Chapter 32
Obesity: A Sociological Examination

Christine L. Himes and Valerie Episcopo

Over the past several decades, the prevalence of obesity has increased across all ages and socio-economic groups in the United States. Obesity has been described as one of the most significant public health issues of the new century (National Institutes of Health 2004). The associated health problems have raised concerns about the costs of lost productivity, increased medical care needs, and the possible effects on longevity (Cutler et al. 2003; Finkelstein et al. 2005; Olshansky et al. 2005). Because of these concerns, researchers are interested in understanding the factors behind the increase and the potential for changing the trend. In this chapter, we will examine the patterns, explanations, and consequences of the increased prevalence of obesity for the older population. We will end with a discussion of the social implications of increasing obesity and social policy options for addressing the issue.

Patterns

Obesity

At the most basic level, obesity is the result of an energy imbalance, individuals taking in more calories than they expend. The equation for energy balance has not changed over time, so the increased prevalence of obesity in the population must be the result of changes in caloric intake, energy expenditure, or both. These changes do not have to be large; researchers have concluded that the observed increase in mean BMI in the United States could be accounted for by an excess of 100–150 calories per day (Hill et al. 2003).

There is evidence that energy intake has gone up over the last 30 years, more calories are consumed per capita. Working at the macrolevel, economists comparing national measures of food consumption concluded that the trend in per capita daily total energy supply is responsible for the trend for increased obese and overweight individuals (Silventoinen et al. 2004). The Centers for Disease Control and Prevention (CDC) agree with this analysis (CDC 2004a). They found that between 1971 and 2000 the mean energy intake in the United States increased from 2,450 to 2,618 kcal for men and from 1,542 to 1,877 kcal for women. The CDC goes on to show that fat and protein intake decreased in the same time period while carbohydrate consumption increased. The CDC suggested that this increase in caloric intake was due to foods consumed away from the home:

C.L. Himes (✉)
School of Behavioral and Social Science, St. Edwards University, Austin, TX, USA
e-mail: clhimes@syr.edu

R.A. Settersten, Jr. and J.L. Angel (eds.), *Handbook of Sociology of Aging*, Handbooks of Sociology and Social Research, DOI 10.1007/978-1-4419-7374-0_32, © Springer Science+Business Media, LLC 2011

salty snacks, soft drinks, pizza, and increased portion sizes. As we will discuss later, the types of food consumed, irrespective of caloric count, may also contribute to obesity.

Food consumption has increased, but what has happened to the other side of the energy balance equation, energy use? The measurement of energy expenditure starts with the basil metabolic rate (BMR). Since the BMR must be measured under strict conditions (before a person gets out of bed and after a 12 h break from all physical activity, consuming any food or beverage, or inhaling any nicotine), it is rarely used (Mahan and Escott-Stump 2000). Instead, an alternative measure, resting energy expenditure (REE), is more common. REE can be calculated by direct calorimetry, in which heat output is measured by, for instance, submerging a person in water and measuring the change in the temperature of the water. Alternatively, indirect calorimetry measures oxygen consumption. For indirect calorimetry, a person is asked to breath into a tube that measures the levels of oxygen and carbohydrates in the air before the person inhales them and after he or she exhales, several times. REE accounts for 65–70% of daily energy expenditures and is thought to have remained relatively constant over time (Mifflin et al. 1990).

Another factor of energy expenditure that has not changed in the last 30 years is the thermic effect of food (TEF), the energy used to digest food. TEF varies by the types of food that an individual consumes and usually is approximately 10% of total energy expenditure (TEE) (Mifflin et al. 1990). The shift in energy consumption noted by the CDC, above, might suggest that an increase in carbohydrate intake with a decrease in fat and protein intake would result in lower TEF, since sugars dissolve in water. It is however important to remember that fruits and vegetables are forms of high caloric foods that often require more energy to digest.

The final piece of the energy expenditure equation is the energy used in activity. Physical activity expenditures account for the remaining 20–30% of daily energy expenditure (Mifflin et al. 1990). This is the element of the equation which has very likely changed during the last 30 years. Activity factors were developed to estimate the energy used in physical activity. A sedentary person is assigned an activity factor between 1.0 and 1.4. Someone who participates in low levels of activity has an activity factor between 1.4 and 1.6. An active person burns 1.6–1.9 times his or her resting metabolic rate, and a very active person can spend up to two and a half times his or her REE. Current guidelines call for a minimum of 150 min of moderate-intensity physical activity a week, like brisk walking, water aerobics, slow bicycling, playing doubles tennis, ballroom dancing, and general gardening (USDHHS 2008). Approximately, 25% of adults receive no leisure time physical activity, and this percentage has been decreasing approximately 1% each year (CDC 2004b). Nearly one-half of those over the age of 65 receive no leisure time physical activity, and 80% participate in no vigorous leisure time activity (NCHS 2009).

The relative contribution of the increased intake of calories and decreased physical activity to the increased prevalence of obesity is unclear. The relationship between energy intake and expenditure is complex with many compensatory loops. Recent research has shown, for instance, that weight loss rarely occurs due to exercise alone (Church et al. 2009). Bleich et al. (2008) conclude that the primary cause of the observed weight gain in the population is overconsumption. Some researchers argue that food intake is more important for changing weight while activity is more important for maintaining weight (USDHHS 2008). Before exploring some of the reasons that both energy intake and expenditure may have changed over the past 30 years, we will look at the overall patterns of obesity in the population.

Measurement

Ideally, the percentage of body fat is determined at the individual level by directly measuring lean and fat body masses. Methods such as dual energy X-ray absorptiometry (DEXA scans) allow the precise measurement of lean soft tissue and total body fat. This, and similar methods, are very accurate; however, they require specialized equipment and trained administrators. Bioelectrical impedance is another alternative for measuring body composition and is based on the differing electrical impedance of water and fat tissues in the body. It is not considered a gold standard method for measuring body composition, but is widely available and relatively simple to use.

Most population surveys rely on the body mass index (BMI) for measuring obesity. Calculation of BMI requires only current height and weight. In most surveys this information is self-reported, but some national health surveys, most notably the National Health and Nutrition Examination Survey (NHANES), clinically measure both height and weight. Individuals with a BMI of 30.0 or higher are considered obese, and those between 25.0 and 29.9 are considered overweight. Within the category of obesity further distinctions are made, having those with a BMI between 30 and 35 are considered Class 1 obese, those with BMIs between 35 and 40 are considered Class 2 obese, and those with BMI of 40.0 or higher are considered Class 3, or morbidly, obese. These levels were selected to parallel the types of health problems associated with different levels of BMI (NIH 1998).

BMI as a measure of adiposity suffers from several flaws. It is imperfectly correlated to body fat, since individuals with muscular bodies can have identical weights to those with more fatty tissue at the same height (Prentice and Jebb 2001). This problem becomes increasingly important with age, as older adults tend to have less fat than younger individuals of the same weight (Gallagher et al. 1996). The distribution of body fat changes with age and BMI becomes increasingly inaccurate as a measure of adiposity (Kuk et al. 2009). At very old ages, underweight and weight loss, rather than obesity, are significant health problems and are often associated with increased frailty (Wallace et al. 1995). The self-reported nature of height and weight is also problematic. Individuals tend to underreport weight and overreport height (Burkhauser and Cawley 2008).

Some sociologists and policy analysts argue that the over reliance on BMI as a definition of obesity reflects current social trends and attitudes, rather than true health problems, and is associated with a moral, rather than medical, stance (Kwan 2009; Oliver 2005). As noted above, BMI is only a proxy measure for body composition and the definition of obesity; a BMI of 30.0 or higher is an arbitrary point selected to reflect the level at which health problems are believed to begin (NIH 1998). Using BMI as the sole measure of body composition will undoubtedly lead to misclassification of some individuals, particularly those with large muscle mass or the elderly (Prentice and Jebb 2001).

Alternatives to BMI include waist circumference (WC), waist to hip ratio (WHR), waist to stature ratio (WSR), and skin fold thickness. In an analysis of the relationship of BMI, WC, and WSR to body fat, Flegal et al. (2009) found that those three indicators were more closely related to each other than to body fat. For any individual, these measures may be inaccurate indicators of body fat, but they correspond fairly well to categories of body fat (such as overweight and obese). There is evidence that abdominal fat is more closely related to cardiovascular disease than BMI. Measurement incorporating WC may identify persons who are at increased risk for obesity-related cardiometabolic disease, above and beyond the measurement of BMI (Klein et al. 2007).

Trends

The proportion of the American population that is overweight and obese has risen dramatically for all ages although there is evidence that this trend may be slowing. Between 1960 and 2004, the proportion of overweight adult men rose from 50 to 71%, while the proportion of women who were overweight rose from 40 to over 62%. The percentage of men who were obese rose from 10 to 31%, and the proportion of women who were obese rose from 15 to about 33% in the same 44-year period (Ogden et al. 2006). However, between 2004 and 2006 there was no significant change in obesity prevalence for either men or women in the United States (Ogden et al. 2007).

The increase of obesity hides an important trend in the overall distribution of BMI. While the overall distribution of body sizes shifted to the right, the shift was greatest among those in the upper percentiles of BMI (Ogden et al. 2007). This shift indicates that while the entire population is heavier, those who are the heaviest have become much heavier over time. Analysis of data from the Behavioral Risk Factor Surveillance System (BRFSS) shows that between 2000 and 2005 the prevalence of a BMI over 40 increased twice as fast as the prevalence of a BMI over 30 (Sturm 2007). The rapid increase of those in the morbidly obese category, for whom the health consequences are most severe, contradicts the past understanding that individuals in this group suffered from a rare pathological condition.

Obesity rates vary across racial, ethnic, and socioeconomic groups. Although the prevalence of obesity is greatest among those at the lowest levels of educational attainment, the prevalence of obesity has increased for all educational groups (Himes and Reynolds 2005; Truong and Sturm 2005). A similar pattern is found by relative income: Those in the highest income group have lower prevalence of obesity, but the increase – particularly in the last 20 years – is similar to the increase in prevalence seen in the lowest income group (Truong and Sturm 2005). Among men, there are no significant racial or ethnic differences in obesity prevalence. This is not the case for women. Non-Hispanic black women and Mexican American women are significantly more likely to be obese compared to non-Hispanic white women (Ogden et al. 2006).

Obesity and the Life Course

Understanding the changing prevalence of obesity across age and time provides insights into the possible explanations for the increase and its effects. The transition from normal weight to overweight to obese tends to occur gradually over the life course, sometimes starting in childhood, but often beginning in middle age. Because obesity is difficult to reverse, understanding the timing of the transition and the lifetime consequences of obesity is vital. A life course perspective underscores particular concern over the increasing rate of obesity among children and adolescents (U.S. Surgeon General 2001). The health problems associated with obesity affect children, as well, and are difficult to reverse. For example, there is a strong relationship between childhood obesity and the development of diabetes in adulthood (Bloomgarden 2004). There is evidence that individuals who are obese as children are more likely to be obese as adults; about one third of obese preschoolers and half of obese school age children are obese as adults (Serdula et al. 1993). Ferraro et al. (2003) find that overweight children are at significantly greater risk of becoming severely obese (BMI ≥ 35) compared to normal weight children. In some cases, obesity in childhood is related to parental obesity. The familial transmission of obesity is poorly understood and could be the result of genetics, learned behaviors of eating and exercising, or other socio-economic factors.

The standards for measuring obesity are slightly different for children and are age and sex dependent (Barlow 2007). About 10% of children aged 2–5 are at or above the 95th percentile BMI for age. This nearly doubles to 19.6% of children age 6–11. This represents an almost tripling in prevalence rates since 1976. Among adolescents age 12–19, the proportion considered obese is 18.1% (Ogden et al. 2010). Below age 6, girls are slightly more likely to be obese, but from age 6 onward, boys have higher levels of obesity, measured by BMI. The racial and ethnic patterns of children mimic those of adults; obesity is more common among non-Hispanic blacks and Mexican Americans, compared to non-Hispanic whites, with differences significantly larger for girls (Ogden et al. 2008).

Weight gain is steady through early adulthood (Baum and Ruhm 2009). After adjusting for the secular trend in obesity, average BMI rose from 24.3 to 27.3 between the ages of 18 and 40 in the National Longitudinal Survey of Youth (NLSY) cohort. Similarly, the prevalence of obesity generally increases with age through adulthood (Cook and Daponte 2008). People between the ages of

18 and 32 have the lowest average BMI (Cook and Daponte 2008) and BMI increases steadily until about age 75, when there is a small drop (Flegal et al. 1998). In cross-sectional studies, peak values of BMI are observed in the age range 50–59 in both men and women, with gradual declines in BMI after age 60 (Flegal et al. 1998; Hedley et al. 2004; Ogden et al. 2006).

However, premature mortality of the obese may influence these cross-sectional relationships. In a 10-year follow-up study, individuals under age 55 exhibited a greater tendency to gain weight, with the magnitude of increase decreasing with age (Williamson 1993). Rates of overweight and obesity in longitudinal studies generally increase with age until age 75, when there is a small drop (Ferraro et al. 2003; Flegal et al. 1998; Must and Strauss 1999). Adults who are obese are more likely to remain obese until death than to leave the classification of obese (Ferraro et al. 2003). The loss of weight in late adulthood is often considered a sign of underlying chronic health problems or increased frailty (Kuk et al. 2009). This loss of weight, however, may mask an increase in adiposity since the amount of fat an individual has for a given weight may change as lean muscle mass is lost (Carmelli et al. 1991).

The observed increase in obesity over time appears to have affected all ages and cohorts. Three studies (Cook and Daponte 2008; Reither et al. 2009; Reynolds and Himes 2007) use age-period-cohort analyses to examine the reasons for the observed increase. Age-period-cohort analyses are useful for determining if an observed trend in the population is the result of a particular cohort's experience, of changes in one age group, or if the observed trend is seen across ages and cohorts at a particular time. The overwhelming conclusion is that the observed increase in obesity prevalence occurred at all ages and for all cohorts, and that period effects are principally responsible for the increased obesity prevalence. Cook and Daponte (2008) note that the increases in obesity prevalence are fastest at youngest adult ages; indicating that more adolescents are reaching adulthood already obese. Within the middle and late adulthood years, however, the rate of increase in obesity has been similar. Older adults were not immune to the obesity "epidemic."

Explanations

A wide variety of explanations have been put forth to explain the increased prevalence of obesity in the population. Some focus on individual psychosocial factors, such as self-control. Other explanations look at genetic influences. Still another set of explanations focuses on cultural, environmental, and economic factors.

Psychosocial Factors

Obesity is often considered a measure of personal failing, an indication of an inability to exercise self-control. This explanation for obesity puts the responsibility on the individual. Research suggests that it is easier for individuals to gain weight than to lose it (Berthoud and Morrison 2008). This would imply that the control of appetite and eating is not symmetrical (Blundell 2002). Although eating is controlled according to biological need, eating is also subject to environmental constraints. Since eating can be consciously controlled, as in hunger strikes or dieting, the assumption is that limiting food intake can be controlled in order to control weight or limit weight gain. Individuals are bombarded with seductive messages designed to increase the consumption of less healthy, high calorie foods. The expectation that individuals can counteract these messages may be unrealistic.

Another psychosocial explanation advanced to explain individual obesity is stress. Stress is thought to influence eating behavior. Individuals experiencing stress may over- or under-eat

(Oliver and Wardle 1999; Popper et al. 1989). Although the evidence is mixed, acute stressors tend to result in a lower food intake while those experiencing chronic stress show a preference for foods high in sugar and fat and a greater food intake (Torres and Nowson 2007). These effects are thought to operate because stress alters the control of cortisol and insulin leading to a disregulation of appetite and fat distribution (Adam and Eppel 2007). The effects can be long term, as at least one study shows a relationship between stress in childhood (measured by exposure to family violence) and obesity in adulthood (Greenfield and Marks 2009).

Genetic Factors

Genetic influences cannot explain the increased obesity of the past 3 decades. However, genetic influences set the stage for the current rapid increase in body weight. Evolutionary influences created a human body with a powerful defense against under-nutrition, the capacity to store excess energy as fat. However, this advantage in times of scarcity is not well adapted to an environment in which food is plentiful. The theory of the "thrifty gene" emerged in the 1960s advanced by James Neel to explain the prevalence of Type II diabetes and obesity in the population (Neel 1962). In its most general form, the theory posits that genotypes enabling the deposition of fat during times of abundance would be an evolutionary advantage. Over time, however, this genotype advantage would be lost as food sources became more abundant. As a result, individuals are predisposed to deposit fat, regardless of the need to store such reserves for times of famine. This hypothesis, although later rejected by Neel himself (Neel 1989), gained popularity as an explanation for high rates of obesity among particular groups exposed to Western diets.

The thrifty gene hypothesis cannot explain all of the increase in obesity prevalence or the variation within population groups. It is more likely that a wide range of genetic influences affect weight gain. Research has shown that there are individual differences, based on biology, in the predisposition to gain weight (Bouchard 2007; Farooqi and O'Rahilly 2007). Genes have been identified associated with poor regulation of satiety and appetite, diminished ability to use dietary fats as fuel, and easily stimulated ability to store body fat (de Krom et al. 2009). The value of pursuing a biological – or genetic predispositional – approach to obesity lies in its ability to contribute to pharmaceutical development and behavioral or dietary strategies for weight loss (Farooqi and O'Rahilly 2007). The interaction of genetic predisposition with shifting environments is likely to be the explanation of increased obesity.

Cultural Factors

Genetic explanations, while useful for understanding the long-term trends in body size, and for understanding the biological framework upon which the current obesity levels can be viewed, cannot explain the very recent changes observed. Similarly, individual level psychosocial factors cannot explain the long-term trend. For this, we must look more closely at social and cultural factors, which have changed in the past 40–50 years and may have contributed to the increased body size seen in most developed nations.

One cultural change often associated with the rise of obesity is the increased participation of women in the labor force. The argument is that as more women have begun working full time, families have tended to eat out more and to prepare more convenience foods at home – foods that, in general, have higher fat contents than foods prepared from fresh ingredients. Anderson et al. (2003) advanced this argument as a partial explanation for the rising obesity among children. Chou et al. (2004)

show that as the value of women's time has increased with labor force participation, the amount of time spent in the home is reduced, increasing the reliance on convenience foods. However, in their analysis Cutler et al. (2003) conclude that there is no relationship between female labor force participation and obesity trends.

Another area of cultural change has been the decline in smoking. In general, smoking is associated with lower body weight. This effect might be particularly strong in determining the initiation of smoking behavior. Young women who are overweight or trying to lose weight are more likely to begin smoking (Cawley et al. 2004). Chou et al. (2004) argue that as the cost of smoking has increased, smoking rates have declined, and there has been a concomitant increase in weight. In their research, Cawley et al. (2004) found that this price effect was strong for young men, but not for young women.

The use of leisure time has changed as well. Over the last few decades more recreational time, especially among children, is spent on television watching, computer use, and video games. Based on data from the National Time Use Survey, Americans spent about 3 h a day watching television, compared to less than 1 h/day in leisure time physical activities, like sports or exercising (American Time Use Survey 2008). Although national estimates of the time spent on the computer are not available, in the latest data available, 2005, over 60% of households had access to the Internet at home (U.S. Bureau of the Census 2007).

Data from the National Health Interview Survey indicate that 32% of American adults engage in some regular leisure time physical activity, defined as light-moderate activity at least 5 times a week for 30 min or vigorous activity at least 3 times a week for 20 min (NCHS 2009). This prevalence declines steadily with age, to about 26% of Americans age 65–74 and 18% of Americans age 75 and older. At all ages, the rates are higher for men than for women. There has been little change in the population level of physical activity since 1997, with the annual age adjusted percentages ranging from 29.6 to 32.8 with little consistent trend evident.

Environmental Factors

A variety of environmental factors may also play a role in the rise of obesity prevalence. Environmental changes have affected both diet and levels of physical activity. One dietary change suspected of contributing to weight gain is the increased use of high fructose corn syrup (HFCS). An extensive review of epidemiologic and clinical evidence finds that this hypothesis can be neither supported nor refuted (Forshee et al. 2007). HFCS is used more extensively in the United States than in other countries where sucrose continues to be the primary caloric sweetener. The link between HFCS and weight gain is indirect. Some research has shown that HFCS is sweeter than sucrose and leads to greater consumption of calories. There is also evidence that increased levels of HFCS have adverse metabolic consequences due to changes in the fructose:glucose (F:G) ratio. HFCS may decrease production of the satiety hormone leptin and increase levels of ghrelin, associated with appetite stimulation. In addition, the use of HFCS may be related to an increased consumption of liquid calories, primarily in the form of carbonated soda drinks. Liquid calories tend to be less satiating than calories obtained through solid food consumption.

Environmental changes may have contributed to a decrease in physical activity, and, consequently to an increase in weight. One such factor is the fear of crime. In areas where crime rates are high, children and adults may not feel safe walking in their neighborhoods or using playgrounds. This effect might be particularly strong for girls (Gomez et al. 2004). In addition, in many urban areas, sidewalks and public parks have not been maintained, making them both unsafe and unattractive for use. In other areas, sidewalks may not exist at all. Schools devote less time to physical activity, either through free play time, like recess or structured physical education courses (Story et al. 2006).

Another environmental change is the changing nature of work and work-related tasks. As labor has become less physically demanding, the amount of energy expended in paid employment has declined (Philipson and Posner 2003). However, evidence from time diary studies indicates that the majority of the declines in energy expenditure occurred between 1965 and 1975 (Cutler et al. 2003). In addition, the shift to cars rather than walking to work may have contributed to a decline in physical activity. However, both of these changes occurred before the obesity increase, making them less likely as explanations.

Economic Factors

One economic explanation for the obesity increase focuses on the relative prices of food items. Lakdawalla and Philipson (2009) argue that technological advances in agriculture have caused food prices to fall. This decline in real prices of groceries caused a surge in caloric intake. Cawley (1999) finds that BMI is negatively related to prices. In addition, if the prices of calorie-dense foods (e.g., foods sold by fast food restaurants) fall faster than those for less calorie-dense foods (e.g., vegetables), consumers will tend to shift consumption to the cheaper alternatives (Finkelstein et al. 2005).

It is unlikely that any one explanation can account for the recent dramatic increases in BMI. The evolutionary predisposition toward storing energy in the form of fat and increasing appetite in times of plenty has created a situation in which imbalances in caloric intake and energy expenditure will lead to excessive fat. In addition, cultural and environmental changes have made such an imbalance more likely to occur. The increased availability and reliance on energy dense foods at the same time as physical activity declined have made the energy balance more precarious. Given the increased levels of overweight and obesity, attention has focused on the potential negative consequences of this trend.

Consequences and Harm

Physical Health

It is well established that overweight and obesity are significant risk factors for developing several chronic health conditions in later life, including diabetes, high blood pressure, high cholesterol, coronary heart disease, arthritis, and certain types of cancer (Mokdad et al. 2003; Paul and Townsend 1995; Wolf and Colditz 1998; Villareal et al. 2005). These effects are found across the life course, beginning in childhood and persisting into later life (Ferraro et al. 2003; Gregg et al. 2005; Koplan et al. 2005; Whitmer et al. 2005). Most generally, obesity has been shown to be related to an overall decline in health-related quality of life (Ford et al. 2001). Most of the increased risk for chronic diseases is a direct physical result of overweight and obesity, but several authors suggest that the stigma of being overweight is so pronounced in the medical field that many avoid going to the doctor, complicating the diagnosis of medical conditions and their care (Puhl and Brownell 2001, 2003; Schwartz et al. 2003).

The diseases most closely associated with obesity are Type II diabetes and coronary heart disease. Since the likelihood of developing diabetes increases significantly as body fatness increases, many have attributed the increased prevalence of Type 2 diabetes to the increased obesity of the world's population. According to the *World Health Report 2002*, approximately 58% of diabetes globally is attributable to excess weight (WHO 2002), while in the United States the prevalence of diabetes rose 132% between 1980 and 2006 (CDC 2008). Diabetes in midlife is associated with a variety of complications later in life. Those with diabetes are more likely to develop heart problems or suffer from strokes (see http://diabetes.niddk.nih.gov/dm/pubs/stroke/index.htm).

The effects of obesity on mortality are less definitive. Although researchers agree that there is some effect, the overall magnitude and age gradient is less clear (Flegal et al. 2005; Fontaine et al. 2003; Olshansky et al. 2005). The risk is highest for those who have been overweight for longer periods of time and decreases if one does not become overweight or obese until after age 50 (Flegal et al. 2005). Adults under the age of 50 show the clearest association between obesity and increased mortality (Stevens et al. 1998; Thorpe and Ferraro 2004). In longitudinal analyses, obesity in middle adulthood (ages 30–49) has been shown to be associated with an approximately 6 year lesser life expectancy when compared to normal weight individuals (Peeters et al. 2003). At very old ages, higher BMIs may be associated with lower mortality risks and the BMI associated with the lowest mortality appears to increase compared to younger age groups (Heiat et al. 2001). The lack of a clear relationship between obesity and mortality at older ages has been labeled by some as the "obesity paradox" (Beddhu 2004; Uretsky et al. 2007).

The reasons for the observation that obese subjects tend to fare better than, or at least as well as, their normal weight peers may be related to an unobserved underlying factor, nutritional reserves, or medical therapy (Osher and Stern 2009). Variations in weight, including weight loss, gain, and weight cycling, among the elderly may signal underlying health problems associated with higher mortality (Arnold et al. 2010). The effect of obesity on mortality may be changing over time as well. The introduction of better drugs for treating high cholesterol and hypertension appears to be reducing the disease risks of the obese, at least with respect to cardiovascular disease (Gregg et al. 2005). Although opinions differ, the long-term impact of these interventions on mortality rates and life expectancy may counteract the increased risks associated with obesity, at least at BMI levels below 35.0 (Olshansky et al. 2005; Preston 2005; Reuser et al. 2008).

Perhaps because of the association between obesity and disease, obese individuals tend to have an increased prevalence of functional limitations (Ferraro et al. 2002; Himes 2000; Jenkins 2004). Ferraro and Booth (1999) summarize three pathways through which obesity may impact physical functioning. First, excess weight adds stress to the skeleton and weight-bearing joints, increasing the likelihood of arthritis and joint problems. In addition, excessive weight contributes to insulin resistance, which may damage connective tissues. Finally, they argue, weight may lead to a pattern of blood lipids that leads to atherogenesis and decreased functioning.

Obesity may also limit physical activity, depriving individuals of the benefits of exercise resulting in decreased cardiovascular fitness and muscle strength. This would be particularly relevant for the development of mobility limitations. Obese individuals have more trouble walking, climbing stairs, and getting in and out of bed compared to those who are not obese (Himes 2000; LaCroix et al. 1993; Launer et al. 1994). Jenkins (2004) examines individuals 70 and older over a 3-year time period and finds that obese are more likely to suffer the onset of functional limitations (loss of lower body mobility, strength, or ADL limitations) than those who are not obese. Ferraro et al. (2002) find similar longitudinal results across a wider age range, and also note that obesity is associated with a more rapid increase in disability over time. This limitation in mobility may be particularly problematic for older individuals who may need assistance to carry out daily tasks.

Numerous cross-sectional studies have examined the relationship between body weight and a variety of measures of functioning and disability. In general, greater levels of impairment are found at the extremes of the body size distribution (Galanos et al. 1994; Okoro et al. 2004).

Cross-sectional studies also have shown that excess weight has a negative effect on lower body functioning when using both direct measures of functioning (Apovian et al. 2002) and self-reports of limitations (Himes 2000). Data from the NHANES III survey show that for women aged 70 and older there is a strong relationship between obesity and mobility-related functional limitations. Obese women were two times as likely to report a functional limitation as normal weight women.

This relationship is weaker for men, but obese men were still 1.5 times as likely to report a limitation as their normal weight counterparts (Davison et al. 2002).

There is a documented negative effect of both obesity and overweight on ADL and IADL functioning. Sturm et al. (2004) find that for older women the probability of ADL limitations doubles for those with moderate obesity and quadruples for those with severe obesity. Using data from the Medicare Current Beneficiary Survey, Lakdawalla et al. (2005) estimate that obese 70-year-olds can expect to spend 40% more time in disability than their normal weight counterparts. In addition, the obese spend more time in the most disabled groups (at least three ADL limitations or institutionalized) than those of normal weight. At the same time, they find few differences in life expectancy or disability free life expectancy when comparing the overweight and normal weight groups.

In terms of cognitive functioning, BMI may operate differently at different stages of the life course. Higher BMI at midlife is associated with higher risk of dementia at older ages (Whitmer et al. 2005). One reason for this relationship may be the increased prevalence of diabetes among the obese in midlife. Diabetes at midlife has been linked to dementia more than 3 decades later (Beeri et al. 2004). At the same time, independent of disease status, there is a link between weight loss and Alzheimer's disease in later life (Atti et al. 2008; Buchman et al. 2005). Unexplained weight loss among the elderly may be an indicator of incipient cognitive decline in late life (Atti et al. 2008).

Combining the effects of mortality and morbidity, researchers have compared estimates of active life expectancy between obese and nonobese adults (Lakdawalla et al. 2005; Peeters et al. 2004; Reynolds et al. 2005). All find that because of the increased risks of disability and mortality, obese populations have significantly lower life expectancy free of disability than the normal weight population. The explanation for this difference may be due to a similar number of years of disability lived between normal weight and obese populations, but shorter life expectancies (Peeters et al. 2004) or due to similar overall life expectancy, but differences in the number of years spent disabled (Lakdawalla et al. 2005; Reynolds et al. 2005).

Mental Health

Obesity is considered one of the strongest stigmas in American society. Obesity is still viewed by many as a personal failing, a sign of character weakness. Common stereotypes of the overweight include laziness, self-indulgence, impulsivity, and incompetence (Paul and Townsend 1995; Roehling 1999; Rothblum 1992). People hold those who are overweight responsible for their own condition and often think that if they simply had more willpower, they would reduce their food intake and, thus, lose weight (Puhl and Brownell 2003; Rothblum 1992). These stereotypes persist despite evidence that overweight people generally do not have higher caloric intakes than those of average weight (Rothblum 1992). Even overweight and obese people themselves have been found to subscribe to these stereotypical anti-fat attitudes, suggesting that they have internalized the social stigma of being overweight (Wang et al. 2004). The stigma of obesity is so strong, that one survey found that 24% of women and 17% of men would choose to live three or more years less if they could be their desired weight (Puhl and Brownell 2003). Being overweight at older ages appears to have somewhat fewer social consequences than does at younger ages. There is significantly more pressure on younger adults to be thin and fit. Moreover, older people are significantly less likely to be in either the marriage or job markets, thus they are less likely to be subjected to sanctions on the basis of body size. Thus being overweight may not be as stigmatizing for the elderly as for those at younger ages.

The relationship between weight and psychiatric disorders is complex. There is little evidence that obesity is associated with anxiety disorders (Bjerkeset et al. 2007; Williams et al. 2009). However, obesity may be a clinical condition that predisposes an individual to depressive disorders

(Williams et al. 2009). Weight stigmatization may be one factor increasing the vulnerability to depression among obese individuals. Recent analyses of a community-based sample in Norway found higher body mass to be associated with increased risk of depression for both men and women (Bjerkeset et al. 2008). Studies of obese patients find a relationship between childhood teasing based on appearances and adult depression (Jackson et al. 2000). This supports the finding that it is not obese itself which contributes to depression, but the interpersonal mistreatment due to weight (Carr et al. 2007).

Individual-Level Economic Consequences

As a result of both the physical consequences and stigmatization, obesity has been shown to be related to generally negative economic outcomes at the individual level. For example, in the United States white females have both lower rates of obesity and higher average income than African-American or Hispanic women. Chang and Lauderdale (2005) find strong negative correlations between income and BMI for white and African-American women, with a weaker correlation for Mexican-American women. Among men, they find a weak negative correlation between income and BMI for white men, but for Mexican-American and African-American men they find a positive correlation between income and BMI. Hedley and Ogden (2006) find that within each race-gender group, the prevalence of obesity rose across all income categories in recent decades, and that the differences in the prevalence of obesity by income (within race-gender group) have decreased over time.

The lower earnings of obese individuals have been attributed to several factors. Obese adolescents, especially women, are less likely to graduate from high school and less likely to attend college than their average weight peers (Crosnoe 2007). This effect is stronger if obesity is normative in the school (Crosnoe and Muller 2004). Obese employees also suffer from discriminatory practices (Puhl and Brownell 2001). In addition, obese workers are more likely to have moderate to high levels of absenteeism from work than their nonobese counterparts (Wolf and Colditz 1998). In addition, Cawley (2004) finds that heavier women are significantly more likely than women at the recommended weight to report employment disability. The effects of lower earnings may persist into later life. Many retirement benefits, including Social Security, are determined at least in part by lifetime earnings. Lower earnings can translate into lower incomes and increased economic insecurity in later life. In fact, older women who are obese have lower net worth than their normal weight peers (Fonda et al. 2004). This relationship appears not to hold true for men, however, indicating a difference in the effects of body size on earnings and asset accumulation.

Societal Economic Impact

The impacts of obesity on individual health, well-being, and economic situation are not the only considerations. The high prevalence of obesity in the adult population also has broader economic implications. Given the public financing of many health care services, especially Medicaid and Medicare, the medical costs of obesity are important to consider. Estimates are that from 5 to 7% of all annual health care expenditures are attributable to obesity (Finkelstein et al. 2005). As noted above, the effects of obesity are much stronger for morbidity than mortality, particularly at old ages. The use of simulation models of the health care costs associated with obesity. Lakdawalla et al. (2005) estimate that from age 70 onward Medicare spends 35% more on an obese person than one of normal weight. Underweight individuals also have high Medicare costs relative to normal weight, but these costs are incurred for fewer years. In similar analyses, Daviglus et al. (2004) have shown that obesity is linked to higher lifetime health care costs.

Health care costs are not the only economic considerations. Most studies show that overweight, and particularly obese, individuals miss more days of work. Obese employees are more likely to have moderate to high levels of absenteeism from work than their nonobese counterparts. Wolf and Colditz (1998) estimate that in 1988 alone, over 52 million work days were lost to obesity, while in 1994 another 58 million work days were lost, at annual price tags in excess of $5 billion. Burton et al. (1998, 1999) found that as BMI increases, so do the number of sick days and absenteeism from work. Tucker and Freidman (1998) studied over 10,000 employees and found that obese workers were 2 times as likely to have high-level absenteeism, defined as seven or more absences in the past 6 months, and 1.5 times as likely to have moderate absenteeism, defined as 3–6 absences in the past 6 months, than lean employees. The higher rates of absenteeism and missed work days contribute to lower overall productivity and reduced public revenue.

The individual and societal costs of obesity are numerous. Individuals who are obese have poorer physical health, lower educational attainment, and lower earnings. As a country, an increasing proportion of health care dollars is spent treating and managing the effects of obesity. Despite these costs, the proportion of the population considered obese has increased. If efforts to date have done little to stop or reverse the trend, what new approaches to the problem can be considered?

New Frontiers

The majority of American adults are now overweight and over a third are obese. Within specific subpopulations, the prevalence is even higher. Current approaches to curbing obesity focus on individual change. However, as the preceding discussion makes clear, the obesity problem has sources outside of the control of individuals. Even individual behaviors like diet and exercise patterns are embedded in social relationships and culture. The recent emphasis on social network analysis to examine the spread of obesity through social relations highlights the complex social nature of the factors leading to weight gain (Christakis and Fowler 2007). To expect that individuals can, on a widespread scale, overcome those cultural strictures is unrealistic. The focus on individual self-control for weight control cannot be effective. Like other public health problems throughout history, obesity needs to be addressed on a societal level. The complex causes and consequences of obesity point to a multidisciplinary and multilevel research approach. If obesity is considered as a social problem, with multiple causes outside of the control of individuals, new considerations can be given to a wide range of approaches (Nestle and Jacobson 2000).

Although obesity is linked to a variety of health problems, the advantages of weight loss at older ages are unclear. Among those with diabetes, a modest weight loss of 5–10 lb has been shown to significantly improve control of glucose levels and a reduction in cardio-vascular risk factors (Espelande et al. 2007). Weight loss is recommended for obese patients suffering from high blood pressure, heart disease, and arthritis (Osher and Stern 2009). The value of weight loss among the elderly population without chronic conditions, however, is unclear. The BMI associated with lower mortality is higher for those over age 65 compared to those under 65 (Janssen and Mark 2007). In fact, weight loss is associated with excess mortality among normal, overweight, and mildly obese among those aged 50–70 (Myrskala and Chang 2009). This suggests that the benefits of lower BMI may not hold true late in life. Still, there is considerable evidence that entering later life obese increases the chances that an individual will have chronic health problems and an increased chance of experiencing limitations in activity (Osher and Stern 2009). Focusing on addressing obesity at younger ages is likely to result in a healthier older population (Ferraro et al. 2003; Olshansky et al. 2005).

An individual focus often leads to medical solutions. For instance, the rates of bariatric surgery have increased dramatically in recent years (Santry et al. 2005). Such surgery can be effective for some individuals; however, long-term results are difficult to maintain (Shah et al. 2006). Other medical interventions are based on pharmacological treatments options. There is great interest in studying the hormonal and neural mechanisms involved in the control of appetite in hopes of identifying methods of controlling eating. But current drug treatments for obesity are limited and the associated weight loss is small, usually not more than 10% (Berthoud and Morrison 2008).

What types of societal interventions are possible? Fiscal and regulatory policies can be implemented at the federal, state, or local level. Two widely discussed options are tax policies that would influence food prices and food labeling policies in restaurants that would provide consumers with nutritional information. Other, broader, options focus on making changes in the built environment which would encourage physical activity and influence children's behavior through school-based programs.

Over the past several years, there have been many attempts to regulate food prices through differential tax policies. These efforts are modeled after the established "sin taxes" in place of tobacco and alcohol products. Proponents argue that taxes on certain foods would limit their consumption and result in desirable health effects. The item most often targeted is sugared beverages. As noted above in the discussion of HFCS, but even more generally of all sugared beverages, their consumption is linked to increased body weight, poor nutrition, and increased risk for diabetes (Nielsen and Popkin 2004). Limiting their consumption, through increased prices, could be one factor in obesity prevention. One study has suggested that for every 10% increase in price of sugared beverages, consumption decreases by 7.8% (Brownell and Frieden 2009). Objections to this type of tax focus on the unfairness of targeting one type of food; that such a limited approach would not solve the obesity problem. However, if obesity is seen as a multileveled problem, requiring multiple approaches, tax policy could be one part of such an approach.

Food labeling policies may influence food choices through better information on the nutritional value of specific foods. One study of the effects including calorie information on menus showed that consumers altered their behavior only when additional information on the daily recommended allowance of calories was included (Roberto et al. 2010). New York City recently implemented a menu labeling policy requiring fast food restaurants to post calorie labels on their menu boards and sit down restaurants to include calorie information on the printed menu. Analysis of the implementation of this policy found limited effects at the population level on the total number of calories purchased (Elbel et al. 2009). One conclusion is that labeling must be accompanied by widespread educational campaigns to be successful in altering behavior (Nestle 2002). As with tax policies, one single intervention is unlikely to have a large impact on behavior, and a multifaceted approach has greater chances of success.

Environmental changes that would increase physical activity are another approach to creating more balance in the energy equation. Federal funding has focused on the development of interstate highways and the facilitation of motorized transportation. Prompted by both health and environmental concerns, emphasis is shifting to the construction of pedestrian and bicycle pathways as alternatives (Handy et al. 2009). This focus on "active travel" can influence behavior. An overview of the evidence demonstrates that changes in the built environment can increase physical activity levels (Transportation Research Board and Institute of Medicine 2005). One study of residents in neighborhoods with high walkability (well-connected streets, sidewalks, and nonresidential destinations) got 40–50 min more exercise per week than their counterparts in low-walkability areas of the same cities (Sallis et al. 2009).

The best programs may involve multiple levels of involvement. An example of a successful partnership between school and community is the Shape Up Somerville program in Somerville, Massachusetts (Economos et al. 2007). Started in 2002 the program involved children attending grades one through three in public elementary schools in three participating communities. The intervention involved increased physical activity and increased availability of healthful foods. Most notably, the efforts extended beyond the school to include changes in home and community environments.

The success of the program, measured by lower BMI increases in children at high risk for obesity, demonstrates the potential value of a multi-pronged approach.

All of these options – tax policy, food labeling, changes in the built environment, and education – can address one piece of the energy imbalance. Just as the increased prevalence of obesity has no one identifiable cause, it has no one identifiable solution. Efforts to limit the increasing body size of the population cannot focus solely on individual and medical intervention. Bariatric surgery can be beneficial for individuals facing severe health consequences, but reliance on surgical and pharmaceutical solutions ignores the societal structure in which individuals will continue to live. With obesity, social scientists have the opportunity to apply their understanding of the social world to address a pressing social problem.

References

Adam, Tanja C. and Elissa S. Eppel. 2007. "Stress, Eating and the Reward System." *Physiology & Behavior* 91:449–58.

American Time Use Survey. 2008. "Time Spent in Detailed Primary Activities, and Percent of the Civilian Population Engaging in Each Detailed Activity Category, Averages per Day by Sex." Retrieved (http://www.bls.gov/tus/tables/a1_2008.pdf). Accessed on 2/7/2011.

Anderson, Patricia M., Kristin F. Butcher, and Philip B. Levine. 2003. "Maternal Employment and Overweight Children." *Journal of Health Economics* 22:477–504.

Apovian, Caroline M., Carolin M. Frey, G. Craig Wood, Joanne Z. Rogers, Christopher D. Still, and Gordon L. Jensen. 2002. "Body Mass Index and Physical Function in Older Women." *Obesity Research* 10:740–7.

Arnold, Alice M., Anne B. Newman, Mary Cushman, Jingzhong Ding, and Stephen Kritchevsky. 2010. "Body Weight Dynamics and Their Association with Physical Function and Mortality in Older Adults: The Cardiovascular Heart Study." *Journal of Gerontology: Biological Sciences and Medical Sciences* 65:63–70.

Atti, Anna Rita, Katie Palmer, Stefano Volpato, Bengdt Winblad, Diana DeRonchi, and Laura Fratiglioni. 2008. "Late-Life Body Mass Index and Dementia Incidence: Nine-Year Follow-Up Data from the Kungsholmen Project." *Journal of the American Geriatrics Society* 56:111–6.

Barlow, Sarah E. 2007. "Expert Committee Recommendations Regarding the Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report." *Pediatrics* 120:S164–92.

Baum, Charles L. and Christopher J. Ruhm. 2009. "Age, Socioeconomic Status, and Obesity Growth." *Journal of Health Economics* 28:635–48.

Beddhu, Srinivisan. 2004. "The Body Mass Index Paradox and an Obesity, Inflammation, and Artherosclerosis Syndrome in Chronic Kidney Disease." *Seminars in Dialysis* 17:229–32.

Beeri, Michal Schnaider, Uri Goldbourt, Jeremy M. Silverman, Shlomo Noy, James Schmeidler, Ramit Ravona-Springer, A. Sverdlick, and Michael Davidson. 2004. "Diabetes Mellitus in Midlife and the Risk of Dementia Three Decades Later." *Neurology* 63:1902–7.

Berthoud, Hans Rudolf, and Christopher Morrison. 2008. "The Brain, Appetite, and Obesity." *Annual Review of Psychology* 59:55–92.

Bjerkeset, Ottar, Pal Romunstad, Jonathan Evans, and David Gunnell. 2007. "Association of Adult Body Mass Index and Height with Anxiety, Depression, and Suicide in the General Population." *American Journal of Epidemiology* 167:193–202.

Bleich, Sara N., David Cutler, Christopher Murray, and Alyce Adams. 2008. "Why Is the Developed World Obese?" *Annual Review of Public Health* 29:273–95.

Bloomgarden, Zachary T. 2004. "Type 2 Diabetes in the Young." *Diabetes Care* 27:998–1010.

Blundell, John E. 2002. "A Psychobiological System Approach to Appetite and Weight Control." Pp. 43–49 in *Eating Disorders and Obesity*, edited by C.G. Fairburn and K.D. Brownell. New York: Guilford Press.

Bouchard, Claude. 2007. "The Biological Predisposition to Obesity: Beyond the Thrifty Gene Hypothesis." *International Journal of Obesity* 31:1337–9.

Brownell, Kelly D. and Thomas R. Frieden. 2009. "Ounces of Prevention: The Public Policy Case for Taxes on Sugared Beverages." *New England Journal of Medicine* 360:1805–8.

Buchman, Aron S., Robert S. Wilson, Julia L. Bienias, Raj C. Shah, Denis A. Evans, and David A. Bennett. 2005. "Change in Body Mass Index and Risk of Incident Alzheimer Disease." *Neurology* 65:892–7.

Burkhauser, Richard V. and John Cawley. 2008. "Beyond BMI: The Value of More Accurate Measures of Fatness and Obesity in Social Science Research." *Journal of Health Economics* 27:519–29.

Burton, Wayne N., Chen Yu Chen, Alyssa B. Schultz, Dee W. Edington. 1998. “The Economic Costs Associated with Body Mass Index in a Workplace.” *Journal of Occupational and Environmental Medicine* 40:786–92.

Burton, Wayne N., D.J. Conti, Chen Yu Chen, Alyssa B. Schultz, Dee W. Edington. 1999. “The Role of Health Risk Factors and Disease on Worker Productivity.” *Journal of Occupational and Environmental Medicine*. 41:863–77.

Carmelli, Dorit, M.R. McElroy, R. H. Rosenman. 1991. “Longitudinal Changes in Fat Distributions in the Western Collaborative Group Study: A 23 Year Follow-Up.” *International Journal of Obesity* 15:67–74.

Carr, Deborah, Michael A. Friedman, and Karen Jaffe. 2007. “Understanding the Relationship Between Obesity and Positive and Negative Affect: The Role of Psychosocial Mechanisms.” *Body Image* 4:165–177.

Cawley, John. 1999. *Rational Addiction, the Consumption of Calories, and Body Weight*. Ph.D. dissertation. University of Chicago, Chicago, IL.

———. 2004. “The Impact of Obesity on Wages.” *Journal of Human Resources* 39:451–474.

Cawley, John, Sara Markowitz, and John Tauras. 2004. “Lighting Up and Slimming Down: the Effects of Body Weight and Cigarette Prices on Adolescent Smoking Initiation.” *Journal of Health Economics* 23:293–311.

Centers for Disease Control and Prevention. 2004a. “Trends in Intake of Energy and Macronutrients: United States, 1971–2000.” *Morbidity and Mortality Weekly Report* 53:80–82.

———. 2004b. “Prevalence of No Leisure-Time Physical Activity: 35 States and the District of Columbia, 1988–2002.” *Morbidity and Mortality Weekly Report* 53:82–86.

———. 2008. “Crude and Age-Adjusted Percentage of Civilian, Noninstitutionalized Population with Diagnosed Diabetes, United States, 1980–2006.” http://www.cdc.gov/diabetes/statistics/prev/national/figage.htm

Chang, Virginia W. and Diane S. Lauderdale. 2005. “Income Disparities in Body Mass Index and Obesity in the United States, 1971–2002.” *Archives of Internal Medicine*, 165:2122–8.

Chou, Shin Yi, Murray Grossman, Henry Saffer. 2004. “An Economic Analysis of Adult Obesity: Results from the Behavioral Risk Factor Surveillance System.” *Journal of Health Economics* 23:565–87.

Christakis, Nicholas A. and James H. Fowler. 2007. “The Spread of Obesity in a Large Social Network over 32 Years.” *New England Journal of Medicine* 357:370–9.

Church, Timothy S., Corby K. Martin, Angela M. Thompson, Conrad P. Earnest, Catherine R. Mikus, Steven N. Blair. 2009. “Changes in Weight, Waist Circumference, and Compensatory Responses with Different Doses of Exercise among Sedentary, Overweight Postmenopausal Women.” *PLoS One* 4:e4515.

Cook, Andrew and Beth Daponte. 2008. “A Demographic Analysis of the Rise in the Prevalence of the US Population Overweight and/or Obese.” *Population Research and Policy Review* 27:403–26.

Crosnoe, Robert. 2007. “Gender, Obesity, and Education.” *Sociology of Education* 80:241–60.

Crosnoe, Robert and Chandra Muller. 2004. “Body Mass Index, Academic Achievement, and School Context: Examining the Educational Experiences of Adolescents at Risk of Obesity.” *Journal of Health and Social Behavior* 45:393–407.

Cutler, David M., Edward L. Glaeser, and Jesse M. Shapiro. 2003. “Why Have Americans Become More Obese?” *Journal of Economic Perspectives* 17:93–118.

Daviglus, Martha L., Kiang Liu, Lijing L. Yan, Amber Pirzada, Larry Manheim, Willard Manning, Daniel B. Garside, Renwai Wang, Alan R. Dyer, Philip Greenland, and Jeremiah Stamler. 2004. “Relation of Body Mass Index in Young Adulthood and Middle Age to Medicare Expenditures in Older Age.” *Journal of the American Medical Association* 292:2743–49.

Davison, Kirsten K., Earl S. Ford, Mary E. Cogswell, and William H. Dietz. 2002. “Percentage of Body Fat and Body Mass Index Are Associated with Mobility Limitations in People Aged 70 and Older from NHANES III.” *Journal of the American Geriatric Society* 50:1802–9.

de Krom, Mariken, Florianne Bauer, David Collier, R.A.H. Adan, Susanne E. laFleur. 2009. “Genetic Variation and Effects of Human Eating Behavior.” *Annual Review of Nutrition* 29:283304.

Economos, Christina D., Raymond R. Hyatt, Jeanne P. Goldberg, Aviva Must, Elena N. Naumova, Jessica J. Collins, and Miriam E. Nelson. 2007. “A Community Intervention Reduces BMI z-score in Children: Shape Up Somerville First Year Results.” *Obesity* 15:1325–36.

Elbel, Brian, Rogan Kersh, Victoria L. Brescoll, and L. Beth Dixon. 2009. “Calorie Labeling and Food Choices: A First Look at the Effects on Low-Income People in New York City.” *Health Affairs* 28:w1110–21.

Espeland, M., et al. 2007. “Reduction in Weight and Cardiovascular Disease Risk Factors in Individuals with Type 2 Diabetes–One-year Results of the Look AHEAD trial. *Diabetes Care* 30:1374–1383.

Farooqi, I. Sadaf and Stephen O’Rahilly. 2007. “Genetic factors in Obesity.” *Obesity Reviews* 8:37–40.

Ferraro, Kenneth F., Roland J. Thorpe Jr., and Jody A. Wilkinson. 2003. “The Life Course of Obesity: Does Childhood Overweight Matter?” *Journal of Gerontology: Social Sciences* 58b:S110–9.

Ferraro, Kenneth F., Ya-ping Su, Randy J. Greteback, D. Randy Black, and Stephen F. Badylak. 2002. “Body Mass Index and Disability in Adulthood: A 20-Year Panel Study.” *American Journal of Public Health* 92:834–40.

Ferraro, Kenneth F. and Tara L. Booth. 1999. “Age, Body Mass Index, and Functional Illness.” *Journal of Gerontology: Social Sciences* 54B:S339–48.

Finkelstein, Eric A., Christopher Ruhm, and Katherine Kosa. 2005. "Economic Causes and Consequences of Obesity." *Annual Review of Public Health* 26:239–57.

Flegal, Katherine M., Barry I. Graubard, David F. Williamson, and Mitchell H. Gail. 2005. "Excess Deaths Associated with Underweight, Overweight, and Obesity." *Journal of the American Medical Association* 293:1861–7.

Flegal, Katherine M., Margaret D. Carroll, Robert J. Kuczmarski, and Clifford L. Johnson. 1998. "Overweight and Obesity in the United States: Prevalence and Trends, 1960–1994." *International Journal of Obesity and Related Metabolic Disorders* 22:39–47.

Flegal, Katherine M., John A. Shepherd, Anne C. Looker, Barry I. Graubard, Lori G. Borrud, Cynthia L. Ogden, Tamara B. Harris, James E. Everhart, and Nathaniel Schenker. 2009. "Comparisons of Percentage Body Fat, Body Mass Index, Waist Circumference, and Waist-Stature Ratio in Adults." *American Journal of Clinical Nutrition* 89:500–8.

Fonda, Stephanie J., Nancy H. Fultz, Kristi Rahrig Jenkins, Laura M. Wheeler, and Linda A. Wray. 2004. "Relationship of Body Mass and Net Worth for Retirement-Aged Men and Women." *Research on Aging* 26:153–76.

Fontaine, Kevin R., David T. Redden, Chenxi Wang, Andrew O. Westfall, and David B. Allison. 2003. "Years of Life Lost to Obesity." *JAMA* 289:187–193.

Ford, Earl S., David G. Moriarty, Matthew M. Zack, Ali H. Mokdad, and Daniel P. Chapman. 2001. "Self-Reported Body Mass Index and Health Related Quality of Life: Findings from the Behavioral Risk Factor Surveillance System." *Obesity Research* 9:21–31.

Forshee, Richard A., Maureen L. Storey, David B. Allison, Walter H. Glinsman, Gayle L. Hein, David R. Lineback, Sanford A. Miller, Theresa A. Nicklas, Gary A. Weaver, and John S. White. 2007. "A Critical Examination of the Evidence Relating High Fructose Corn Syrup and Weight Gain." *Critical Reviews in Food Science and Nutrition* 47:561–82.

Galanos, Anthony N., Carl F. Pieper, Joan C. Cornoni-Huntley, Connie W. Bales, and Gerda G. Fillenbaum. 1994. "Nutrition and Function: Is There a Relationship between Body Mass Index and the Functional Capabilities of Community-Dwelling Elderly?" *Journal of the American Geriatrics Society* 42:368–73.

Gallagher, Dympna, Marjolein Visser, Dennis Sepulveda, Richard N. Pierson, Tamara Harris, and Steven B. Heymsfield. 1996. "How Useful is BMI for Comparison of Body Fatness across Age, Sex and Ethnic Groups?" *American Journal of Epidemiology* 143:228–39.

Gomez, Jorge E., Beth Ann Johnson, Martha Selva, and James F. Sallis. 2004. "Violent Crime and Outdoor Physical Activity among Inner-City Youth." *Preventive Medicine* 39:876–81.

Greenfield, Emily A. and Nadine F. Marks. 2009. "Violence from Parents in Childhood and Obesity in Adulthood: Using Food in Response to Stress as a Mediator of Risk." *Social Science and Medicine* 68:791–8.

Gregg, Edward W., Yiling J. Cheng, Betsy L. Cadwell, Giuseppina Imperatore, Desmond E. Williams, Katherine M. Flegal, K.M. Venkat Narayan, and David F. Williamson. 2005. "Secular Trends in Cardiovascular Disease Risk Factors According to Body Mass Index in U.S. Adults." *JAMA* 293:1868–74.

Handy, Susan L., Barbara McCann, Linda Bailey, Michelle Ernst, Lanier McRee, Emily Meharg, Reid Ewing, and Kate Wright. 2009. *The Regional Response to Federal Funding for Bicycle and Pedestrian Projects*. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-09-15

Hedley, Allison A., and Cynthia L. Ogden. 2006. "More for the Money? Differences in the Prevalence of Adult Obesity in the U.S. by Income Level – 1999–2002." Paper presented at the 2006 Population Association of America Conference. Los Angeles, California.

Hedley, Allison A., Cynthia L. Ogden, Clifford L. Johnson, Margaret D. Carroll, Lester R. Curtin, and Katherine M. Flegal. 2004. "Prevalence of Overweight and Obesity among US Children, Adolescents, and Adults, 1999–2002." *JAMA* 291:2847–50.

Heiat, Asefeh, Viola Vaccarino, and Harlan M. Krumholz. 2001. "An Evidence Based Assessment of Federal Guidelines for Overweight and Obesity as They Apply to Elderly Persons." *Archives of Internal Medicine* 161:1194–203.

Hill, James O., Holly R. Wyatt, George W. Reed, and John C. Peters. 2003. "Obesity and the Environment: Where Do We Go from Here?" *Science* 299:853–5.

Himes, Christine L. 2000. "Obesity, Disease, and Functional Limitation in Later Life." *Demography* 37:73–82.

Himes, Christine L. and Sandra L. Reynolds. 2005. "The Changing Relationship between Obesity and Educational Status." *Gender Issues* 22:45–57.

Jackson, Tamara D., Carlos M. Grilo, and Robin M. Masheb. 2000. "Teasing History, Onset of Obesity, Current Eating Disorder Psychopathology, Body Dissatisfaction, and Psychological Functioning in Binge Eating Disorder." *Obesity Research* 8:451–8.

Janssen, Ian and Amy E. Mark. 2007. "Elevated Body Mass Index and Mortality Risk in the Elderly." *Obesity Reviews* 8:41–59.

Jenkins, Kristi R. 2004. "Obesity's Effects on the Onset of Functional Impairment among Older Adults." *The Gerontologist* 44:206–16.

Klein, Samuel, David B. Allison, Steven B. Heymsfield, David E. Kelley, Rudolph L. Leibel, Cathy Nonas, and Richard Kahn. 2007. "Waist Circumference and Cardiometabolic Risk: A Consensus Statement from Shaping America's Health: Association for Weight Management and Obesity Prevention; NAASO, The Obesity Society; the American Society for Nutrition; and the American Diabetes Association." *Obesity* 15:1061–7.

Koplan, J.P., Catharyn T. Liverman, and Vivica L. Kraak, eds. 2005. *Preventing Childhood Obesity: Health in the Balance*. Washington DC: National Academy Press.

Kuk, Jennifer L., Travis J. Saunders, Lance E. Davidson, and Robert Ross. 2009. "Age-Related Changes in Total and Regional Fat Distribution." *Aging Research Reviews* 8:339–48.

Kwan, Samantha. 2009. "Framing the Fat Body: Contested Meanings between Government, Activists, and Industry." *Sociological Inquiry* 79:25–50.

LaCroix, Andrea Z., Jack M. Guralnik, Lisa F. Berkman, Robert B. Wallace, and Suzanne Satterfield. 1993. "Maintaining Mobility in Late Life: Smoking, Alcohol Consumption, Physical Activity, and Body Mass Index." *American Journal of Epidemiology,* 137:858–69.

Lakdawalla, Darius N., Dana P. Goldman, and Baoping Shang. 2005. "The Health and Cost Consequences of Obesity among the Future Elderly." *Health Affairs,* 24:W5R30–41.

Lakdawalla, Darius N. and Tomas J. Philipson. 2009. "The growth of obesity and technological change." *Economics and Human Biology* 7:283–93.

Launer, Lenore J., Tamara Harris, Catherine Rumpel, and Jennifer Madans. 1994. "Body Mass Index, Weight Change, and Risk of Mobility Disability in Middle-Aged and Older Women." *Journal of the American Medical Association* 271:1093–8.

Mahan, L. Kathleen and Sylvia Escott-Stump. 2000. *Krause's Food, Nutrition, and Diet Therapy*. Philadelphia PA, W. B. Saunders.

Mifflin, Mark D., Sachiko T. St Jeor, Lisa A. Hill, Barbara J. Scott, Sandra A. Daugherty, and Young O. Koh. 1990. "A New Predictive Equation for Resting Energy Expenditure in Healthy Individuals." *American Journal of Clinical Nutrition* 51:241.

Mokdad, Ali H., Earl S. Ford, Barbara A. Bowman, William H, Dietz, Frank Vinicor, Virginia S. Bales, and James S. Marks. 2003. "Prevalence of Obesity, Diabetes, and Obesity-Related Health Risk Factors, 2001." *JAMA* 289:76–9.

Must, Aviva and Richard S. Strauss. 1999. "Risks and Consequences of Childhood and Adolescent Obesity." *International Journal of Obesity* 23:s2–11.

Myrskala, Mikko and Virginia W. Chang. 2009. "Weight Change, Initial BMI, and Mortality among Middle- and Older-Aged Adults." *Epidemiology* 20:840–8.

National Center for Health Statistics. 2009. Early Release of Selected Estimates Based on Data From the 2008 National Health Interview Survey. http://www.cdc.gov/nchs/data/nhis/earlyrelease/200906_07.pdf

National Institutes of Health. 1998. *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*. Bethesda, MD: National Institutes of Health.

———. 2004. *Strategic Plan for NIH Obesity Research*. National Institutes of Health: U.S. Department of Health and Human Services.

Neel, James V. 1962. "Diabetes Mellitus: A 'Thrifty' Genotype Rendered Determined by Progress?" *American Journal of Human Genetics* 14:353–63.

———. 1989. "The Study of Natural Selection in Primitive and Civilized Human Populations-Update" *Human Biology* 61:811–23.

Nestle, Marion. 2002. *Food Politics: How the Food Industry Influences Nutrition and Health*. Berkeley and Los Angeles: University of California Press.

Nestle, Marion and M.F. Jacobsen. 2000. "Halting the Obesity Epidemic: A Public Health Policy Approach." *Public Health Reports* 115:12–24.

Nielsen, Samara Joy and Barry J. Popkin. 2004. "Changes in Beverage Intake between 1977 and 2001." *American Journal of Preventive Medicine* 27:205–210.

Ogden, Cynthia, Margaret D. Carroll, and Katherine M. Flegal. 2008. "High Body Mass Index for Age among US Children and Adolescents, 2003–2006." *JAMA* 299:2401–5.

Ogden, Cynthia L., Margaret D. Carroll, Lester R. Curtin, Margaret A. McDowell, Carolyn J. Tabak, and Katherine M. Flegal. 2006. "Prevalence of Overweight and Obesity in the United States, 1999–2004." *JAMA* 295:1549–55.

Ogden, Cynthia L., Margaret D. Carroll, Margaret A. McDowell, and Katherine M. Flegal. 2007. "Obesity among Adults in the United States – No Change since 2003–2004." *NCHS Data Brief, No. 1*. Hyattsville, MD: National Center for Health Statistics.

Ogden, Cynthia L., Margaret D. Carroll, Lester R. Curtin, Molly M. Lamb, Katherine M. Flegal. 2010. "Prevalence of High Body Mass Index in US Children and Adolescents, 2007–2008." *JAMA,* 303:242–9.

Okoro, Catherine A., Jennifer M. Hootman, Tara W. Strine, Lina S. Balhuz, and Ali H. Mokdad. 2004. "Disability, Arthritis, and Body Weight among Adults 45 years and Older." *Obesity Research* 12:854–61.

Oliver, J. Eric. 2005. *Fat Politics: The Real Story behind America's Obesity Epidemic*. New York: Oxford University Press.
Oliver, Georgina and Jane Wardle. 1999. "Perceived Effects of Stress on Food Choice." *Physiology & Behavior* 66:511–5.
Olshansky, S. Jay, Douglas J. Passaro, Ronald C. Hershow, Jennifer Layden, Bruce A. Carnes, Jacob Brody, Leonard Hayflick, Robert N. Butler, David B. Allison, and David S. Ludwig. 2005. "A Potential Decline in Life Expectancy in the United States in the 21st Century." *New England Journal of Medicine* 352:1138–45.
Osher, Etty and Naftali Stern. 2009. "Obesity in Elderly Subjects: In Sheep's Clothing Perhaps, But Still a Wolf!" *Diabetes Care* 32:S398–402.
Paul, R.J. and J.B. Townsend. 1995. "Shape Up or Ship Out? Employment Discrimination against the Overweight." *Employee Responsibilities and Rights Journal* 8:133–45.
Peeters, Anna, Jan J. Barendregt, Frans Willekens, Johan P. Mackenback, Abdullah Al Mamun, and Luc Bonneux. 2003. "Obesity in Adulthood and Its Consequences for Life Expectancy: A Life-table Analysis." *Annals of Internal Medicine* 138:24–32.
Peeters, Anna, Luc Bonneux, Wilma J. Nusselder, Chris De Laet, and Jan J. Barendregt. 2004. "Adult Obesity and the Burden of Disability throughout Life." *Obesity Research* 12:1145–51.
Philipson, Tomas J. and Richard A. Posner. 2003. "The Long-Run Growth in Obesity as A Function Of Technological Change." *Perspectives in Biology and Medicine* 46:S87–107.
Popper, R., G. Smits, Herbert L. Meiselman, Edward Hirsch. 1989. "Eating in Combat: A Survey of U.S. Marines." *Military Medicine* 154:619–23.
Prentice, Andrew M. and Susan A. Jebb. 2001. "Beyond Body Mass Index." *Obesity Reviews* 2:141–7.
Preston, Samuel H. 2005. "Deadweight? The Influence of Obesity on Longevity." *New England Journal of Medicine* 352:1135–7.
Puhl, Rebecca M. and Kelly D. Brownell. 2001. "Bias, Discrimination, and Obesity." *Obesity Research* 9:788–805.
———. Brownell. 2003. "Psychosocial Origins of Obesity Stigma: Toward Changing a Powerful and Pervasive Bias." *Obesity Reviews* 4:213–27.
Reither, Eric N., Robert M. Hauser, and Yang Yang. 2009. "Do Birth Cohorts Matter? Age-Period-Cohort Analyses of the Obesity Epidemic in the United States." *Social Science and Medicine* 69:1439–48.
Reuser, Mieke, Luc Bonneux, and Frans Willekens. 2008. "The Burden of Mortality of Obesity at Middle and Old Age is Small: A Life Table Analysis of the US Health and Retirement Survey." *European Journal of Epidemiology* 23:601–7.
Reynolds, Sandra L. and Christine L. Himes. 2007. "Cohort Differences in Adult Obesity in the U.S.:1982–1996." *Journal of Aging and Health* 19:831–50.
Reynolds, Sandra L., Y. Saito, and Eileen M. Crimmins. 2005. "The Impact of Obesity on Active Life Expectancy in Older American Men and Women." *The Gerontologist* 45:439–44.
Roberto, Christina, Peter D. Larsen, Henry Agnew, Jenny Baik, and Kelly D. Brownell. 2010. "Evaluating the Effects of Menu Labeling on Food Choices and Intake." *American Journal of Public Health* 100:312–8.
Roehling, Mark V. 1999. "Weight-based Discrimination in Employment: Psychological and Legal Aspects." *Personnel Psychology* 52:969–1016.
Rothblum, Esther D. 1992. "The Stigma of Women's Weight: Social and Economic Realities." *Feminism and Psychology* 2:61–73.
Sallis, James F., Brian E. Saelens, Lawrence D. Frank, Terry L. Conway, Donald J. Slymen, Kelli L. Cain, James E. Chapman, and Jacqueline Kerr. 2009. "Neighborhood Built Environment and Income: Examining Multiple Health Outcomes." *Social Science and Medicine* 68:1285–93.
Santry, Heena P., Daniel L. Gillen, and Diane S. Lauderdale. 2005. "Trends in Bariatric Surgical Procedures." *JAMA* 294:1901–17.
Schwartz, Marlene B., Heather O'Neal Chambliss, Kelly D. Brownell, Steven N. Blair, and Charles Billington. 2003. "Weight Bias among Health Professionals Specializing in Obesity." *Obesity Research* 11:1033–9.
Serdula Mary K., D. Ivery, Ralph J. Coates, David S. Freedman, David F. Williamson, and Tim Byers. 1993. "Do Obese Children Become Obese Adults? A Review of the Literature." *Preventive Medicine* 22:167–77.
Shah, Meena, Vinaya Simha, and Abhimanyu Garg. 2006. "Review: Long-term Impact of Bariatric Surgery on Body Weight, Comorbidities, and Nutritional Status." *Journal of Clinical Endocrinology and Metabolism* 91:4223–31.
Silventoinen, Karri, Susana Sans, Hanna Tolonen, D. Monterde, Kari A. Kuulasmaa, Hugo E.C. Kesteloot, and J.O. Tuomilehto. 2004. "Trends in Obesity and Energy Supply in the WHO MONICA Project." *International Journal of Obesity* 28:710–8.
Stevens, June, Jianwn Cai, Elsie R. Pamuk, David F. Williamson, Michael J. Thun, and Joy L. Wood. 1998. "The Effect of Age on the Association between Body-mass Index and Mortality." *New England Journal of Medicine* 338:1–7.
Story, Mary, Karen M. Kaphingst, and Simone French. 2006. "The Role of Schools in Obesity Prevention." *The Future of Children* 16:109–42.

Sturm. Roland. 2007. “Increases in Morbid Obesity in the USA: 2000–2005.” *Public Health* 121:492–6.
Sturm, Roland, Jeanne S. Ringel, Tatiana Anderyeva. 2004. “Increasing Obesity Rates and Disability Trends.” *Health Affairs* 23:199–205.
Thorpe, Roland and Kenneth Ferraro. 2004. “Aging, Obesity, and Mortality: Misplaced Concern about Obese Older People?” *Research on Aging* 26:108–29.
Torres, Susan J., and Caryl A. Nowson. 2007. “Relationship between Stress, Eating Behavior, and Obesity.” *Nutrition* 23:887–94.
Transportation Research Board and institute of Medicine. 2005. *Does the Built Environment Influence Physical Activity? Examining the Evidence.* Special Report 282. Washington, D.C.: National Academies Press.
Truong, Khoa Dang, and Roland Sturm. 2005. “Weight Gain Trends across Socioeconomic Groups in the United States.” *American Journal of Public Health* 95:1602–16.
Tucker, Larry A., and Glenn M. Friedman. 1998. “Obesity and Absenteeism: An Epidemiologic Study of 10,825 Employed Adults.” *American Journal of Health Promotion* 12:202–7.
Uretsky, Seth, Franz H. Messerli, Sripal Bangalore, Annette Champion, Rhonda M. Cooper-Dehoff, Qian Zhou, and Carl J. Pepine. 2007. “Obesity Paradox in Patients with Hypertension and Coronary Artery Disease.” *American Journal of Medicine* 120:863–870.
U.S. Bureau of the Census. 2007. Computer and Internet Use in the United States: October 2007. http://www.census.gov/population/www/socdemo/computer/2007.html
U.S. Department of Health and Human Services. 2008. *Physical Activity Guidelines Advisory Committee Report.* Washington, DC:U.S. Government Printing Office.
U.S. Surgeon General. *Overweight and Obesity: Health Conseque*nces. Retrieved ([http://www.surgeongeneral.gov/topics/obesity/calltoaction/fact_consequences.htm]. Rockville: MD. 2001).
Villareal, Dennis T., Caroline M. Apovian, Robert F. Kushner, and Samuel Klein. 2005. “Obesity in Older Adults: Technical Review and Position Statement of the American Society for Nutrition and NAASO, The Obesity Society.” *American Journal of Clinical Nutrition* 82:923–34.
Wallace, Jeffrey I., R.S. Schwartz, A.Z. LaCroix, Richard F. Uhlmann, and Robert A. Pearlman. 1995. “Involuntary Weight Loss in Older Outpatients: Incidence and Clinical Significance.” *Journal of the American Geriatrics Society* 43:329–37.
Wang, Shirley S., Kelly D. Brownell, and Thomas A. Wadden. 2004. “The Influence of the Stigma of Obesity on Overweight Individuals.” *International Journal of Obesity* 28:1333–1337.
Whitmer, Rachel A., Erica P. Gunderson, Elizabeth Barrett-Connor, Charles P. Quesenberry, Jr., and Kristine Yaffe. 2005. “Obesity in Middle Age and Future Risk of Dementia: A 27 Year Longitudinal Population Based Study.” British Medical Journal, 330:1360.
Williams, Lana J., Julie A. Pasco, Margaret J. Henry, Felice N. Jacka, Seetal Dodd, Geoffrey C. Nicholson, Mark A. Kotowicz, and Michael Berk. 2009. “Lifetime Psychiatric Disorders and Body Composition: A Population Based Study.” *Journal of Affective Disorders* 118:173–9.
Williamson, David F. 1993. “Descriptive Epidemiology of Body Weight and Weight Change in U.S. Adults.” *Annals of Internal Medicine* 119:646–9.
Wolf, Anne M., and Graham A. Colditz. 1998. “Current Estimates of the Economic Cost of Obesity in the United States.” *Obesity Research* 6:97–106.
World Health Organization. 2002. *World Health Report: 2002*. Geneva, Switzerland: World Health Organization.