Current and Future Prevalence of Obesity and Severe Obesity in the United States

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Ruhm, C. (2007). Current and Future Prevalence of Obesity and Severe Obesity in the United States, *Forum for Health Economics and Policy*, Vol. 10(2): 1-26.

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Abstract:

This study examines past patterns and projects future prevalence rates of obesity and severe obesity among US adults. Trends in body mass index (BMI), overweight (BMI≥25), obesity (BMI≥30), class 2 obesity (BMI≥35), class 3 obesity (BMI≥40) and class 4 obesity (BM≥45) of 20-74 year olds are obtained using data from the first National Health Examination Survey and the National Health and Nutrition Examination Surveys. Quantile regression methods are then used to forecast future prevalence rates through 2020. By that year, 77.6% of men are predicted to be overweight and 40.2% obese, with class 2, 3 and 4 obesity prevalence rates projected at 16.4%, 6.3% and 3.1%. The corresponding forecasts for women are 71.1%, 43.3%, 25.3%, 12.8% and 5.6%. The large growth predicted for severe obesity represents a major public health challenge, given the accompanying high medical expenditures and elevated risk of mortality and morbidity. Combating severe obesity is likely to require strategies targeting the particularly large weight gains of the heaviest individuals.
KEYWORDS: adiposity, obesity, body mass index, trends, future prevalence

Article:

Americans are gaining weight. The average adult added 9 to 12 pounds during the 1990s (Freeman et al., 2002). Persons with a body mass index (BMI) of 25 kg/m2 or more are classified as overweight (World Health Organization, 1997; National Heart, Lung and Blood Institute, 1998). Using this criterion, almost two-thirds of Americans 20 and older weighed too much in 1999-2000, compared to 46 percent in 1976-80 (Flegal et al., 1998, 2002). The prevalence of overweight and obesity is particularly high in the US but is growing rapidly throughout much of the world (World Health Organization, 1997; International Obesity Task Force, 2005).

The rise in excess weight in the US has been widely documented (Flegal et al., 2002; Mokdad et al., 2001; Hedley et al., 2004). However, because the BMI distribution has both shifted to the right and become increasingly skewed (Flegal and Troiano, 2000), severe obesity has increased especially quickly. Based on self-reported data, the 10th percentile of the adult BMI distribution rose 0.6 kg/m2 between 1990-91 and 2000, compared to 1.2 kg/m^2 at the median and 3.2 kg/m^2 at the 95th percentile (Freedman et al., 2002). Examination data reveal that median adult BMI rose 9.5 percent between 1976-80 and 1999-2000, versus 15.2 percent at the 95th percentile (Anderson et al., 2003). The prevalence of obesity (BMI≥ 30) doubled between 1986 and 2000, based on self-reports, while class 3 obesity (BMI ≥ 40) quadrupled and BMI ≥ 50 quintupled (Sturm, 2003).

The growth of obesity, particularly in its most extreme forms, represents a major current public health issue and is likely to become even more problematic in the future. Compared to normal weight or overweight but non-obese individuals, the severely obese have substantially elevated mortality (Allison et al., 1999; Calle et al., 1999; Engeland et al., 2003; Fontaine et al., 2003; Peeters et al., 2003; Flegal et al., 2005) and much higher rates of diabetes, high blood pressure, asthma and other diseases (Must et al., 1999; Mokdad et al., 2001; Okoro et al, 2004). Extreme obesity raises medical expenditures, stresses the health care system and results in productivity losses due to disability, illness and premature mortality (Quesenberry, 1998; Thompson et al., 2001; Finkelstein et al., 2003; Andreyeva et al., 2004). Olshansky et al., (2005) raise concern that growing obesity may limit or even reverse historical gains in life expectancy. Since their analysis did not account for the effects of excess weight beyond a BMI of 35 kg/m^2, it may understate the decline in lifespan associated with the rapid increases in severe adiposity.

This study begins by detailing trends in adult body weight since the 1960s. Compared to earlier research, it supplies unusually detailed information on changes over the entire BMI distribution, which is important for the second stage of analysis – forecasting the future prevalence of overweight, obesity and severe obesity. Predictions, through 2020, are obtained assuming a continuation of recent trends and using quantile regression techniques that provide a flexible method of allowing increases in BMI to differ across the distribution (e.g. to be larger at the 90th than the 50th percentile) in ways that closely align with observed patterns. The investigation next decomposes obesity trends into the portions due to population-wide increases in median BMI, versus those resulting from particularly fast growth among the heaviest individuals. For ease of exposition, these will sometimes be referred to as "general" versus "concentrated" weight gains.

The study yields three major findings. First, it confirms previous evidence that rapid increases in overweight and obesity date from the middle 1970s. Although this partially reflects shifts in the entire BMI distribution, disproportionately large growth occurred at the highest BMI levels. Second, a continuation of these trends implies that the prevalence of all forms of excess weight will rise in the future, but with particularly rapid increases in severe and extreme obesity.[1] Third, future growth in overweight and mild forms of obesity is predicted to largely result from shifts in the overall BMI distribution and might therefore be effectively addressed by modest but widely dispersed reductions in weight. By contrast, previous and expected future increases in severe obesity are dominated by the particularly large weight growth in the right tail of the distribution. Reducing these prevalence rates is therefore likely to require new medical and behavioral interventions targeted at extremely obese adults and high risk youths.

1. Data and Outcomes

Baseline information was obtained from the first National Health Examination Survey (NHES 1, 1960-1962), the first, second and third National Health and Nutrition Examination Surveys (NHANES 1, 1971-1974; NHANES 2, 1976- 1980; NHANES 3, 1988-1994), and the first six years (1999-2004) of the most recent NHANES survey (hereafter referred to as NHANES 99), which is continuously conducted and with data publicly released at two year intervals.[2]

1. *Of course, recent trends may not continue, in part because of public health campaigns and policy initiatives aimed at slowing or reversing future increases in body weight. The success of these efforts remains uncertain, however, and it is useful to understand the patterns predicted by current trends.*

2. *Additional information on these data sets is available from National Center for Health Statistics (1965, 994); Miller (1973); McDowell et al. (1981), and at the website: http://www.cdc.gov/nchs/nhanes.htm.*

Each is a cross-sectional nationally representative survey conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention and were designed to provide prevalence estimates for selected diseases and risk factors, monitor trends in risky behaviors and environmental exposures, and to study the relationship between diet, nutrition, and health.

The NHES/NHANES data have several features that are particularly useful for this project. Most importantly, almost all respondents complete health and laboratory examinations that include clinical measurements of height and weight obtained using standardized procedures and equipment.[3] Such clinical data are helpful because self-reports of height and weight contain errors that generally lead to an underestimate of BMI, with most evidence suggesting a bigger downwards bias for heavier individuals.[4] Sample sizes are also reasonably large – although bigger samples would be desirable when measuring low-prevalence conditions such as severe obesity – and minorities and senior citizens are oversampled. Finally, sufficient information is provided on the geographic location and sampling strategy to permit standard errors to be corrected for complex survey design.

Analysis is restricted to 20-74 year olds because different weight classification criteria are used for persons under 20 and individuals older than 74 were excluded from NHANES 2. Pregnant women are retained in the primary analysis sample because larger than anticipated differences in reported pregnancy rates across NHANES surveys raised the possibility of classification errors. Sensitivity analysis conducted after omitting pregnant women yielded virtually identical estimates to those presented below.

BMI is calculated as weight in kilograms divided by height in meters squared. Following national and international standards (World Health Organization, 1997; National Heart, Lung and Blood Institute, 1998), overweight is defined as BMI$\geq$ 25, obesity as BMI$\geq$ 30, class 2 obesity as BMI$\geq$ 35 and class 3 obesity as BMI $\geq$ 40.[5] No standards have been established for obesity beyond class 3. This analysis categorizes "class 4" obesity as BMI $\geq$ 45, to illustrate growth of a more extreme form of excess weight.

2. Empirical Methods

Trends in BMI and the prevalence of overweight and alternative classes of obesity were ascertained for all 20-74 year olds and for subsamples stratified by sex. Total changes and annual growth rates were calculated for the period from NHES 1 (1960-1962) to NHANES 2 (1976-

3. *For the NHES, two pounds were subtracted from measured weight, because the examinee was partially dressed (unlike the other surveys where individuals wore only underwear) and the remaining clothing was estimated to weigh approximately two pounds (National Center for Health Statistics, 1981).*

4. *Specifically, there is a tendency over-report height and understate weight (Strauss, 1999; Goodman et al., 2000; Kuczmarski et al., 2001). A number of (not entirely satisfactory) regression-based procedures have been proposed for correcting the self-report errors.*

5. *BMI is the favored method of assessing excess weight since it is simple, rapid, and inexpensive to calculate. However, it is less accurate than laboratory measures of body composition because it does not account for variations in muscle mass or the distribution of body fat (e.g. intra-abdominal versus overall adiposity). Some researchers prefer alternative anthropometric measures such as waist circumference (Sönmez et al., 2003), waist-hip ratio (Dalton et al., 2003), or waist-height ratio (Cox and Whichelow, 1996). Cawley and Burkhauser (2008) recommend the use of Bioelectrical Impedance Analysis (BIA).*

1980) and from NHANES 2 to NHANES 99 (1999-2004), as well as for some subperiods. Annual percent changes were based on years elapsed between the midpoints of the specified surveys (i.e. a 17-year time difference between 1960-1962 and 1976-1980; a 13-year difference between 1976-1980 and 1988-1994; and a 10.5-year difference between 1988-1994 and 1999-2004). Statistical and econometric analysis was conducted using the STATA statistical software (StataCorp, 2005). Sampling weights were incorporated to allow for unequal selection probabilities and standard errors were computed using Taylor series linearization methods to account for complex survey design.

Future prevalence rates were projected as the fraction of the population, in the specified year, predicted to have BMI at or above the threshold level (e.g. ≥ 30 kg/m^2 for obesity). Traditional regression methods are useful for estimating relationships between covariates and mean values of the dependent variable but, without strong parametric assumptions, will not accurately indicate changes at other points in the distribution. Such restrictions are unlikely to be justified since, as shown below, BMI increased more over time (in both absolute and percentage terms) at high than low values.

As an alternative, future outcomes were forecasted using a series of quantile regressions that allowed BMI growth trends to vary across the distribution.[6] The projections were based on time trends using data from NHANES 2, 3 and 99, covering the period 1976-1980 to 1999-2004. Data from NHES 1 and NHANES 1 were excluded because the BMI distribution changed little during these periods. The dependent variable in the quantile regressions was body mass index. Covariates included dummy variables for race/ethnicity (non-Hispanic Black, Hispanic, other nonwhite) and age (25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69 and 70-74 years old), as well as a linear time trend showing years elapsed since 1975.[7]

Quantile regressions were estimated for each of the 1st through 99th BMI percentiles (a total of 99 estimates). In the baseline model, projected BMI, at the specified percentile, was obtained by setting the time trend to its value in the forecast year of interest (2001, 2010 or 2020), with other explanatory variables evaluated at the NHANES 99 averages.[8] These forecasts were therefore based on the race/ethnicity and age characteristics of the 1999-2004 population.[9]

Overweight and obesity prevalence rates were calculated by linear interpolation between adjacent percentiles where expected BMI spanned the threshold. For instance, if BMI was predicted to be 34.75 kg/m^2 at the 87th percentile and 35.25 kg/m^2 at the 88th percentile, the

6. *Quantile regression minimizes the weighted sum of the absolute deviations of the error term, unlike standard regression that minimizes the sum of the squared residuals (Manning et al., 1995; Koenker and Hollack, 2001). At quantile q, the weights q and (1-q) are applied to positive and negative residuals. In the special case of median regression, q and (1-q) are both 0.5, implying that estimates minimize the unweighted sum of the absolute residuals.*

7. *The survey year was not specified in the public-use versions of NHANES 3 and 99 but the data sets do indicate whether measurements occurred in 1988-1991, 1991-1994, 1999-2000, 2001-2002 or 2003-2004. The year was set to the midpoint of the range in these cases (1989.5, 1992.5, 1999.5, 2001.5 and 2003.5).*

8. *Sampling weights were incorporated throughout.*

9*. The same procedure, but with the explanatory variables set to the NHANES 2 means, was used when predicting 2001 values based on 1976-1980 population characteristics.*

estimated prevalence of class 2 obesity was 12.5 percent (since 35.0 kg/m^2 is half way between the two estimates). These interpolations will be quite accurate when the difference in BMI across adjacent percentiles is small but less so in tails of the distribution, where the changes are often quite large. Therefore, forecasts of class 3 or class 4 obesity involved the additional step of estimating quantile regressions for each 0.1 percentile within the BMI percentile spanning the threshold value and using linear interpolation for the adjacent 0.1 percentiles above and below it. To illustrate, if predicted BMI at the 95^{th} and 96^{th} percentile was 44.05 kg/m^2 and 45.83 kg/m^2, estimates would be obtained for the 95.1^{st} through 95.9^{th} percentiles. If these indicated that BMI was 44.95 kg/m^2 and 45.05 kg/m^2 at the 95.4^{th} and 95.5^{th} percentile, the forecasted prevalence of class 4 obesity was 4.55 percent.

Prevalence rates were estimated separately for males and females. Rates for the combined (male and female) sample were calculated as a weighted average of the sex-specific prevalence rates, with weights corresponding to NHANES 99 population shares.[10] Median BMI was forecasted as the predicted value at the 50th percentile in the specified year, using the methods just described, except that the value for the combined sample of men and women was obtained from a single (full sample) median regression.

Ninety-five percent confidence intervals were constructed in two steps. First, prevalence rates at each BMI percentile were forecasted (for the specified year) after subtracting or adding 1.96 times the associated standard error to the trend regression coefficient. Next, upper and lower bounds on the 95 percent confidence interval were obtained using these forecasts and the linear interpolation procedures described above.

Alternative forecasts accounting for the expected age or race/ethnicity characteristics of the population in 2020 were obtained as follows. First, the proportion of 20-74 year olds in the age ranges and race/ethnicity categories controlled for in the regression analysis were calculated for 2000 and 2020, using U.S. Census Bureau (2004) population estimates for these years.[11] Forecasts for 2020 were then calculated using the procedures described above but with sampling weights multiplied by an adjustment factor equal to the ratio of estimated population share in 2020 versus that in 2000 (for the relevant age or race/ethnicity group).[12]

Secular increases in obesity may reflect a combination of a general rise in body weight and disproportionate growth at the top of the distribution. The contribution of population-wide growth in BMI was obtained by a three-step procedure: 1) quantile regression was used to

10. *Projected 2020 population estimates were used when adjusting for projected future changes in the distribution of age or race/ethnicity (as discussed later in the text).*

11. *The race/ethnicity categories in NHANES are more limited than those provided by the Census (which separately groups Asians and persons of two or more races). To make them conform, Census estimates of population shares of "other nonwhites" were calculated as a residual after subtracting those who are "white alone, non-Hispanic", "black alone, non-Hispanic" and of "Hispanic origin" (of any race).*

12*. For example, population shares of non-Hispanic white, non-Hispanic black, Hispanic and other nonwhite women were 71.16%, 11.75%, 10.89% and 6.20% in 2000 versus 2020 forecasts of 62.57%, 12.45%, 15.98% and 9.00 percent. Taking ratios of the corresponding percentages, the sampling weights of NHANES 99 females in these groups were multiplied by 0.879, 1.060, 1.467 and 1.451, to provide estimates using the projected 2020 race/ethnicity distribution.*

Table 1. Trends in Body Mass Index and Excess Weight for 20-74 Year Olds

Time Period	Body Mass Index (BMI)	Over-weight (BMI ≥ 25)	Obese (BMI ≥ 30)	Obese: Class 2 (BMI ≥ 35)	Obese: Class 3 (BMI ≥ 40)	Obese: Class 4 (BMI ≥ 45)
Average/Prevalence Rate						
1960-1962	25.05 (0.08)	45.27% (0.80)	13.41% (0.53)	3.35% (0.22)	0.88% (0.13)	0.28% (0.09)
1976-1980	25.31 (0.07)	45.91% (0.83)	14.48% (0.41)	4.42% (0.16)	1.30% (0.13)	0.42% (0.09)
1988-1994	26.57 (0.12)	54.59% (0.92)	22.39% (0.72)	8.12% (0.54)	2.91% (0.25)	1.02% (0.14)
1999-2004	28.18 (0.11)	65.45% (0.65)	31.51% (0.77)	12.95% (0.51)	5.17% (0.32)	2.07% (0.20)
% Change						
1960-62 to 1976-80	1.06%	1.43%	7.98%	32.16%	48.72%	48.16%
1976-80 to 1988-94	4.95%	18.90%	54.59%	83.46%	123.45%	143.67%
1988-94 to 1999-2004	6.07%	19.90%	40.75%	59.60%	77.56%	103.42%
Annual Growth Rate						
1960-62 to 1976-80	0.06%	0.08%	0.45%	1.65%	2.36%	2.34%
1976-80 to 1988-94	0.37%	1.34%	3.41%	4.78%	6.38%	7.09%
1988-94 to 1999-2004	0.56%	1.74%	3.31%	4.55%	5.62%	7.00%

Note: Data from 1960-1962 are from NHES 1. Those from 1976-1980, 1988-1994 and 1999-2004 are from NHANES 2, 3 and 99. Sample sizes were were 6,257, 1,1864, 14,756 and 12,025. BMI is weight in kilograms divided by height in meters squared. The data were weighted to provide nationally representative estimates and standard errors, displayed in parentheses, were corrected for complex survey design. Annual percent changes were calculated assuming a 17-year time difference between 1960-62 and 1976-80, a 13-year difference between 1976-80 and 1988-94 and a 10.5-year difference between 1988-94 and 1999-2004.

estimate annual growth in sex- specific median BMI; 2) the increase in median BMI predicted to occur between the baseline and forecast periods was calculated and added to the BMI of each respondent in the baseline NHANES survey; 3) median BMI and overweight/obesity prevalence rates were computed using the transformed data and differences between these and corresponding untransformed estimates were attributed to general growth in body weight.[13] To illustrate, assume that median BMI was predicted (in step one) to increase by 0.110 kg/m2 per year. This implies projected growth of 2.035 kg/m^2 (18.5 x 0.110 kg/m^2) between 2001.5 – midpoint of NHANES 99 – and 2020. If adding this amount to the BMI of each NHANES 99 sample member raises obesity prevalence from 30 to 35 percent, then a 5- percentage point increase is attributed to general weight gains. Assuming that the obesity rate was forecasted to be 38 percent in 2020 (using the quantile regressions), 62.5 percent of the total increase (5 out of 8 percentage points), would be attributed to general weight gains and 37.5 percent to larger than typical BMI growth in the right tail of the distribution.[14]

3. Trends in Obesity and Severe Obesity

The average BMI of 20-74 year olds changed little between 1960-1962 and 1976- 1980 (rising just 0.26 kg/m^2) but rose much more rapidly thereafter: by 1.26 kg/m^2 between 1976-1980 and 1988-1994 and 1.61 kg/m^2 from 1988-1994 to 1999-2004 (see Table 1). On an annualized basis, body mass index grew over 50 percent faster from 1988-1994 to 1999-2004 than between 1976-1980 and 1988-1994 (0.56 percent versus 0.37 percent per year).

Obesity and severe obesity increased even more. The prevalence of overweight rose 43 percent between NHANES 2 and 99, while obesity more than doubled and class 2, 3 and 4 obesity tripled, quadrupled and quintupled.[15] To place this in perspective, class 2 obesity was nearly as prevalent in 1999-2004 as obesity had been two decades earlier; class 3 obesity was more frequent than class 2 obesity had been at that time; and class 4 obesity rose from a clinical rarity to affecting over two percent of the population.

Figure 1 demonstrates that the particularly large rise of severe obesity reflects a shift in the overall BMI distribution, combined with increasing skewness, resulting in a much thicker right tail. This provides preliminary evidence of the roles of both general and concentrated weight gains in explaining the growth in extreme obesity. Figure 2 shows that the height of U.S. adults changed little during the period of rapidly rising obesity: in 1976-1980, the 10th, 50th, 90th and

13. *This can be thought of as a simplified version of the regression accounting analyses conducted by Smith and Welch (1989) or Heckman et al. (2000). Consider the case where the change over time in the i^{th} percentile of expected BMI (ΔBMI_i) is: $\Delta BMI_i = \Delta X ß_i + \gamma_i$, for X a vector of control characteristics and γ a percentile-specific growth factor. The forecasting procedure here holds the controls constant ($\Delta X_i = 0$), so that $\Delta BMI_i = \gamma_i$. Since the expected change in median BMI is $\Delta BMI_{50} = \gamma_{50}$, $\Delta BMI_i = \gamma_{50} + (\gamma_i - \gamma_{50})$, where the first term on the right-hand-side is the change due to increases in median BMI and the second is that due to distribution-specific weight gains.*

14. *When conducting corresponding decompositions for weight gains occurring between 1976-1980 and 1999-2004, an additional adjustment was made for changes in population characteristics occurring between these periods.*

15. *Results for 1971-1975 are very similar to 1976-1980 and so are not displayed on this or future tables. For instance, average BMI was 25.30 kg/m2, overweight prevalence was 46.56 percent and obesity and class 3 obesity prevalence were 14.30 and 1.29 percent respectively.*

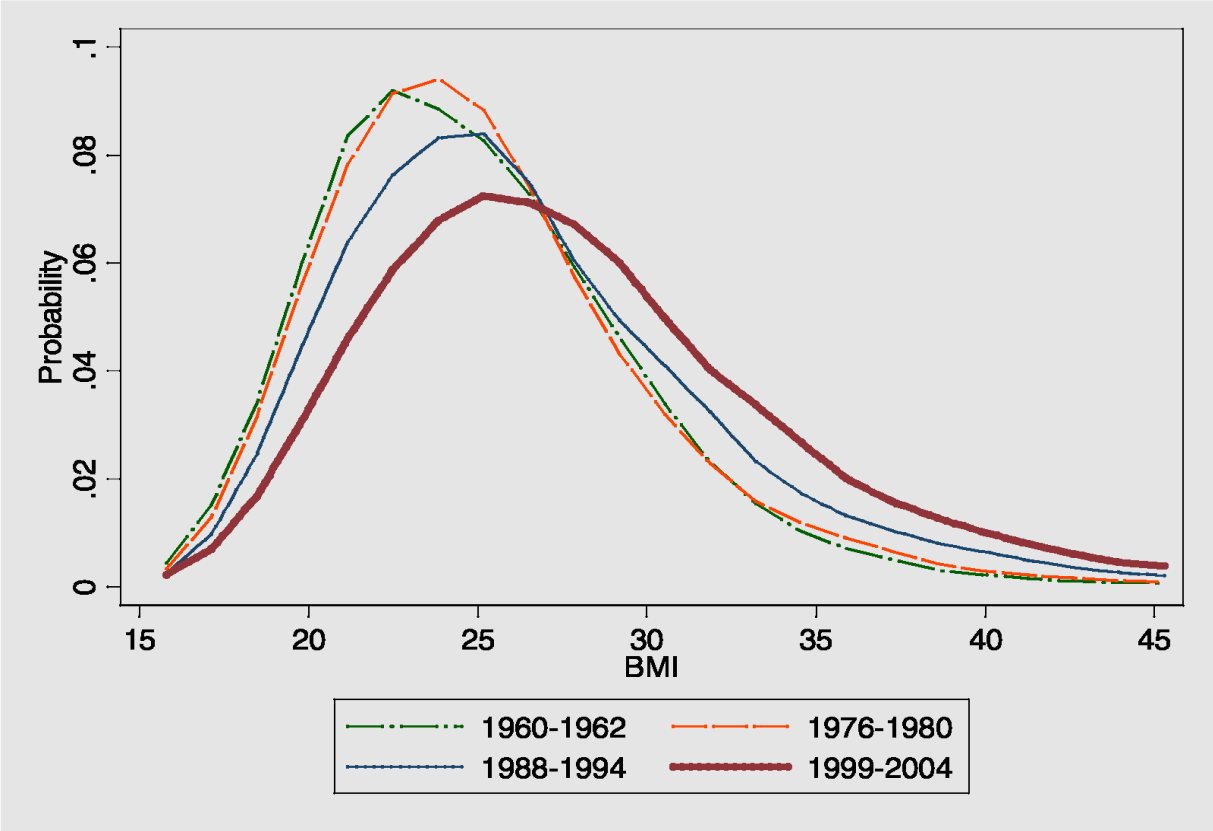

Figure 1. Trends in the Body Mass Index Distribution of 20-74 Year Olds. Data are weighted so as to be nationally representative.

99th percentiles were 156.0, 167.8, 181.2 and 190.0 cm, compared to 156.7, 168.8, 182.8, and 191.5 cm in 1999-2004. By contrast, weight rose 4.1 kg (from 53.3 to 57.4 kg) at the 10th percentile, and 8.3 kg (from 70.2 to 78.5 kg), 15.5 kg (from 91.9 to 107.3 kg) and 27.3 kg (from 116.4 to 143.6 kg) at the 50th, 90th and 99th percentiles.

The overall pattern of stable weight prior to NHANES 2 and rapid increases thereafter was observed for both sexes (see Table 2) but with two noteworthy differences. First, as previously recognized (Flegal et al., 1998; Hedley et al, 2004; Must et al., 1999), males were somewhat more likely to be overweight but were much less frequently obese or severely obese: in 1999-2004, the prevalences of class 3 and 4 obesity were 6.9 and 2.9 percent for women versus 3.3 and 1.2 percent for men. Second, weight increased faster over time for females than males: between 1976-1980 and 1999-2004, average BMI rose 12.7 percent for women compared to 9.9 percent for men. This reflected larger growth for females at all points of the distribution except the very highest: BMI rose 6.2, 9.0, 12.6, 16.2 and 16.9 percent at the 10th, 25th, 50th, 75th and 90th percentile for women, compared to 4.3, 7.1, 8.8, 10.8 and 14.4 percent for men.[16]

16. *Median height rose 0.8 cm for males and 1.1 cm for females between 1976-1980 and 1999-2004. This was accompanied by weight gains of 7.4, 11.6, 15.1 and 19.4 kg at the 50th, 75th, 90th and 95th percentile for men and 8.3, 12.5, 16.9 and 19.4 kg for women.*

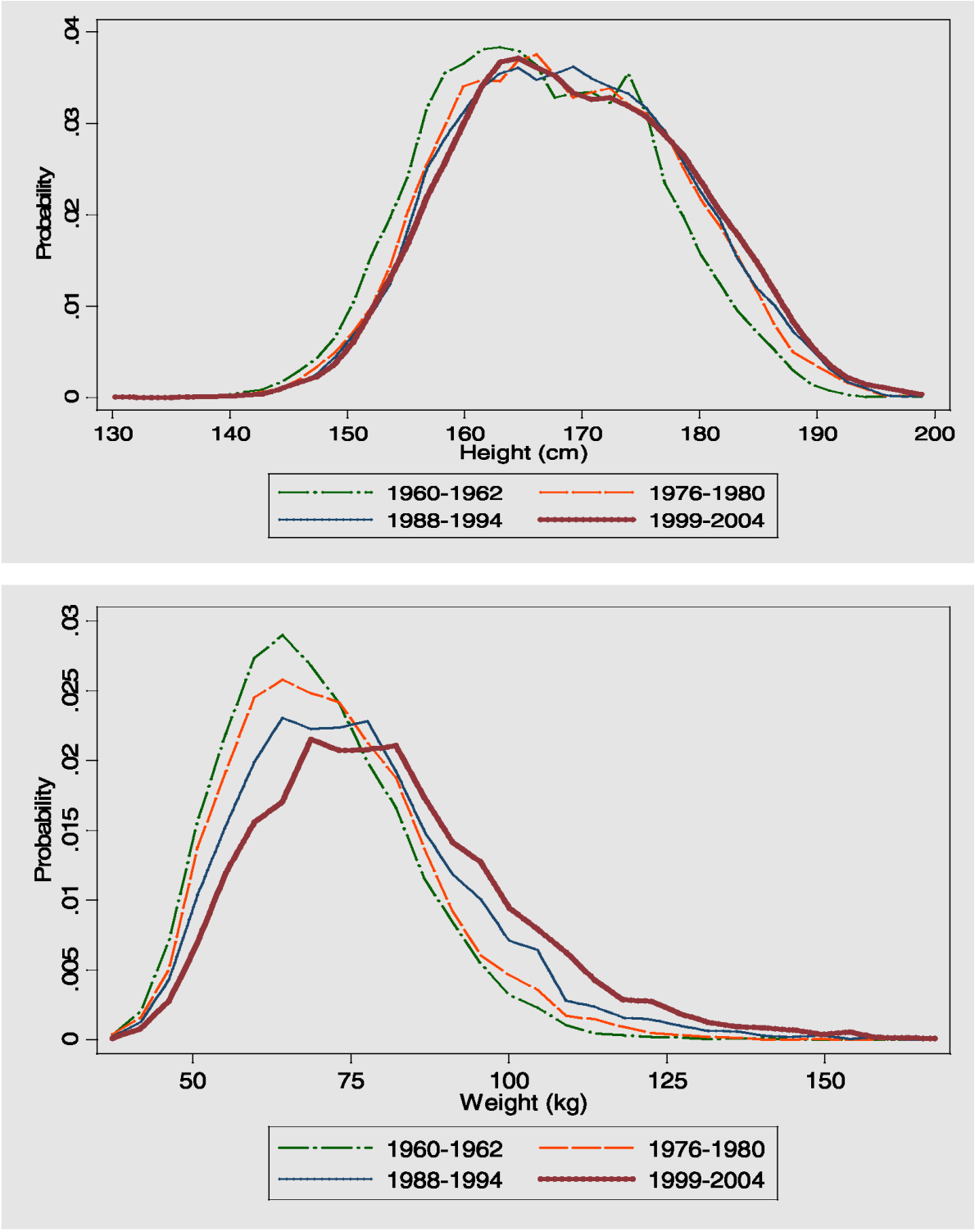

Figure 2. Trends in the Height and Weight of 20-74 Year Olds. Data are weighted so as to be nationally representative.

Table 2. Trends in Body Mass Index and Excess Weight for 20-74 Year Olds, By Sex

Period	Body Mass Index	Over-weight	Obese	Obese: Class 2	Obese: Class 3	Obese: Class 4
	Males					
1960-1962	25.15	49.42%	10.66%	1.49%	0.29%	0.15%
	(0.09)	(1.13)	(0.73)	(0.23)	(0.11)	(0.10)
1976-1980	25.48	51.06%	12.07%	2.30%	0.40%	0.06%
	(0.07)	(0.95)	(0.55)	(0.20)	(0.08)	(0.04)
1988-1994	26.63	59.10%	19.64%	5.31%	1.80%	0.53%
	(0.11)	(1.07)	(0.71)	(0.55)	(0.33)	(0.17)
1999-2004	28.00	69.09%	28.74%	9.61%	3.34%	1.23%
	(0.10)	(0.76)	(0.77)	(0.59)	(0.36)	(0.19)
	Females					
1960-1962	24.95	41.51%	15.90%	5.03%	1.41%	0.40%
	(0.11)	(1.07)	(0.59)	(0.41)	(0.19)	(0.11)
1976-1980	25.16	41.23%	16.68%	6.35%	2.13%	0.75%
	(0.11)	(1.00)	(0.56)	(0.28)	(0.24)	(0.17)
1988-1994	26.50	50.37%	24.96%	10.75%	3.95%	1.47%
	(0.17)	(1.14)	(1.05)	(0.78)	(0.34)	(0.22)
1999-2004	28.35	62.01	34.14%	16.12%	6.91%	2.88%
	(0.14)	(0.95)	(1.00)	(0.66)	(0.44)	(0.29)

Note: See note on Table 1. Sample sizes for NHES 1 and NHANES 2, 3 and 99 were 2,895, 5,604, 6,916 and 5,696 for males and 3,362, 6,260, 7,840 and 6,329 for females.

Age-adjusting the data to the 2000 Census population, using the age groups 20-39, 40-59 and 60-74, slightly increases BMI and obesity prevalence but does not change the basic trends. For instance, age-adjusted BMI averaged 25.16, 25.58 and 28.29 kg/m^2 in 1960-62, 1976-1980 and 1999-2004 (results not shown on a table). The corresponding prevalence of obesity was 13.8, 15.4 and 31.9 percent and that of class 3 obesity was 0.9, 1.4 and 5.2 percent.

4. General Versus Concentrated Weight Gains

Class 3 obesity quadrupled and class 4 obesity quintupled between 1976-80 and 1999-2004. This was mostly due to abnormally large weight increases at the top of the BMI distribution, rather than a general rise in body weight, and contrasts with a more dominant role of dispersed changes in explaining the growth in overweight and mild obesity. These findings are documented in

Table 3. Results for the 1976-1980 are shown in column (a). Column (b) displays corresponding statistics predicted, assuming the race/ethnicity and age characteristics of the 1999-2004 population.[17] Prevalence rates in the two columns are similar, indicating that changes in age and race/ethnicity are of small importance. Column (c) indicates expected values in 2001, using 1976-1980 population characteristics but adjusted for predicted sex-specific median growth in BMI occurring between 1978 (the midpoint of NHANES 2) and 2001.[18] Actual 1999-2004 prevalence rates are displayed in column (d), and column (e) shows the share of the increase since 1976-1980 attributed to median BMI growth, rather than concentrated weight gains or changing population characteristics. This is calculated as the proportion of the total change (column (d) – column (a)) predicted to result from higher median BMI (column (c) – column (a)). To illustrate, obesity prevalence increased 17.0 percentage points (from 14.5 to 31.5 percent) between 1976-1980 and 1999-2004, of which 9.8 percentage points (57.6 percent) reflected a rise in median BMI, 7.6 points (44.4 percent) were due to larger BMI increases at the top of the distribution, and -0.4 points (-2.0 percent) resulted from changes in population characteristics.[19]

General growth in body weight was responsible for the entire rise in overweight occurring between the NHANES 2 and 99 periods, which is not surprising since more than half of males and two-fifths of females were already overweight in 1976-1980. Conversely, increases in median BMI accounted for less than three-fifths of the elevation of obesity and just 36, 23 and 18 percent of the growth of class 2, class 3 and class 4 obesity. Median BMI increased faster over time for women than men and so explains a greater portion of their rise in severe obesity; however, even for females, dispersed weight gains account for just 40, 30 and 24 percent of the growth in class 2, 3 and 4 obesity.[20] By contrast, larger than median increases in the right tail of the BMI distribution are responsible for 65, 79 and 77 percent of the rise in class 2, 3 and 4 obesity. An important implication, discussed in greater detail below, is that generally targeted weight reduction are unlikely to be successful in curbing future increases in severe obesity.

5. Future Forecasts of Obesity and Severe Obesity

Table 4 displays forecasts of median BMI and the prevalence of overweight and various classes of obesity in 2001, 2010 and 2020. Projections for 2001 are similar to actual 1999-2004 rates (shown in the first column), indicating that the prediction procedures work well within the sample period: the actual value is outside the forecast 95 percent confidence interval in only one of 18 cases (obesity prevalence of females) and the differences are generally small. For example, 65.5 percent of 20-74 year olds were overweight and 31.5 percent were obese in 1999- 2004, compared to the 2001 predictions of 65.2 and 30.0 percent. The projected prevalences of class 2, 3 and 4 obesity in 2001 (12.1, 4.8 and 1.9 percent) were all slightly below the rates observed in

17. *These are obtained using the previously described quantile regression methods for the NHANES 99 sample but with the time trend variable set to 1978.*

18*. Median BMI is predicted to rise 0.0844 (0.1027) kg/m2 per year for men (women).*

19*. The statistics were calculated to six significant digits, with some differences in the table due to rounding error.*

20*. Median weight growth accounts for 80 percent (87 percent for men and 72 percent for women) of the rise in class 1 obesity (BMI: 30.0-34.9).*

Table 3. Excess Weight in 1976-80 and 1999-2004 Under Alternative Assumptions

Outcome	1976-80: Actual	1976-80: at 1999-2004 Characteristics	2001: Projected at Median BMI Growth	1999-2004: Actual	Increase Due to Median BMI Growth
	(a)	(b)	(c)	(d)	(e)
Males					
Median BMI	25.1	25.1	27.1	27.3	90.2%
Overweight	51.1%	51.4%	72.5%	69.1%	118.9%
Obese	12.1%	11.3%	22.4%	28.7%	61.7%
Obese: Class 2	2.30%	2.17%	4.45%	9.61%	29.4%
Obese: Class 3	0.40%	0.47%	0.67%	3.34%	9.3%
Obese: Class 4	0.06%	0.21%	0.13%	1.23%	6.0%
Females					
Median BMI	23.9	24.2	26.3	26.9	80.5%
Overweight	41.2%	43.2%	62.2%	62.0%	101.1%
Obese	16.7%	16.8%	26.1%	34.1%	53.8%
Obese: Class 2	6.35%	6.38%	10.2%	16.1%	39.6%
Obese: Class 3	2.13%	1.97%	3.57%	6.91%	30.1%
Obese: Class 4	0.75%	0.78%	1.26%	2.88%	23.9%
Males & Females					
Median BMI	24.6	24.7	26.7	27.1	84.5%
Overweight	45.9%	47.2%	67.1%	65.5%	108.5%
Obese	14.5%	14.1%	24.3%	31.5%	57.6%
Obese: Class 2	4.42%	4.33%	7.47%	13.0%	35.7%
Obese: Class 3	1.30%	1.24%	2.19%	5.17%	22.9%
Obese: Class 4	0.42%	0.51%	0.72%	2.07%	18.2%

Note: Projections based on time trends for the period covered by NHANES 2, 3 and 99, and obtained from gender-specific estimates that controlled for race/ethnicity and age. Those projected for "1976-1980 at 1999-2004 characteristics" allowed for variations across the distribution, using the methods described in the text, and were evaluated for NHANES 99 respondents with the time trend set to the year 1978. Those projected at "median BMI growth" assumed the same trend increase in BMI as for the median individual of the same gender and are evaluated at 1976-1980 population characteristics. "Increases due to median BMI growth" were calculated as the proportion of the total change (column (d) minus column (a)) explained by increases projected at median BMI growth (column (c) minus column (a)).

NHANES 99 (13.0, 5.2 and 2.1 percent). A likely reason is that the predictions are based on a linear time trend, while the evidence indicates that the secular increase in weight is accelerating. Point estimates of moderate and severe obesity prevalence in 2010 and 2020 may therefore be slightly understated.

Body weight is projected to grow rapidly during the first two decades of the 21st century. Median male BMI is expected to be 1.8 percent (0.5 kg /m^2) greater in 2010 than in 1999-2004, while the median BMI of females is predicted to rise 2.2 percent (0.6 kg /m^2). By 2020, median BMI is anticipated to be 5.1 percent (1.4 kg/m^2) higher than in 1999-2004 for men and 6.3 percent (1.7 kg /m^2) greater for women. Based on current trends, 78 percent of men and 71 percent of women will be overweight in 2020.

Severe adiposity is expected to rise much more. Obesity is forecasted to grow from 28.7 (34.1) percent of males (females) in 1999-2004 to 40.2 (43.3) percent in 2020. Class 2 obesity is estimated to climb over 70 percent for men (from 9.6 to 16.4 percent) and 57 percent for women (from 16.1 to 25.3 percent). Class 3 obesity is anticipated to rise more than 80 percent for both males (from 3.3 to 6.3 percent) and females (from 6.9 to 12.8 percent), with class 4 obesity growing from 1.2 to 3.1 percent of men and from 2.9 to 5.6 percent of women.

As mentioned, the preceding estimates assumed a linear time trend did not adjust for the accelerating growth in body weight occurring at the 20th century. Accounting for such nonlinearities yields still higher estimates of future obesity. In a second set of projections using the same methods but measuring trends over the shorter period covered by NHANES 3 and 99 only (1988-94 through 1999-2004), 45.1 percent of men and 48.6 percent of women were forecasted to be obese in 2020, with class 2, 3 and 4 obesity predicted for 19.2, 7.9 and 3.3 percent of men and 29.3, 13.8 and 6.4 percent of women (see Appendix Table A.1). Even larger future obesity rates are obtained using other specifications, such as including a quadratic time trend for the NHANES 2 through 99 period.

Table 5 details alternative 2020-year forecasts. The "baseline" scenario, in column (a), repeats the findings presented in Table 4. Columns (b) and (c) account for changes in the age and race/ethnicity distributions predicted to occur by 2020.[21] Neither has much effect on the estimates. Accounting for population aging marginally raises forecasted future overweight or obesity prevalence (because weight increases with age), but the differences are small. For instance, the baseline obesity forecast for 2020 is 21.0 percent, compared to 21.1 percent after accounting for population aging. Changes in race/ethnicity are anticipated to have even less of an impact, because of offsetting effects – Hispanics have relatively high BMI but with relatively low values for "other" nonwhites (those who are neither black nor Hispanic) – and since the changes in population characteristics are too small to result in large absolute effects.[22]
Column (d) of Table 5 shows the outcomes in 2020 forecasted under the assumption that BMI of the entire distribution would increase at the predicted sex- specific median (1.85 kg/m^2 for males and 2.37 kg/m^2 for females), rather than by the larger amounts actually anticipated in the right tail of the distribution. The proportion of changes, from 1999-2004 through 2020, expected to result from general (rather than concentrated) weight gains is then shown in column (e).[23]

Table 4. Projected Future Prevalence of Excess Weight for 20-74 Year Olds

Outcome	1999-2004 (Actual)	Projected: 2001	2010	2020
Males				
Median BMI	27.3	27.1 [26.8 – 27.3]	27.8 [27.5 – 28.1]	28.7 [28.3 – 29.0]
Overweight	69.1%	69.0% [67.0 – 70.8]	73.9% [71.3 – 76.2]	77.6% [75.3 – 80.5]
Obese	28.7%	27.4% [25.5 – 29.4]	33.0% [30.2 – 36.2]	40.2% [35.9 – 42.7]
Obese: Class 2	9.61%	8.97% [7.49 – 10.2]	12.8% [11.2 – 14.1]	16.4% [14.6 - 18.9]
Obese: Class 3	3.34%	3.15% [2.45 – 3.87]	4.77% [3.84 – 5.52]	6.27% [5.07 – 8.07]
Obese: Class 4	1.23%	1.15% [0.44 – 1.55]	2.01% [1.03 – 2.51]	3.10% [2.31 – 3.99]
Females				
Median BMI	26.9	26.6 [26.3 – 26.9]	27.5 [27.1 – 28.0]	28.6 [28.0 – 29.1]
Overweight	62.0%	61.5% [59.7 – 63.5]	66.0% [64.2 – 68.2]	71.1% [68.1 – 73.2]
Obese	34.1%	32.4% [30.7 – 33.9]	37.8% [35.8 – 40.2]	43.3% [40.6 – 46.3]
Obese: Class 2	16.1%	15.0% [13.3 – 16.3]	19.2% [17.0 – 20.9]	25.3% [21.9 – 27.8]
Obese: Class 3	6.91%	6.40% [5.46 – 7.37]	9.12% [7.34 – 10.6]	12.8% [10.3 – 14.5]
Obese: Class 4	2.88%	2.52% [1.82 – 3.15]	3.68% [2.82 – 4.66]	5.57% [4.08 – 7.19]
Males and Females				
Median BMI	27.1	26.9 [26.7 – 27.1]	27.8 [27.5 – 28.0]	28.7 [28.4 – 29.0]
Overweight	65.5%	65.2% [63.3 – 67.0]	69.9% [67.7 – 72.1]	74.3% [71.6 – 76.7]
Obese	31.5%	30.0% [28.2 – 31.7]	35.5% [33.1 – 38.3]	41.8% [38.3 – 44.6]
Obese: Class 2	13.0%	12.1% [10.5 – 13.3]	16.1% [14.2 – 17.6]	21.0% [18.4 – 23.5]
Obese: Class 3	5.17%	4.82% [4.00 – 5.67]	7.00% [5.66 – 8.12]	9.60% [7.75 – 11.4]
Obese: Class 4	2.07%	1.86% [1.15 – 2.37]	2.87% [2.13 – 3.61]	4.37% [3.22 – 5.63]

Note: Table shows predicted prevalence rates based on time trends for the period covered by NHANES 2, 3 and 99, using methods described in the text, with race/ethnicity and age evaluated at 1999-2004 population characteristics; 95 percent confidence intervals are shown in brackets.

21. *The population is expected to become older and less (non-Hispanic) white by 2020. For instance, the share of 20-74 year old females (males) aged 65 or older is forecasted to rise from 10.7 (9.1) to 15.0 (13.3) percent and the fraction of white non-Hispanics to fall from 71.2 (71.6) to 62.6 (63.2) percent.*

22. *For example, being Hispanic is predicted to reduce the median BMI of females by 2.21 kg/m2. Since the share of 20-74 year old Hispanic women is anticipated to increase by 5.1 percentage points (from 10.9 to 16.0 percent) between 2000 and 2020, this is predicted to raise median BMI by just 0.11 kg/m2.*

23. *No correction for changes in population characteristics is needed, since the 2020 estimates are forecasted using the 1999-2004 age and race/ethnicity distribution.*

Table 5. BMI and Obesity in 2020 Under Alternative Assumptions

Outcome	Baseline Forecast	At 2020 Age Distribution	At 2020 Race/ Ethnicity Distribution	At Median BMI Growth	Increase Since 1999-2004 Due to Median BMI Growth
	(a)	(b)	(c)	(d)	(e)
Males					
Median BMI	28.7	28.7	28.6	28.9	115.0%
Overweight	77.6%	77.9%	77.4%	81.2%	142.6%
Obese	40.2%	40.6%	40.0%	40.6%	103.3%
Obese: Class 2	16.4%	16.6%	16.2%	13.8%	62.2%
Obese: Class 3	6.27%	6.28%	6.27%	4.62%	43.6%
Obese: Class 4	3.10%	3.00%	3.00%	1.67%	24.1%
Females					
Median BMI	28.6	28.6	28.6	28.8	114.6%
Overweight	71.1%	71.5%	71.3%	74.5%	136.6%
Obese	43.3%	43.7%	43.3%	43.4%	101.5%
Obese: Class 2	25.3%	25.5%	25.3%	22.0%	63.9%
Obese: Class 3	12.8%	12.9%	12.8%	9.99%	52.8%
Obese: Class 4	5.57%	5.57%	5.57%	3.92%	38.8%
Males & Females					
Median BMI	28.7	28.7	28.8	28.9	110.3%
Overweight	74.3%	74.7%	74.3%	77.7%	139.4%
Obese	41.8%	42.1%	41.7%	42.1%	102.4%
Obese: Class 2	21.0%	21.1%	20.8%	18.0%	63.2%
Obese: Class 3	9.60%	9.63%	9.57%	7.38%	49.8%
Obese: Class 4	4.37%	4.30%	4.30%	2.82%	32.9%

Note: Projections based on time trends for the period covered by NHANES 2, 3 and 99, and obtained from gender-specific estimates that controlled for race/ethnicity and age, using the procedures discussed in the text. Those projected at "median BMI growth" assumed the same trend increase in BMI for all persons as for the median individual of the same gender. "Increases since 1999-2004 due to median BMI growth" are calculated as the portion of the growth between the baseline 2020 estimates (column (a)) and actual 1999-2004 values (shown in column (d) of Table 3) attributed to median BMI growth (column (d)).

Growth in severe obesity, between 1999-2004 and 2020 is again anticipated to be dominated by particularly large weight gains at the top of the BMI distribution. Median BMI growth explains less than half the predicted growth in class 3 obesity and one-third of the rise in class 4 obesity, with even smaller contributions for males. By contrast, increases in overweight and mild obesity are expected to result entirely from general weight gains.

6. DISCUSSION

Obesity became ubiquitous during the last quarter of the 20th century – its prevalence among 20-74 year olds rose from 15 percent in 1976-1980 to 32 percent in 1999-2004 – following a period of relatively stable weight. If these trends continue, 33 percent of men and 38 percent of women will be obese in 2010, with predicted prevalences of 40 and 43 percent in 2020. To provide perspective, the ***Healthy People 2010*** target is to lower the adult obesity rate to 15 percent (US Department of Health and Human Services, 2000).

Even more significant are the increases forecasted for severe forms of excess weight. Class 3 obesity, sometimes referred to as "morbid" obesity, was unusual in the late 1970s – affecting just over one percent of 20-74 year olds – but its prevalence surpassed 3 percent of men and 6 percent of women at the turn of the 21st century, and is predicted to exceed 6 percent of males and approach 13 percent of females in 2020.

There are currently no generally accepted US or international standards for excess weight beyond class 3 obesity but the rapid growth in BMI suggests the importance of classifying and monitoring such extremes. To illustrate, the prevalence of "class 4" obesity, defined as BMI $\geq$ 45, increased from 0.4 percent of 20-74 year olds in 1976-1980 to 2.1 percent in 1999-2004, and is forecasted to reach 4.4 percent in 2020. For women, the class 4 obesity rate was 2.9 percent in 1999-2004 and is predicted to be 5.6 percent in 2020.

Extreme obesity represents a particular public health risk. In 2000, approximately nine million 20-74 year olds had class 3 (or higher) obesity, making them potential candidates for interventions such as antiobesity surgery (National Institutes of Health Consensus Development Conference, 1992). The projections above indicate that the corresponding number will exceed 17 million in 2020, even abstracting from future population growth. Some (but not all) negative consequences of obesity may be declining over time but the health risks remain much higher for obese than non-obese individuals and a portion of the reduction is probably due to medical interventions that raise health care costs (Gregg et al., 2005; Henderson, 2005). Moreover, the medical problems associated with high BMI may be larger for women than men (Flegal, 2006), raising additional concern about the particularly high prevalence of severe obesity among females.

Between 1976-80 and 1999-2004, class 3 obesity quadrupled and class 4 obesity quintupled. This was mostly due to especially large weight increases at the top of the BMI distribution, rather than because of more general growth in body weight. To illustrate, if BMI had increased at the sex-specific median for all adults, prevalences of class 3 and 4 obesity would have been 2.2 and 0.7 percent in 1999-2004, rather than 5.2 and 2.1 percent. Projecting forward from actual rates in the NHANES 99 period, BMI growth at the projected sex-specific median across all individuals (rather than at the higher amounts expected for heavier persons) would imply class 3

and class 4 obesity rates of 7.4 and 2.8 percent in 2020, substantially below the forecasted prevalences of 9.6 and 4.4 percent.

Some analysts suggest that interventions designed to reverse the obesity epidemic should "focus on the population rather than solely on the heaviest individuals" (Flegal and Troiano, 2000, p. 818). Others believe this can be accomplished with "small behavior changes that fit relatively easily into most people's lifestyles" (Hill et al., 2003, p. 855). By contrast, this analysis suggests that such population-wide changes may reduce the future growth in overweight and mild obesity but will be less effective in combating the epidemic of severe obesity. Doing so is likely to require additional strategies targeting the especially large weight gains of the heaviest individuals, probably involving substantial behavior modifications or medical interventions.

Additional monitoring of extreme obesity represents an important first step. Even the analysis of class 4 obesity presented above may be inadequate, given the rapid growth of the highest levels of body weight. For instance, 1.0 percent of 20-74 year old women had BMI≥ 50 in 1999-2004 but 2.4 percent are projected (using quantile regression techniques) to exceed this threshold in 2020 . Future research also needs to examine whether there are differences in the energy balance of normal weight or overweight and mildly obese individuals, compared to those who are severely obese. For example, evidence that class 3 or 4 obesity primarily results from high levels of energy intake would suggest the importance of reducing calories consumed or absorbed, although presumably accompanied by efforts to raise energy expenditure.

The form such efforts should take, however, remains uncertain. Recent economic research (Cutler et al., 2003; Chou et al., 2004; Lakdawalla and Philipson, 2007) suggests that increases in body weight reflect reductions in the cost of consuming energy-dense foods, possibly combined with more sedentary employment. These trends seem unlikely to be reversed and probably result in particularly large weight gains for persons with self-control problems (Stutzer, 2007). Nor do most current interventions seem promising. The long-term efficacy of weight reduction programs for obese adults generally remains unproven, particularly when focused on dietary and lifestyle changes or pharmacologic therapies (Douketis et al., 2005).[24] The difficulty in losing weight suggests a potential role for prevention programs targeting at-risk children and adolescents but, once again, most previous efforts have had limited success.[25]

These findings should be evaluated in light of several methodological limitations. First this study examines BMI rather than more accurate measures of body composition. However, the resulting errors are likely to be quite small when considering severe obesity. To illustrate, note that waist circumference exceeding 102 (88) cm for men (women) represents a separate obesity risk factor (Freedman et al, 2000; Janssen et al., 2002; Sönmez et al., 2003; Dalton, 2003). By this standard, 39.1 percent of males and 58.5 percent of women were at risk in 1999- 2004, compared to projections (using the quantile regression methods) of 56.2 and 72.4 percent in 2020. Moreover, while 52 percent of overweight but non-obese (BMI: 25.0-29.9) adults in NHANES 3 and 99 had waist sizes below the threshold, the same was true of less than 8 percent of the class 1 obese (BMI: 30.0 – 34.9) and 0.3 percent of those with class 2 or higher obesity.

24. *Surgical interventions may result in larger weight reductions but involve considerable risk.*

25. *For instance, only 21 percent of the programs examined by Stice et al. (2006) had significant positive effects.*

More importantly, the obesity projections used extrapolations of prior trends but without identifying the sources for them. It is possible that the factors increasing obesity during the last quarter of the 20th century will be ameliorated over the next two decades. Indeed, an important goal of public health policies and medical interventions is to do precisely this. However, evidence of the recent success of these efforts is mixed at best. Ogden et al. (2006), using data from NHANES 99, find that the overweight and obesity prevalence of adult females did not increase by statistically significant amounts between 1999 and 2004; however, male obesity continued to rise and the sample sizes for the time periods examined were too small to reject the possibility that large increases occurred. Using much bigger samples, but self-reported data, Sturm (2007) indicates that the growth of moderate and severe obesity continued to accelerate after the turn of the century, consistent with available evidence for longer time periods. This suggests that future rates of obesity and severe obesity may be even higher than those predicted by this analysis. Subsequent research is likely to arrive at more sophisticated forecasts by examining how obesity trends vary with population characteristics, across geographic locations, and by accounting more fully for lifecycle changes in body weight, variations in specific components of the energy balance across types of individuals, and personal decisions relating to energy intake and expenditure.

Appendix

Appendix Table A.1. Projected Future Prevalence Rates Using Shorter Time Trends

Outcome	1999-2004 (Actual)	Projected: 2001	2010	2020
Males				
Median BMI	27.3	27.2 [26.5 – 27.8]	28.2 [27.4 – 29.1]	29.4 [28.3 – 30.5]
Overweight	69.1%	69.6% [64.2 – 75.0]	75.1% [69.7 – 79.9]	78.9% [73.9 – 84.9]
Obese	28.7%	27.9% [23.9 – 32.0]	36.2% [29.0 – 43.2]	45.1% [38.4 – 55.1]
Obese: Class 2	9.61%	9.25% [5.57 – 12.0]	13.9% [9.87 – 18.2]	19.2% [13.8 – 25.3]
Obese: Class 3	3.34%	3.23% [0.42 – 5.10]	4.99% [2.39 – 7.22]	7.88% [4.12 – 11.5]
Obese: Class 4	1.23%	1.24% [0.23 – 2.21]	2.01% [0.20 – 3.93]	3.34% [0.19 – 5.78]
Females				
Median BMI	26.9	26.8 [26.1 – 27.5]	28.1 [27.2 – 29.0]	29.6 [28.4 – 30.8]
Overweight	62.0%	62.6% [58.1 – 67.0]	68.2% [63.3 – 73.8]	74.1% [68.0 – 80.0]
Obese	34.1%	33.4% [27.9 – 37.8]	40.8% [35.7 – 44.8]	48.6% [41.7 – 52.5]
Obese: Class 2	16.1%	15.1% [11.7 – 17.8]	20.8% [15.0 – 26.8]	29.3% [21.0 – 35.8]
Obese: Class 3	6.91%	6.53% [4.46 – 9.07]	9.66% [6.15 – 13.7]	13.8% [8.61 – 17.7]
Obese: Class 4	2.88%	2.72% [0.28 – 3.89]	4.14% [0.27 – 6.58]	6.37% [3.01 – 9.87]
Males and Females				
Median BMI	27.1	27.0 [26.6 – 27.5]	28.2 [27.6 – 28.8]	29.6 [28.8 – 30.3]
Overweight	65.5%	66.0% [61.1 – 70.9]	71.5% [66.4 – 76.8]	76.4% [70.9 – 82.4]
Obese	31.5%	30.8% [25.9 – 35.0]	38.6% [32.5 – 44.0]	46.9% [40.1 – 53.8]
Obese: Class 2	13.0%	12.3% [8.72 – 15.0]	17.4% [12.5 – 22.6]	24.4% [17.5 – 30.7]
Obese: Class 3	5.17%	4.92% [2.49 – 7.14]	7.39% [4.32 – 10.6]	10.9% [6.43 – 14.7]
Obese: Class 4	2.07%	2.00% [0.25 – 3.07]	3.10% [0.24 – 5.30]	4.89% [1.64 – 7.88]

Note: Prevalence rates projected using trends for the period covered by NHANES 3 and 99.

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