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Obesity and Severe Obesity Forecasts Through 2030

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Background: Previous efforts to forecast future trends in obesity applied linear forecasts assuming that the rise in obesity would continue unabated. However, evidence suggests that obesity prevalence may be leveling off.

Purpose: This study presents estimates of adult obesity and severe obesity prevalence through 2030 based on nonlinear regression models. The forecasted results are then used to simulate the savings that could be achieved through modestly successful obesity prevention efforts.

Methods: The study was conducted in 2009–2010 and used data from the 1990 through 2008 Behavioral Risk Factor Surveillance System (BRFSS). The analysis sample included nonpregnant adults aged ≥18 years. The individual-level BRFSS variables were supplemented with state-level variables from the U.S. Bureau of Labor Statistics, the American Chamber of Commerce Research Association, and the Census of Retail Trade. Future obesity and severe obesity prevalence were estimated through regression modeling by projecting trends in explanatory variables expected to influence obesity prevalence.

Results: Linear time trend forecasts suggest that by 2030, 51% of the population will be obese. The model estimates a much lower obesity prevalence of 42% and severe obesity prevalence of 11%. If obesity were to remain at 2010 levels, the combined savings in medical expenditures over the next 2 decades would be $549.5 billion.

Conclusions: The study estimates a 33% increase in obesity prevalence and a 130% increase in severe obesity prevalence over the next 2 decades. If these forecasts prove accurate, this will further hinder efforts for healthcare cost containment.
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Introduction

Obesity prevalence has increased dramatically since the 1970s.[1,2] According to the National Health and Nutrition Examination Survey (NHANES),[2] obesity prevalence in 2007–2008 was 33.8%, representing a >100% increase from 1976–1980 and a 50% increase from 1988–1994.[1] Since 2003–2004, obesity prevalence might be leveling off for some adult subpopulations.[2] Severe obesity was extremely rare before the early 1970s but has since increased faster than obesity, with no evidence of slowing.[3]

Given the relationship between excess weight, poor health, and high medical expenditures, successful cost-containment efforts will need to address obesity. For example, Thorpe et al.[4] report that 27% of the rise in inflation-adjusted medical expenditures between 1987 and 2001 was due to the rising prevalence and costs of obesity. Finkelstein et al.[5] estimate that costs of obesity may be as high as $147 billion per year, or roughly 9% of annual medical expenditures.

The current paper forecasts future obesity and severe obesity prevalence over the next 20 years. The forecasted results are then used to simulate the savings that could be achieved through modestly successful obesity prevention efforts. All previous attempts to forecast future trends

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and costs of obesity[6–9] used past obesity prevalence data to predict linear future trends. For example, using data from the NHANES, Wang et al.[6] projected that if historical trends continue linearly, by 2030, 51% of U.S. adults will be obese. However, this and other forecasts likely overstate future obesity prevalence given the recent evidence of slower growth.[2]

This analysis also uses past trends to predict future obesity prevalence, but incorporates two improvements over prior estimates. First, consistent with the recent data showing slower obesity growth, the assumption of linear trajectories in the future rise of obesity prevalence is relaxed. Second, rather than relying solely on historical obesity levels, the relationship between obesity and exogenous, state-level variables thought to influence obesity, is estimated. Although this approach also necessitates using past data to forecast future trends, it allows for a better model fit than a regression of linear time trends alone and should produce more-accurate predictions of future obesity prevalence and related healthcare costs.

Methods

Analysis was conducted in 2009–2010, and the primary data source was the 1990 through 2008 Behavioral Risk Factor Surveillance System (BRFSS). BRFSS is a state-based, cross-sectional telephone interview survey conducted by the CDC and state health departments. The survey is based on a multistage cluster design that uses random-digit dialing to select samples that represent the civilian, non-institutionalized adult population in each of the 50 states, the District of Columbia, and three U.S. territories.

The present study used data from the 50 states and the District of Columbia. Self-reported height and weight were adjusted for self-reporting error using measured and self-reported values of height and weight from 1999–2000 NHANES data.[10] Exclusion criteria included subjects who reported a weight ≥500 pounds or a height ≥7 feet or <3 feet, subjects who were missing data for height or weight, subjects who had an adjusted BMI <10, and pregnant women. The final sample included 3,475,103 adults aged ≥18 years. Table 1 reports sample sizes for selected years.

The study estimated two logistic regressions that predict the probability that each individual is (1) obese (BMI ≥30) and (2) severely obese (BMI ≥40) as a function of individual-level demographics and state-level variables that are hypothesized to influence obesity[11,12]:

$$P\left(Obes_{ijt} = 1\right) = f\left(\alpha + \beta_1 Z_{ijt} + \beta_2 X_{jt} + \beta_3 * g\left(TIME\right) + \lambda_j\right), \quad \textbf{(1)}$$

where i indexed individuals, j was the state in which an individual lived, and t was the interview year. Z was a set of individual-level variables, X was a set of state-level variables, *TIME* indicated the year in which the data were collected, $g(\cdot)$ was a function of *TIME*, λ was a set of state dummies, and $f(\cdot)$ was the logit probability function. All analyses accounted for the complex survey design of BRFSS. Individual-level variables included gender, age, race/ethnicity, education, marital status, and annual household income. Table 1 reports categories for these variables.

State-level variables, chosen based on findings from prior studies,[11–14] included annual unemployment rates; prices (in constant 2009 dollars) for alcohol, gas, and fast food; prices of groceries relative to nongrocery items; prices of healthier foods relative to less-healthy foods; access to the Internet; and number of fast-food and full-service restaurants per 10,000 people. All of these variables are posited to affect obesity prevalence through changes in the costs and benefits of obesity-related behaviors. For example, changes in food prices affect obesity prevalence by influencing food consumption patterns, whereas changes in gas prices reflect the relative cost of active transportation.

Annual unemployment data were obtained from the U.S. Bureau of Labor Statistics (BLS). Prices of alcohol, gas, and food were obtained from the American Chamber of Commerce Research Association (ACCRA) cost-of-living index.[15] The ACCRA data also were used to construct three food-price indices: (1) price of fast food; (2) price of groceries relative to nongrocery items; and (3) price of healthier foods relative to less-healthy foods as a proportion of a typical household market basket. Grocery items included a list of 22 items typically purchased in grocery stores. Nongrocery items included all other categories from the ACCRA data (housing, utilities, transportation, and health care), excluding miscellaneous items that also included some food categories.

This index allows for quantifying the influence on obesity prevalence of relative changes in food to nonfood items. For the relative food price index, healthier foods included fresh fruits and vegetables and lean protein (ground beef, frying chicken, chunk light tuna, potatoes, bananas, lettuce, cornflakes, sweet peas, peaches, and frozen corn) and less-healthy foods included fast food and high-sugar and high-fat foods (shortening, soft drinks, hamburgers, pizza, and fried chicken). This index allows for quantifying the effects of relative changes in healthy and unhealthy food prices over time. The price indices were weighted so the relative price indices represent the price of one share of overall consumption to another share. The indices do not compare prices per serving.

The number of fast-food and full-service restaurants (per 10,000 people) was obtained from the Census of Retail Trade. Definitions and additional details are included in Appendix A (available online at www.ajpmonline.org). To account for changes in the definitions of alcohol price and the price of groceries relative to nongrocery items in the ACCRA data between 1999 and 2000, the analysis used an indicator for how the years after 2000 interacted with the variables affected by this change.

Following Nonnemaker et al.,[12] the basic specification includes state-specific linear time trends (i.e., interactions between *TIME* and state dummies). In addition to the basic model, models with a single national log time trend [ln(TIME–1980)] and state-specific log time trends also were run. Goodness of fit of each model was measured using Akaike information criterion, Bayesian information criterion, and pseudo-R^2, which ranges from 0 to 1, with higher values indicating better model fit.

The ability of each model to generate out-of-sample forecasts also was assessed by dropping the last 5 years of data and comparing the predicted obesity prevalence for those 5 years with the actual prevalence. On the basis of these criteria, the specification that provided the best combination of fit and plausible parameters was one that included national linear and log time trends and state-specific linear time trends. Therefore, this was considered the preferred model specification.

To generate forecasts of future obesity and severe obesity prevalence, a synthetic cohort was constructed using the 2008 BRFSS data and U.S. Census population projections.[16] To account for population increases, the 2008 BRFSS sampling weights were adjusted by the ratio of the percentage of people in the corresponding gender/age/race/ethnicity/state cell in the specified year to the percentage of people in the same cell in 2008. This calculation was repeated for each year through 2030, and then the coefficients from the two logit models were multiplied by the individual-level data for each year of the synthetic cohort assuming that the state-level variables remained at their 2008 levels.

The study also forecasted future obesity and severe obesity rates using forecasts of state-level variables through 2030. To generate forecasts of the annual unemployment rate, actual BLS employment data for each state through 2010 were used and the rate in each state was linearly decreased until it reached 5% in 2020. Beyond 2020, the assumption was that each state would have 5% unemployment—the average historical unemployment rate. Projections for prices of gas, alcohol, fast food, healthier foods relative to less-healthy foods, groceries relative to nongrocery items, and number of restaurants per 10,000 people were generated using a historical linear time trend. Internet access was forecasted using a logistic model. Appendix B (available online at www.ajpmonline.org) shows predictions for the state-level variables.

To gauge sensitivity of the estimates, the results present forecasts for a linear trend consistent with past studies

Table 1. Descriptive statistics of the analysis sample, 1990, 2000, and 2008, % unless otherwise noted

	1990 n=72,059	2000 n=152,937	2008 n=375,091
Obesity (BMI≥30)	12.7	22.1	28.6
Unadjusted	11.1	20.5	26.8
Severe obesity (BMI≥40)	0.9	2.6	4.1
Unadjusted	0.8	2.2	3.5
INDIVIDUAL-LEVEL DEMOGRAPHIC CHARACTERISTICS			
Gender			
Male	49.4	50.0	50.4
Female	50.6	50.0	49.6
Age (years)			
18–44	58.3	52.1	49.1
45–64	25.5	30.2	33.8
≥65	16.2	17.7	17.1
Race/ethnicity			
White (non-Hispanic)	80.4	74.4	69.7
Black (non-Hispanic)	9.4	9.8	9.9
Hispanic	7.5	11.6	13.5
Other race	2.7	4.2	6.8
Education			
Less than high school	16.4	12.8	10.9
High school graduate	34.1	31.1	28.9
Some college	38.0	27.6	26.7
College graduate	23.6	28.5	33.6
Marital status			
Single	21.1	21.8	22.8
Married	63.6	60.9	62.1
Widowed	7.3	7.3	6.2
Divorced	8.0	10.0	8.9
Annual household income ($)			
<10,000	11.4	4.6	4.2
10,000–14,999	9.5	4.8	4.2
15,000–19,999	9.1	7.1	6.2
20,000–24,999	9.8	8.9	7.5
25,000–34,999	15.8	13.6	9.9
35,000–49,999	16.0	16.5	13.0
≥50,000	6.1	32.0	44.2
Missing income data	22.2	12.5	10.8

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Table 1. *(continued)*

	1990	2000	2008
	n=72,059	*n*=152,937	*n*=375,091
STATE-LEVEL CHARACTERISTICS, M (SD)			
Annual unemployment rate	5.63 (0.52)	4.01 (0.59)	5.80 (1.41)
Prices ($)			
Alcohol	2.10 (0.21)	2.45 (0.13)	2.26 (0.22)
Gas	1.69 (0.05)	1.86 (0.15)	3.57 (0.27)
Fast food	5.95 (0.24)	5.82 (0.26)	5.77 (0.41)
Groceries relative to nongrocery items	0.53 (0.13)	0.29 (0.07)	0.34 (0.14)
Healthier foods relative to less-healthy foods	0.34 (0.03)	0.32 (0.02)	0.33 (0.03)
Number of restaurants (per 10,000)	14.2 (3.6)	12.1 (2.71)	22.9 (34.52)
Internet access	1.0 (0.00)	45.6 (0.03)	68.8 (0.07)

Note: All values for 2000 and 2008, on all variables except age, were significantly different from 1990 values ($p<0.05$). Prevalence of obesity and severe obesity is reported using height and weight measures adjusted for the self-reporting bias. The unadjusted prevalence is based on self-reported height and weight measures.

and for the preferred model specification under three alternatives: (1) holding all independent variables fixed at their 2008 levels but forecasting the time trend; (2) forecasting the individual-level variables and time trend but keeping the state-level variables fixed at their 2008 levels; and (3) forecasting all independent variables. To estimate savings that could be achieved through modestly successful obesity prevention efforts, reductions in obesity-attributable medical expenditures (from trend) were estimated as resulting from (1) modest reductions in future forecasted obesity prevalence, such as a 1 percentage point reduction in each year's forecasted rate; (2) no growth in obesity after 2010; and (3) Healthy People 2010 goal obesity prevalence of 15%.

For each of these scenarios, the number of averted cases of obesity was estimated by applying forecasted obesity prevalence to the projected number of people from the census for that year and then calculating the difference that would result if obesity prevalence were at the new level. The averted cases of obesity were then multiplied by the average annual medical costs attributable to obesity ($1429±$156).[5] To account for growth in real medical costs over time, real medical costs were assumed to grow at an average annual rate of 3.6%.[17,18] This approach generates obesity-attributable savings in medical costs due to lower-than-forecast obesity prevalence. However, it does not take into account prevention or other costs that may be incurred to generate the reductions in obesity prevalence or increased costs that may result from longer life expectancies as a result of a less-obese population.

Results

Descriptive statistics for the analysis sample in years 1990, 2000, and 2008 are presented in Table 1. Self-reported prevalence of obesity and severe obesity more than doubled during this 19-year period, increasing from 11.1% to 26.8% and from 0.9% to 3.5%, respectively. The annual unemployment rate was 5.63% in 1990, decreased to 4.01% in 2000, but then increased to 5.80% in 2008. The price of alcohol increased from 1990 to 2000 (from $2.10 to $2.45 per ounce) and then decreased from 2000 to 2008 (to $2.26). There was a slight increase in the price of gas from 1990 to 2000 (from $1.69 to $1.86 per gallon) and then a large increase in 2008 (to $3.57). Fast-food prices remained relatively stable over this period, ranging from $5.95 per meal in 1990 to $5.77 per meal in 2008. The index of prices for groceries relative to nongrocery items decreased from 0.53 in 1990 to 0.29 in 2000 but rose slightly to 0.34 in 2008. A reduction in the ratio indicates that groceries have become cheaper relative to nongrocery items.

There was no change in the measure of the price of healthier foods relative to less-healthy foods in the market basket during this period. After a small reduction in restaurants per 10,000 people between 1990 and 2000 (from 14.2 to 12.1), restaurants increased to 22.9 restaurants per 10,000 people in 2008. The percentage of people with access to the Internet increased from 1% in 1990 to 45.6% in 2000 to 68.8% in 2008.

The individual-level variables in the logistic regressions are consistent with expectations and results from prior studies[12] and are significant ($p<0.05$) (Table 2). Although the state-level variables are jointly significant ($p<0.05$) in the obesity model, few of the variables are significant on their own. For the obesity specification, higher prices of healthier relative to less-healthy foods in the market basket were associated with higher odds of being obese ($p<0.05$), as was greater Internet access ($p<0.05$). No associations were detected between any of the state-level variables and the probability of being severely obese. Psuedo-R^2 for Specifications 1 and 2 are 0.040 and 0.059, respectively, suggesting that much of the variation in weight across individuals remains unexplained. Appendix C (available online at www.ajpmonline.org) reports coefficients of the time and state variables.

Forecasts based on a linear time trend suggest that 51% of the population will be obese by 2030 (Table 3 and Figure 1). The preferred-model specification estimates a lower obesity prevalence of 42% in 2030, a 33% increase in obesity prevalence over the next 2 decades. Forecasts with independent variables fixed at 2008 levels show a prevalence of 40% in 2030, revealing that the net effect of the forecast changes in the individual- and state-level variables is to increase obesity prevalence by 2 percentage points more than what would have occurred had these variables remained at their 2008 levels.

Forecasts for severe obesity generate different conclusions. The linear forecast estimates that 9% of the population will be severely obese by 2030 (Figure 2). The preferred-model specification estimates a higher prevalence of 11%, which is 2.2 times greater than the 2010 prevalence of 5%. Fixing some or all of the independent variables at their 2008 levels resulted in slightly lower predictions (9.9% in 2030).

Potential savings in medical expenditures from bending the obesity-prevalence trajectory could be large. For example, a 1 percentage point decrease from the predicted trend based on the preferred-model specification would lead to 2.6 million fewer obese adults in 2020 and 2.9 million fewer obese adults in 2030 (Appendix D, available online at www.ajpmonline.org). This reduction from trend would reduce obesity-

Table 2. OR (95% CI) for obesity and severe obesity—from logistic regression analysis

	Obesity (BMI≥30)	Severe obesity (BMI≥40)
INDIVIDUAL-LEVEL DEMOGRAPHIC CHARACTERISTICS		
Gender		
Male	1.10 (1.09, 1.11)	0.64 (0.62, 0.65)
Female	1.00	1.00
Age (years)		
18–44	1.00	1.00
45–64	1.46 (1.44, 1.47)	1.40 (1.36, 1.44)
≥65	0.89 (0.87, 0.9)	0.50 (0.47, 0.52)
Race/ethnicity		
White (non-Hispanic)	1.00	1.00
Black (non-Hispanic)	1.85 (1.82, 1.88)	1.89 (1.83, 1.96)
Hispanic	1.18 (1.16, 1.21)	0.89 (0.84, 0.95)
Other	0.67 (0.65, 0.68)	0.72 (0.68, 0.77)
Education		
Less than high school	1.11 (1.09, 1.13)	1.13 (1.09, 1.18)
High school graduate	1.00	1.00
Some college	0.98 (0.97, 1)	1.01 (0.99, 1.05)
College graduate	0.71 (0.7, 0.72)	0.68 (0.65, 0.7)
Marital status		
Single	1.00	1.00
Married	1.39 (1.37, 1.41)	1.02 (0.99, 1.06)
Widowed	1.36 (1.33, 1.39)	0.99 (0.93, 1.05)
Divorced	1.28 (1.26, 1.31)	1.04 (1, 1.09)
Annual household income ($)		
<10,000	1.32 (1.28, 1.35)	2.26 (2.15, 2.38)
10,000–14,999	1.27 (1.24, 1.3)	2.15 (2.03, 2.27)
15,000–19,999	1.21 (1.19, 1.24)	1.82 (1.73, 1.91)
20,000–24,999	1.16 (1.13, 1.18)	1.68 (1.61, 1.77)
25,000–34,999	1.12 (1.1, 1.14)	1.47 (1.4, 1.53)
35,000–49,999	1.11 (1.09, 1.13)	1.34 (1.29, 1.4)
≥50,000	1.00	1.00
Missing income data	0.87 (0.85, 0.88)	1.09 (1.04, 1.14)
STATE-LEVEL CHARACTERISTICS		
Annual unemployment rate	1.00 (0.99, 1.01)	1.00 (0.98, 1.02)
Prices		
Alcohol	1.01 (0.94, 1.09)	1.08 (0.89, 1.33)
Interacted with post–Year 2000 indicator	0.96 (0.88, 1.04)	0.79 (0.64, 0.98)

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Table 2. *(continued)*

	Obesity (BMI≥30)	Severe obesity (BMI≥40)
Gas	1.02 (0.99, 1.05)	0.99 (0.92, 1.07)
Fast food	0.98 (0.94, 1.02)	0.96 (0.87, 1.06)
Groceries relative to nongrocery items	1.00 (0.81, 1.24)	1.39 (0.78, 2.46)
Interacted with post–Year 2000 indicator	0.83 (0.64, 1.08)	0.61 (0.31, 1.22)
Healthier foods relative to less healthy foods	1.45 (1.05, 2.02)	1.66 (0.73, 3.76)
Number of restaurants	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)
Internet access	1.27 (1.11, 1.45)	1.18 (0.84, 1.65)
Post–Year 2000 indicator	1.17 (0.94, 1.46)	2.10 (1.17, 3.76)
Pseudo-R^2	0.040	0.059

Note: The ORs were calculated using the logistic regression model presented in Equation 1. Logit models were run with the OR option in Stata, Version 9. Specifications included national linear and log time trends and state-specific linear time trends. 95% CIs are based on robust SEs that account for clustering of observations within states.

attributable annual medical expenditures by $4.0 (±$0.5) billion in 2020 (in $2008) and by $4.7 (±$0.5) billion in 2030.

Over the next 2 decades, this 1 percentage point reduction from trend would reduce obesity-attributable medical expenditures by $84.9 (±$9.3) billion. If obesity prevalence were to remain at 2010 levels, the combined obesity-attributable savings in medical expenditures over the next 2 decades (when compared with forecasts from the present study) would be $549.5 (±$60) billion (Appendix E, available online at www.ajpmlonline.org). Had obesity prevalence remained constant at 15%, which was the Healthy People 2010 target for obesity, obesity-attributable medical savings would have totaled $1.9 trillion (Appendix F, available online at www.ajpmonline.org).

Discussion

The current study contributes to the literature on the future prevalence and costs of obesity by moving beyond simple linear predictions and allowing the forecasts to vary based on expected trends in both individual- and state-level variables. With respect to obesity, the present study estimates lower forecasts than those of prior studies. These forecasts

Table 3. Projected prevalence of obesity and severe obesity, % (95% CI)

	Year				
	2010	2015	2020	2025	2030
OBESITY (BMI≥30)					
Linear trend	31.66 (31.34, 31.98)	36.43 (35.98, 36.87)	41.19 (40.62, 41.76)	45.96 (45.26, 46.65)	50.72 (49.9, 51.55)
Logit models					
Holding all variables except time trend fixed	30.27 (29.35, 31.2)	33.06 (31.11, 35.07)	35.51 (32.1, 39.07)	37.66 (32.6, 43.01)	39.57 (32.73, 46.84)
Predicted demographics keeping state variables fixed	30.23 (29.65, 30.81)	33.02 (31.22, 34.87)	35.46 (32.14, 38.93)	37.62 (32.62, 42.89)	39.53 (32.73, 46.74)
Extrapolating all variables	30.94 (29.93, 31.97)	34.47 (32.62, 36.37)	37.40 (34.35, 40.55)	39.93 (35.48, 44.56)	42.19 (36.18, 48.43)
SEVERE OBESITY (BMI≥40)					
Linear trend	4.77 (4.61, 4.93)	5.77 (5.54, 5.99)	6.76 (6.48, 7.05)	7.76 (7.41, 8.11)	8.76 (8.35, 9.17)
Logit models					
Holding all variables except time trend fixed	4.69 (4.21, 5.23)	5.92 (4.82, 7.26)	7.21 (5.12, 10.04)	8.52 (5.2, 13.58)	9.85 (5.12, 17.92)
Predicted demographics keeping state variables fixed	4.70 (4.37, 5.04)	5.93 (4.91, 7.14)	7.21 (5.17, 9.94)	8.52 (5.24, 13.49)	9.85 (5.15, 17.84)
Extrapolating all variables	4.93 (4.38, 5.54)	6.39 (5.27, 7.73)	7.90 (5.86, 10.56)	9.47 (6.23, 14.1)	11.08 (6.4, 18.39)

Note: 95% CIs for predictions are based on sampling variance only and do not account for uncertainty in the future values of the explanatory variables.

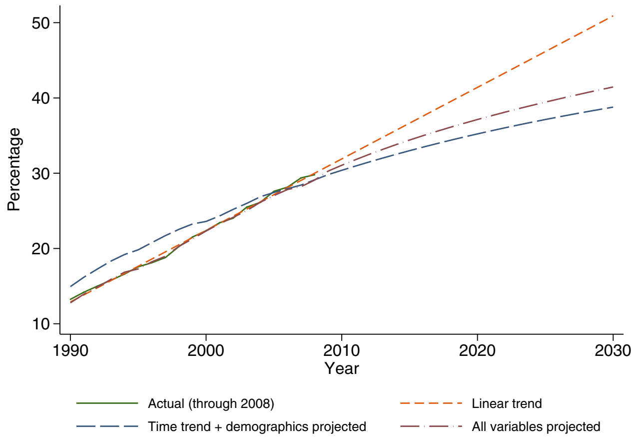

Figure 1. Actual and predicted prevalence of obesity (BMI ≥30)

are more consistent with recent NHANES data, suggesting a leveling off of obesity for some subpopulations. The projections presented here did not completely level off because BRFSS does not show the same pattern as NHANES.[19,20] These projections were lower than prior studies largely because of the assumption that future trends in obesity will follow a logarithmic, as opposed to a linear, trajectory as inclusion of the available state-level variables had only a small effect on the results. However, the study still forecasts a 33% increase in the prevalence of obesity over the next 2 decades.

For severe obesity, the current study forecasts a larger increase in prevalence than that generated from a linear trend. This result is consistent with data revealing that the BMI distribution among adults is becoming more right-skewed.[2] Thus, these projections were based on data showing higher historical growth for the severely obese subsample. Further, the severe-obesity prevalence could have been closer to the steeply sloped region to the left of the logistic sigmoid curve. The severe-obesity results are concerning, given the nonlinear relationship between excess weight and adverse health outcomes. Those with a BMI higher than 40 are at much greater risk for diabetes and other medical conditions than those with a BMI between 30 and 35.[21,22] They also have a much shorter life expectancy and generate greater lifetime medical costs,[23] suggesting that future healthcare costs may continue to increase even if obesity prevalence levels off.

This analysis has several limitations. The projections assume that logistic regression parameters and costs from past data will continue to hold in the future. BRFSS excludes people who do not have land-line telephones; wireless-only households are likely to be different from the general population, although the effect of this bias is unclear.[24]

Another limitation of BRFSS is the reliance on self-reported height and weight. Although under-reporting was adjusted for using 1999–2000 NHANES data, the midpoint of the BRFSS panel, this correction under-predicts measured 2008 obesity prevalence. This results from differences in self-reporting bias between BRFSS and NHANES.

Although this bias may make predictions presented here conservative, it will not change the shape of the forecasts or the estimated medical savings resulting from successful obesity prevention efforts. Obesity-attributable medical expenditures are attributable to obesity, its causes and consequences. SEs do not take into account uncertainty in the future values of the explanatory variables. To gauge uncertainty around these variables, the study presented obesity forecasts under the assumption that they maintain their 2008 values and based on their predicted values. Applying state-level variables with potentially large local variability and imputing city-based ACCRA variables to the state level likely generated substantial measurement error, which would tend to bias the estimates toward 1 (equal ORs). Moreover, state-level variables used in the present study are limited by the available data.

Yet partly as a result of the obesity epidemic, other variables, such as increased access to recreational facilities, improvements in urban design, anti-obesity social marketing programs, worksite health promotion programs, new drugs and technologies, and others are changing in ways that could slow obesity growth even further than these forecasts predict. Finally, although these forecasts focused on adults, future trends in childhood obesity prevalence will have a major impact on adult obesity prevalence and related healthcare costs, given the high degree of tracking or stability of excess weight from childhood into adulthood.[25]

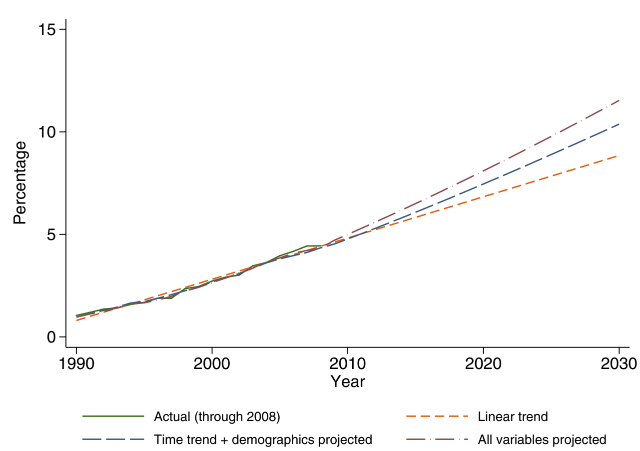

Figure 2. Actual and predicted prevalence of severe obesity (BMI ≥40)

Conclusion

Given the many caveats listed in the preceding paragraph, the current study forecasts a 33% increase in the prevalence of obesity over the next 2 decades based on extrapolating prior available data and assuming these trends continue into the future. If these forecasts prove accurate, this will further hinder efforts for healthcare cost containment. Yet successful interventions that generate even small improvements in obesity prevalence, including those noted in the preceding paragraph, could result in substantial savings.

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Appendix

Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.amepre.2011.10.026.