

Clinical Management of Obesity

Second Edition

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Prevalence of Obesity and Related Mortality

Prevalence

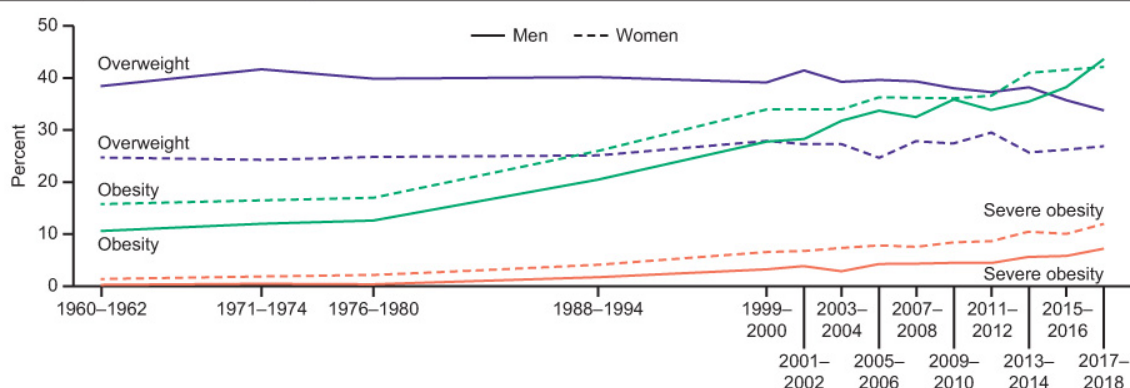
During the past 6 decades, there has been an increasing concern over a significant increase in the prevalence of obesity in the United States. While the overall prevalence of overweight (body mass index [BMI] 25 to <30) adults aged 20 years and over remained constant (30-35%) since the 1960s, the prevalence of obesity (BMI ≥ 30) increased from 13.4% in 1960-1962 to 30.5% in 1999-2000 and 42.4% in 2017-2018. The prevalence of class three obesity (BMI ≥ 40) increased from <2% (1960-1962) to 4.7% (1999-2000) to 9.2% (2017-2018).^{1,2}

However, the trends among adult men and women differed during this period (**Figure 1.1**). The prevalence of overweight was relatively stable, but the rate was higher among men (~40%) compared with women (~25%) and remained so through 2017-2018, though prevalence rates may now be converging. The prevalence of obesity among men and women rose almost imperceptibly from the early 1960s to the late 1970s, but then increased linearly until it almost tripled in women and more than tripled in men by 2017-2018. The prevalence of obesity exceeded that of overweight by the early 1990s in women and the late 2010s in men.

Although the prevalence of obesity was consistently higher in women than in men in the latter decades of the 20th century, a convergent trend began around the turn of the century until the prevalence of obesity in adult men and women was essentially the same by 2017-2018. At that point, 42.4% of US men and women had obesity.² There was no significant difference in prevalence between men and women at any age, nor among age groups - adults aged 60 and over and younger adults were equally likely

to have obesity. When grouped by race and gender, the prevalence of obesity in 2017-2018 was significantly higher in the non-Hispanic Black population in general (49.6%), and non-Hispanic Black women in particular (56.9%), and significantly lower in non-Hispanic Asian men (17.5%) and women (17.2%). The increasing prevalence trend shows little signs of abating: one projection estimated that by 2030, approximately 1 in 2 adults in the United States will have obesity.³

FIGURE 1.1 — Trends in the Prevalence of Overweight, Obesity, and Class III Obesity Among Adults Aged 20 and Over by Sex: 1960-1962 Through 2017-2018



NOTES: Data are age adjusted by the direct method to US Census 2000 estimates using age groups 20-39, 40-59, and 60-74. Overweight is body mass index (BMI) of 25.0-29.9 kg/m². Severe obesity is BMI at or above 40.0 kg/m². Pregnant women are excluded from the analysis.

Fryar CD, et al. <https://www.cdc.gov/nchs/data/hestat/obesity-adult-17-18/obesity-adult.htm>. Accessed March 15, 2022.

The prevalence of obesity among US children and adolescents also is a growing concern. In the past 50 years, the prevalence of obesity has more than tripled in children and adolescents.⁴ In 1971-1974, 5.0% of children aged 2-5 years, 4.0% of children aged 6 to 11 years, and 6.1% of adolescents aged 12 to 19 years had obesity. By 2017-2018, the prevalence rates increased to 13.4% in children 2-5 years of age, 20.3% in children 6-11 years of age, and 21.2% in adolescents 12-19 years of age. Overall, 19.3% of children and adolescents had obesity in 2017-2018, 6.1% had class three obesity, and a further 16.1% were classified as overweight.⁴ Like in adults, the increasing trend of obesity prevalence shows no signs of plateauing.

In addition to its direct effects on the lives and livelihoods of millions of people globally, the SARS-CoV-2 pandemic that began in 2019 has had a considerable impact on mental health and undesired weight change.

According to the American Psychological Association, 42% of Americans reported undesired weight gain since the start of the pandemic, with 10% reporting gaining more than 50 lb (~27 kg).⁵ Significant weight gain has been documented among people under shelter-in-place orders (irrespective of comorbidities or geographic location),⁶ and those in self-isolation.⁷ Among people who gained more than 5 lb during lockdown, 33% gained even more weight in the post-lockdown period.⁸ These and other data reveal that the pandemic has exacerbated the overall trend toward weight gain, although the long-term significance of this development is unknown.

Obesity and Mortality

A considerable body of evidence has documented significant associations between obesity and a spectrum of comorbidities (see [Chapter 3](#)). Similarly, obesity is also associated with increased mortality, both all-cause and cause-specific.⁹⁻¹²

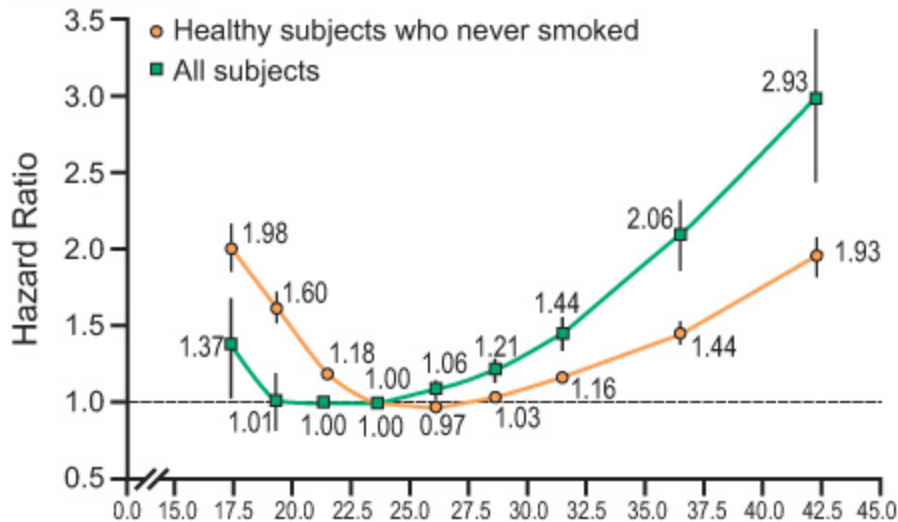
■ All-Cause Mortality

Berrington de Gonzalez and associates analyzed pooled data from 19 prospective studies that included 1.46 million White adults to assess the association between BMI and all-cause mortality.⁹ A total of 160,087 deaths were identified during a median follow-up period of 10 years. To minimize the effects of potentially confounding conditions, the results were calculated for all subjects and then sequentially re-analyzed after exclusion of specific subpopulations (eg, healthy subjects who never smoked, those specific medical conditions, etc). The hazard ratios (HR) among healthy participants who never smoked (the population of interest) and all subjects formed a J-shaped relationship between BMI and all-cause mortality with a BMI of 22.5 to 24.9 as the reference category ([Figure 1.2](#)). In both men and women, the HRs increased in almost a linear fashion according to BMI to reach 2.51 among women and 2.93 among men at BMI 42.5. It is interesting to note that overweight (BMI 25 to <30) was also associated with small increases in HR.

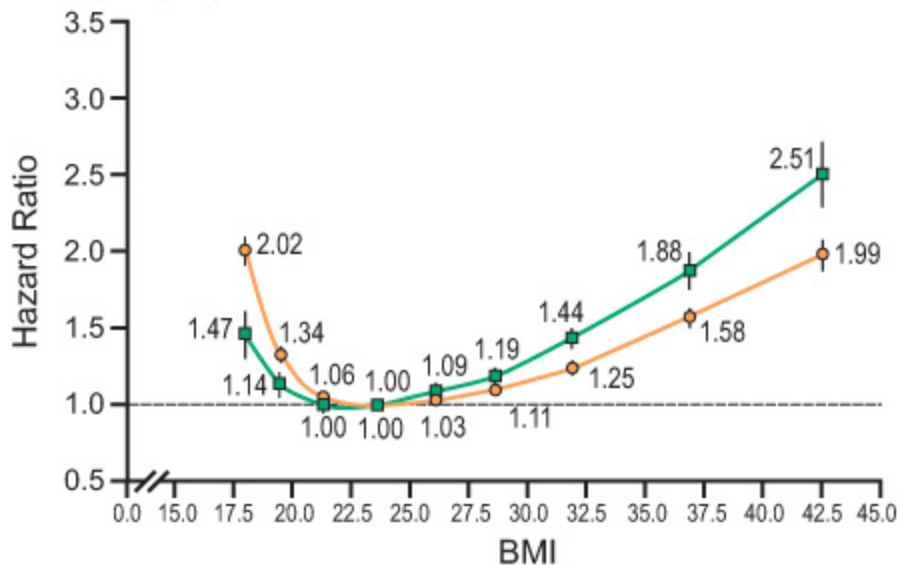
Another review and meta-analysis estimated the all-cause mortality risks associated with normal weight, overweight, and obesity relative to normal weight based on data from 97 prospective studies with a combined sample size of more than 2.88 million individuals and more than 270,000 deaths.¹⁰ The populations of these studies included those from United States, Canada, Europe, Australia, China or Taiwan, Japan, Brazil, Israel, India, and Mexico. Similar to the results of the previously discussed study, the HRs for all-cause mortality relative to normal weight (BMI = 18.5 to <25) increased according to incremental increases in BMI. The all-cause mortality HRs were 0.94 for overweight, 1.18 for obesity (all classes combined), 0.95 for class I obesity (BMI 30-<35), and 1.29 for class II (BMI 35-<40) and class III obesity (BMI \geq 40). Thus, relative to normal weight, both obesity (all classes) and class II and III obesity were associated with significantly higher all-cause mortality. Whereas, class I obesity overall was not associated with higher mortality, and overweight was associated with significantly lower all-cause mortality.

FIGURE 1.2 — Hazard Ratios for Death From Any Cause According to BMI for All Study Participants and for Healthy Subjects Who Never Smoked: Pooled Data From 19 Prospective Studies That Included 1.46 Million White Adults, 19 to 84 Years of Age

White Men



White Women



Subjects were considered healthy if they had no cancer or heart disease at baseline.

Berrington de Gonzalez A, et al. *N Engl J Med*. 2010;363:2211-2219.

■ Cause-Specific Mortality

Collaborative analyses of 57 prospective studies with 894,576 participants calculated the HRs of all-cause and cause-specific mortality vs baseline BMI.¹¹ Study participants were mostly (61%) from Western Europe and North America with a mean recruitment age 46, and a mean BMI of 25. To limit reverse causality, the first 5 years of follow-up were excluded, leaving 66,552 deaths of known cause during a mean of 8 further years of follow-up (mean age at death 67). The numbers of deaths according to specific cause were: 30,416 vascular; 2070 diabetic, renal or hepatic; 22,592 neoplastic; 3770 respiratory; 7704 other. Ischemic heart disease accounted for more than a quarter of all deaths of known cause. Overall, BMIs in the overweight/obese range (25-50) were associated with higher mortality HRs compared with the normal/underweight BMI range (15-25) (**Table 1.1**). The highest HRs were associated with cardiovascular (CV) disease, diabetes, and non-neoplastic kidney and liver diseases. Overall, at a BMI of 30 to 35, median survival was reduced by 2 to 4 years and at a BMI of 40 to 45, it was reduced by 8 to 10 years.

TABLE 1.1 — Cause-Specific Mortality vs BMI in the Ranges of 15-25 kg/m² and 25-50 kg/m²

	Hazard Ratios	
	BMI 15-25 kg/m ²	BMI 25-50 kg/m ²
Ischemic heart disease	1.22	1.39
Stroke	0.92	1.39
Other vascular disease	0.84	1.47
Diabetes	0.96	2.16
Kidney disease ^a	1.14	1.59
Liver disease ^a	0.69	1.82
Lung cancer	0.71	0.98
Upper aerodigestive cancer	0.49	0.98
Other specified cancer	0.94	1.12
Respiratory disease	0.31	1.20
Other specified disease	0.62	1.20
External cause	0.82	1.19
Unknown cause	0.72	1.22

^a Non-neoplastic.

Prospective Studies Collaboration, et al. *Lancet*. 2009;373:1083-1096.

► Cancer-Related Mortality

An analysis of a prospectively studied population of more than 900,000 US adults (404,576 men and 495,477 women) who were free of cancer at enrollment in 1982 examined the relation in men and women between the BMI in 1982 and the relative risk (RR) of death from all cancers and from cancers at individual sites during 16 years of follow-up.¹² The cancer-related deaths rates among subjects with a BMI of ≥ 40 were 52% higher for men and 62% higher for women than the rates in men and women of normal weight. For men, the RR of death was 1.52 while the RR risk was 1.62 for women. On the basis of the associations observed in this study, the authors estimated that current patterns of overweight and obesity in the

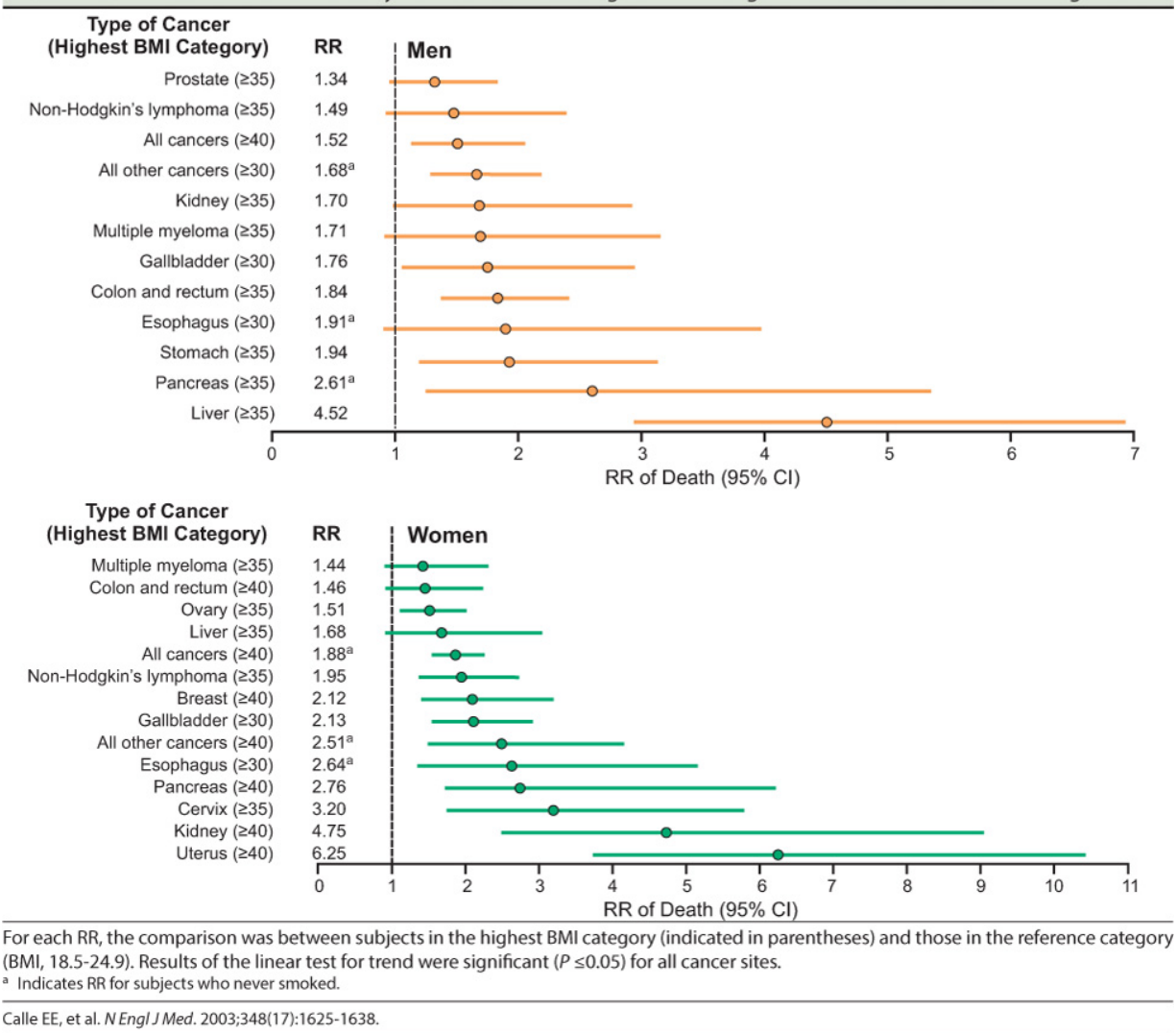
United States could account for 14% of all cancer-related deaths in men and 20% of all cancer-related deaths in women.¹²

The relationship between obesity and cancer mortality also holds for individual-site cancer mortality. The RRs for mortality from specific cancers among US men with obesity ranged from 1.34 for prostate cancer to 2.61 for pancreatic cancer and 4.52 for liver cancer (**Figure 1.3, top**). Among US women, the RRs tended generally to be higher than in men. For example, the most potentially deadly relationships were between obesity and pancreatic (RR 2.76), cervical (RR 3.20), kidney (RR 4.75), and uterine (RR 6.25) cancers (**Figure 1.3, bottom**).¹²

► COVID-19-Related Mortality

Since the start of the SARS-CoV-2 pandemic, obesity has emerged as an independent risk factor for severe disease and death from COVID-19.¹³ In a meta-analysis of 46 studies enrolling more than 600,000 patients, obesity was found to increase the risk of SARS-CoV-2 infection (odds ratio [OR] 2.73), hospitalization for COVID-19 (OR 1.72), severe disease (OR 3.81), ICU admission (OR 2.25), and death (OR 1.61).¹⁴ Another meta-analysis, encompassing 208 studies and more than 3 million patients, uncovered a linearly-increasing risk of COVID-19-related hospitalization in patients with overweight (defined as a BMI of 23–24.9 in Asia-Pacific and 25–29.9 elsewhere; OR 1.19), obesity (BMI ≥ 25 in Asia-Pacific and ≥ 30 elsewhere; OR 1.72), and class III obesity (BMI ≥ 30 in Asia-Pacific and ≥ 40 elsewhere; OR 2.53).¹⁵ The risk of death was also significantly higher in patients with obesity (OR 1.25) and extreme obesity (OR 2.06), though not in those with overweight (OR 1.02). Although the mechanistic link between obesity and worse COVID-19 outcomes is not fully understood, possible contributing factors include increased inflammation, impaired immune function, reduced lung capacity, and adipose tissue serving as a viral reservoir.^{13,15}

FIGURE 1.3 — Relative Risks for Mortality From Cancer According to BMI Among US Men and Women: 1982 Through 1998



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