on Medicaid for health insurance than did individuals not eligible for surgery: 11.9% versus 4.5% (Table II).

**Comorbid conditions.** Diabetes, hypertension, and lung disease are all problems known to increase in prevalence with obesity. Table III demonstrates that each of these conditions also results in greater disability for morbidly obese and surgery-eligible respondents. In contrast, musculoskeletal conditions, arthritis, and fractures—all generally associated with obesity—did not result in greater disability with increased body weight.

**Socioeconomic factor interactions.** Figure 2 demonstrates the relationship between gender, race, poverty, educational level, and surgical eligibility. Approximately 14% of those who were not eligible for surgery who were impoverished or undereducated were white men. Of the surgery-eligible population, this proportion increased to 22% for white men. For all women, greater fractions of the surgery-eligible population were impoverished, indicating that poverty was an independent risk factor for surgical eligibility for all women and white men. Lower levels of education were a risk factor for surgical eligibility for white men and for white and black women.

**Surgical procedures.** In 2000, the HCUP database reported that 20,771 gastric bypasses (coded as 44.31) were performed in the United States. Of these, 86% were in women and 14% in men. The majority had commercial insurance plans (81%), 5% had Medicare, and 8% had Medicaid; 4% were uninsured. Only 4% of patients undergoing gastric bypass surgery were below the poverty level. There was excellent concordance between the HCUP and NHDS databases: in NHDS, there were 21,228 estimated gastric bypass procedures coded as 44.31 compared with the 20,771 that were similarly coded in HCUP. Because not all anti-obesity operations are gastric bypasses, other gastric procedure codes will capture these operations if used in conjunction with DRG-288 (OR procedures for obesity). Inclusion of the other gastric surgery codes increased the estimate to 28,590 anti-obesity operations performed in 2000.

Figure 3 illustrates the differential access to obesity surgery by whites and blacks, and the influence of insurance coverage. For the entire population, the same numbers of whites who are eligible for surgery receive it. In contrast, 21% of all surgery-eligible individuals are black, but only 9% of all those undergoing anti-obesity operations are black. Twenty-five percent of white and 34% of black surgery-eligible individuals relied on Medicare or Medicaid for their health insurance. Only 6% of white and 12% of black patients undergoing these operations had Medicaid or Medicare health insurance. Approximately three fourths of all white individuals who were surgery eligible had private insurance, similar to the proportion receiving obesity operations. About half of all blacks eligible for surgery had private insurance, and three fourths of those undergoing the surgery were insured. There was a good match between surgery eligibility and proportions of individuals receiving operations in the South and West, but more than expected

**Table II.** Health care access in relation to obesity

| | Non-surgery eligible | Surgery eligible |
|---|---|---|
| Location of health care | | |
| Clinic or health center | 16.1% | 21.4% |
| Doctors' office or HMO | 79.2% | 74.6% |
| Hospital ER | 0.9% | 1.5% |
| Hospital OPD | 1.8% | 3.0% |
| Health care access and utilization | | |
| Seen during the past year.... | | |
| Mental health provider | 6.0% | 10.7% |
| Podiatrist | 5.9% | 12.9% |
| NP/PA/midwife | 11.5% | 19.3% |
| Specialist | 24.4% | 34.7% |
| General MD | 65.7% | 77.3% |
| Need a referral for specialized care | 24.6% | 34.7% |
| Cannot afford dental care | 8.5% | 14.5% |
| Cannot afford eyglasses | 5.0% | 10.5% |
| Cannot afford presecription medicines | 5.7% | 13.8% |
| Cannot afford mental health care | 1.6% | 3.7% |
| Could not get an appointment soon enough-delayed health care access | 5.1% | 9.1% |
| Lack of transportation Delayed access to medical care | 1.2% | 3.3% |
| Receive home health care | 1.8% | 4.0% |
| Number of office visits during the past year | | |
| 0–3 | 62.5% | 44.2% |
| >4 | 36.9% | 54.1% |
| Preventative health care | | |
| Pap smear in the past year | 66.8% | 57.5% |
| PSA in the past year | 67.0% | 74.9% |
| Health care insurance | | |
| No health insurance | 14.5% | 13.8% |
| Private health insurance from employer or work | 64.2% | 61.3% |
| Private health insurance purchased directly | 8.7% | 4.9% |
| Medicare | 16.9% | 15.5% |
| Medicaid | 4.5% | 11.9% |

Data are presented in reference to those who were surgery eligible compared to those who were not. Values in the columns are the percentages of individuals in these categories for the characteristics listed in the left column.
*HMO*, Health maintenance organization; *ER*, emergency room; *OPD*, outpatient department; *NP*, nurse practitioner; *PA*, physician's assistant; *PSA*, prostate-specific antigen.

numbers of individuals had operations in the Northwest and fewer in the Midwest (Fig 4).

## DISCUSSION

Since the 1991 NIH obesity surgery consensus statement, there has been a substantial increase in the number of obese Americans. In 1991, 4 million Americans had BMIs between 35 and 40 kg/m$^2$, and

**Table III.** Functional limitations associated with comorbid conditions

| | Non-surgery eligible | Surgery eligible |
|---|---|---|
| Activity limitations | | |
| Any | 28.7% | 64.9% |
| By a chronic illness: | | |
| Diabetes | 3.7% | 8.4% |
| Lung | 6.4% | 9.5% |
| Cancer | 1.4% | 1.1% |
| Depression/anxiety | 6.1% | 7.0% |
| Musculoskeletal | 8.5% | 9.7% |
| Circulatory system | 1.6% | 1.4% |
| Nervous system | 3.4% | 2.8% |
| Digestive problem | 1.0% | 1.3% |
| Genitourinary condition | 0.8% | 0.7% |
| Alcohol/drug problem | 0.1% | 0.0% |
| Arthritis | 30.9% | 31.9% |
| "Old age" | 1.6% | 0.2% |
| Back/neck problems | 27.6% | 24.6% |
| Bone/joint fracture | 13.4% | 11.8% |
| Injury | 4.6% | 3.5% |
| Heart problem | 7.2% | 6.7% |
| Stroke | 2.3% | 1.0% |
| Hypertension | 4.6% | 27.8% |

Values are the column percentages for the non-surgery–eligible and surgery-eligible populations.

another 1.5 million,[3] or 0.9% of the population,[4] had BMIs higher than 40. Based on the 2000 NHIS results, there are now 9,169,914 Americans with BMIs ranging from 35.0 to 35.9 kg/m$^2$ and 4,646,810 Americans, or 2.4% of the population, with BMIs exceeding 40. The addition of the 677,313 individuals with BMIs ranging from 35 to 40 who are functionally disabled results in 5,324,123, or 2.8% of the American population, eligible for obesity surgery.

There was a striking pattern in the data: respondents eligible for obesity surgery had lower educational and income levels and a greater dependence on Medicaid than their non-morbidly obese counterparts. Of the morbidly obese population, 21% are black, 10% are Hispanic, 29% are near or below the poverty line, 54% have a high school education or less, nearly 12% have Medicaid health insurance, and another 16% use Medicare. Substantial numbers of patients undergoing obesity surgery operations rely on public insurance programs for coverage. They are less educated than their non-obese counterparts. Successful maintenance of weight loss after obesity surgery relies on patient compliance with postoperative medical and dietary management and regular follow-up. A significant number of patients eligible for these operations may have difficulty complying with the

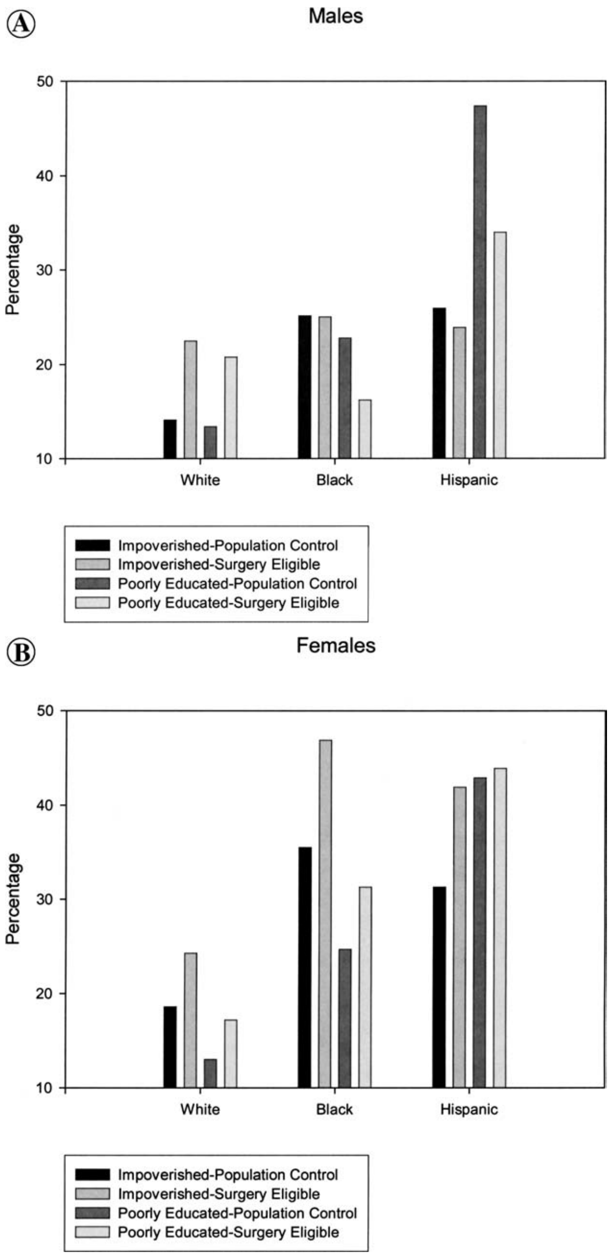


**Fig 2. A,** Effect of poverty and highest educational level achieved on surgical eligibility for males. The bars represent the proportions of the white, black, and Hispanic populations that are impoverished or undereducated stratified by surgical eligibility. **B,** Effect of poverty and highest educational level achieved on surgical eligibility for females. The bars represent the proportions of the white, black, and Hispanic populations that are impoverished or undereducated stratified by surgical eligibility.

necessary postoperative management schemes because of financial and educational limitations. NHIS data showed that access to health care resources was good for this population, although

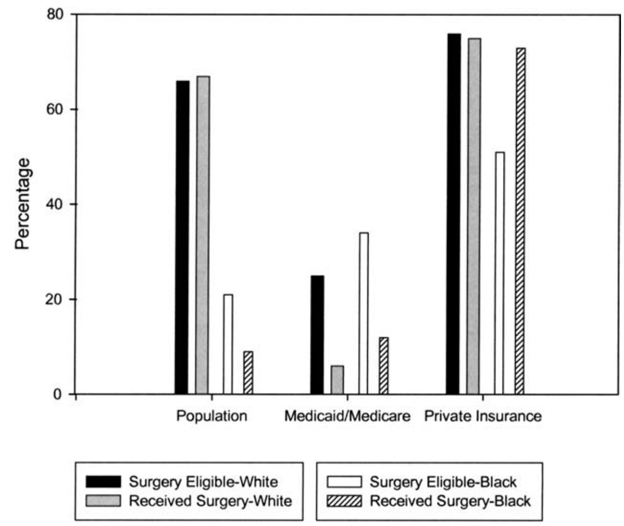


**Fig 3.** Distribution of surgical eligibility compared to surgery performed. Approximately 66% of all individuals meeting the criteria for bariatric surgery were white, as were 67% of all those who received obesity operations. In contrast, 21% of all those eligible for surgery were black, but only 9% of those undergoing these operations were black. Substantially fewer individuals with Medicaid insurance receive surgery than were eligible. For whites, 76% have private insurance, with a similar proportion of whites receiving the operation having private insurance. For blacks, 51% of all surgery eligible individuals had private health insurance, yet 73% of all blacks undergoing the procedures had private health insurance.

they frequently could not afford to pay for medications or other necessary medical treatments. For obesity surgery to result in sustained weight control, the education and financial constraints that many of these patients have must be accounted for.

Despite the fact that nearly one third of the American population lacks or has inadequate health insurance, access to routine, outpatient health care is good. We found that utilization of health care resources increased with morbid obesity despite the fact that larger proportions of these individuals were impoverished or underinsured. In Canada, where there is national health insurance, health care utilization increased with obesity. It was hypothesized that this trend related to improved access resulting from universal health insurance coverage.[5] Similarly, for female HMO patients, utilization of health care resources and costs increased with increasing BMI.[6,7] These trends could be related to equal health care access in an HMO setting irrespective of socioeconomic status. Few studies have examined health care access and utilization in nationally representative populations. Of these, the cohorts investigated

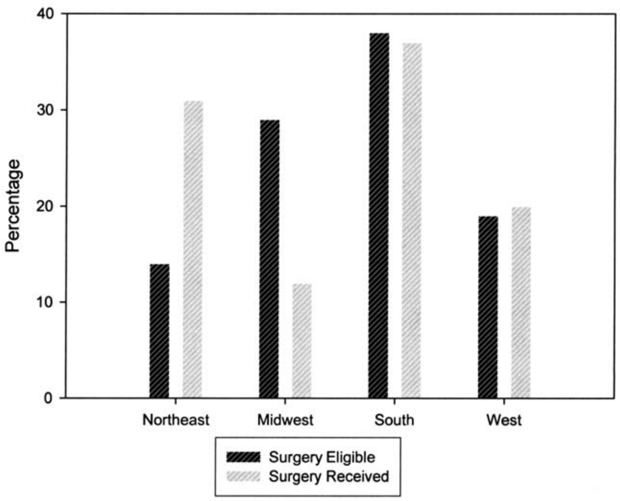


**Fig 4.** Distribution of surgical eligibility and surgery performed by geographic region. Fourteen percent of all surgery-eligible patients reside in the Northeast, whereas 31% of all anti-obesity operations performed were done there. Fewer procedures than expected were performed in the Midwest: 29% of all surgery-eligible patients were located in the Midwest, yet only 12% of all the operations were performed there. The numbers of surgery-eligible and surgeries performed were matched in the South (38%) and West (20%).

were limited in scope. Review of women aged 45 to 49 found that health care utilization increased with BMI.[8] Utilization increased with obesity, and preventative care decreased when the 1992 NHIS was analyzed for the impact obesity had on women's health.[9] We also found that fewer Pap smears were performed with increasing obesity, yet for men greater proportions of the population had PSA tests as the degree of obesity increased. Despite good access and increased utilization of health care by obese women, why fewer Pap smears are performed is not fully understood.

There is good access to outpatient care for the obese, but there is a significant mismatch between the population needs for bariatric surgery and its availability. Twenty-two percent of morbidly obese individuals rely on Medicare, but only 7% of patients undergoing these operations have this form of health insurance. A similar pattern exists for Medicaid: 19% of morbidly obese individuals have Medicaid insurance, yet only 6% of the operations are being performed on Medicaid patients. Fourteen percent of morbidly obese individuals have no health insurance, with 6% of patients undergoing gastric bypass receiving the operation despite having no insurance. These data show that although a significant number of obese individuals are poor, they have reasonable access to health care except when it comes to obesity surgery treatment. Gastric bypass surgery has been advocated as a highly effective means of achieving long-term weight loss for morbidly obese individuals; however, it is not readily available to many patients who might benefit from it. This may relate in part to the lack of Medicaid coverage for the procedure in some states.

Obesity results in substantial morbidity.[10-14] Poverty and low socioeconomic status are associated with both obesity[15-18] and with poor health.[19-25] Obesity has been demonstrated to be a risk factor for morbidity independent of poverty[26]; however, we found that obesity, poverty, and ethnic composition are interrelated. These factors all should be accounted for when developing treatment strategies. The economic cost of obesity and its complications to society is high.[7,27-29] Obese patients frequently use the health care system and require greater access to specialized care.[7] Modest reductions in weight can reduce morbidity and obesity-related health care costs.[19,30-34] Medical therapy for morbidly obese patients is rarely effective in the long-term,[35] and only surgical approaches result in sustained weight loss.[3,36,37] For these reasons, surgical therapy should be available for morbidly obese patients to improve their health status and potentially reduce the obesity-related overall health care cost to society. As our study demonstrates, many patients who would benefit from this therapy are not receiving it. Perioperative management strategies should account for the fact that a significant proportion of those eligible for obesity surgery are poorly educated and of low socioeconomic status.

A possible limitation of our analysis is that studies using self-reported height and weight information will tend to underestimate BMI because respondents underestimate weight and overestimate body height,[38-44] although in one survey there was excellent correlation.[45] If NHIS underestimates obesity because of its reliance on self-reported data, then the prevalence of obesity is higher than our analysis suggests. Our data do correlate to another large-scale survey: The Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is a population-representative survey that emphasizes the relationship between behaviors and disease risk. The BRFSS demonstrated that the incidence of class III obesity rose from 0.78% in 1990 to 2.2% in 2000. The greatest prevalence of obesity was found in blacks, and individuals with low incomes who were poorly educated.[46]

Potential limitations of our analysis exist relating to national estimates of the obesity surgery-eligible population. We have probably underestimated the total number of adult Americans eligible for obesity surgery. For those with class II obesity and surgery eligibility based on having concomitant medical conditions, we were only able to count those in the NHIS database reporting "functional limitations secondary to obesity." We assumed that for individuals with obesity complications severe enough to justify surgical intervention, respondents would report that obesity resulted in limited activity. Obese individuals will have sleep apnea, arthritis, diabetes, and hypertension develop that, in turn, could limit their function. However, respondents could report that these diseases result in limited activities and yet not be weight-related. The most conservative use of the NHIS data was to only include those who specifically reported that their weight caused a problem and not include those who may be limited by diabetes, hypertension, or arthritis. The NHIS does not include specific questions regarding sleep apnea, so this could not be evaluated independently as a potential indication for obesity surgery.

A combination of the NHDS and HCUP databases was used to derive complete information regarding the number of anti-obesity operations performed and the socioeconomic condition of the patients undergoing the operations. Analysis of the actual (CD-ROM) HCUP-National Inpatient Survey database revealed that significant proportions of the data entries lacked ethnicity information (data not shown). Thus, we used the easily accessed online version of HCUP to derive payer information that was not available in NHDS, and used NHDS for ethnicity data. We found that there was an excellent correlation between these databases in terms of the numbers of gastric bypass procedures encoded as 44.31: 20,771 in HCUP and 21,228 in NHDS. When all gastric types of anti-obesity operations were extracted from NHDS, there were 28,590. This latter figure most likely represents the true number of anti-obesity operations performed in the United States in 2000. It was derived from a DRG designation (288) specific for OR procedures for obesity and included all gastric operations (44.31, 44.39, 44.5, and 44.69) falling within this DRG. The NHDS is population-representative and contains correction factors based on the US census. For this reason, estimates derived from it are the best possible representations of hospital activity in the United States. Given the concordance between the NHDS and HCUP for the number of procedures encoded by ICD-9 = 44.31, we believe that our estimates of proportions of individuals of various racial, financial, and ethnic backgrounds derived from the different databases are accurate.

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