Will All Americans Become Overweight or Obese? Estimating the Progression and Cost of the US Obesity Epidemic

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We projected future prevalence and BMI distribution based on national survey data (National Health and Nutrition Examination Study) collected between 1970s and 2004. Future obesity-related health-care costs for adults were estimated using projected prevalence, Census population projections, and published national estimates of per capita excess health-care costs of obesity/overweight. The objective was to illustrate potential burden of obesity prevalence and health-care costs of obesity and overweight in the United States that would occur if current trends continue. Overweight and obesity prevalence have increased steadily among all US population groups, but with notable differences between groups in annual increase rates. The increase (percentage points) in obesity and overweight in adults was faster than in children (0.77 vs. 0.46–0.49), and in women than in men (0.91 vs. 0.65). If these trends continue, by 2030, 86.3% adults will be overweight or obese; and 51.1%, obese. Black women (96.9%) and Mexican-American men (91.1%) would be the most affected. By 2048, all American adults would become overweight or obese, while black women will reach that state by 2034. In children, the prevalence of overweight (BMI ≥ 95th percentile, 30%) will nearly double by 2030. Total health-care costs attributable to obesity/overweight would double every decade to 860.7–956.9 billion US dollars by 2030, accounting for 16–18% of total US health-care costs. We continue to move away from the Healthy People 2010 objectives. Timely, dramatic, and effective development and implementation of corrective programs/policies are needed to avoid the otherwise inevitable health and societal consequences implied by our projections.

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INTRODUCTION

Obesity has become a public health crisis in the United States. Nationally representative survey data show that the prevalence has steadily increased over the past three decades although there are large disparities between population groups and continuing changes in the associated patterns (1–3). Current evidence suggests that the prevalence is likely to remain on the rise (1,4,5), and it will not be possible to meet the objectives set for Healthy People 2010 of reducing obesity prevalence in adults to 15% and in children to 5% (6). Obesity has many health, social, psychological, and economic consequences for the individuals being affected and for the society (7). The current US generation may have a shorter life expectancy than their parents if this obesity epidemic cannot be controlled (8). The economic impact is especially evident in health-care costs (9–13). A recent study estimated that medical expenditures attributed to overweight and obesity accounted for 9.1% of total US medical expenditures in 1998 and might have reached 78.5 billion US dollars (10). Expenditures will continue to rise particularly due to the increases in obesity prevalence and in the cost of related health care (11).

This study aims to provide a thorough analysis to illustrate potential future trends in obesity and the related health-care costs were current trends to continue, based on nationally representative survey data collected over the past three decades, to characterize the need for national polices and programs. Such information will help the United States and perhaps other policy makers, health professionals, and the general public to be better prepared to face the related challenges, and motivate the development of public health and clinical programs to address the obesity epidemic in order to avoid the many adverse health and social consequences that will otherwise ensue.

METHODS AND PROCEDURES

Overview

Our projection analyses were based on prevalence data from the National Health and Nutrition Examination Study (NHANES)

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collected between the 1970s and 2004 (ref. 14). Compared with other available data sources, the NHANES provides high quality, directly measured height and weight data from nationally representative samples, and the data are comparable over time (1). Our projections of obesity-related health-care costs are mainly based on recently published studies using national health-care expenditure data.

Key outcome variables

Overweight and obesity. For practical purposes and among both children and adults, BMI (weight (kg)/height $(m)^2$) is widely used nowadays to assess obesity (15–18). In adults, the BMI (kg/m^2) cut-off points for overweight and obese are set at 25 and 30, respectively (17,19). In children and adolescents, "Overweight" is defined as BMI (kg/m^2) ≥ the sex–age-specific 95th BMI percentile, and "at risk for overweight" as 85th ≤ BMI <95th percentile (20–22). In children and adolescents, we focused on overweight because national estimates of the prevalence of "at risk for overweight" have not been made available for all waves of NHANES.

Health-care costs attributable to obesity and overweight. Medical costs associated with overweight and obesity may involve direct and indirect costs (13). Direct medical costs may include preventive, diagnostic, and treatment services related to obesity. Indirect costs relate to morbidity and mortality. Morbidity costs are defined as the value of income lost from decreased productivity, restricted activity, absenteeism, and bed days. Mortality costs are the value of future income lost by premature death. Note that our projections only provide estimates of the overall direct medical costs. We chose not to estimate the indirect costs because of the larger uncertainty and the need for more data. In addition, we focused on adults in our cost projections because of the absence of published estimates on health-care costs attributable to obesity for children or adolescents.

Main original databases used for projections

NHANES. The NHANES comprises a series of cross-sectional, nationally representative examination surveys conducted since the 1970s including NHANES I (1971–1974), II (1976–1980), and III (1988–1994). Beginning in 1999, NHANES became a continuous survey. Data on weight and height are collected through direct physical examination in a mobile examination center (14). Most recently, the NHANES data collected in 2003–2004 were made available. Previous analyses show little increase in the prevalence of obesity and overweight between NHANES I and II, but prevalence has been steadily increasing since NHANES II (1,3,23).

Medical Expenditure Panel Survey and National Health Expenditure Accounts. Recently published studies that estimate obesity-related health-care costs using the Medical Expenditure Panel Survey (MEPS) data (10,11) provide a base for our projections of future health-care costs attributable to overweight and obesity. The MEPS is a set of large-scale nationwide surveys of families and individuals, their medical providers (primarily doctors, hospitals, and pharmacies), and employers across the United States, which is designed to support studies of health-care use and expenditures (24,25). The survey began in 1996 and collects data on the specific health services that Americans use, how frequently they use them, the cost of these services, and how they are paid for, as well as data on the cost, scope, and health insurance coverage. National Health Expenditure Account (NHEA) provides aggregate measures of health-care expenditures in the United States by type of service delivered (hospital care, physician services, nursing home care, etc.) and source of funding for those services (private health insurance, Medicare, Medicaid, out-of-pocket spending, etc.). The Office of the Actuary in the Centers for Medicare and Medicaid Services annually produces projections of health-care spending for categories within the NHEA for the next decade (26).

Statistical analysis

Projection of future overweight and obesity trends. We estimated the average annual increase in the prevalence of overweight and obesity and predicted the future prevalence among US adults and children assuming the trends would be similar to those of the past three decades. Most of the past prevalence estimates based on NHANES data used in our analysis were based on previously published estimates, all of which were based on analyses done with consideration of survey design effects and sampling weights (1,3,23). Additional estimates were obtained only when necessary (e.g., prevalence and shift in BMI distributions) and were also calculated taking design effects and sample weights into account. For example, such analyses were conducted using the survey-related commends in STATA Release 9.0 (Stata, College Station, TX), and the relevant strata, primary sampling units, and sampling weight variables were used. We fit linear regression models with the prevalence as the dependent variable and the survey time as the predictors for different sociodemographic groups. The β coefficients indicate the average annual increases in the prevalence. The models fit the data well in each sociodemographic stratum, and explained 60–100% (i.e., R^2) of the variance in the prevalence. The majority (~90%) of the models had an $R^2 > 0.90$. Based on the findings, we then projected the future situation for the years of 2010, 2020, and 2030 as well as when the prevalence would reach the landmark levels (e.g., 80 and 100%). In addition, we calculated prediction intervals based on the s.e. of the predicted prevalence (27).

Further, based on previously observed BMI distribution shifts between 1976 and 2004 we predicted future BMI distributions among American adults aged ≥20 and then projected the mean BMI and prevalence based on these projected BMI distributions. We created weighted percentiles for each wave and estimated mean BMI within each percentile. Subsequently, the cumulative relative frequency (proportion) was compared between waves and the yearly shift in mean BMI for each percentile was estimated using ordinary least squares linear regression models with survey mid-period as the predictor for mean BMI in each percentile. This yearly shift was then applied to the NHANES 1999–2004 population to project future BMI distributions.

Projection of obesity-related health-care costs. We make two sets of projections based on our projected prevalence and two recently published estimates of per capita excess health-care costs attributable to obesity and overweight among US adults (10,11). Thorpe *et al.* used the MEPS and found that in 2001 the average health-care costs for the obese group was $1,069 higher than for the normal weight group, and for the overweight (25 ≤ BMI < 30) group, was higher by $340 (refs. 10,11). Finkelstein *et al.* estimated that the annual excess health-care costs attributable to obesity were $732 per person in 1998, and $247 for overweight (10). We estimated per capita excess health-care costs due to obesity and overweight for each year from 2000 to 2030, assuming that the excess costs grow at the same rate as per capita personal health-care costs in the NHEA, which have been projected to 2016 (ref. 28). We applied the average annual growth rate of per capita personal health costs between 2005 and 2016, 6.0%, to the rest of the study period.

To calculate total health-care costs attributable to obesity and overweight for all US adults, we applied our projected prevalence to the population projection provided by the Census Bureau. We also expressed these costs as a percentage of the total personal health-care costs in the NHEA, and as a percentage of total health-care costs estimate from MEPS. Total personal health-care costs in the NHEA are projected to grow at 6.9% from 2016 to 2030, the same as the annualized growth rate from 2005 to 2016 projected. Total health-care expenditures from MEPS are available for 1996–2004. We assume that these estimates grow at the same rate as the NHEA personal health-care costs. Note that primarily because of coverage differences (e.g., sample population included) that MEPS estimates of total health-care expenditures are lower than those of the NHEA (29). The projected costs were also converted to 2,000 dollars assuming a 3% annualized increase in the gross domestic product deflator.

Table 1 Average annual increase in prevalence of obesity and overweight among US adults and children and future projections based on NHANES 1976–1980 to 2003–2004

Age	Gender	Ethnicity	Current (1999–2004)	Average annual increase (percentage points) (OLS)			Prevalence projections: prevalence (%) and projection interval		
				Rate (β)	s.e.	R^2	2010	2020	2030
Adults, ≥20 years	Men and women	All	66.3	0.772	0.044	0.99	70.8 (68.4–73.1)	78.5 (75.6–81.4)	86.3 (82.9–89.8)
Overweight and obesity (BMI ≥ 25 kg/m^2)	Men	All	67.0	0.653	0.022	0.99	73.5 (72.3–74.7)	80.1 (78.5–81.7)	86.6 (84.6–98.6)
	Women	All	62.0	0.911*	0.153	0.97	69.0 (60.9–77.0)	78.1 (67.5–88.7)	87.2 (73.9–100.0)
	Men	Non-Hispanic white	67.5	0.654	0.017	0.99	74.7 (73.7–75.7)	81.3 (80.1–82.5)	87.8 (86.2–89.4)
		Non-Hispanic black	60.1	0.419*	0.083	0.96	64.3 (73.7–75.7)	68.5 (80.1–82.5)	72.7 (86.2–89.4)
		Mexican American	74.4	0.595	0.003	1	79.3 (79.1–79.5)	85.2 (85.0–85.4)	91.1 (90.9–91.3)
	Women	Non-Hispanic white	57.5	0.856*	0.152	0.97	65.2 (57.2–73.2)	73.7 (63.3–84.1)	82.3 (69.2–95.4)
		Non-Hispanic black	78.0	0.694*	0.180	0.94	83.0 (73.4–92.6)	90.0 (77.5–100)	96.9 (81.2–100)
		Mexican American	71.8	0.481*	0.094	0.96	77.1 (72.0–82.2)	81.9 (75.4–88.4)	86.7 (78.5–94.9)
Obesity (BMI ≥ 30 kg/m^2)	Men and women	All	32.2	0.682	0.031	0.99	37.4 (35.6–39.2)	44.2 (42.2–46.2)	51.1 (48.5–53.6)
	Men	All	27.7	0.685*	0.064	0.98	33.9 (30.6–37.2)	40.7 (36.4–45.0)	47.6 (42.1–53.1)
	Women	All	34.0	0.778*	0.070	0.98	42.5 (38.8–46.2)	50.3 (45.4–55.0)	58.0 (51.9–64.1)
	Men	Non-Hispanic white	31.1	0.727	0.037	0.99	34.3 (32.3–36.3)	41.5 (38.9–44.0)	48.8 (45.7–51.9)
		Non-Hispanic black	34.0	0.636	0.141	0.87	36.4 (28.7–44.0)	42.7 (33.1–52.3)	49.1 (37.3–60.9)
		Mexican American	31.6	0.575	0.075	0.97	33.3 (29.2–37.4)	39.0 (33.9–43.3)	44.8 (38.5–51.1)
	Women	Non-Hispanic white	30.2	0.616	0.055	0.98	35.6 (32.7–38.5)	41.7 (38.0–45.4)	47.9 (43.4–52.4)
		Non-Hispanic black	53.9	0.878	0.107	0.97	58.1 (52.2–64.0)	66.9 (59.6–74.1)	75.6 (66.6–84.6)
		Mexican American	42.3	0.569	0.084	0.96	44.4 (39.9–48.9)	50.1 (44.4–57.8)	55.8 (48.7–62.8)
Children, 6–11 years	Boys and girls	All	18.8	0.462	0.051	0.97	20.4 (17.6–23.1)	25.0 (21.5–28.5)	29.7 (25.4–34.0)
Overweight (BMI ≥ 95th percentile)[a]	Boys	All	19.9	0.492	0.052	0.97	20.8 (12.0–29.6)	25.7 (22.2–29.2)	30.7 (26.4–35.0)
	Girls	All	17.6	0.406	0.041	0.97	19.8 (17.4–22.1)	23.8 (21.0–26.5)	27.9 (24.6–31.2)
	Boys	Non-Hispanic white	18.5	0.4	0.100	0.84	19.7 (14.2–25.2)	23.7 (17.0–30.4)	27.7 (19.5–35.9)
		Non-Hispanic black	17.5	0.441	0.029	0.99	21.4 (19.8–23.0)	25.8 (23.8–27.8)	30.2 (27.8–32.5)
		Mexican American	25.3	0.548	0.098	0.91	30.2 (24.7–35.7)	35.7 (29.2–42.2)	41.1 (33.0–49.1)
	Girls	Non-Hispanic white	16.9	0.403	0.073	0.91	17.0 (12.9–21.1)	21.1 (16.2–26.0)	25.1 (19.0–31.2)
		Non-Hispanic black	26.5	0.564	0.056	0.97	28.2 (25.1–31.3)	33.9 (30.2–37.6)	39.5 (34.8–44.2)
		Mexican American	19.4	0.314*	0.142	0.62	20.2 (12.4–28.0)	23.4 (14.0–32.8)	26.5 (14.7–38.3)

Table 1 Continued on next page

Table 1 Average annual increase in prevalence of obesity and overweight among US adults and children and future projections based on NHANES 1976–1980 to 2003–2004 (Continued)

Age	Gender	Ethnicity	Current (1999–2004)	Average annual increase (percentage points) (OLS)			Prevalence projections: prevalence (%) and projection interval		
				Rate (β)	s.e.	R^2	2010	2020	2030
Adolescents, 12–19 years	Boys and girls	All	17.4	0.492	0.016	0.99	21.1 (19.7–22.5)	26.0 (24.4–27.6)	31.0 (29.2–32.8)
	Boys	All	18.3	0.528	0.018	0.99	21.1 (19.3–22.8)	26.4 (24.4–28.4)	31.6 (29.0–34.1)
Overweight (BMI ≥ 95th percentile)[a]	Girls	All	16.4	0.449	0.022	0.98	18.8 (17.2–20.4)	23.3 (21.5–25.0)	27.8 (25.4–30.1)
	Boys	Non-Hispanic white	19.1	0.526	0.108	0.88	20.0 (13.9–26.1)	25.2 (17.9–32.4)	30.5 (21.5–39.5)
		Non-Hispanic black	18.5	0.537	0.129	0.85	22.1 (14.8–29.3)	27.4 (18.8–36.0)	32.8 (22.2–43.4)
		Mexican American	18.3	0.589	0.226	0.69	25.3 (12.7–37.8)	31.2 (16.1–46.3)	37.1 (18.5–55.7)
	Girls	Non-Hispanic white	15.4	0.391	0.058	0.94	16.9 (13.7–20.0)	20.8 (16.9–24.7)	24.7 (20.0–29.4)
		Non-Hispanic black	25.4	0.581	0.096	0.92	29.5 (24.2–35.8)	35.3 (28.8–41.8)	41.1 (33.3–48.9)
		Mexican American	14.1	0.36*	0.154	0.64	20.4 (11.8–29.0)	24.0 (13.6–34.4)	27.6 (14.8–40.3)

Ordinary least squares (OLS) linear regression models included prevalence as a function of time as the independent variable. The β coefficients can be interpreted as the annual change in prevalence. Note that time periods for each National Health and Nutrition Examination Study (NHANES) survey (1976–2004) were represented by the mid-point of the survey period. For Mexican American, only NHANES data collected between 1988 and 2004 were adequate and used in our projection. The projections were conducted assuming no population distribution changes regarding age, sex, and ethnicity after 2004. Prediction intervals were estimated after estimating the predicted projection s.e. for each projection year. 95% confidence intervals were estimated as predicted prevalence ± 1.96 × s.e.
[a]Based on the 2000 CDC Growth Charts.
*$P > 0.05$ for null hypothesis that $\beta = 0$; all the others $P < 0.05$.

All analyses were conducted using STATA Release 9.0. We have considered other projection methods, but felt the presented approaches are appropriate and provide straightforward and interpretable results. Our linear models had excellent fit as shown by the high R^2 values. Our projected results based on year-specific prevalence (linear models) and those based on BMI distribution are consistent. Even though prediction intervals were estimated in our study, literal prediction of the future scenario in the United States would be affected by many possible uncertainties including policy-, environmental-, and behavioral changes that would require many more assumptions and more complex models than were applied here. Rather we aimed to show in a relatively straightforward manner what the future would be if the trends observed in the past continue.

RESULTS

Projected prevalence of overweight and obesity from 2010 to 2030

On average, the prevalence of overweight and obesity has increased steadily among all US population groups over the past two to three decades ($P < 0.05$), but some noticeable differences exist in the average annual increase (percentage point) across sex-, age-, and ethnic groups (Table 1 and Figure 1). In general, US adults saw a faster increase in obesity than the increase in overweight in children and adolescents (0.68 vs. 0.46 and 0.49, respectively); women had a faster increase than men (0.91 vs. 0.65 for combined prevalence of overweight and obesity). Girls had a slower increase in overweight than boys (0.41 vs. 0.49 in children and 0.45 vs. 0.53 in adolescents). White men and women had the highest increase rate in the combined prevalence, compared with African Americans and Mexican Americans (MAs), within gender. Regarding obesity, African-American women had the highest prevalence and rate

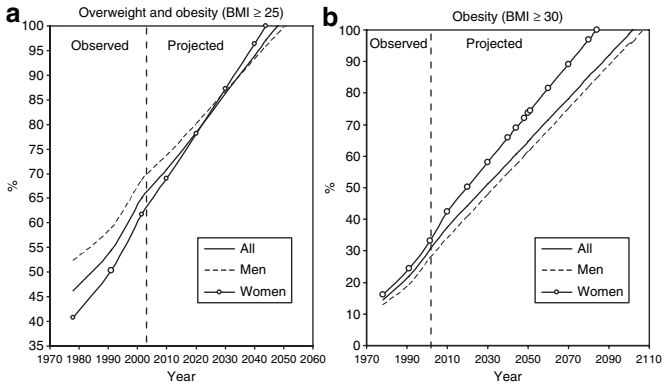

Figure 1 Prevalence of obesity and overweight among US adults: Observed during 1976–2004 and projected. The projected prevalence presented here are those based on our linear regression models.

of increase overall; and in men, the prevalence was similar, but white men had the highest increase rate. The patterns in children and adolescents were complex.

Our projection models show that by the year 2030, ~90% (86.3%) of all American adults would become overweight or obese and 51.1% of them would be obese. Black women (combined prevalence 96.9%) and MA men (91.1%) would be the groups most affected. In children and adolescents, prevalence of overweight would increase 1.6-fold (to ~30%) by 2030. MA young boys and black adolescent girls would have the highest prevalence (both 41.1%), a level that would be 10 percentage points higher than the national average. Further, the prevalence

Table 2 Future projections:[a] time when the prevalence of overweight or obesity among US adults will reach 80, 85, 90, and 100% and prevalence of overweight (BMI ≥ 95th percentile[b]) among US children will reach 30, 40, and 50%

			Year when the prevalence will reach		
	Gender	Ethnicity	80%	90%	100%
US adults					
Overweight and obesity (BMI ≥ 25 kg/m^2)	All	All	2022	2035	2048
	Men	All	2020	2035	2051
	Women	All	2022	2033	2044
	Men	Non-Hispanic white	2018	2033	2049
		Non-Hispanic black	2047	2071	2095
		Mexican American	2011	2028	2045
	Women	Non-Hispanic white	2027	2039	2051
		Non-Hispanic black	2006	2020	2034
		Mexican American	2016	2037	2058
Obesity (BMI ≥ 30 kg/m^2)	All	All	2072	2087	2102
	Men	All	2077	2092	2107
	Women	All	2058	2071	2084
	Men	Non-Hispanic white	2073	2087	2100
		Non-Hispanic black	2079	2094	2110
		Mexican American	2091	2109	2126
	Women	Non-Hispanic white	2082	2098	2115
		Non-Hispanic black	2035	2046	2058
		Mexican American	2073	2090	2108
			Year when the prevalence will reach		
US children and adolescents			30%	40%	50%
Children, 6–11 years	All	All	2031	2052	2074
Overweight[b]	Boys	All	2029	2049	2069
	Girls	All	2035	2060	2084
	Boys	Non-Hispanic white	2036	2061	2086
		Non-Hispanic black	2029	2052	2075
		Mexican American	2010	2028	2046
	Girls	Non-Hispanic white	2042	2067	2092
		Non-Hispanic black	2013	2031	2049
		Mexican American	2041	2073	2105
Adolescents, 12–19 years	All	All	2028	2048	2069
	Boys	All	2027	2046	2065
Overweight[b]	Girls	All	2035	2057	2080
	Boys	Non-Hispanic white	2029	2048	2067
		Non-Hispanic black	2025	2043	2062
		Mexican American	2018	2035	2052
	Girls	Non-Hispanic white	2043	2069	2095
		Non-Hispanic black	2011	2028	2045
		Mexican American	2037	2064	2092

[a]The projections were made using linear regression models based on National Health and Nutrition Examination Study data collected between 1974 and 2004, and assumed no population distribution changes regarding age, sex, and ethnicity after 2004. [b]Based on the 95th BMI percentiles in the 2000 CDC Growth Chart.

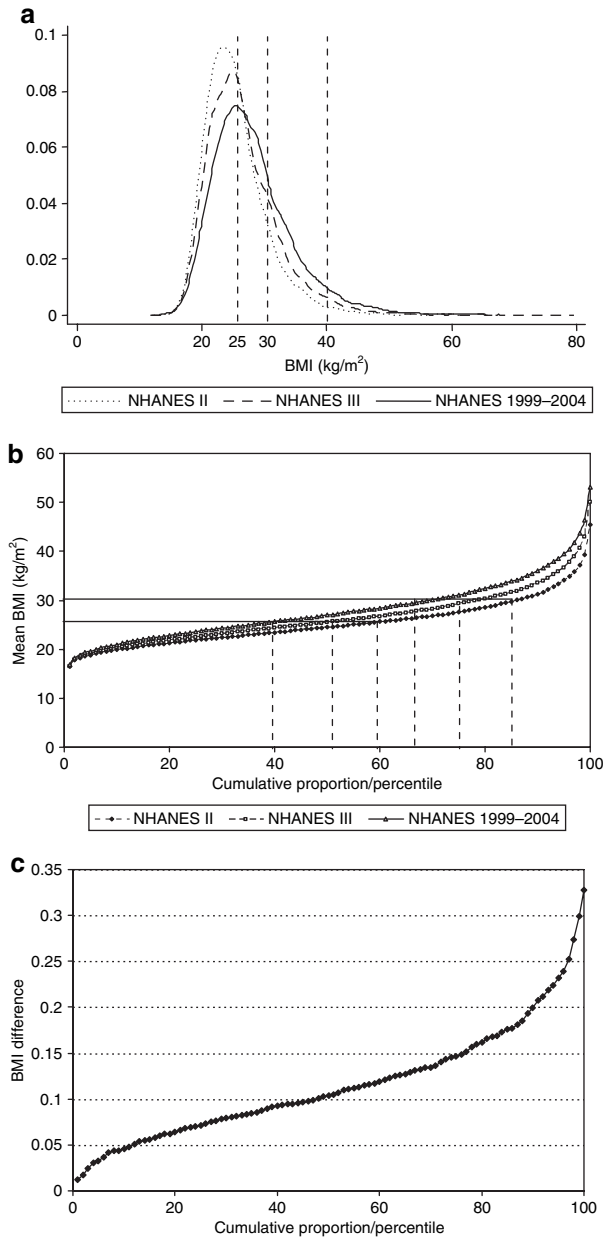

Figure 2 Shifts in BMI distribution among American adults between 1976 and 2004: NHANES II (1976–1980), III (1988–1994), and 1999–2004. (**a**) Kernel density plot of BMI. (**b**) Cumulative proportion distribution of BMI. (**c**) Mean BMI difference within percentile, *m–d*: ordinary least squares (OLS) estimate of average yearly shift.

in MA adolescents will increase by twofold and among African-American teens, by 1.8-fold, the largest increases.

Furthermore, our findings from comparing BMI distributions between NHANES II (1976–1980) and 1999–2004 suggest a great BMI increase in the upper part of the distribution. Note that a previous study has examined the shift up to NHANES III (1988–1994) (ref. 30). This is clearly shown in the increasing area under the upper tail, the widening of the BMI mean differences in the upper percentiles and an upward sloping *m–d* plot (Figure 2). Assuming these trends will persist, we projected the future BMI distributions. Based on these projections, mean BMI

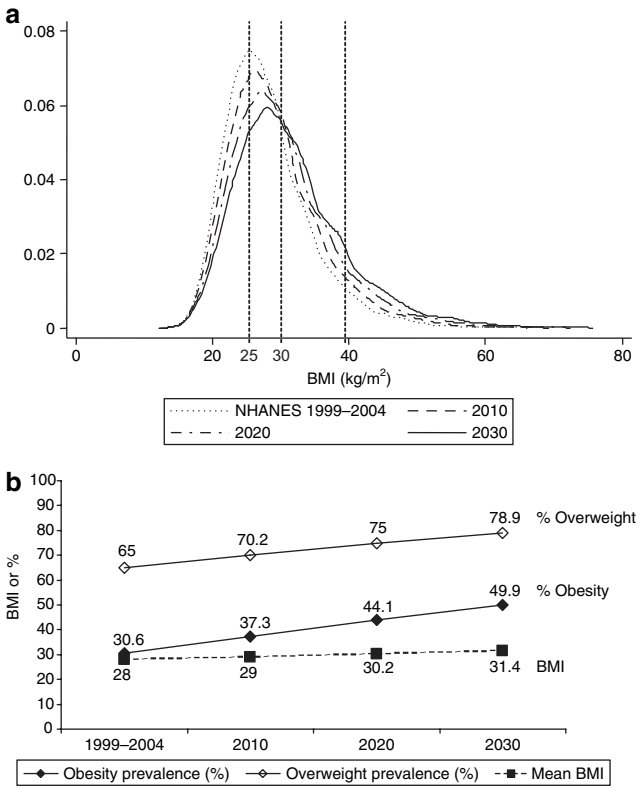

Figure 3 Current BMI distribution and projected distributions for the years of 2010, 2020, and 2030. (**a**) BMI Kernel density plots. (**b**) Mean BMI, obesity, and overweight prevalence.

Table 3 Projected direct health-care costs, in billions of dollars, attributable to overweight and obesity for US adults: 2000–2030

	Overweight and obesity (BMI ≥ 25 kg/m²)				Obesity (BMI ≥ 30 kg/m²)			
	Billions ($)	Billions of $2,000	% NHEA	% MEPS	Billions ($)	Billions of $2,000	% NHEA	% MEPS
Projection A[a]								
2000	81.5	$81.5	7.1	13.0	60.9	$60.9	5.3	9.7
2010	194.3	$151.1	8.4	13.5	151.3	$117.7	6.5	10.5
2020	437.6	$276.0	9.7	15.6	351.1	$221.4	7.8	12.5
2030	956.9	$507.5	10.9	17.6	784.8	$416.2	9.0	14.4
Projection B[b]								
2000	72.2	$72.2	6.3	11.5	53.2	$53.2	4.7	8.5
2010	175.2	$136.3	7.6	12.2	114.6	$104.7	5.8	9.4
2020	394.0	$248.5	8.8	14.1	312.3	$197.0	6.9	11.2
2030	860.7	$456.4	9.8	15.8	698.3	$370.3	8.0	12.8

MEPS, Medical Expenditure Panel Survey; NHEA, National Health Expenditure Account.
[a]Projection based on per capita excess health-care costs attributable to obesity and overweight estimated by Thorpe *et al*. (11). [b]Projection based on per capita excess health-care costs attributable to obesity and overweight estimated by Finkelstein *et al.* (10).

will increase linearly from 27.9 in 1999–2004 to 31.2 in 2030; and by 2030, 78.9% of American adults will be overweight or obese, while 49.9% will be obese (Figure 3). In general, these results are consistent with our linear regression model–based projections.

Time course to arrive at 100% prevalence

In ~15 years, by the year 2022, 80% of American adults would be overweight or obese; and the prevalence would reach 100% in ~40 years (by the year 2048) (**Table 2** and **Figure 1**). For black women, the time course to reach 100% prevalence is <30 years (by 2034). Half of US children and adolescents overall will become overweight around the year 2070, but this level will be reached among black girls and MA boys by 2050.

The projected obesity-related direct health-care costs

Total health-care costs attributable to obesity and overweight will be more than doubled every decade (**Table 3**). By 2030, health-care costs attributable to obesity and overweight could range from $860 to $956 billion, which would account for 15.8–17.6% of total health-care costs, or for 1 in every 6 dollars spent on health care. Because of the assumptions we made and the limitations of the available data, these figures are likely an underestimation of the true impact.

DISCUSSION

Our analyses, based on nationally representative data collected over the past three decades and the assumptions of similar future increase rate and health costs as observed in the past, clearly show an alarming picture of the future obesity epidemic and related challenges. Our projections show that if the trends continue, in only 15 years 80% of all American adults will be overweight or obese. The potential for all adults to become overweight or obese is a reality, especially for subgroups such as black women where the current prevalence is already 78%. At the current rate of increase it will take <30 years for all black women to become overweight or obese. Our projections also indicate that the direct health-care costs attributable to obesity and overweight will be more than doubled every decade. By 2030, costs could range from 860.7 to 956.9 billion US dollars, accounting for 1 in every 6 dollars spent on health care. This is likely to be a gross underestimate, as we assumed that the obesity-related per capita health-care costs grow at the same rate as the per capita total health-care costs, when some evidence suggests that the gap between per capital spending between obese and normal weight individuals in fact is growing significantly larger over time (11). For example, possible future changes such as earlier onset of obesity and complications in younger adults and availability of more costly health-care services may substantially increase related health-care costs.

Although some may question the assumption that the observed trends in the past 30 years will continue and some ongoing and future policy and program changes may affect the future trends, based on the current literature, there are few signs that the increase will slow down. It is possible that the increase may slow down when the future prevalence reaches a high level or due to emerging effective interventions. On the other hand, there are continuing changes in the society (e.g., contextual environmental factors) and people's lifestyles that may put a growing proportion of the population at increased risk for obesity. In fact, the increase observed among black women over the past two decades and the recent catch up of prevalence in white women provide some evidence to support this concern. The potential role of social norms in promoting obesity development was suggested by an analysis of weight gain within social networks (31). Increasing proportions of the population who are obese may result in changes in attitudes about what constitutes a healthy body weight. The environmental and behavioral forces fueling the obesity epidemic are unlikely to be modified overnight, and even effective prevention programs may take years to show a significant impact.

A clear implication of our findings is that the national objectives specified in Healthy People 2010 related to obesity cannot be met, except for the limitations of this study (e.g., the assumptions made). These objectives need be reassessed and reframed to be more realistic and to provide the motivation for a paced but deliberate effort to stabilize and then reverse the trends of obesity increase. A growing body of research aiming at a better understanding of the underlying causes of the growing obesity epidemic suggests that complex factors operating interactively at multiple levels (e.g., individual, community/school, society, and international) are important contributors to this national public health crisis (7,32–34). For a problem as pervasive and serious as the obesity epidemic we have observed at present and projected for the future in the United States, it is likely that broad, comprehensive approaches are needed to address it.

As articulated by the World Health Organization for the global situation (35) and by the Institute of Medicine with respect to childhood obesity in the United States (36), dramatic and effective population-based programs and related policies need to be developed and implemented to address the epidemic. But until recently, there were few truly multifactorial prevention initiatives, the focus being instead on changing individual behaviors. More recently, there has been increasing recognition of the major role that the "obesogenic" environment plays in perpetuating the epidemic (37–39). What is needed now are creative initiatives to actually effect environmental changes, and this will require a strong and sustained collaboration among the public and private sectors, educators, food producers, urban planners, transportation experts, parents, and the general public. The nation's health-care system should be prepared to face the rising burden of obesity-related health consequences, by providing more relevant training to medical and health-care professionals and developing the needed infrastructures.

Our study has certain limitations. As noted previously, our projections are based on a number of assumptions, some of which are simplified scenarios. Future policy-, environmental- and behavioral changes may prove these assumptions wrong. Future obesity rates may not proceed linearly as the epidemic continues, while our projections essentially assume that the environment will continue to worsen at past rates. Other potentially relevant factors include a segment of the population that may be genetically protected from obesity or who may maintain a lower risk of developing obesity through persistent healthy lifestyle behaviors. The forces of the US obesity epidemic may not affect such individuals. In addition, our projected obesity-related medical costs were probably underestimates considering that more obese people will be severely obese in the future; thus, health-care costs per obese person will be higher. Future obesity-related health costs will also be higher due to the

availability of more expensive related services. Careful exploration of these complex factors was beyond the scope of this study and the information provided by currently available data.

It is our hope that the predicted grim future of the obesity epidemic will not turn into the actual scenario in the United States or any other countries. Projections for population subgroups that already have a prevalence of 80%, e.g., black women, suggest that it is indeed possible for the hypothetical levels estimated here to become a reality. Although some individuals may be less prone, genetically, to gain excess weight, we might indeed be approaching environmental and behavioral conditions such that few are exempt.

We hope that the results presented here will provide evidence of the severity of the obesity epidemic, of its impacts on the society, the lessons that other countries can learn from the United States, and ultimately, of the recognition that we, collectively, are the only ones who can prove these projections wrong. Hence, we offer these analyses to pose the questions—what obesity prevalence will be acceptable going forward? What goals will we set, and how will we attain these goals?

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DISCLOSURE

The authors declared no conflict of interest.

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