Invited Commentary

Invited Commentary: Body Mass Index and Mortality

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In the midst of an epidemic of obesity, epidemiologists are seeking to establish the relationship of body mass index (BMI; weight (kg)/height (m)²) with mortality. In an accompanying article, Adams et al. (Am J Epidemiol. 2014;179(2):135–144) used a subsample of the National Institutes of Health-AARP Diet and Health Study cohort, recruited in 1995–1996 (109,947 people), to examine associations of BMI in early (18 years) and middle (35 and 50 years) adulthood with mortality, as well as the effect of weight gain between these ages on subsequent mortality during 12.5 years’ follow-up. They report a positive association between BMI and mortality at each age (using BMI 18.5–22.4 as the referent). Furthermore, there were strong positive associations of weight gain between ages 18 and 35 years and ages 35 and 50 years with mortality. Attainment of a BMI of 25 or higher at a younger age increased risk of death. The findings contrast sharply with those of a recent systematic review and meta-analysis of 97 studies, which found that only the grade 2 and 3 obesity categories (i.e., BMI ≥ 35) were responsible for elevated risk of mortality, with slight protection from overweight (25.0–29.9). Due consideration of the limitations of BMI as a measure of detrimental adiposity and of mortality measures alone to inform clinical practice is indicated.

body mass index; mortality; weight gain

The relationship between body weight for height and mortality has been of interest to actuaries and health professionals for decades. Some readers will be old enough to remember the tables of ideal weight published by the Metropolitan Life Insurance Company (MetLife, New York, New York) 5 decades ago (1). However, with the genesis and worsening of the obesity epidemic, establishing the true nature of the relationship has never been more important for public health. There is much debate, with the arguments including but not limited to the views that: only obesity, not overweight, influences mortality (2); the timing in the life cycle and the length of the period of obesity influences age at death (3); and overweight offers protection from death among persons aged 65 years or more (4).

In this issue of the Journal, Adams et al. (5) report on their investigation of the relationship between changes in body mass index (BMI; weight (kg)/height (m)²) during adult life and risk of mortality using a subgroup of participants from the National Institutes of Health-AARP Diet and Health Study recruited in 1995–1996 (109,947 people). In order to avoid confounding by smoking or heavy alcohol consumption (more than 3 standard deviations above the 75th percentile) and proxy reporting, cohort members with those characteristics were removed from the analysis. In addition, anyone who was aged 70 years or older at the time of the first survey was excluded. The final analytical sample comprised 53,126 men and 56,821 women aged 50–69.9 years upon study entry, with 12,017 deaths being recorded in the ensuing 12.5 years.

The analysis design is elegant, attempting to determine the relationship between BMI at ages 18, 35, and 50 years and mortality, in addition to the association between weight gain during each of the intervals between these ages and the relative risk of death. It was found that at each age investigated (i.e., 18, 35, and 50 years), the risk of all-cause mortality demonstrated a positive “dose-response” relationship with BMI, with a BMI of 18.5–22.4 used as the referent. BMI was categorized into underweight (<18.5), low normal weight.
(18.5–22.4), high normal weight (22.5–24.9), low overweight (25.0–27.4), high overweight (27.5–29.9), and obesity (in 2 groups: 30.0–32.4 and ≥32.5). These categories are unconventional but were based on the observed distributions of BMI by age and the premise of detecting “dose-response” relationships. More than a decade ago, very similar findings were reported in an analysis of data from the American Cancer Society’s Cancer Prevention Study 1 (6).

However, the results run somewhat contrary to those recently reported in a meta-analysis of observational studies that examined the association of all-cause mortality with standard BMI categories as defined by the World Health Organization (i.e., normal weight, 18.5–<25; overweight, 25–<30; and obesity, ≥30 (with subcategories of grade 1 (<35), grade 2 (35–<40), and grade 3 (≥40) obesity)). In that analysis, Flegal et al. (2) included 97 studies with a combined sample size of 2.88 million and more than 270,000 deaths. The hazard ratios relative to normal weight showed that only obesity was associated with increased mortality (hazard ratio = 1.18, 95% confidence interval: 1.12, 1.25); interestingly, overweight was found to be protective (hazard ratio = 0.94, 95% confidence interval: 0.91, 0.96). Furthermore, when obesity was examined by subcategory, it was grade 2 and grade 3 obesity that were responsible for the increased mortality in the obese category (2). Conversely, what one would deduce from the findings of Adams et al. is that the lower the BMI within the normal range, the better (5). Does this mean that we should be revising our definition of what constitutes “normal” weight to a BMI of 18.5–22.4? The authors make no such suggestion.

The obvious discrepancy between the current study and the meta-analysis is the referent group used, which obscures comparative interpretation. While it is unlikely, it could be that persons who are heavier but within the normal weight range are not different from overweight persons or vice versa. BMI is a proxy for body fat but it does not directly measure body fat, muscle, or skeleton, nor does it provide information on the distribution of body fat, particularly abdominal fat around the viscera, which may prove to be a better predictor of the relationship between body fat and mortality.

In recent decades, a trajectory of increasing weight throughout adulthood has been demonstrated at the population level. One of the difficulties in examining the relationship between mortality and BMI is that what may be most pertinent is the rate of weight change, whether it be loss or gain, and the point in the life cycle at which this occurs. For the National Institutes of Health-AARP Diet and Health Study cohort, the changes in weight between ages 18 and 35 years, ages 35 and 50 years, and ages 50 and 69 years were calculated and then averaged to obtain weight change per annum. Categories used for analysis were weight loss (≥0.2 kg annually); stable weight (±0.2 kg); and 3 groupings for weight gain (0.2–<0.6 kg, 0.6–<1 kg, and ≥1 kg per annum). Weight gain between ages 18 and 35 years and ages 35 and 50 years demonstrated a positive association with mortality, but gain between ages 50 and 69 years was weaker (5). Above 50 years of age, the relationship of weight gain with death might be confounded by the presence of illness, as evidenced by a lack of relationship among persons reporting poor health. Furthermore, a BMI of 25 or more at age 18 or 35 years with continued weight gain strongly predicted mortality (5). This latter finding is important, because here the conventional cutpoint for overweight and obesity was used. At age 18 years, 9.1% of the cohort had a BMI of 25 or greater (6.2% at BMI 25.0–27.4). At age 35 years, 28.3% of the cohort had a BMI greater than or equal to 25 (5.0% at BMI ≥30).

To date, the numbers of studies that report an increased risk of mortality with weight gain are lower than the numbers of studies reporting no effect. This does not appear to be readily explained, but disparate ages during which weight gain is studied, differences in ethnicities and birth cohorts, and differing measurement of confounders such as diet and physical activity may contribute to altered findings.

The important message is that we cannot be complacent about weight gain, especially movement into categories that increase risk. It must also be remembered that the endpoint used here is mortality. Modern medicine is increasingly able to delay time to death for many chronic diseases (7). The effect of BMI, age, and weight gain throughout adulthood on the development of chronic disease is probably a better endpoint for informing clinical decision-making than mortality. The detriment to the individual and the community in terms of personal hardship, increased need for health services, and economic burden are important considerations in formulating guidelines and policies on body weight for clinical practice and public dissemination. There is considerable support for the authors’ call to focus intervention efforts on young and middle-aged adults to prevent large increases in body weight during adulthood.

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REFERENCES