Long-term Obesity and Avoidable Hospitalization Among Younger, Middle-aged, and Older Adults

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Background: Avoidable hospitalizations are considered to result from conditions that are preventable with timely and effective ambulatory care. We examined whether obesity, particularly long-term obesity, is associated with risk for and frequency of avoidable hospital stays.

Methods: Data were drawn from the First National Health and Nutrition Examination Survey Epidemiological Follow-up Survey, a 20-year study of adults aged 25 to 74 years (N=6833). Using measures of body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) at baseline and at 25 years of age, we estimated the effect of obesity (BMI ≥30.0) on avoidable hospitalization risk using Cox proportional hazards models, and we estimated its influence on the rate of avoidable stays per year using interval regression models. All multivariate analyses were adjusted for morbidity and other covariates.

Results: One thousand twenty-three subjects experienced a hospitalization considered avoidable. Compared with normal-weight subjects, the adjusted hazard ratio of an avoidable stay among obese subjects was 1.82 (95% confidence interval [CI], 1.31-2.51) for those aged 25 to 44 years, 1.29 (95% CI, 1.05-1.59) for those aged 45 to 64 years, and 1.46 (95% CI, 1.23-1.74) for those 65 years and older. Among participants aged 45 to 64 years at baseline, obesity at 25 years of age was strongly associated with both the risk (hazard ratio, 1.91; 95% CI, 1.59-2.29) and frequency (β coefficient, 0.057; SE, 0.018) of avoidable stays when accounting for baseline BMI category and additional covariates. For subjects 65 years and older, obesity at 25 years of age was associated with increased risk of avoidable hospitalization (hazard ratio, 1.87; 95% CI, 1.14-3.08) and with increased frequency of such admissions (β coefficient, 0.138; SE, 0.038).

Conclusions: As indicated by its association with avoidable hospitalizations, long-term obesity is a substantial risk for complications in medical care. Interventions should target obesity early in the life course to help improve lifelong delivery of ambulatory care and to reduce strains on health care resources.

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In light of the rising prevalence of obesity in the United States, access to and use of medical care among obese individuals has become an important area of research.[1] A growing body of literature has assessed the relationship between obesity and medical care, generally finding that excess body mass leads to higher utilization of health care services.[2-4] However, other studies have suggested that certain barriers may prevent obese individuals from receiving adequate care.[5,6] As reflected in the literature, the prevalence of weight bias in the health care setting is a problem that compromises the receipt of suitable treatment.[7]

One indicator of accessible and effective primary care is the prevalence of avoidable hospitalizations, also called *ambulatory care–sensitive or preventable hospitalizations*.[8-10] These hospital stays are considered avoidable because their resulting diagnoses are preventable with "timely and effective ambulatory care."[11] Many studies on the causes of these hospitalizations, however, have emphasized community-level variables (eg, zip code area income level) with limited individual-level data.[8,12] Some studies have examined subject-level variation in avoidable hospitalizations, especially racial and socioeconomic differences, but scant attention has been given to obesity as a risk factor.[13]

Although researchers have investigated how obesity affects other types of hospital experiences, such as the risk of hospitalization,[2] length of stay in acute care wards,[4] length of stay and mortality in the intensive care unit,[14] and complications in specialized procedures,[15] we are not aware of any studies that systematically consider obesity's effect on avoidable hospitalizations.

To address this gap, the present study uses data from the First National Health

and Nutrition Examination Survey National Epidemiological Follow-up Study (NHEFS), a 20-year longitudinal study, to investigate whether obesity increases the risk for an avoidable hospital stay and the frequency of such hospitalizations. Furthermore, it draws on recent designs that incorporate body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) indicators from early in the adult life course to estimate health care services utilization later in adulthood.[16,17] In this way, we address whether chronic obesity raises the risk of avoidable hospitalization.

METHODS

The wave 1 (W1) NHEFS data were collected from 1971 through 1975 from a multistage, stratified, probability sample of noninstitutionalized persons aged 25 to 74 years who received follow-up interviews from 1982 through 1984 (W2), in 1987 (W3), and in 1992 (W4). All analyses make use of nonpregnant respondents who were given the "detailed component" of the interview, including the Health Care Needs Questionnaire and the medical examination at baseline (n = 6833). This group, about half of the overall NHEFS sample, does not differ appreciably from the other subjects, but was asked critical questions pertaining to insurance coverage, Medicaid status, and physician availability.

AVOIDABLE HOSPITALIZATION MEASURES

At each follow-up wave, respondents were asked about any hospital stays they have had since the preceding interview, including approximate admission date and reason for hospitalization. A strength of NHEFS data is that researchers matched about 85% of these self-reported hospital stays with official facility records and obtained records for deceased subjects. Official records provided diagnosis data based on *International Classification of Diseases, 9th Revision, Clinical Modification* (*ICD-9-CM*) codes and exact dates of admission and discharge. Only matched hospital records were used for analysis because an exact diagnosis is crucial for classifying hospitalizations as avoidable. Previous work has found that these reporting errors do not introduce appreciable bias in regression estimates.[18]

Consistent with the corpus of literature about health care services, a hospitalization is considered avoidable if the primary (first) *ICD-9-CM* diagnosis matches one of the following conditions: angina, asthma, cellulitis, chronic obstructive pulmonary disease, congestive heart failure, dehydration, diabetes mellitus, gangrene, gastroenteritis, grand mal status and epileptic convulsions, hypertension, hypoglycemia, hypokalemia, immunizable conditions, kidney and/or urinary tract infections, pneumonia, ruptured appendix, and severe ear, nose, or throat infection (eg, *ICD-9-CM* code 411.1 [angina diagnosis]).[9,11,19] Based on these criteria, there were 2043 avoidable hospitalizations experienced by 1023 subjects.

The first outcome variable of interest is the time to a subject's first avoidable hospitalization. A dichotomous variable was created for whether subjects have ever experienced an avoidable hospitalization, and the length of time to the first avoidable stay was measured by the difference between the date of avoidable hospital admission and the interview date. The second outcome variable is a rate of avoidable hospitalizations per year observed in the NHEFS. This variable was created by dividing the total number of avoidable hospital stays by the number of years the subject was alive and observed.

BMI MEASURES

At W1, research staff weighed participants on a self-balancing scale and measured their height. Participants were classified by baseline BMI according to the 1998 National Heart, Lung, and Blood Institute guidelines as underweight (BMI, <18.5), healthy weight (BMI, 18.5-24.9), overweight (BMI, 25.0-29.9), and obese (BMI, ≥ 30.0). Seven subjects were missing W1 height or weight measurement and were dropped from the analyses. Measures of BMI from early adulthood come from W2, when respondents were asked, "What was your usual weight at the age of 25?" The W1 height was used to compute recalled BMI. Recalled self-reported weight, although commonly used, is a conservative measure of body weight.[20] Therefore, it is likely that levels of obesity at 25 years of age have been underestimated.

For the 1121 respondents who died or refused a follow-up interview from W1 to W2, we imputed values for missing BMI at 25 years of age using predicted scores from a linear regression equation. Subjects necessitating imputation scores tended to be older, less healthy, and poorer and were disproportionately female and black. We undertook sensitivity analyses to verify whether imputing values changed the results from those obtained through listwise deletion. The conclusions did not change, although there was a marked decline in statistical power among older adults when using this method, leading to an underestimation of relationships. Therefore, findings are presented with imputed values.

STATUS CHARACTERISTICS AND RESOURCES

Models include a number of control variables that could mediate the relationship between obesity and avoidable hospitalization. Age (25-74 years), education (0 indicates no more than an eighth-grade education; 7, a postbaccalaureate education), and annual income (1 indicates $\leq$ \$1000; 12, $\geq$ \$25 000 in 1970 dollars) are continuous variables, whereas black, female, and rural residence are all coded as dummy variables (1 indicates that the individual has that status; 0, otherwise). Three related covariates for health care resources are included. Medicare status, having private health insurance, and having a regular physician are all coded as dummy variables. Three variables are also used to assess the potential role of health-related behaviors. Respondents who indicated any form of current smoking were identified, as were individuals consuming 2 or more alcoholic drinks per day (each with a binary variable of 0 or 1). Subjects who reported getting little or no physical exercise from recreational activities or from daily tasks were coded 1 for a sedentary lifestyle binary variable.

Finally, it is important to consider major illnesses, which are related to obesity and hospitalization. Specifically, having a primary diagnosis of diabetes mellitus or hypertension at hospital admission designates a stay as avoidable; however, both conditions are common comorbidities of obesity. As a precaution against this confounding association, the models include dummy variables for diabetes and hypertension, as well as for cancer and heart disease. All 4 serious illnesses were assessed at W1 by asking respondents whether they had ever been diagnosed by a physician as having each of the conditions. Seven chronic health conditions are also included as control variables. These health problems—arthritis, asthma, bone fracture, cataracts, gout, psoriasis, and ulcer—were summed and coded as an index (0 to ≥ 4 conditions).

STATISTICAL ANALYSIS

Whereas hospitalization is highly related to age, subjects were divided into the following 3 groups: those aged 25 to 44 years

Table 1. Distribution of Variables for 6826 NHEFS Participants by Age Group[a]

Variable	Age Group		
	25-44 y (n=2723)	45-64 y (n=2880)	≥65 y (n=1223)
Avoidable hospitalization observed	5.99	17.95	28.29
Rate of avoidable hospitalizations per year, mean (SD)[b]	0.01 (0.04)	0.02 (0.07)	0.04 (0.14)
BMI			
< 18.5	3.82	2.67	4.01
18.5-24.9	54.43	40.97	39.33
25.0-29.9	29.27	37.08	37.78
≥ 30.0	12.49	19.27	18.89
30.0-34.9 (class I obesity)	8.26	13.92	14.06
35.0-39.9 (class II obesity)	2.72	3.61	3.60
≥ 40.0 (class III obesity)	1.51	1.74	1.23
BMI ≥ 30.0 at age 25 y	5.58	3.64	3.27
Age, mean (SD), y[c]	33.7 (5.9)	53.9 (5.6)	69.0 (2.9)
Female	56.81	52.88	51.51
Black	11.9	12.74	15.21
Cancer	0.84	2.78	6.05
Diabetes mellitus	1.98	5.59	10.3
Heart disease	1.91	8.16	15.94
Hypertension	13.81	27.01	38.02
No. of chronic diseases, mean (SD)[d]	0.11 (0.33)	0.35 (0.51)	0.56 (0.61)
Sedentary lifestyle	6.21	8.23	12.02
Smoker	49.32	42.85	26.57
Heavy drinker	12.38	12.85	8.50
Medicaid	2.97	2.74	7.77
Private insurance	82.96	81.15	92.07
Regular physician	82.26	86.67	86.67
Education level, mean (SD)[e]	4.24 (1.39)	3.51 (1.51)	2.84 (1.63)
Rural residence	35.11	40.90	44.97

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); NHEFS, First National Health and Nutrition Examination Survey National Epidemiological Follow-up Study.

[a] Differences between age groups were analyzed with χ^2 tests. Mean differences between age groups were analyzed with 1-way analysis of variance tests. All variables had significant differences between age groups ($P < .05$). Unless otherwise indicated, data are expressed as percentage of subjects (binary variables); means and standard deviations are reported for continuous variables.

[b] Described in the "Avoidable Hospitalization Measures" subsection of the "Methods" section (range, 0-3.57).

[c] Range, 25 to 74 years.

[d] Coding is described in the "Status Characteristics and Resources" subsection of the "Methods" section (range, 0-3).

[e] Coding is described in the "Status Characteristics and Resources" subsection of the "Methods" section (range, 0-7).

(younger group), those aged 45 to 64 years (middle-aged group), and those 65 years and older (older group) for all multivariate analyses. Within each age group, age was also controlled as a continuous variable. We used 1-way analysis of variance tests to assess mean differences among these 3 groups on the continuous study variables and χ^2 tests to compare the groups on dichotomous study variables. The first phase of multivariate analysis uses Cox proportional hazards models to estimate hazards ratios of time to avoidable hospitalization among the 3 age groups. Time is measured as years from the first interview to the first avoidable hospitalization. The second phase of multivariate analysis uses interval regression to predict the rate of hospitalizations per year observed in the NHEFS. Because most subjects did not have any avoidable hospitalizations, this outcome variable is left censored and therefore unsuited for linear regression. Interval regression models are a derivation of tobit regression,[21] thereby accounting for censoring of the dependent variable's distribution while providing estimates of robust standard errors. All analyses are performed on the weighted sample and adjust for the multistage sampling design with Stata statistical software (version 9.0; StataCorp, College Station, Texas).

RESULTS

Table 1 presents descriptive statistics for the 3 age groups. Older subjects had a higher incidence of avoidable hospitalizations, had higher rates of avoidable hospitalizations per year, and were more likely than younger individuals to have been diagnosed as having cancer, diabetes mellitus, heart disease, and hypertension. Individuals in the middle-aged group were the most likely to be obese (19.27%) and those in the younger group were the least likely (12.49%). Conversely, individuals in the younger group were most likely to report obesity-level weight at 25 years of age (5.58%). Only 5.99% of the younger subjects had at least 1 avoidable hospitalization, compared with 17.95% of the middle-aged group and 28.29% of the older group. Correspondingly, the older group had the highest rate of avoidable hospitalizations per year (0.04). Although there were insufficient cases to divide respondents into obesity classes I (BMI, 30.0-34.9), II (BMI, 35.0-39.9), and III (BMI, ≥40.0) for multivariate analyses, the percentage in each age group is displayed in Table 1. Class I obesity was the most common form of obesity for each age group.

In the bivariate comparison of avoidable hospitalization outcomes among baseline BMI categories (**Table 2**), a clear pattern emerges in which underweight and obese individuals have the highest likelihoods of an avoidable hospital stay (18.01% and 24.03%, respectively) and the highest rate of avoidable admissions per year (0.03).

Next, we conducted multivariate analyses, controlling for the variables shown in Table 1. As shown in **Table 3**, overweight was associated with higher risk of an avoidable hospitalization among the younger and older subjects, as was underweight among the older group. Irrespective of age group, the risk of an avoidable hospitalization was greater for obese persons relative to normal-weight individuals. Although being obese at 25 years of age was not a significant risk factor for an avoidable stay among the younger group, it was a significant predictor of an avoidable hospitalization among the middle-aged (hazard ratio [HR], 1.91; 95% confidence interval [CI], 1.59 - 2.29) and older (HR, 1.87; 95% CI, 1.14-3.08) groups. The lack of significance of early obesity among the younger group is unsurprising, considering the high correlation between recalled BMI at 25 years of age and BMI measured at baseline ($r = 0.72$). This association was more modest for the middle-aged and older groups ($r = 0.53$ and $r = 0.55$, respectively). All observed associations between BMI and risk of avoidable hospitalizations were adjusted for relevant covariates.

Similar to the results in Table 3, underweight was associated with a higher rate of avoidable hospitalizations

Table 2. Differences in Avoidable Hospitalization Outcomes for 6826 NHEFS Participants by Baseline BMI Category[a]

Outcome	BMI Category			
	Underweight[b] (<18.5) (n = 230)	Normal[c] (18.5-24.9) (n = 3143)	Overweight[d] (25.0-29.9) (n = 2327)	Obese[e] (≥30.0) (n = 1126)
Avoidable hospitalization observed, %	18.01	11.74	17.20	24.34
Rate of avoidable hospitalizations per year, mean (SD)[f]	0.03 (0.09)	0.01 (0.09)	0.02 (0.07)	0.03 (0.09)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); NHEFS, First National Health and Nutrition Examination Survey National Epidemiological Follow-up Study.

[a] Avoidable hospitalizations observed by BMI categories were analyzed with χ^2 tests. Avoidable hospitalizations per year between BMI categories were analyzed with 1-way analysis of variance tests. Both outcome variables had significant differences between BMI categories ($P < .05$). The BMI categories are described in the "BMI Measures" subsection of the "Methods" section.

[b] The 3 most common diagnoses for underweight persons included chronic obstructive pulmonary disease (COPD) (in 38.27% of individuals), asthma (in 19.18%), and congestive heart failure (CHF) (in 14.87%).

[c] The 3 most common diagnoses for normal-weight persons included COPD (in 19.96% of individuals), CHF (in 17.68%), and gastroenteritis (in 13.36%).

[d] The 3 most common diagnoses for overweight persons included CHF (in 26.06% of individuals), COPD (in 14.10%), and diabetes mellitus (in 14.05%).

[e] The 3 most common diagnoses for obese persons included CHF (in 27.19% of individuals), diabetes mellitus (in 24.38%), and hypertension (in 14.58%).

[f] Described in the "Avoidable Hospitalization Measures" subsection of the "Methods" section (range, 0-3.57).

Table 3. Cox Regression Analysis for Time to First Avoidable Hospital Admission by Age Group in 6826 NHEFS Participants[a]

BMI Category	HR (95% CI) by Age Group		
	25-44 y (n = 2723)	45-64 y (n = 2880)	≥65 y (n = 1223)
Baseline			
Underweight (<18.5)	0.91 (0.86-2.14)	1.23 (0.76-1.98)	1.63 (1.10-2.41)[b]
Normal (18.5-24.9)	1 [Reference]	1 [Reference]	1 [Reference]
Overweight (25.0-29.9)	1.43 (1.14-1.80)[b]	1.09 (0.97-1.24)	1.25 (1.11-1.42)[b]
Obese (≥30.0)	1.82 (1.31-2.51)[b]	1.29 (1.05-1.59)[b]	1.46 (1.23-1.74)[b]
Obesity at age 25 y[c]	1.36 (0.86-2.14)	1.91 (1.59-2.29)[b]	1.87 (1.14-3.08)[b]

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CI, confidence interval; HR, hazard ratio; NHEFS, First National Health and Nutrition Examination National Survey Epidemiological Follow-up Study.

[a] Adjusted for age; sex; race; ever having a physician diagnosis of cancer, diabetes mellitus, heart disease, or hypertension; number of chronic diseases; sedentary lifestyle; smoker; heavy drinker; Medicaid status; private insurance; having a regular physician; education; income and rural residence. The BMI categories are described in the "BMI Measures" subsection of the "Methods" section.

[b] $P < .05$.

[c] In this analysis, obesity at 25 years of age was used as an independent variable. Imputation for missing BMI was used as a single linear regression prediction. The following wave 1 variables were used for imputation: age, race, sex, education, income, marital status, sedentary lifestyle, rural residence, smoking, serum cholesterol level, score from physician's global health rating, number of conditions identified in physician examination, sum of self-reported serious illnesses (cancer, hypertension, stroke, diabetes mellitus, and heart disease), and BMI. Results using listwise deletion were parallel to those presented herein, but there was insufficient statistical power for subjects 65 years and older.

Table 4. Interval Regression Analysis for Rate of Avoidable Hospitalizations per Year Observed in 6826 NHEFS Participants[a]

BMI Category	Avoidable Hospitalizations per Year by Age Group		
	25-44 y (n = 2723)	45-64 y (n = 2880)	≥ 65 y (n = 1223)
Baseline			
Underweight (< 18.5)	0.004 (0.079)	0.052 (0.042)	0.091 (0.043)[b]
Normal (18.5-24.9)	1 [Reference]	1 [Reference]	1 [Reference]
Overweight (25.0-29.9)	0.044 (0.014)[b]	0.012 (0.012)	0.015 (0.034)
Obese (≥ 30.0)	0.093 (0.022)[b]	0.016 (0.014)	0.045 (0.025)
Obesity at age 25 y[c]	0.040 (0.042)	0.057 (0.018)[b]	0.138 (0.038)[b]

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); NHEFS, First National Health and Nutrition Examination Survey National Epidemiological Follow-up Study.

[a] Adjusted for age; sex; race; ever having a physician diagnosis of cancer, diabetes mellitus, heart disease, and hypertension; number of chronic diseases; sedentary lifestyle; smoker; heavy drinker; Medicaid status; private insurance; having a regular physician; education; income; and rural residence. Data are expressed as β coefficients (robust standard errors). The BMI categories are described in the "BMI Measures" subsection of the "Methods" section.

[b] $P < .05$.

[c] In this analysis, obesity at 25 years of age was used as an independent variable (0 indicates BMI < 30.0). Imputation for missing BMI was used as a single linear regression prediction. The following wave 1 variables were used for imputation: age, race, sex, education, income, marital status, sedentary lifestyle, rural residence, smoking, serum cholesterol level, score from physician's global health rating, number of conditions identified in physician examination, sum of self-reported serious illnesses (cancer, hypertension, stroke, diabetes mellitus, and heart disease), and BMI. Results using listwise deletion were parallel to those presented herein, but there was insufficient statistical power for subjects 65 years and older.

per year among the older group (β coefficient, 0.091; SE, 0.043), as was overweight (β coefficient, 0.044; SE, 0.014) in the younger group (**Table 4**). Baseline obesity predicted a higher rate of avoidable hospitalization among the younger subjects but not among middle-aged and older participants. Similar to the results in Table 3, obesity at 25 years of age was not associated with a higher rate of avoidable hospitalization among the younger respondents but was a significant predictor for middle-aged (β coefficient, 0.057; SE, 0.018) and older (β coefficient, 0.138; SE, 0.038) subjects. All results from Table 4 include adjustment for important control variables.

Supplemental analyses (not presented herein) reexamined models from Tables 3 and 4 and included the change in BMI category between W1 and W2 as an independent variable. The change in BMI category was inconsequential in those models.

COMMENT

To our knowledge, this is the first systematic investigation of how long-term obesity contributes to the risk and frequency of avoidable hospitalizations. In general, subjects with a BMI of 30.0 or higher had a greater likelihood than normal-weight persons of experiencing an avoidable hospital stay, as did older underweight respondents. Beyond the baseline BMI, however, early-adulthood obesity exerted an independent influence. That is, being obese at 25 years of age predicted one's risk for avoidable hospitalization among middle-aged and older persons, even while adjusting for baseline BMI group. In addition to estimating the risk of an avoidable hospital stay, we also investigated the rate of avoidable hospitalizations per year as an outcome. We found that the role of long-term obesity remains compelling: when baseline BMI level is held constant, obesity at 25 years of age is associated with a higher rate of avoidable hospital stays per year among middle-aged and older adults. Indeed, the influence of early-adulthood obesity surpassed the effects of BMI classification at baseline, which, except in the case of underweight older subjects, failed to predict a higher rate of avoidable hospitalizations. Taken together, these findings suggest that obesity experienced early in the adult life course has an enduring influence on the risk and frequency of avoidable hospitalizations, even when a more proximal measure of an individual's BMI is considered. These results are consistent with a growing body of literature linking early-adulthood obesity with a number of outcomes later in adulthood, including hospitalization[16] and Medicare expenditures.[17] There are long-term consequences to early obesity.

Other variables correlated with obesity present significant barriers to timely and efficacious ambulatory care and increase the chances of complications in medical care. To isolate the effects of obesity, our estimates of the risk for and frequency of avoidable hospital stays were adjusted a number of covariates relevant to the study of health care system access and utilization. For example, the literature regarding avoidable hospitalization has emphasized socioeconomic status and health care resources as important factors that shape ambulatory care delivery.[9] Fortunately, the NHEFS contains questions about private insurance and Medicare and about having a regular physician, which were included with income, education, and race as control variables. Because age is also an important dynamic in studying avoidable hospitalizations, with older adults being more vulnerable than younger persons, the present study stratified subjects into 3 categories and included age as a control variable. Finally, the present study adjusted for serious illnesses and chronic conditions to control for whether these ailments could precede obesity and account for the risk or frequency of avoidable hospitalizations.

Although our analyses focused on obesity, there is also evidence that underweight adults are at higher risk of avoidable hospitalization. This finding is consistent with research suggesting that being at either extreme of the BMI spectrum is deleterious to health and complicates medical care.[4]

The present study yields fresh insight into how long-term obesity poses challenges for the nation's health care system, but several limitations warrant consideration. First, this study used baseline BMI categories and examined outcomes prospectively. Although supplementary analyses examining change in BMI category did not alter the conclusions, complex trajectories of weight gain and loss (cycling) may alter the results presented herein. Second, given the conservative bias for recalled self-reported weight, we have also likely classified too few subjects as obese at 25 years of age. Despite this probable underestimation, obesity at 25 years of age was a strong predictor of outcomes among middle-aged and older adults. An additional concern is the large number of cases that were missing recalled weight values. Our imputation method was effective in restoring many of these cases in the analysis, but having estimates of recalled weight at W1 instead of at W2 would clearly have been a preferable scenario. Finally, this study is limited by the relatively small number of subjects hospitalized for many of the 18 avoidable-stay diagnoses, reducing the ability to make valid statistical comparisons across diseases.

Despite these limitations, long-term obesity should be recognized as a significant concern for clinicians and policy makers. Beyond the effects of health care resources and morbidity, obesity experienced early in life is an enduring obstacle to effective medical care. Future research can further elucidate how and why long-term obesity represents a barrier in health care delivery. Several studies have found that obese women are less likely than their leaner counterparts to undergo preventive gynecological examinations, identifying patients' concerns over embarrassment, disrespectful treatment, and undersized equipment as factors obstructing timely care.[22,23] Research has also documented widespread discomfort and bias on the part of health care professionals in treating obese patients, suggesting that obese people have a valid basis for uneasiness in the health care setting.[7]

Interferences to timely and effective ambulatory care have broader implications for health care policy and delivery. As increasing numbers of young people cope with obesity, considerable economic strain associated with long-term obesity will confront the health care system. With the general upsurge in national obesity rates showing no sign of reversal,[24] the various medical conditions caused and exacerbated by chronic obesity dictate that timely access to health care services is of high economic import[25] because complications in care beget substantial costs.[26] Estimates suggest that health care expenditures caused by excess weight exceed $47 billion per year[27] and that 6% of all national health care expenditures have obesity at their root.[28] The present study offers a rich and unique data source to examine how avoidable hospital stays are a crucial part of this dilemma. Given these his-

torical data, one can project increasing concerns over when and how obese people encounter health care systems. We also invite replications of these results with more recent data.

To help assuage American health care disparities and to heed pragmatic cost concerns, interventions should target obesity among adolescents and young adults. Early-adulthood obesity has long-term consequences for health care service utilization; thus, reducing excess weight during early adulthood may yield considerable benefit by lowering the incidence and frequency of avoidable hospitalizations.

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