# Chapter 2
# Obesity and Cancer: Epidemiology in Racial/Ethnic Minorities

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**Abstract** Overweight and obesity continue to be major public health concerns in the United States and increasingly, throughout the world [1]. Obesity is the nation's fastest rising public health problem and has become the second leading cause of preventable death in the United States, second only to tobacco use [1]. Obesity rates among US adults increased by more than 75% between 1991 and 2006, and rates doubled in children and tripled in teens over the past 20 years. While obesity rates have increased dramatically among most of the population, particular racial, ethnic, and socioeconomically disadvantaged groups have experienced disproportionate increases in the prevalence of overweight and obesity over this time [2]. This chapter will explore the differences in these trends, discuss implications for cancer prevention and control, examine contributing factors and review potential strategies for positively influencing overweight and obesity trends among all population groups.

## 1 The Burden of Overweight and Obesity in Racial/Ethnic Minority Populations

Obesity rates in the United States have increased dramatically since the early 1980s, although recent data indicate no significant change in obesity prevalence between 2003–2004 and 2005–2006 for men or women [3]. Despite this positive finding, data from national surveys consistently indicate that there are large disparities in the prevalence of overweight and obesity among women, children, and adolescents in the United States. Non-Hispanic black women and children, Mexican-American women and children, Native Americans, and Pacific Islanders are all disproportionally affected.

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## *1.1 Adults*

In adults, NHANES data consistently demonstrate trends of higher overweight and obesity prevalence for non-Hispanic blacks and Mexican Americans compared with non-Hispanic whites. The most current data from 2005 to 2006 show that non-Hispanic blacks had the highest prevalence of overweight, followed closely by Mexican Americans.

Large disparities exist in obesity prevalence by race/ethnicity among women; among men, however, the prevalence of obesity did not differ significantly by race/ethnic group (See Fig. 2.1). Non-Hispanic black and Mexican-American women were more likely to be obese than white women. Approximately 53% of non-Hispanic black women and 51% of Mexican-American women 40–59 years of age were obese, compared with about 39% of non-Hispanic white women of the same age. Among women 60 years and older, 61% of non-Hispanic black women were obese compared with 32% of non-Hispanic white women and 37% of Mexican-American women [2].

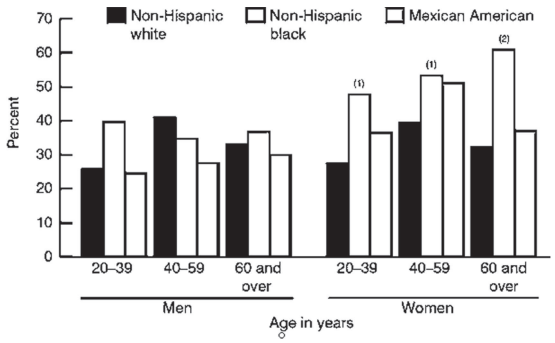


**Fig. 2.1** Prevalence of obesity, by age, race/ethnicity, and sex, adults aged 20 years and older: United States, 2005–2006. (*Source*: CDC/NCHS, National Health and Nutrition Examination Survey) (1) Significantly different from the non-Hispanic white population (2) Significantly different from the non-Hispanic white and Mexican-American population. *Note*: Obesity is defined as body mass index>30

While NHANES provides data on non-Hispanic blacks and Mexican Americans, the survey does not include sufficient numbers of people from other minority backgrounds. Other data sources, do, however, indicate obesity prevalence is also higher across adult age ranges for American Indians and Alaska Natives, other Hispanic populations, Native Hawaiians, and Pacific Islanders when compared with non-Hispanic whites [4–5]. Studies also have found that the longer racial/ethnic minority immigrants are in the United States; the prevalence of obesity increases and approaches rates seen among US-born citizens [6–8].

Analysis of data over the past three decades reveals that the prevalence of overweight has increased at an average annual rate of approximately 0.3–0.9 percentage

points across different racial/ethnic population groups. Assuming a similar increase in trends, it is estimated that by 2015, 75% of US adults are likely to be overweight or obese. Given the existing disparities in prevalence, some population groups will be more seriously affected: it is projected that among men, 78% of Caucasians, 66% of African Americans, and 82% of Hispanics will be overweight and among women, 69% of Caucasians, 87% of African Americans and 80% of Hispanics will be overweight [9].

## *1.2 Children and Adolescents*

The prevalence of obesity has tripled since 1980 among children 6–11 years of age and adolescents 12–17 years of age, and as in adults, racial/ethnic disparities in obesity prevalence are also seen in children and adolescents [10–12]. A recent study showed that these disparities may begin as early as by 4 years of age. (See Fig 2.2). Because it is estimated that about half of youngsters who are overweight as children will remain overweight in adulthood and that 70% of those who are overweight by adolescence will remain overweight as adults [13], it is critical that targeted efforts be made to establish positive, lifelong eating and exercise habits during childhood.

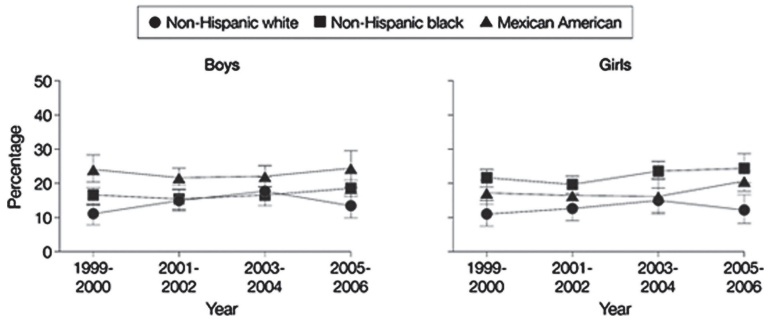


**Fig. 2.2** Body mass index for age at or above the 95th percentile by race/ethnicity in 1999–2006. [92]

Although the overall prevalence of childhood obesity continued to increase during the first half of this decade (17% in 2006 vs. 14% in 2000), the differences by race/ethnicity appear to be diminishing, in part due to increases in obesity in non-Hispanic white children. Over time, non-Hispanic black children have experienced the steepest increase in overweight, as compared to Mexican American and non-Hispanic white children [14]. While there was no significant change in prevalence rates between 2003–2004 and 2005–2006, further data tracking will be needed to determine if rates have indeed reached a plateau.

The most recent NHANES data showed that for boys ages 6–11 years of age, the prevalence rate of obesity (defined as $\geq$95% of the 2000 BMI-for-age growth charts)

was highest for Mexican American boys (27%), followed by non-Hispanic black boys (18.6%) and non-Hispanic white boys (15.5%). Among girls, non-Hispanic black girls had the highest prevalence (24%), followed by Mexican American girls (19.7%) and non-Hispanic white girls (14.4%) [10].

For adolescent boys, the rate of obesity was higher among Mexican American boys (22.1%) than among non-Hispanic white boys (17.3%) and non-Hispanic black boys (18.5%) [10]. Data from NHANES III (1988–1994) through NHANES 2003–2006 showed that the largest increases in the prevalence of obesity occurred among non-Hispanic black boys (7.8%) and Mexican American boys (8.0%) compared to non-Hispanic white boys (5.7%). Among non-Hispanic white boys, the prevalence of obesity increased from 11.6 to 17.3%. Among non-Hispanic black boys, the prevalence of obesity increased from 10.7 to 18.5%. Among Mexican American boys, the prevalence of obesity increased from 14.1 to 22.1%.

Non-Hispanic black adolescent girls had the highest prevalence of obesity (27.7%) compared to that of non-Hispanic white (14.5%) and Mexican American (19.9%) girls [10]. Data from NHANES III (1988–1994) through NHANES 2003–2006 showed that non-Hispanic black girls experienced the largest increase in the prevalence of obesity (14.5%) compared to non-Hispanic white girls (7.1%) and Mexican American (10.7%) girls. Among non-Hispanic white girls, the prevalence of obesity increased from 7.4 to 14.5%. Among non-Hispanic black girls, the prevalence of obesity increased from 13.2 to 27.7%. Among Mexican American girls, the prevalence of obesity increased from 9.2 to 19.9%. See Fig. 2.3 These rates may

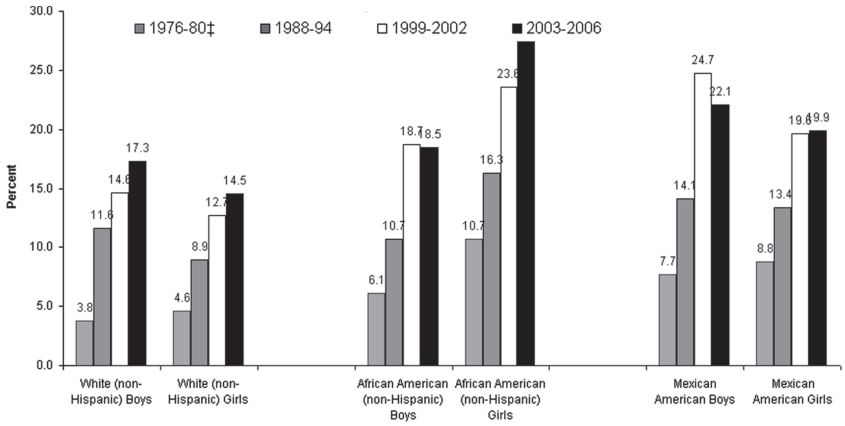


**Fig. 2.3** Obesity*, adolescents 12–19 years, by gender and race/ethnicity†, US, 1976–2006 *BMI at or above the sex- and age-specific 95th percentile BMI cutoff points from the 2000 sex-specific BMI-for-age CDC Growth Charts. †Persons of Mexican origins may be of any race. Data estimates for white (non-Hispanic) and African American (non-Hispanic) races for 1999–2002 may not be strictly comparable with estimates for earlier years because of changes in Standards for Federal data on Race and Ethnicity. The differences in overweight estimates for current and earlier standards for these race categories do not exceed 0.5 percentage points. ‡Data for Mexican Americans are for 1982–1984

be related in part to differences in stages of pubertal maturation. Girls who mature early tend to have higher a BMI during the teenage years than girls who mature later [15], and this relationship appears to be strongest in non-Hispanic black girls [16]. On average, these girls undergo pubertal maturation earlier than non-Hispanic white girls, which may account for some of the racial differences seen in adolescent obesity.

Based on current trends, it is projected that by 2015, for children ages 6–11 years, the prevalence of overweight will be 23%. Among boys, 22% of non-Hispanic whites, 24% of non-Hispanic blacks and 33% of Mexican Americans will be overweight. Among girls, 19% of non-Hispanic whites, 31% of non-Hispanic blacks, 22% of Mexican Americans will be overweight. For adolescents aged 12–19 years, the prevalence of overweight will be 24%. Among males, 23% of non-Hispanic whites, 25% of non-Hispanic African Americans, and 28% of Mexican Americans will be overweight. Among females, 19% of non-Hispanic whites, 32% of non-Hispanic blacks, and 22% of Mexican Americans will be overweight [9].

## *1.3 Socioeconomic Disparities*

Population-based surveys also indicate a higher prevalence of obesity in populations with lower socioeconomic status (SES) [17–18]. Because of the association between race/ethnicity and socioeconomic status, some have hypothesized that differences in obesity among different racial/ethnic minorities might be easily explained by individual SES. Recent studies, however, have indicated that the racial/ethnic differences in obesity cannot be explained by SES alone; that two commonly used markers for SES – education and income – do not reflect SES level equally across racial/ethnic groups; and that the relationship between race/ethnicity, SES, gender, and obesity is quite complex [9]. For example, Wang and colleagues report that overall, those with less than a high school education tend to have higher rates of obesity than those with more education, although non-Hispanic black women are an exception and had the lowest prevalence of obesity when compared to those with more education. SES differences in children and adolescents appear to be equally complex and inconsistent across ethnicity, age, and gender [19–21]. Recent NHANES data, for example, shows an inverse association of obesity prevalence with SES in non-Hispanic white girls, while higher SES was associated with higher obesity rates in non-Hispanic black girls.

A number of recent studies have also attempted to determine the extent to which neighborhood location may be related to obesity rates. In a study conducted by Drewnowski and colleagues, the authors concluded that neighborhood property values in the Seattle area predict local obesity rates better than education or income level [22]. For each additional $100,000 in the median price of homes, obesity rates in a given ZIP code dropped by 2%, and obesity rates reached 30% in the most deprived areas but were only around 5% in the most affluent ZIP codes.

### *1.4 Geographic and Urban–Rural Differences*

Geographic variation in obesity has been reported by state and by degree of urbanization. Obesity rates remain highest in Southern states, according to the 2007 Behavioral Risk Factor Surveillance System (BRFSS) survey, nine of the top ten most obese states were in the South. In addition, all ten states with the highest rates of diabetes and hypertension, nine of the ten states with the highest rates of physical inactivity, and eight of the ten states with the highest rates of poverty are in the South. Northeastern and Western states have the lowest obesity rates [23]. The highest prevalence of obesity was seen in Mississippi, West Virginia, and Alabama, while the lowest prevalence was seen in Colorado and Hawaii [24]. Results of the National Health Interview Survey show that rural populations, when compared to urban and suburban populations, have a higher prevalence of obesity [25–27]. Differences in obesity rates among these population groups may also reflect socioeconomic differences, with rural areas tending to experience higher levels of poverty [25].

## 2 Implications for Cancer Incidence and Mortality

Because of the impact that excess weight has on cancer risk, current and projected trends in overweight and obesity among all population groups threaten to jeopardize progress made in cancer incidence and mortality since the early 1990s. In the United States, overweight and obesity contribute to 14–20% of all cancer-related mortality [28]. Overweight and obesity are clearly associated with increased risk for developing many cancers, including cancers of the breast in postmenopausal women, colon, endometrium, adenocarcinoma of the esophagus, and kidney. Evidence is highly suggestive that obesity also increases risk for cancers of the liver, prostate, stomach, pancreas, gallbladder, thyroid, ovary, and cervix, and for multiple myeloma, Hodgkin's lymphoma, and aggressive prostate cancer.

Increasing evidence also suggests that overweight and obesity increases the risk of breast cancer recurrence and decreases survival, and evidence is accumulating regarding other sites, as well [29–32]. Related diet and physical activity behaviors may also play a role in recurrence. Consumption of the typical "Western" diet among colorectal cancer survivors has been associated with a 3.5 times increased risk of recurrence [33]. The Women's Intervention Nutrition Study (WINS) demonstrated reduced risk of breast cancer recurrence among intervention subjects following a low-fat diet as compared to controls (9.8% vs 12.4%) [34]. In the Nurses Health Study, higher levels of post-treatment physical activity were associated with a 26–40% reduction in the risk of breast cancer recurrence, breast cancer-specific mortality, and all-cause mortality [35].

Thus overweight and obesity are such strong risk factors for so many different types of cancers, and given disparate rates of overweight and obesity among

racial/ethnic minority populations, it is likely that excess weight plays a role, at least in part, in the disparities in cancer incidence seen among these population groups.

## 2.1 Racial and Ethnic Differences in Cancer Incidence in the United States

Compared with non-Hispanic whites, African Americans experience higher incidence rates for cancers of the colorectum, lung, prostate, liver, kidney, and cervix, and Hispanics, Asians, and Pacific Islanders experience higher incidence of cancers of the liver, stomach, and cervix [36]. The causes of these inequalities are complex and are predominantly thought to reflect social and economic disparities as opposed to biologic differences associated with race/ethnicity. These include inequalities in work, wealth, income, education, housing and overall standard of living, barriers to high-quality health care, and racial discrimination. Environmental issues that affect access to and availability of healthy, affordable foods and opportunities for safe, enjoyable physical activity, thus contributing to disparities in overweight and obesity, are part of the complexity of factors influencing disparities in cancer incidence.

Studies that look specifically at obesity and risk of cancer in minority populations are limited. There is some evidence that, among African American women, the risk of breast cancer associated with obesity may be absent or less than that of other population groups [37–39]. However, a recent report showed that African American women who have a high BMI are more likely to have an advanced stage of breast cancer at diagnosis [40]. Another report showed that obese Hispanic women were twice as likely to develop breast cancer as non-obese Hispanics, but the researchers did not detect a difference in risk for obese Hispanic women before and after menopause [41].

Some have hypothesized that women with higher BMI's may be less likely to undergo recommended cancer screening tests, such as Pap tests and mammography, because of embarrassment and/or discomfort associated with these tests. While a number of studies have shown that obese white women were significantly less likely to undergo cervical or breast cancer screening, in part because of feelings of embarrassment and/or discomfort associated with these screenings, BMI was not associated with mammography utilization in African American women, nor Pap testing among African American or Hispanic women, although overweight and obese Hispanic women were more likely than normal weight Hispanic women to cite cost concerns as a reason for not undergoing screening [42].

## 2.2 The Bottom Line

Current trends in obesity have already negatively impacted cancer rates in the United States. Increasing trends in adenocarcinoma of the esophagus and kidney cancer

have been attributed to, in part, the increasing rates of obesity [43–45]. And while the incidence of both colorectal cancer and postmenopausal breast cancer continues to decline, according to the American Cancer Society, it is likely that the declines in both would have started earlier and would have been steeper had it not been for the increasing prevalence of obesity. Efforts to curtail and ultimately reverse the obesity epidemic among all population groups are likely to have a considerable impact on reducing incidence rates of the many cancers that are impacted by excess weight.

## 3 Determinants of Obesity

The determinants of obesity in the United States are complex, numerous, and involve a combination of social, economic, and other environmental effects, as well as individual behavior effects. When considering *why* trends in overweight and obesity have increased so dramatically overtime, it is necessary to consider the individual factors that play a role, but the broader environment in which individual food and physical activity choices occur must be taken into account. Indeed, based on the rapidity with which overweight and obesity trends have increased among all population groups, it is likely that social, economic, and other environmental factors – rather than individual behavior factors – have been key drivers of the accelerating trends over the past three decades.

### *3.1 Behavioral Determinants of Obesity*

A variety of individual factors have been associated with overweight and obesity. These include, but are not limited to, fruit and vegetable consumption, fast-food intake, soft drink consumption, television time, breastfeeding, and physical activity levels. Racial/ethnic differences in some of these factors may contribute in part to disparities seen in obesity rates among different population groups.

### *3.2 Fruit and Vegetable Consumption*

Emerging evidence suggests that increasing fruit and vegetable consumption may be associated with lower rates of obesity. While more research is needed to determine the exact relationship between produce consumption and weight, there are many benefits to consuming a diet high in fruits and vegetables. Unfortunately, consumption levels among both adults and youth, including by race/ethnicity, have been essentially flat for years.

Among adults, 2007 BRFSS data indicate that while overall consumption of fruit and vegetable is low, there is little difference in fruit and vegetable consumption by race/ethnicity: 24.1% non-Hispanic whites, 23.1% of non-Hispanic blacks,

and 24.7% of Mexican Americans report eating five or more servings of fruit and vegetable a day [24].

Similar to adults, overall consumption of fruits and vegetables remains low among youth. Overall, only 21.4% of youth consume fruits and vegetables five or more times a day. Only 18.8% of non-Hispanic white youth, 24.9% of non-Hispanic black youth, and 24% of Mexican American youth report eating the recommended number of fruit and vegetable servings [46].

## *3.3 Fast-Food Intake*

Fast-food consumption is associated with consumption of more calories, more saturated fat, fewer fruits and vegetables, and less milk [47–49]. Racial/ethnic differences in total calorie and fat consumption have been linked in part to high levels of fast-food consumption [48, 50]. Data indicates that fast food currently makes up nearly three-quarters of total restaurant visits [51] and that approximately one-fifth of restaurant meals were purchased from a car (e.g., drive-through or curbside) in 2005, up from 14% in 1998 [52].

Despite the addition of healthier items such as salads to restaurant menus, the top five most popular foods ordered in restaurants in 2005, for consumption on-site or take out, were for men – hamburgers, french fries, pizza, breakfast sandwiches, and side salads; for women – french fries, hamburgers, pizza, side salads, and chicken sandwiches; for students ages 18–24 – french fries, hamburgers, pizza, Mexican foods, and chicken sandwiches; and for children under age 6 – french fries, chicken nuggets, pizza, hamburgers, and ice cream [52].

## *3.4 Physical Activity*

Similar to fruit and vegetable consumption, the majority of adults do not get the minimum recommended amount of moderate physical activity. Overall, only 48.9% report meeting recommendations, and only 50.9% of non-Hispanic white adults, 41.3% of non-Hispanic black adults, and 45.1% of Mexican Americans report meeting the recommended 30 min of moderate activity five or more days per week [24].

Data on youth are even more dismal: overall, only 34.7% of youth meet the recommended 60 min minimum on five or more days per week. Thirty seven percent of non-Hispanic white youth, 31.1% of non-Hispanic black youth, and 30.2% of Mexican American youth report meeting the minimum recommendation [46].

Additional issues related to body image and perception of weight status may play a role in individual behaviors regarding diet and physical activity factors. For example, studies have shown that compared to women of other race/ethnicity, African American women are more likely to accept a larger ideal body image [53–55], and also appear to be less likely than non-Hispanic white or Mexican American women

to report they are trying to lose weight [56]. In addition, overweight and obese non-Hispanic blacks, compared to their non-Hispanic whites, were disproportionately more likely to categorize themselves as being "about the right" weight [57]. While these differences exist, the extent to which these factors may influence eating and physical activity behaviors is not currently known.

### *3.5 Television Time*

Increasing time spent watching television has been associated with excess weight among youth, in part because of its sedentary nature, but also due to increased snacking that occurs while watching television and the amount of exposure to food- and beverage-related advertisements that are viewed. Among youth, it has been reported that non-Hispanic black youth and Mexican American youth spend significantly more time watching TV than do non-Hispanic white youth. In 2007, 27.2% of non-Hispanic white youth, 62.7% of non-Hispanic black youth, and 43% of Hispanic youth report watching three or more hours of television per day [46]. Media use differs, as well, by socioeconomic status: low-income youth spend more time watching TV than higher income children. In addition, the lower the education of the parent, the more likely it is that a child will have a television in the bedroom and that the family will watch television during meals, both of which are associated with higher caloric intake [58].

### *3.6 Breastfeeding*

Breastfeeding is associated with a reduced risk of obesity in children and is recommended by CDC as a "promising approach" to prevent obesity. Breast feeding rates have been increasing for all population groups, although non-Hispanic black women are less likely to breast feed immediately post-birth and to still be breastfeeding at six months, compared to Mexican American and non-Hispanic white women [59].

### *3.7 Environmental Influences on Obesity*

American society has become what has been termed "obesogenic," characterized by environments that promote increased food intake; less healthy, energy-dense foods; and physical inactivity. While many Americans would like to adopt a healthy lifestyle, substantial barriers exist that make it difficult for many to follow nutrition and physical activity recommendations. Indeed, current trends toward increasing portion sizes, both at home and while eating out [13, 60–62]; increased consumption of high-calorie convenience foods, sugar-sweetened beverages and meals outside the home; and declining levels of physical activity are all factors that have contributed to the obesity epidemic [29, 63–64]. In addition, more time spent working outside

of the home and more households with multiple wage earners reduce the amount of time available for meal preparation, resulting in increased consumption of meals outside the home, which tend to be higher in calories and less nutritious than foods prepared at home [65]. Portion sizes, especially of high-energy dense foods, have increased over time, and the availability of these is extensively marketed by restaurants, supermarkets, and food and beverage companies [13, 60, 62]. Reductions in leisure time, increased dependence on automobiles for transportation, and increased availability of electronic media all contribute to reduced physical activity [63, 64]. Increasing evidence also indicates that the built environment has the potential to impact obesity and physical activity levels [66, 67]: limited access to sidewalks, parks, and recreation facilities is associated with greater risk of obesity [68], while neighborhoods that are designed to facilitate walking and safe physical recreation tend to have lower obesity rates [66].

While these environmental issues impact the entire population, recent studies have demonstrated that racial/ethnic minority and low income groups may be especially impacted by these issues. Less availability of and access to affordable healthy foods; the marketing and availability of energy –dense foods and beverages; safety concerns that may limit opportunities for physical activity; and other factors may help explain, in part, why obesity does not affect all population groups equally.

## *3.8 The Food Environment*

Numerous studies have reported on differences in the accessibility of supermarkets in neighborhoods made up of predominantly racial/ethnic minority and/or low-SES residents. Access to supermarkets increases access to healthy foods and has been associated with more healthful diets, greater consumption of fruits and vegetables, and lower rates of obesity [69, 70]. In one study, communities with a greater proportion of ethnic minority residents were found to have approximately 30% fewer supermarkets that carry high-quality fresh fruits and vegetables and affordable healthy foods such as whole grains, low-fat dairy products, and meats. In another, African American and Hispanic neighborhoods had fewer chain supermarkets compared with white and non-Hispanic neighborhoods by about 50 and 70%, respectively [71]. Yet another study found that the poorest neighborhoods in Detroit with a high percentage of African American residents were further away from the closest supermarket than neighborhoods that were not as poor and with a lower percentage of African American residents [72]. Limited access to supermarkets frequently results in residents shopping for food at local convenience stores, where healthy food options tend to be of lesser quality and more expensive [73]. For example, one study reported that although low-fat milk was available in the majority of the smaller grocery stores in areas whose residents were predominantly Hispanics and those of low-SES status, some stores charged more for low-fat milk than for regular milk [74]. Evidence also suggests that higher prices for healthier foods have an effect on children's weight: a recent study of elementary school children concluded

that lower gains in BMI between kindergarten and third grade were seen among children living in areas with lower prices of fruits and vegetables. These effects were larger for low-SES children, as well as Asian and Hispanic children [75].

Coupled with limited access to supermarkets is potentially increased access to fast-food restaurants in neighborhoods with predominantly black and low-SES residents. Block and colleagues [50] found that neighborhoods where 80% of the residents were African American had 2.4 fast-food restaurants per square mile compared to neighborhoods where 80% of the residents were non-Hispanic white that had only 1.5 fast-food restaurants per square mile. The implication of this is that there were six more fast-food restaurants in an average-sized shopping area for the predominantly African American versus predominantly white neighborhoods. Another study conducted in California examining the availability of types of restaurants found that compared with restaurants in more affluent areas with fewer African Americans, restaurants in less affluent neighborhoods with more African American residents were more likely to be fast food and/or fast casual, and less likely to offer healthier options [76]. The availability of fast-food restaurants is an important consideration within discussions regarding the obesity epidemic, as higher consumption of fast food is associated with higher caloric intake, higher saturated fat intake, lower consumption of fruits and vegetables, and possibly obesity.

Another important food-related factor impacting socioeconomically disadvantaged communities is the relative costs of low-calorie versus high-calorie foods. Calorie for calorie, refined grains, added sugars, and fats are relatively inexpensive, while more nutrient-dense foods such as fruits, vegetables, and whole grains tend to cost more [77], and the price disparity between the low-nutrient, high-calorie foods, and healthier food options continues to grow. While fats and sweets cost only 30% more than 20 years ago, the cost of fresh produce has increased more than 100%. More recent studies in Seattle supermarkets showed that foods with the lowest energy density (mostly fresh vegetables and fruit) increased in price by almost 20% over 2 years, whereas the price of energy-dense foods high in sugar and fat remained constant [78]. Therefore, even in neighborhoods where supermarkets are available, low-income residents may purchase a relatively higher calorie diet of less expensive, higher calorie foods, and indeed, studies have suggested that lower cost foods make up a greater proportion of the diet of lower income individuals [79]. In US Department of Agriculture (USDA) studies, female recipients of food assistance had more energy-dense diets, consumed fewer vegetables and fruit, and were more likely to be obese.

In addition to increased access to fast food and less expensive, energy dense foods, racial/ethnic minorities may be exposed to more advertisements for low-nutrient foods, due to both targeted marketing as well as higher rates of television viewing. Tirodkar and colleagues found that more food commercials are aired during black prime time than general prime time (4.78 per 30 min program vs. 2.89 per 30 min program on general prime time). The researchers also found that 30% of the food commercials featured candy and 13% featured soda, significantly more than on general prime time [80].

Because of their heavy media use, ethnic minority and low-income youth are exposed to a great deal of food advertising at home, and research has found that such advertising can affect children's food preferences even after a brief exposure [81]. Findings related to time spent watching television are important to consider within the context of addressing obesity trends: many more studies have confirmed that television-watching is associated with obesity, in part because of its sedentary nature but also because of the advertisements that are viewed and related snacking while watching [82].

## *3.9 The Physical Activity Environment*

In addition to disparities in the access to and availability of healthy foods among racial/ethnic minorities and low-SES populations, a few studies suggest that disparities also exist in the built environment, which is likely to contribute to differences in physical activity among population groups, particularly among low-income populations. Access to parks, gyms, and other opportunities for physical activity – such as the availability of sidewalks and the close proximity of residential areas to stores, jobs, schools, and recreation centers – have been shown to contribute to more physically active lifestyles [83–84]. However, Powell and colleagues studied 409 communities and found significantly fewer sports areas, parks, greenways, and bike paths in high-poverty areas when compared to areas with lower poverty rates [85]. Additionally, even when these facilities are available, cost factors, distance from exercise facilities, and transportation availability may still affect access among low-income populations [86–87]. Heavy traffic, lack of street lighting, unleashed dogs, high crime rates, and lack of sidewalks and traffic calming measures are other factors that may present barriers to physical activity, particularly in low-income areas.

A recent systematic review of the built environment and health behaviors among African Americans found that associations between the built environment and physical activity among African Americans were inconsistent [88]. In some but not all studies, light traffic and the presence of sidewalks were significantly associated with higher levels of physical activity among those living in both metropolitan and non-metropolitan areas. Similarly, safety from crime was associated with higher activity levels among urban participants in some but not all studies.

A variety of studies have been conducted to examine the built environments' impact on physical activity among youth [89]. In low-income urban communities, the built environment appears to have a larger impact on children's physical activity than that of adults. Many adults in these communities must rely on public transportation to get to and from work, for shopping, and for other activities, and must spend time being physically active to access such transportation. For safety reasons, however, parents may restrict their children's outdoor activities, particularly when no adult is home. Indeed, a recent study suggests that social factors – such as increased social contact and the availability of a network of parents who know each other and can watch out for each other's children – may have more of an impact on

children's activity levels than factors associated with the physical environment [90]. In low-income communities, it is also possible that family work schedules, discretionary time, money, and transportation challenges may make it difficult for parents and caregivers to transport children to sports and other recreational activities.

## 4 Improving Public Health and Reducing Disparities in Obesity – What Will It Take?

Addressing the extraordinary increase in obesity among all population groups – and especially among those of racial/ethnic minority groups and of low SES – will require a broad range of strategies that include policy and environmental changes that improve the access of and availability of healthy, affordable, high-quality foods and opportunities for safe, enjoyable physical activity, as well as strategies that empower individuals with the knowledge and skills they need to make healthy food and physical activity choices.

While many factors have been identified as contributing to the obesity trends that the United States has experienced over the last three decades, effectively addressing racial/ethnic and socioeconomic disparities in obesity will require in-depth knowledge of how these factors affect these populations disproportionately; how the interplay of social, economic, and cultural considerations specific to particular minority groups further impact these factors; and ultimately, as with any population group, identifying those combination of strategies that will be most effective in removing barriers to making healthy food and activity choices.

Much more research, however, is needed to help guide action to reduce obesity levels and address disparities among minority populations. From identifying the impact that different home environments have on obesity rates, to understanding the impact that food advertising and marketing have on particular racial/ethnic minority groups, to quantifying neighborhood characteristics which will be most successful in facilitating physically active lifestyles among both youth and adults, many questions remain to be answered.

In the meantime, however, lessons learned from other public health movements can provide guidance to public health and other professionals working to improve the nutritional and physical activity environments of racial/ethnic communities. Indeed, the tobacco epidemic exemplifies the importance of policy and environmental changes in positively influencing health behaviors. Adult per-capita cigarette consumption increased steeply from 1910 until 1964, when the first US Surgeon General Report publicized the health hazards of smoking. However, efforts that focused primarily on public education produced only a gradual decrease in cigarette consumption from 1964 through the early 1980s [91]. It was the subsequent introduction of community-wide policy and environmental change approaches that produced much larger reductions in cigarette smoking among children and adults, beginning in the mid-1980s. These included restrictions on cigarette advertising, increases in the price of tobacco products through taxation, laws preventing exposure to secondhand smoke in public places, and restrictions on the access of children

to tobacco products. Only recently have communities begun to strategically consider policy and environmental approaches that might promote improved nutrition and physical activity at the population level, and it is likely that among all population groups, it is these types of changes that will be instrumental in reducing obesity rates.

Government agencies, industries, non-profit organizations, schools, communities, the media, public health professionals and other professionals, and individuals all need to play an active role in the growing national, state, and local efforts to combat the obesity epidemic. Health care professionals and community leaders, in particular, have new opportunities to provide leadership in promoting policy and environmental changes in their communities that will help reduce obesity levels and the racial, ethnic, and socio-economic disparities in obesity seen today.

## References

1. American Institute for Cancer Research (2007). Food, Nutrition and the Prevention of Cancer: a Global Perspective, World Cancer Research Fund/American Institute for Cancer Research. Washington, DC
2. Centers for Disease Control and Prevention (2007). National Health and Nutrition Examination Survey Public Use Data Files, 2005–2006 2007. Atlanta, GA: National Center for Health Statistics
3. Ogden CL, Carroll MD, McDowell MA, Flegal KM (2007). Obesity Among Adults in the United States – NO Statistically Significant Change Since 2003–2004. NCHS data brief no 1. Hyattsville, MD: National Center for Health Statistics
4. Mullis RM, Blair SN, Aronne LJ et al. (2004). Prevention Conference VII: Obesity, a worldwide epidemic related to heart disease and stroke: Group IV: prevention/treatment. *Circulation*. 110(18):e484–88
5. Adams PF, Schoenborn CA (2006). Health behaviors of adults: United States, 2002–2004. *Vital Health Stat*, (230):1–140
6. Goel MS, McCarthy EP, Phillips RS, Wee CC (2004). Obesity among US immigrant subgroups by duration of residence. *Jama*, 292(23):2860–867
7. Kaplan MS, Huguet N, Newsom JT, McFarland BH (2004). The association between length of residence and obesity among Hispanic immigrants. *Am J Prev Med*, 27(4):323–26
8. Himmelgreen DA, Perez-Escamilla R, Martinez D et al. (2004). The longer you stay, the bigger you get: length of time and language use in the U.S. are associated with obesity in Puerto Rican women. *Am J Phys Anthropol*, 125(1):90–96
9. Wang Y, Beydoun MA (2007). The obesity epidemic in the United States–gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiol Rev*, 29:6–28
10. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM (2006). Prevalence of overweight and obesity in the United States, 1999–2004. *Jama*, 295(13):1549–1555
11. Baskin ML, Ard J, Franklin F, Allison DB (2005). Prevalence of obesity in the United States. *Obes Rev*, 6(1):5–7
12. Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM (2004). Prevalence of overweight and obesity among US children, adolescents, and adults, 1999–2002. *Jama*, 291(23):2847–850
13. US Department of Health and Human Services: The Surgeon General's call to action to prevent and decrease overweight and obesity. Washington, DC US Department of Health and Human Services, Public Health Service, Office of the Surgeon General

14. Freedman DS, Khan LK, Serdula MK, Ogden CL, Dietz WH (2006). Racial and ethnic differences in secular trends for childhood BMI, weight, and height. *Obesity (Silver Spring)*, 14(2):301–08
15. Biro FM, McMahon RP, Striegel-Moore R et al. (2001). Impact of timing of pubertal maturation on growth in black and white female adolescents: The National Heart, Lung, and Blood Institute Growth and Health Study. *J Pediatr*, 138(5):636–43
16. Adair LS, Gordon-Larsen P (2001). Maturational timing and overweight prevalence in US adolescent girls. *Am J Public Health*, 91(4):642–44
17. Zhang Q, Wang Y (2004). Trends in the association between obesity and socioeconomic status in U.S. adults: 1971–2000. *Obes Res*, 12(10):1622–632
18. Robert SA, Reither EN (2004). A multilevel analysis of race, community disadvantage, and body mass index among adults in the US. *Soc Sci Med*, 59(12):2421–434
19. Gordon-Larsen P, Adair LS, Popkin BM. The relationship of ethnicity, socioeconomic factors, and overweight in US adolescents. *Obes Res*, 11(1):121–29
20. Miech RA, Kumanyika SK, Stettler N, Link BG, Phelan JC, Chang VW (2006). Trends in the association of poverty with overweight among US adolescents, 1971–2004. *Jama*, 295(20):2385–393
21. Wang Y, Zhang Q (2006). Are American children and adolescents of low socioeconomic status at increased risk of obesity? Changes in the association between overweight and family income between 1971 and 2002. *Am J Clin Nutr*, 84(4):707–16
22. Drewnowski A, Rehm CD, Solet D (2007). Disparities in obesity rates: analysis by ZIP code area. *Soc Sci Med*, 65(12):2458–463
23. Levi J, Vinter S, St. Laurent R, Segal L (2008). F as in Fat: How Obesity Policies are Failing in America 2008, Trust for America's Health, Robert Wood Johnson Foundation, Washington, DC
24. Centers for Disease Control and Prevention (CDC) (2008). Behavioral Risk Factor Surveillance System Survey Data 2007. Department of Health and Human Services, Centers for Disease Control and Prevention Atlanta, Georgia: U.S. ; 2008. http://apps.nccd.cdc.gov/brfss/index.asp. Accessed August 2008
25. Ramsey PW, Glenn LL (2002). Obesity and health status in rural, urban, and suburban southern women. *South Med J*, 95(7):666–71
26. Patterson PD, Moore CG, Probst JC, Shinogle JA (2004). Obesity and physical inactivity in rural America. *J Rural Health*, 20(2):151–59
27. Jackson JE, Doescher MP, Jerant AF, Hart LG (2005). A national study of obesity prevalence and trends by type of rural county. *J Rural Health*, 21(2):140–48.
28. Calle EE, Rodriguez C, Walker-Thurmond K, Thun MJ (2003). Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *N Engl J Med*, 348(17):1625–638
29. Vainio H, Bianchini F (2002). Weight Control and Physical Activity. Vol 6. Lyon, France: International Agency for Research on Cancer
30. Caan BJ, Kwan ML, Hartzell G et al. (2008). Pre-diagnosis body mass index, post-diagnosis weight change, and prognosis among women with early stage breast cancer. *Cancer Causes Control*, 19(10):1319–328
31. Dignam JJ, Polite BN, Yothers G et al. (2006). Body mass index and outcomes in patients who receive adjuvant chemotherapy for colon cancer. *J Natl Cancer Inst*, 98(22): 1647–654
32. Freedland SJ, Grubb KA, Yiu SK et al. (2005). Obesity and risk of biochemical progression following radical prostatectomy at a tertiary care referral center. *J Urol*, 174(3):919–22
33. Meyerhardt JA, Niedzwiecki D, Hollis D et al. (2007). Association of dietary patterns with cancer recurrence and survival in patients with stage III colon cancer. *Jama*, 298(7):754–64
34. Chlebowski RT, Blackburn GL, Thomson CA et al. (2006). Dietary fat reduction and breast cancer outcome: interim efficacy results from the Women's Intervention Nutrition Study. *J Natl Cancer Inst*, 98(24):1767–776

35. Holmes MD, Chen WY, Feskanich D, Kroenke CH, Colditz GA (2005). Physical activity and survival after breast cancer diagnosis. *Jama*, 293(20):2479–86
36. Sedjo RL, Byers T, Barrera E, Jr. et al. (2007). A midpoint assessment of the American Cancer Society challenge goal to decrease cancer incidence by 25% between 1992 and 2015. *CA Cancer J Clin*, 57(6):326–40
37. McTiernan A (2000). Associations between energy balance and body mass index and risk of breast carcinoma in women from diverse racial and ethnic backgrounds in the U.S. *Cancer*, 88(5 Suppl):1248–55.
38. Mayberry RM, Stoddard-Wright C (1992). Breast cancer risk factors among black women and white women: similarities and differences. *Am J Epidemiol*, 136(12):1445–56
39. Adams-Campbell LL KK, Dunston G et al. (1996). The relationship of body mass index to reproductive factors in pre– and postmenopausal African American women with and without breast cancer. *Obesity Res*, 4(5):451–56
40. Cui Y, Whiteman MK, Langenberg P et al. (2002). Can obesity explain the racial difference in stage of breast cancer at diagnosis between black and white women? *J Womens Health Gend Based Med*, 11(6):527–36
41. Wenten M, Gilliland FD, Baumgartner K, Samet JM (2002). Associations of weight, weight change, and body mass with breast cancer risk in Hispanic and non-Hispanic white women. *Ann Epidemiol*, 12(6):435–34
42. Wee CC, McCarthy EP, Davis RB, Phillips RS (2004). Obesity and breast cancer screening. *J Gen Intern Med*, 19(4):324–31
43. Vizcaino AP, Moreno V, Lambert R, Parkin DM (2002). Time trends incidence of both major histologic types of esophageal carcinomas in selected countries, 1973–1995. *Int J Cancer*, 99(6):860–68.
44. Hollingsworth JM, Miller DC, Daignault S, Hollenbeck BK (2006). Rising incidence of small renal masses: a need to reassess treatment effect. *J Natl Cancer Inst*, 98(18):1331–34
45. Brown LM, Devesa SS (2002). Epidemiologic trends in esophageal and gastric cancer in the United States. *Surg Oncol Clin N Am*, 11(2):235–56
46. Eaton DK, Kann L, Kinchen S et al. (2008). Youth risk behavior surveillance–United States, 2007. *MMWR Surveill Summ*, 57(4):1–131
47. Taveras EM, Berkey CS, Rifas-Shiman SL et al. (2005). Association of consumption of fried food away from home with body mass index and diet quality in older children and adolescents. *Pediatrics*, 116(4):e518–24
48. Schmidt M, Affenito SG, Striegel-Moore R et al. (2005). Fast-food intake and diet quality in black and white girls: the National Heart, Lung, and Blood Institute Growth and Health Study. *Arch Pediatr Adolesc Med*, 159(7):626–31
49. Bowman SA, Vinyard BT (2004). Fast food consumption of U.S. adults: impact on energy and nutrient intakes and overweight status. *J Am Coll Nutr*, 23(2):163–68.
50. Block JP, Scribner RA, DeSalvo KB (2004). Fast food, race/ethnicity, and income: a geographic analysis. *Am J Prev Med*, 27(3):211–17
51. Stewart H, Blisard N, Bhuyan S, Nayga R (2004). The Demand for Food Away from Home: Full-Service or Fast Food? Agricultural Economic Report #829. USDA ,Washington, DC
52. NPD Group (2005). The NPD Group, 20th Annual Eating Patterns in America Study. Port Washington, NYNPD Group
53. Sanchez-Johnsen LA, Fitzgibbon ML, Martinovich Z, Stolley MR, Dyer AR, Van Horn L (2004). Ethnic Differences in correlates of obesity between Latin-American and black Women. *Obes Res*, 12(4):652–60
54. Katz ML, Gordon-Larsen P, Bentley ME, Kelsey K, Shields K, Ammerman A (2004). "Does skinny mean healthy?" Perceived ideal, current, and healthy body sizes among African-American girls and their female caregivers. *Ethn Dis* Autumn,14(4): 533–41
55. Gipson GW, Reese S, Vieweg WV et al. (2005). Body image and attitude toward obesity in an historically black university. *J Natl Med Assoc*, 97(2):225–36

56. Bish CL, Blanck HM, Serdula MK, Marcus M, Kohl HW3rd, Khan LK (2005). Diet and physical activity behaviors among Americans trying to lose weight: 2000 Behavioral Risk Factor Surveillance System. *Obes Res*, 13(3):596–607
57. Yancey A, Kumanyika S (2007). Bridging the Gap: Understanding the Structure of Social Inequities in Childhood Obesity. *Am J Prev Med*, 33(4, Supplement 1):S172–S174
58. The Henry J. Kaiser Family Foundation (2004) The Role of Media in Childhood Obesity. Menlo Park, CA
59. National Center for Health Statistics (2004). Health, United States, 2004 With Chartbook on Trends in the Health of Americans Hyattsville, MD
60. Smiciklas-Wright H, Mitchell DC, Mickle SJ, Goldman JD, Cook A (2003). Foods commonly eaten in the United States, 1989–1991 and 1994–1996: are portion sizes changing? *J Am Diet Assoc*, 103(1):41–47
61. Young LR, Nestle M (2002). The contribution of expanding portion sizes to the US obesity epidemic. *Am J Public Health*, 92(2):246–49
62. Nestle M (2003). Increasing portion sizes in American diets: more calories, more obesity. *J Am Diet Assoc*, 103(1):39–40
63. Dong L, Block G, Mandel S (2004). Activities Contributing to Total Energy Expenditure in the United States: Results from the NHAPS Study. *Int J Behav Nutr Phys Act*, 1(1):4
64. Kruger J, Galuska DA, Serdula MK, Kohl HW, 3rd (2005). Physical activity profiles of U.S. adults trying to lose weight: NHIS 1998. *Med Sci Sports Exerc*, 37(3):364–68
65. Paeratakul S, Ferdinand DP, Champagne CM, Ryan DH, Bray GA (2003). Fast-food consumption among US adults and children: dietary and nutrient intake profile. *J Am Diet Assoc*, 103(10):1332–38
66. Saelens BE, Sallis JF, Black JB, Chen D (2003). Neighborhood-based differences in physical activity: an environment scale evaluation. *Am J Public Health*, 93(9):1552–58
67. Frank LD, Andresen MA, Schmid TL (2004). Obesity relationships with community design, physical activity, and time spent in cars. *Am J Prev Med*, 27(2):87–96
68. Giles-Corti B, Macintyre S, Clarkson JP, Pikora T, Donovan RJ (2003). Environmental and lifestyle factors associated with overweight and obesity in Perth, Australia. *Am J Health Promot*, 18(1):93–102
69. Morland K, Diez Roux AV, Wing S (2006). Supermarkets, other food stores, and obesity: the atherosclerosis risk in communities study. *Am J Prev Med*, 30(4):333–39
70. Morland K, Wing S, Diez Roux A, Poole C (2002). Neighborhood characteristics associated with the location of food stores and food service places. *Am J Prev Med*, 22(1):23–29
71. Powell LM, Slater S, Mirtcheva D, Bao Y, Chaloupka FJ (2007). Food store availability and neighborhood characteristics in the United States. *Prev Med*, 44(3):189–195
72. Zenk SN, Schulz AJ, Israel BA, James SA, Bao S, Wilson ML (2005). Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit. *Am J Public Health*, 95(4):660–67
73. Horowitz CR, Colson KA, Hebert PL, Lancaster K (2004). Barriers to buying healthy foods for people with diabetes: evidence of environmental disparities. *Am J Public Health*, 94(9):1549–54
74. Wechsler H, Basch CE, Zybert P, Lantigua R, Shea S (1995). The availability of low-fat milk in an inner-city Latino community: implications for nutrition education. *Am J Public Health*, 85(12):1690–92
75. Sturm R, Datar A (2005). Body mass index in elementary school children, metropolitan area food prices and food outlet density. *Public Health*, 119(12):1059–68
76. Lewis LB, Sloane DC, Nascimento LM et al. (2005). African Americans' access to healthy food options in South Los Angeles restaurants. *Am J Public Health*, 95(4):668–73
77. Andrieu E, Darmon N, Drewnowski A (2006). Low-cost diets: more energy, fewer nutrients. *Eur J Clin Nutr*, 60(3):434–36
78. Monsivais P, Drewnowski A (2007). The rising cost of low-energy-density foods. *J Am Diet Assoc*, 107(12):2071–76

79. Darmon N, Drewnowski A (2008). Does social class predict diet quality? *Am J Clin Nutr*, 87(5):1107–17
80. Tirodkar MA, Jain A (2003). Food messages on African American television shows. *Am J Public Health*, 93(3):439–41
81. Borzekowski DL, Robinson TN (2001). The 30-second effect: an experiment revealing the impact of television commercials on food preferences of preschoolers. *J Am Diet Assoc*, 101(1):42–46
82. A Kaiser Family Foundation Report (2007). Food for Thought: Television Food Advertising to Children in the United States. Menlo Park, CA
83. Duncan MJ, Spence JC, Mummery WK (2005). Perceived environment and physical activity: a meta-analysis of selected environmental characteristics. *Int J Behav Nutr Phys Act*, 2:11
84. King WC, Belle SH, Brach JS, Simkin-Silverman LR, Soska T, Kriska AM (2005). Objective measures of neighborhood environment and physical activity in older women. *Am J Prev Med*, 28(5):461–69
85. Powell L, S S, FJ C (2004). The relationship between community physical activity settings and race, ethnicity and socioeconomic status. *Evidence-Based Prev Med*, 1:135–144
86. Gordon-Larsen P, Nelson MC, Page P, Popkin BM (2006). Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics*, 117(2):417–24
87. Estabrooks PA, Lee RE, Gyurcsik NC (2003). Resources for physical activity participation: does availability and accessibility differ by neighborhood socioeconomic status? *Ann Behav Med*, 25(2):100–104
88. Casagrande SS, Whitt-Glover MC, Lancaster KJ, Odoms-Young AM, Gary TL (2009). Built environment and health behaviors among African Americans: a systematic review. *Am J Prev Med*, 36(2):174–81
89. Sallis JF, Glanz K (2004). The role of built environments in physical activity, eating, and obesity in childhood. *Future Child*, 16(1):89–108
90. Franzini L, Elliott MN, Cuccaro P et al. (2009). Influences of physical and social neighborhood environments on children's physical activity and obesity. *Am J Public Health*, 99(2):271–78
91. Smoking and Health (1990). A National Status Report. A Report to Congress Center for Chronic Disease Prevention and Health Promotion. Office on Smoking and Health United States. Public Health Service. Office of the Surgeon General 1990–2002 (February 1990)
92. Ogden CL, Carroll MD, Flegal KM (2008). High body mass index for age among US children and adolescents, 2003–2006. *JAMA*, 299(20):2401–405