

Obesity: What the Research Shows

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The Colorado Health Foundation™



Summary of Findings

An accumulating body of evidence demonstrates that obesity has reached epidemic proportions in the United States. The Centers for Disease Control and Prevention (CDC) reports that 27 percent of adults, or almost 60 million people, are obese. If current trends continue, two-thirds of adults will be overweight or obese by 2015.

Obesity increases the chances of developing a multitude of chronic diseases, including hypertension, asthma, cardiovascular disease and diabetes—all of which contribute to high medical costs and can lead to premature death. This extensive review of the medical literature has identified factors that contribute to the likelihood of becoming obese. The most predominant of these are modifiable lifestyle behaviors: Most Americans expend fewer calories than they consume. This decreased caloric expenditure is due to increasingly sedentary lifestyles and insufficient exercise.

Environmental factors also contribute to obesity, particularly among poorer, less-educated people. In low-income communities, fast food is much easier to find—and more affordable—than fresh produce. People living in underserved communities have limited access to playgrounds and safe recreational facilities where they can engage in physical activity. Data from the 2007 Behavioral Risk Factor Surveillance Survey (BRFSS) indicate that adults who attended college were significantly more likely to be of normal weight than adults who did not finish high school.

Some research suggests that obesity may have a genetic component. Fifty chromosomal locations on the human genome have been identified as potential causal genes. This line of research suggests the potential for gene-based interventions that may be effective for treating and preventing obesity.

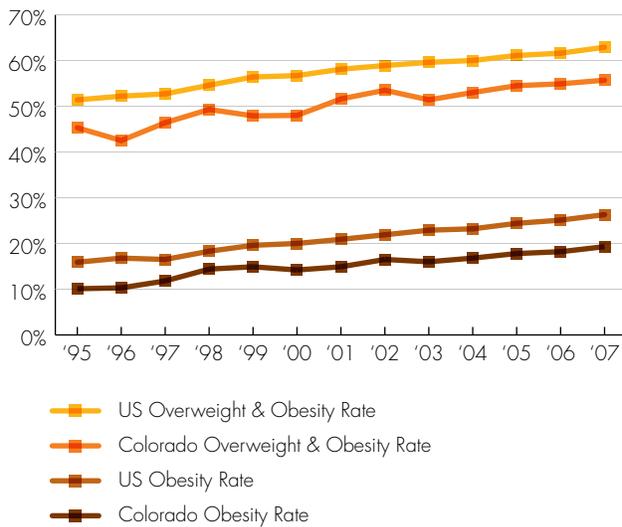
Ethnicity is another predictor of obesity. Data from CDC's National Health and Nutrition Examination Survey (NHANES) reveal that blacks and Hispanics are more likely to be obese than whites and that obesity rates are lowest in Asians. These disparities may be explained in part by differences in cultural perspectives on weight and body image.

This literature review also identified weight-loss interventions that have proven successful among obese people. The majority of these interventions focus on diet and exercise. Obese and overweight children lose weight—often while improving their academic performance—when nutritional choices at school improve and physical education time increases. Recent research on innovative interventions that focus on the entire family or on improving the environment also looks promising.

Overview

CDC reports that obesity in the United States has risen at an alarming rate over the past 20 years.¹ Findings from the BRFSS show notable increases in the number of adults who were either overweight or obese, from 51 percent in 1995 to 63 percent in 2007 (see Figure 1).²

Figure 1
*Trends in Overweight and Obesity among Adults, aged 18 years and older, 1995–2007*²



In early 2008, CDC's National Center for Health Statistics noted that 27 percent of adults 20 years or older (close to 60 million people) were considered obese, having a Body Mass Index (BMI)* of 30 or higher.³ If current trends continue, the number of overweight and obese adults in the United States is expected to rise from 66 percent in 2007 to 75 percent in 2015.⁴

Among children and adolescents, the number of those who are obese, that is, ranking in the 95th percentile of growth charts for their age, has more than tripled since 1980. Data from 2003-2004 indicate approximately 19 percent of children aged 6-11 years and 17 percent of adolescents aged 12-19 years (more than 9 million 6- to 19-year-olds) are obese.⁵

Colorado is doing better than most other states in terms of rates of overweight and obesity. In 2007, CDC reported that Colorado

was the only state with an obesity rate of less than 20 percent, while 30 states had obesity rates equal to or greater than 25 percent of the population. Three states—Mississippi, Alabama and Tennessee—had obesity rates equal to or greater than 30 percent.⁶

Excess body fat is associated with an increased risk for developing many medical problems. These include, but are not limited to, an increased risk for developing diabetes, hypertension, sleep apnea, gallbladder disease, cardiovascular disease and stroke, infertility, depression, complications during pregnancy, certain cancers and premature mortality.⁷ Obesity's close association with many chronic diseases presents policymakers with a number of significant challenges.

Racial, ethnic and socioeconomic disparities in the prevalence of overweight and obesity exist within the general population, especially among individuals and families living in poverty. If the prevalence of obesity continues to rise at current rates, certain individuals will be disproportionately affected and place higher demands on the health care system. The full magnitude of the social, medical and economic costs of current trends are yet to be determined, but it is clear that as the numbers continue to rise, obesity will remain a health problem of epidemic proportions that calls for immediate action.

* BMI is a number calculated from a person's weight and height (weight/height²) and is considered to be a reliable indicator of body fatness.

Contributing Factors

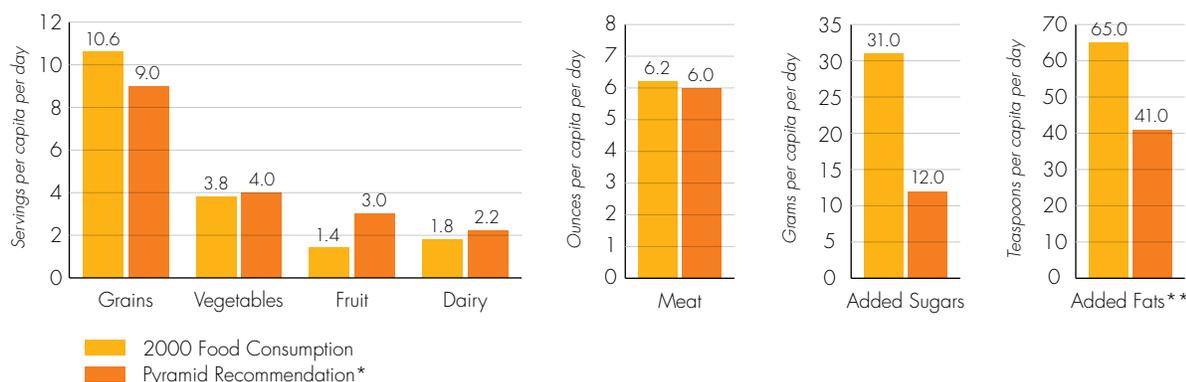
Research points to numerous factors that are associated with being overweight and obese. These include, but are not limited to, excess caloric consumption combined with too little caloric expenditure, environments that don't lend themselves to healthy lifestyles, genetics and certain diseases that are associated with excessive weight gain.⁸ The prevalence of obesity has increased at an alarming rate in the United States in a relatively short period of time. The largest body of obesity-related research points primarily to the over-consumption of energy- and fat-dense foods and to increasingly sedentary lifestyles as primary causal factors.⁹

Caloric Consumption

Over the past two decades, the caloric intake of Americans increased by 19 percent, with much of this increase accounted for by "empty calories." The *2005 Dietary Guidelines for Americans* developed by the U.S. Department of Health and Human Services (HHS) and the U.S. Department of Agriculture (USDA) provide national nutritional guidelines based on existing evidence-based research.¹⁰ Overall, a healthy diet requires a high nutrient content relative to calories, which is achieved through the consumption of a combination of foods from all basic food groups (fruits, vegetables, grains, milk/yogurt/cheese and meat/poultry/fish/dry beans/eggs/nuts). A daily intake of about 2,200 calories is used consistently as a benchmark for the maintenance of healthy weight, although this recommended caloric intake will differ for individuals based on age, gender and activity level. Studies of basic physiology under normal conditions and intervention studies that manipulate these conditions have found that weight gain occurs when energy intake exceeds energy output for a prolonged period.¹¹ Thus, obesity can be attributed largely to an intake of calories that exceeds caloric expenditures.

Trends over the last three decades indicate that Americans, on average, consume more calories than they expend and get many of their calories from poor food and beverage sources. Between 1979 and 1981, data from the Food and Agriculture Organization of the United Nations indicate the average American consumed about 3,180 calories per day. This compares with 3,770 calories consumed between 2002 and 2003. This represents a 19 percent increase in daily caloric intake, with more Americans consuming foods and beverages containing "empty calories."¹² Data from CDC's NHANES indicate similar trends. Between 1971 and 2000 a statistically significant increase in average energy intake was reported among adults aged 20-74 years, caused primarily by a higher consumption of carbohydrates.¹³

Figure 2
2000 Food Consumption Compared with Food Guide Pyramid Recommendations¹⁴



* Pyramid recommendation based on a sample diet of 2,200 calories.

** The Food Guide Pyramid does not make a recommendation for added fats and oils. This recommendation is implied by the 56 percent share of total fats accounted for by added fats and oils in the food supply in 2000 and the upper limit of total fat consumption of 73 grams for a 2,200-calorie diet.

As depicted in Figure 2, a study published in 2002 comparing per capita food serving trends with food guide pyramid recommendations reported an over-consumption of fat grams and carbohydrates coupled with too few servings of fruits and vegetables in the general American population.¹⁵ Another study published in 2000 that included 5,752 adults found that people do not eat enough grains, fruits, vegetables and meats, and they eat more fats, oils and sweets than recommended by the USDA. In addition, one's perception of food group consumption was very different from one's actual consumption based on food diaries. Adults tend to overestimate their consumption of milk products, meat, fruit, eggs and nuts, and underestimated their consumption of grains, fruits, oils and sweets.¹⁶

Although there is a growing body of research into the dietary risk factors for obesity and the basic physiology of energy intake and expenditure, evidence linking the two continues to be weak and inconsistent. This may be due partly to the fact that obesity is a multifaceted condition, but also to numerous methodological obstacles to studying energy intake. First, most observational studies monitor dietary habits over a relatively short period of time, while body weight is the result of diet and exercise habits over a long period of time. Second, research shows that overweight and obese individuals under-report their energy intake by about 30 to 40 percent.¹⁷ For these reasons and others, it is difficult to carry out a rigorous study of nutritional intake using a personal diary approach for reporting.

Caloric Expenditure

Most Americans expend fewer calories than they consume, resulting in weight gain over time that can contribute to premature mortality, morbidity and poor psychosocial health.¹⁸

Guidance from HHS recommends that children, adolescents and adults engage in 60 minutes or more of moderate to vigorous physical activity on most days of the week to maintain good health and fitness, as well as to prevent chronic disease onset and weight gain.¹⁹ Formerly obese individuals have to work even harder. An expert panel on obesity found that formerly obese people had to spend 60 to 90 minutes engaging in moderately intense physical activity on most days of the week to maintain weight loss. The panel concluded that maintaining recommended levels of physical activity throughout the week would require incorporating more incidental and leisure time physical activity into one's daily routine, such as taking the stairs instead of the elevator and parking farther away from a destination.²⁰

Environmental Influences

An emerging body of literature about the interaction between environmental factors and the increased prevalence of overweight and obesity is gaining increased attention. The "built environment," as this area of research is commonly known, focuses on the link between obesity and urban design, land use and public transportation planning. Recent research has found that the built environment both facilitates and hinders engagement in physical activity in a community setting.²¹ Communities with public safety concerns,





uneven and hilly terrain, few recreational facilities or insufficient lighting have been shown to reduce the likelihood of people engaging in outdoor physical activity.²² On the other hand, residents of neighborhoods with mixed-use residential and commercial buildings that include recreational facilities and high levels of “connectivity”—integration of various modes of transportation including pedestrian access—have been found to have lower rates of obesity.²³

Additionally, research has shown that physical proximity to healthy and affordable food is important to maintaining healthy weight. In general, the “food environment” is characterized by access to fresh foods in grocery stores, supermarkets and farmers’ markets on the positive side and, on the negative side, too easy access to fast-food and take-out venues, both of which use large amounts of saturated fats and sugars. A soon to be published study found a relationship between higher rates of obesity and lack of proximity to a supermarket.²⁴ Similarly, a 1991 study found a statistical correlation between the availability of healthy foods and self-reported healthy diets among community members.²⁵

Socioeconomic factors also have been implicated in obesity rates. One marker for this association is that fewer supermarkets offering fresh produce and whole grains are located in poor neighborhoods. In a study reported in 2002 in the *American Journal of Preventive Medicine*, researchers geo-coded food markets in Mississippi, North Carolina, Maryland and Minnesota. They found that poor neighborhoods had three times fewer supermarkets than middle-class neighborhoods, and they had significantly more fast-food restaurants and convenience stores.²⁶ Small independent grocers that were more prevalent in low-income neighborhoods and rural areas tended to have higher-priced fresh produce of lower quality and were more likely to sell processed and energy-dense foods.

Genetics

While obesity has been largely attributed to environmental and modifiable behavioral factors, researchers also are discovering more about the genetic mechanisms that are implicated in the risk of being overweight or obese. Studies of families, adoptees and twins have found fatness is one of the most heritable of human traits, accounting for 45 to 75 percent of individual variations in BMI.²⁷ In severe cases, where obesity is present in multiple family members, multiple genetic markers have been implicated. Additionally, 50 chromosomal locations linked to obesity have been mapped on the human genome and potential causal genes have been identified.²⁸

With a greater understanding of the heritable factors that underlie obesity risk, there is potential for improved genetic counseling, enhanced knowledge about the normal physiology of energy balance and the tailoring of interventions involving specific diets, exercise regimes, drugs or surgery for obese individuals based on their genetic makeup. Scientists at CDC have noted, “The variation in how people respond to the same environmental conditions suggests that genes play a role in the development of obesity. This diversity occurs even among groups of the same racial or ethnic background and within families living in the same environment. All of these observations are consistent with the theory that obesity results from the interaction of genetic variation with shifting environmental conditions.”²⁹

Disparities in Obesity Rates

Socioeconomic Status

In general, the lower the income and the less education, the more likely a person is to be overweight or obese. Income, education and occupational status are among the primary factors comprising socioeconomic status (SES). Examining each of these factors individually reveals that low education (less than a high school education) and low income put individuals at higher risk for obesity.

For example, in a study published in 2002, researchers found that youth in the United States, Sweden and Finland who dropped out of high school were more likely to be obese than those who had completed high school.³⁰ Similarly, data from the 2007 BRFSS found that adults who attended at least some college were significantly more likely to be of normal weight than adults who did not graduate from high school. Additionally, research published in the mid-1980s found that maternal educational attainment impacted their children's nutritional status, as mothers with less education had less knowledge of healthy nutrition, the benefits of physical activity and healthy lifestyle choices.³¹

Various hypotheses have been put forth to explain gender differences in the risk of obesity, particularly for lower occupational categories. For example, women in lower-status occupations may have a harder time balancing work and parenting, making it difficult to make healthy eating choices and physical activity a high priority.³² Women in higher-status jobs report more concern about body image and make attention to diet and exercise a higher priority.³³

Income plays a role in overweight and obesity in various ways. Children and adults in low-income families (annual income less than \$25,000) have higher rates of obesity compared with children and adults in higher-income families (annual income of \$75,000 or more).³⁴ Additionally, the higher cost of fresh produce and other healthy foods is a barrier to healthy eating among low-income populations.³⁵ Low-income children also are less likely to play on sports teams because of the out-of-pocket costs involved for fees, uniforms and equipment.³⁶

In summary, when looking across research findings, the jury is still out as to the ways in which socioeconomic factors function as separate and/or unique influences on the risk of overweight and obesity as opposed to the interactions that exist between them.^{37,38} For example:

- A 2007 study of young adults found that BMI was negatively related to income and education for women but had a positive relationship for men.³⁹
- Data from the 1999-2000 NHANES found that less-educated adults had a higher prevalence of obesity than their more educated counterparts, with the exception of black women. Black women with less than a high school education had lower rates of obesity when compared with black women with higher educational attainment.⁴⁰
- The 1999-2000 NHANES also found that women with lower occupational status* appeared to face an increased risk for obesity, although men in lower-status jobs did not.⁴¹

The true association between individual SES factors and obesity is unclear, as obesity may adversely affect one's opportunities for higher education, occupational attainment, marriage and earnings potential or the relationship could be emanating from the other direction, that is, living in poverty could be a strong predictor of becoming overweight or obese.⁴²

* Occupational status was classified into one of the following categories, in descending order: professional, managerial, skilled non-manual, skilled manual and unskilled manual.

Ethnicity and Race

Overweight and obesity are more common in blacks and Hispanics than in whites and Asians. Data from NHANES, the BRFSS and the National Longitudinal Study of Adolescent Health all report similar disparities in obesity rates among various racial and ethnic groups in the United States, especially among women. Data from the 2003-2004 NHANES show that adult blacks had the highest prevalence of overweight and obesity (76.1 percent), followed by Mexican Americans (75.8 percent) and whites (64.2 percent). These data reveal that minority population groups had a higher prevalence of overweight and obesity than whites by almost 10 percentage points.⁴³ For the 1999-2002 period the combined prevalence of overweight and obesity in adult black women was 20 percentage points higher than among white women (77 percent vs. 57 percent). These disparities are especially stark when looking within certain age-groups. More than 80 percent of black women aged 40 years or older were overweight or obese, with more than half of them classified as obese.⁴⁴

The 2001 BRFSS data found that Asian Americans had the lowest rate of obesity among racial and ethnic groups, with a rate of 5 percent versus the average of 30 percent in other groups.⁴⁵ Native Americans had obesity rates similar to blacks and Pacific Islanders (34 percent, 35 percent and 33 percent, respectively). Although Asian Americans had considerably lower rates, significant differences were found among Asian groups—Native Hawaiians and Samoans had much higher rates of obesity than all other Asian groups.⁴⁶ Although the rates of overweight and obesity vary across racial and ethnic groups, trends over the past three decades suggest that the increasing prevalence of obesity is distributed across all population groups.

It is interesting to note that Asians born in the United States were four times more likely to be obese than their foreign-born counterparts, supporting a general trend that the prevalence of obesity among the foreign born rises with each year spent in the United States. Similar findings were reported among youth in the National Longitudinal Study of Adolescent Health.⁴⁷

As with adults, racial disparities exist among children. Data from the 2003-2004 National Child Health Survey, which includes children aged 5-18 years, found that overweight and obese children were more likely to be black and Hispanic as opposed to white (49 percent, 44 percent and 32 percent, respectively).⁴⁸ When looking at male and female differences, Hispanic boys and black girls had the highest rates of obesity.⁴⁹ Black children were found to have a 50 percent increased incidence of overweight and/or obesity when compared with white children, while Hispanic children had a 30 percent increased incidence of obesity compared with white children.⁵⁰

The reasons for racial and ethnic differences in overweight and obesity rates are complex, but a growing body of evidence points to lifestyle, acculturation, cultural beliefs and practices, and SES factors as important explanatory factors.⁵¹ Studies have shown that both Hispanic and Asian/Pacific Islander immigrants are more likely to become obese the longer they live in the United States, suggesting that acculturation and exposure to unhealthy foods and environments may be at play.⁵²

Additionally, attitudes about body image differ across cultures, partially explaining racial and ethnic differences in body weight. Being overweight has not been found to be associated with low self-esteem among black adolescents, but it has among Hispanic and white adolescents.⁵³ Findings from the 1999 Youth Risk Behavior Survey show that white high school students were more likely to report exercising to lose or maintain their weight than their black and Hispanic counterparts.⁵⁴ Racial and ethnic differences in overweight and obesity rates among youth also have been attributed to SES factors, as black and Hispanic families are three times more likely than whites to live in poverty.⁵⁵

Health Conditions Associated with Obesity

Hypertension

Population-based studies have shown an individual's BMI can be a significant risk factor for high blood pressure (hypertension).⁵⁶ Data from the 1988-1994 NHANES indicate that the risk for high blood pressure among individuals with a BMI higher than 30 is approximately two times higher for both men and women compared with those with a BMI lower than 25. Findings from the Nurses' Health Study report that an increase of one point in BMI translated into a 12 percent increased risk of developing hypertension. For example, a weight gain of more than 55 pounds increased a woman's risk for hypertension five-fold compared with women who gained from five to 11 pounds.⁵⁷ The finding that a strong relationship exists between obesity and hypertension is consistent; what is still under investigation is the specific mechanism of this relationship and to what extent weight loss can control or reverse high blood pressure.

Hypertension is not limited to obese adults; the formerly rare condition of pediatric hypertension has increased as the number of overweight children has increased. Studies show that overweight and obese children have a higher prevalence of hypertension compared with normal-weight children, regardless of race, gender or age.⁵⁸ Obese children are at an approximate three-fold higher risk for hypertension than non-obese children, although the risk of hypertension in children has been shown to increase as the entire range of BMI values increase.⁵⁹

Asthma

Similar to the rise in obesity prevalence, there has been a rapid rate of growth in the prevalence of asthma over the past three decades in the United States. According to CDC, 8 percent of adults had asthma in 2007—a 163 percent increase since 1970.⁶⁰ The relationship between obesity and asthma is under investigation. Several studies suggest that being obese increases the risk of developing asthma and the severity of common asthma by affecting lung capacity and inducing airway inflammation.^{61,62} On the other hand, patients with severe asthma show a 16-fold increased risk of obesity compared with those with mild asthma.⁶³

A number of studies have found gender differences in asthma incidence among obese individuals. One study using data from the Canadian National Population Health Survey found that females aged 12-24 years who had a BMI greater than or equal to 28 had a 50 percent increased risk of developing asthma when compared with females with a BMI of 20 to 25; no significant differences were found among males.⁶⁴ These findings are consistent with other studies conducted in New York, Great Britain and Canada.⁶⁵ A possible explanation for the stronger association between obesity and asthma among women is the role that female sex hormones play in developing asthma and how they might contribute to the tendency to become obese.⁶⁶



Cardiovascular Disease

Research on the link between obesity and cardiovascular disease (CVD) reveals two distinct findings. First, many of the same risk factors associated with obesity are also major risk factors for CVD, including hypertension, diabetes and high cholesterol.⁶⁷ Second, there is potentially a direct physiological association between the two. Part of the direct relationship between obesity and CVD stems from increased cardiac workload. Excessive fat tissue requires a greater blood supply, which increases cardiac workload. When the heart is forced to work harder, cardiac events may occur and symptoms can emerge.

A study that looked at 26-year follow-up data from the Framingham Heart Study found that obesity was an independent risk factor for CVD.^{68,69} Further, the Nurses' Health Studies found that women with a BMI of 25 to 29 experienced a two-fold increased risk for coronary heart disease and those with a BMI greater than 29 had a three-fold increased risk when compared with women with a BMI under 25. Similar results were found among men. As with hypertension, each gain of one BMI point increases by 10 percent the risk for coronary heart disease.⁷⁰ Research is underway exploring the relationship between childhood obesity and CVD. There is growing support for the hypothesis that children with high BMIs are at increased risk for developing the precursors to CVD and therefore are at greater risk of developing CVD in adulthood.^{71,72}

Diabetes

In light of the consistent research finding that a strong link exists between diabetes and obesity, the term "diabesity" has recently emerged to express the primary role obesity plays as a risk factor for the onset of type 2 diabetes. BMI, waist circumference and waist-to-hip ratio have been shown to be independent risk factors for the onset of type 2 diabetes.⁷³ As with the increase in obesity rates over the past two decades, the prevalence of diabetes also has risen. An estimated 23.5 million Americans, or 10.7 percent of the U.S. population aged 20 years and older, is estimated to have diabetes.⁷⁴

A report from the Nurses' Health Study indicates that female patients with a BMI at or above 31 face a more than 40-fold increased risk for developing type 2 diabetes. Moreover, changing body weight has been shown to be a strong predictor of obesity risk. Researchers have found that a gain of 44 pounds or more for adult women results in a 12-fold increased risk for developing diabetes, while a loss of 44 pounds in obese women was shown to lower their risk by 87 percent.

The Professionals Health Study found a similar relationship for men. With a BMI at or above 35, the risk for developing diabetes among men was 42 times higher than for men with a BMI lower than 23. Weight change also increased risk—a 33-pound weight gain after the age of 21 increased the risk for diabetes by 3.4 times compared with men that remained around their weight at age 21.⁷⁵ Excessive weight gain has also been shown to affect the body's ability to regulate insulin.⁷⁶





Financial Burden of Overweight and Obesity

Annual medical expenditures for obese people are up to 37 percent higher than for normal-weight people. With the sharp rise in obesity rates over the past two decades, concern about the personal and societal costs of the epidemic has received increased attention from researchers, employers and policymakers. Poor diet and physical inactivity, leading to obesity and its associated conditions, is the second most preventable cause of death in the United States after smoking and it is a major cause of morbidity and disability.⁷⁷ More than 400,000 deaths per year are attributable to chronic diseases and complications resulting from obesity.⁷⁸ Economist Kenneth E. Thorpe and colleagues estimate that increases in obesity prevalence alone account for 12 percent of the overall growth in health care spending.⁷⁹

One analysis of data from the 1987 National Medical Expenditure Survey and the 2001 Medical Expenditure Panel Survey (MEPS) found that obesity accounted for more than 38 percent of the growth in spending for diabetes, 22 percent of the growth in spending for hyperlipidemia (high cholesterol) and 41 percent of the growth in spending for heart disease.⁸⁰ Another study using nationally representative data from the 1997-1998 Healthcare for Communities Survey found that obese adults aged 18-65 years incurred annual medical expenditures that were 36 percent higher than the expenditures of normal-weight people.⁸¹ Combining data from the 1998 MEPS and the National Health Interview Survey, researchers found that the average increase in annual medical expenditures associated with obesity was 37 percent (\$732).⁸²

Moreover, a 2004 study that compared the use of health care resources by obese and normal-weight individuals found that obese patients had higher hospitalization rates, prescription drug use and outpatient visits compared with normal-weight individuals. Further, obese individuals used more cardiovascular, intranasal allergic rhinitis, asthma, ulcer, diabetes, thyroid and analgesic drugs than individuals of normal weight.⁸³

Like obesity itself, health care costs associated with obesity vary by age and race. Using 1998 MEPS data, researchers found that expenditures related to higher BMI rose dramatically among white and older adults but not among blacks or those younger than 35 years.⁸⁴

Expenditures have also shown to vary according to degree of obesity. One study found that morbidly obese individuals, those with a BMI equal to or greater than 40, incurred \$1,400 more in annual expenses than those with a BMI greater than or equal to 30 or less than 35. Morbidly obese adults had hospital expenditures that were twice as high as normal-weight adults; excess costs among morbidly obese adults resulted from greater expenditures for office visits, outpatient hospital care and prescription drug expenses when compared with normal-weight, overweight and obese adults.⁸⁵

Additionally, as invasive methods to treat obesity become more widespread, the costs of obesity will rise even more. Between 1998 and 2002, bariatric surgery, which costs between \$15,000 and \$30,000, rose by 400 percent and hospital costs associated with these surgeries grew six-fold, to \$948 million in 2002.⁸⁶ While bariatric surgery has the potential to decrease downstream costs, in the short run, it will increase the costs associated with treating morbidly obese individuals.

In addition to the direct costs associated with obesity, an estimated \$64 billion in costs were incurred by private business in 1998 due to the indirect costs resulting from premature mortality, decreased years of disability-free life before retirement and absenteeism at work. These obesity-related expenditures included \$2.4 billion in paid sick leave, \$1.8 billion in life insurance payments and \$800 million in disability insurance payments.⁸⁷ Another study published in 1998 found that obese employees were twice as likely to experience high levels of absenteeism* and almost twice as likely to experience moderate levels of absenteeism** as normal-weight workers.⁸⁸ Further, obese women were found to be 2.5 times more likely to face long-term unemployment and were 60 percent more likely to report low individual or household income compared with women with a BMI of 20 to 25.⁸⁹

Policy and Community Interventions

The World Health Organization's 2003 technical report, *Diet, Nutrition and the Prevention of Chronic Diseases*, states that sedentary lifestyles and high intakes of energy-dense, micronutrient-poor foods, intense marketing of these unhealthy foods, fast-food outlets, high intakes of sugar-sweetened soft drinks and fruit juices, and adverse SES conditions have increased the prevalence of obesity worldwide. The report also states that regular physical activity, breast-feeding, a high intake of dietary fiber, and home and school environments that support healthy food choices for children decrease the risk of obesity.⁹⁰

Recent reviews of obesity research have found the existing body of evidence-based research on the effectiveness of interventions aimed at the prevention and reduction of obesity is surprisingly scant and provides limited evidence on which to base policy recommendations.^{91, 92} The Institute of Medicine's (IOM) 2007 Study Committee on Prevention of Obesity in Children and Youth concluded that the obesity epidemic in children and adults is so severe that immediate actions are warranted based on "the best *available* evidence—as opposed to waiting for the best *possible* evidence."⁹³

Some advocates argue that resources should be targeted at preventing children and adolescents from becoming overweight. Proponents of this position point to the evidence that behavior changes in childhood will yield longer-lasting results by avoiding costly chronic diseases that have their origins in childhood and adolescence, and that schools therefore should be the prime target for obesity-related interventions.^{94, 95}

Others argue that more resources should be aimed at adults because, as a group, they represent the sharpest rate of increase in the incidence of obesity and the highest economic burden (both direct and indirect costs). Finally, others argue that obesity prevention aimed at young adults will have the greatest benefit because this is a time when many lifestyle changes occur, such as settling down to buy a house, getting married, starting a family or working in a more sedentary job, and that these life decisions will likely influence the dietary choices and physical activity levels that ultimately affect the entire family.⁹⁶

Adult-focused Interventions

The majority of interventions aimed at reducing overweight and obesity in the adult population have focused on dietary intake and physical activity, although interventions that incorporate both physical activity and nutritional counseling have proven more effective in preventing weight gain and obesity than changing diet or activity level alone.⁹⁷ Numerous randomized case-control trials involving obese adults have found that

* Defined as seven or more absences due to illness per six months.

** Defined as three to six absences due to illness per six months.

individual and group interventions that are sustained over time are more likely to be effective than time-limited, single-intervention strategies.⁹⁸

The Women's Health Initiative Dietary Modification trial involved 50,000 postmenopausal women who were assigned to either an intervention or control group. The intervention group was provided group and individual dietary counseling sessions to decrease fat intake and increase vegetable, fruit and grain consumption. This intervention resulted in significantly lower BMI scores after one year and at 7.5 years post-intervention when compared with the control group that received diet-related education materials only.⁹⁹

Few studies have attempted to modify the environment to promote healthy eating choices. An exception is research conducted in Great Britain, which found that community-level food access interventions, such as increasing the availability of fresh produce at affordable prices in low-income neighborhoods, were as or more important than simply providing health and nutrition education.¹⁰⁰

In 2001, the Surgeon General released recommendations calling for policy changes that would encourage employers to provide facilities and opportunities for physical activity in the workplace and promote reimbursement for the prevention and treatment of obesity.¹⁰¹ A recent study of 1,139 workers who participated in the Research Triangle Institute telephone survey evaluated views about workforce policies aimed at treating and preventing adult obesity.¹⁰² Eighty-five percent of respondents indicated they would favor a policy that offered employers tax breaks if they provided exercise facilities in the workplace. Another 73 percent favored requiring health insurers to cover obesity treatment and prevention; 72 percent indicated they would favor beneficiary discounts by employers or health insurers as incentives for workers to maintain or make progress toward a healthier weight.

Child-focused Interventions

The 2007 IOM Study Committee and CDC's Guide to Community Preventive Services Task Force reviewed evidence for the efficacy of school-based interventions. Since most children spend approximately 180 days in school per year, six or more hours per day, school-based interventions provide a unique opportunity to reach the majority of children.

In 2007, more than 30.5 million children participated in a school lunch program, resulting in 187 billion lunches served over the course of one year.¹⁰³ Modifying or replacing the types of food available at school has gained traction in recent years, yet there is limited evidence that changes in school food selection has led to changes in students' weight and/or fatness.¹⁰⁴

State policymakers have introduced bills to establish nutritional standards in the schools or to limit the availability of the empty-calorie food selections sold on school campuses. These efforts have come up against formidable obstacles, with only 13 percent of 200 bills introduced passing between 2003 and 2005.¹⁰⁵ Some resistance to these bills has come from schools that fear losing an important source of revenue from the food and beverage companies. Further, critics argue that the state government should not interfere with decisions under the purview of local school districts and parents.

In addition to nutrition, the school environment offers a unique venue to promote physical activity through physical education (PE) classes, recess, competitive and noncompetitive organized sports, and other programs such as dance clubs. The 2007 IOM Study Committee recommended that schools provide students with 30 minutes of PE per day, just half of the 60 minutes per day recommended in current public health guidelines.¹⁰⁶ Researchers observing the activity of children in third grade classes across 10 different schools found that



these children averaged two PE classes per week, each lasting about 33 minutes; only 6 percent of children attended PE every day. During these classes, only five minutes on average were spent in vigorous activity while 12 minutes were spent in moderate-to-vigorous activity.¹⁰⁷

Similar findings from other research indicate the amount of physical activity in PE classes is often below the levels recommended by national health objectives.¹⁰⁸ Similar to the resistance met when trying to change school nutritional guidelines or banning certain types of junk food from schools, of the more than 160 bills in state houses across the country focused on PE requirements introduced between 2003 and 2005, only 16 percent passed. Imposing state PE mandates on local school districts when they are already strapped with testing requirements and a lack of resources to meet competing demands were some of the reasons people opposed the bills.¹⁰⁹

One state level policy intervention, Senate Bill 530, was passed by the Texas State House of Representatives and signed into law in June 2007. Some of the goals of this bill are to measure fitness levels and obesity prevalence among all Texas children in grades three through 12; assess fitness levels relative to academic achievement, absenteeism, obesity, discipline problems and school lunch programs; and implement a mandatory PE program in grades K through 8. The Cooper Institute in Dallas was chosen to complete the testing protocol using the FITNESSGRAM®, a program that assesses aerobic capacity, body composition, muscular strength, endurance and flexibility, and outcomes.¹¹⁰

The El Paso School District implemented the testing and physical education requirement and has had remarkable results—70 percent of girls and 56 percent of boys in the third grade passed all six tests of the FITNESSGRAM compared with a state average of 32 percent for girls and 28 percent for boys.¹¹¹ Fundraising is currently underway to hire trained professionals to implement the new legislative requirements, and health care leaders and policymakers are hopeful they can achieve fitness improvements statewide, similar to those achieved in the El Paso School District.

In another school-based intervention, researchers found a 50 percent reduction in the incidence of overweight children among schools that implemented school self-assessment, nutrition education, uniform nutrition policies, social marketing and parent outreach. The prevalence of overweight children was reduced by 10 percent in the study schools, while control schools saw the prevalence increase by 26 percent.¹¹²

In addition to interventions that focus on school nutrition and physical activity, programs targeted at reducing sedentary time for children outside of school also have shown promising results. One study, in which 21 fourth and fifth graders with a BMI at or above the 85th percentile were enrolled in an after-school soccer team, the program was found to be feasible, acceptable and efficacious for weight reduction. Compared with overweight and obese children who were enrolled only in a health education program, the children on the soccer team had significant decreases in BMI after three and six months and significant increases in daily moderate and vigorous physical exercise at three months. In addition to weight loss, the children on the soccer team reported having fun and making new friends, as well as increased self-esteem and self-confidence. Interventions such as this one offer a different model than the current sports environment that is based

primarily on competition and athleticism. The study found that overweight children not previously exposed to team sports enjoyed and participated in a program specifically designed for them.¹¹³

Family-focused Interventions

Targeting the entire family for obesity prevention is another strategy garnering increased attention.¹¹⁴

The National Institutes of Health recommended the development and evaluation of comprehensive “trans-site” interventions as effective ways to prevent obesity among school-aged children and teens.¹¹⁵ The trans-site approach involves schools, health care providers and other organizations that serve the same students. These groups and individuals collaborate in the sharing of information and resources so that children and their families have more opportunities to learn healthy food habits and engage in physical activity in a safe environment. The 2007 IOM Study Committee recommended that schools make physical activity facilities such as fields, pools and gymnasiums and community centers available during after-school hours for enrolled and non-enrolled students and their families. These kinds of collaborations and “open door” models can be especially important for children who live in unsafe neighborhoods and whose parents are resistant to letting their children engage in physical activity outside school hours or in unsupervised settings.¹¹⁶

Environment-focused Interventions

Addressing environmental risk factors in the obesity epidemic can take many forms—from improving the “built environment” to increasing access to affordable fresh food. The Robert Wood Johnson Foundation invested in Active Living Research and Healthy Eating Research Programs and designated up to \$800,000 in 2008 to support research that will identify promising policy and environmental strategies to increase physical activity, promote healthy eating and prevent obesity across the nation.¹¹⁷

One example of an environmental intervention is the recently completed “Big Dam Bridge” that spans the Arkansas River between Little Rock and North Little Rock, Arkansas. Said to be the longest bridge built specifically for pedestrians and bicyclists in the United States, it is intended to encourage physical activity to help prevent children from becoming overweight and obese and to promote healthy lifestyles.¹¹⁸

A grassroots example of an intervention designed to increase affordable and healthy produce in a low-income neighborhood is the Quality Community Council (QCC) Urban Farm located in Charlottesville, Va. QCC is a citizen-controlled community coalition dedicated to improving the quality of life in Charlottesville’s most challenged neighborhoods. In 2007, the coalition received funding to establish urban vegetable farms totaling one-third of an acre. Tended by a professional farmer with the help of more than 100 volunteers, the garden has helped more than 40 low-income families improve their diets with fresh vegetables harvested in their own backyards, while learning about food security, nutrition and wellness, and how to be better environmental stewards.¹¹⁹



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