Economics and Human Biology 9 (2011) 234–250

Contents lists available at ScienceDirect

Economics and Human Biology

journal homepage: http://www.elsevier.com/locate/ehb

The trend of BMI values of US adults by deciles, birth cohorts 1882–1986 stratified by gender and ethnicity

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ARTICLE INFO

Article history:
Received 1 September 2010
Received in revised form 23 February 2011
Accepted 28 March 2011
Available online 8 April 2011

JEL classification:
I10

Keywords:
BMI
USA
NHANES
Obesity
Overweight
Semiparametric modeling
GAMLSS model
Percentile estimation

ABSTRACT

We estimate trends in BMI values by deciles of the US adult population by birth cohorts 1882–1986 stratified by ethnicity and gender. The highest decile increased by some 18–22 BMI units in the course of the century while the lowest ones increased by merely 1–3 BMI units. For example, a typical African American woman in the 10th percentile and 64 in. (162.6 cm) tall increased in weight by just 12 pounds (5 kg) whereas in the 90th percentile her weight would have increased by 128 pounds (58 kg). Hence, the BMI distribution became increasingly right skewed as the distance between the deciles increased considerably. The rate of change of the BMI decile curves varied greatly over time and across gender and ethnicity. The BMI deciles of white men and women experienced upswings after the two world wars and downswings during the Great Depression and also decelerated after 1970. However, among African Americans the pattern is different during the first half of the century with men's rate of increase in BMI values decreasing substantially and that of females remaining constant at a relatively high level until the Second World War. After the war, though, the rate of change of BMI values of blacks came to resemble that of whites with an accelerating phase followed by a slowdown around the 1970s.

1. Introduction

Descriptive statistics pertaining to the dramatic increase in the prevalence of overweight and obesity among the US population have been reported extensively; (Ogden et al., 2004, 2008, 2010; Flegal et al., 1998, 2010) however, identifying the onset of the increase in BMI values has remained rather elusive. Most studies imply that the phenomenon appeared rather suddenly in the 1980s. Perhaps Troiano and Flegal (1998) reflect the typical view most succinctly by suggesting that "Overweight prevalence increased over time, with the largest increase between NHANES II and NHANES III," surveys, that is to say, in the 1980s (Anderson et al., 2003; Rashad et al., 2006).[1] Moreover, as dozens of other studies, Ogden et al. (2006) point out that "between 1980 and 2002, obesity prevalence doubled in adults aged 20 years or older."[2] Nonetheless, in our view such snapshots do not result in an accurate depiction of trends.[3]

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doi:10.1016/j.ehb.2011.03.005

[1] The upswing in excess weight is said to have begun in Australia in the 1970s (Norton et al., 2006). It is also seldom mentioned that the BMI values in the US are among the highest in the developed world (Komlos and Baur, 2004).

[2] See also http://www.cdc.gov/nchs/data/hestat/overweight/overweight_adult.htm.

[3] Even if the Center for Disease Control reports age-adjusted distributions.

The reason for the ambiguity is that the conventional views refer only to period effects (measurement years) rather than to birth-cohort effects. Insofar as it is not at all evident from cross-sectional evidence when the measured weight status was actually reached, the focus on period effects does not lead to convincing trend estimates as the weight gains could have accumulated at any time between birth and the moment of measurement.

Thus, BMI values obtained at the time when the surveys were conducted do not convey all the information necessary to analyze trends and to devise appropriate policy to address the problems at hand. For instance, the estimates might well mislead policymakers into thinking that earlier technological developments, such as the introduction of automobiles and radios in the 1920s and television in the 1950s, were not associated with the sudden rise in obesity in the 1980s. However, forming hypotheses about possible causal links are useful in devising policies to respond to the current developments. The policy implications are also different if the development started 30 years ago than if they began much earlier, inasmuch as longer processes are presumably ingrained deeper into the cultural and socio-economic fabric of a society and therefore a much more comprehensive policy is needed in order to thwart and reverse the trend.

A good example of the effect of the biases of the conventional trend estimates on an immediate practical level is related to the construction of weight reference charts for the US. The belief that the acceleration in body mass started in the 1980s led the Center for Disease Control to base their US weight standards for children mostly on the surveys of the 1960s and 1970s. However, if the gains in weight among children were already underway by then, then the reference charts currently being used clinically would be actually quite biased and misleading (Komlos et al., 2009). This would have severe implications insofar as many children who are in fact overweight would fall into the chart's normal range and they (and parents) would be consequently misled into complacency about their diet and physical activity.

Hence, in contrast to the most common method, we estimate trends by birth cohorts. The birth cohort estimates have some advantages insofar as social, economic, cultural and technological experiences of birth cohorts are more homogeneous than those of period cohorts. These experiences would have affected their life style, physical activity and food consumption more uniformly than that of measurement cohorts whose experiences were more heterogeneous with respect to the above independent variables. For example, those measured in 1960 were exposed to television viewing for different lengths of time during their lives and therefore one would expect TV to have had a more varied impact on the weight (and body mass) of the population sampled in 1960. In contrast, all those born in 1960 have had access to TV viewing all their lives, regardless of when they were measured. Hence, the impact of this new technology was more uniform on birth cohorts than on measurement-year cohorts. Yet another reason to consider birth cohorts is that lifestyle habits and weight status acquired early in childhood tend to persist into adulthood (Freedman et al., 2005).

In sum, while period effects provide the upper bound for the time when the measured weight level was reached, birth-cohort effects provide the lower bound. Thus, neither approach is perfect, but in the absence of longitudinal data both have a legitimate place in scientific inquiry, even if neither approach is fully specified because of colinearity (period – age = cohort). To be sure, for some policy considerations one might well be interested primarily in the current BMI distribution. For example, in order to plan for the current demand for medicine and medical services related to the adverse effects of obesity one would be primarily interested in the current distribution of BMI values. However, in order to understand the relationship between technological change and the long-run evolution of BMI values the birth cohort approach provides some advantages such as the uniformity of technological experiences of a cohort (Komlos and Brabec, 2010). Another considerable advantage of the birth-cohort perspective is that instead of having only a handful of data points from the cross-sectional surveys about to be analyzed (1959–2006), from which a few differences can be calculated, we obtain data continuously for the 105 years 1882–1986,[4] enabling us to calculate the annual rate of change of BMI deciles.

Analyzing the evolution of the BMI distributions by deciles instead of by central tendencies alone has advantages inasmuch as it provides a comprehensive view of the evolution of the shape of the distribution. It enables one to chart the trends in BMI values among different deciles of population. The distribution was considerably distorted over time implying that some segments of the society were immune to gaining weight while others were excessively prone to it. Gaining a better understanding of the shifts in the shape of the distribution should enable us to gain insights into how various segments of the population experienced the pressures of an obesogenic environment and thereby to improve the chances of formulating appropriate policies to counter the trend in the future.

2. Historical excursion

There is ample evidence that the roots of the obesity pandemic do reach much further back in time than is commonly asserted (Carson, 2009; Cuff, 1993; Coclanis and Komlos, 1995; Komlos, 1987). Even Flegal et al. (2002, p. 1724) recognize even if in passing, that recent developments "may also be viewed as part of a longer-term trend for increases in body size in affluent and well-nourished societies." They infer from the first national survey that the rate of prevalence must have increased earlier: "Even as long ago as 1960, almost 50% of men and more than 40% of women were overweight, and 11% of men and 16% of women were obese" (p. 1727).

One can also infer from scattered archival evidence gleaned from prisons and military schools that BMI values must have been increasing much earlier than the prevailing view would have it. Human weights were not routinely

[4] NHANES continuous is counted in this regard as one survey insofar as the number of observations 1999–2006 is similar to that of NHANES III.