Influence of Race, Ethnicity, and Culture on Childhood Obesity: Implications for Prevention and Treatment

A consensus statement of Shaping America's Health and the Obesity Society

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Obesity may be thought of as a body weight that conveys significant risk for adverse health outcomes. In children, obesity is defined as a BMI at or above the 95th percentile for age and sex, based on population data from the 1970s (1,2). The prevalence of obesity has increased markedly in U.S. children and adolescents in the past 30 years. Obesity-related risk factors and diseases formerly seen only in adults are increasingly being recognized in obese adolescents and even younger children.

Race and ethnicity are terms used to categorize populations on the basis of shared characteristics. Race has traditionally been used to categorize populations on the basis of shared biological characteristics such as genes, skin color, and other observable features. Ethnicity is used to categorize on the basis of cultural characteristics such as shared language, ancestry, religious traditions, dietary preferences, and history. Although ethnic groups can share a range of phenotypic characteristics due to their shared ancestry, the term is typically used to highlight cultural and social characteristics instead of biological ones (3).

Both race and ethnicity are, in fact, social constructs. The assumption that race reflects only biological distinctions is inaccurate. Categories based on race account for only 3–7% of total human genetic diversity, are not reliably measured, and are not always biologically meaningful (3,4). Furthermore, both race and ethnicity are constantly evolving concepts, making the task of comparing groups or following the same group over time quite challenging. For instance, the increasing proportion of the U.S. population describing their race as "mixed" or "other," as well as changes in ethnic self-identification across generations and occasionally even within the same generation, makes it difficult to assign individuals to invariant categories of race or ethnicity. Nevertheless, the social importance given to these constructs to describe groups that have been treated in similar ways based on presumed biological characteristics, as well as the acknowledgment that such classifications themselves have contributed to inequalities in health and health care access, necessitates that we continue to use the terms race and ethnicity.

Although childhood obesity is increasing in all ethnic and racial groups, its prevalence is higher in nonwhite populations. The reasons for the differences in prevalence of childhood obesity among groups are complex, likely involving genetics, physiology, culture, socioeconomic status (SES), environment, and interactions among these variables as well as others not fully recognized. Understanding the influence of these variables on the patterns of eating and physical activity that lead to obesity will be critical to developing public policies and effective clinical interventions to prevent and treat childhood obesity.

To address the evidence base and gaps in knowledge in this area, Shaping America's Health and the Obesity Society convened a consensus development conference on 9–11 April 2008. Following presentations by invited speakers and in-depth discussions, a seven-member panel of experts in pediatric endocrinology, cardiology, gastroenterology, nutrition, epidemiology, and anthropology developed this consensus statement on the influence of race, ethnicity, and culture on childhood obesity, addressing the following questions:

- What are the prevalence, severity, and consequences of childhood obesity across race/ethnicity in the U.S.?
- How might socioeconomic factors influence racial/ethnic differences in childhood obesity?
- What are the biological and cultural factors associated with racial/ethnic differences in childhood obesity?
- What are the implications of race/ethnicity on the prevention of childhood obesity?
- What are the implications of race/ethnicity on the treatment of childhood obesity?

QUESTION 1: What are the prevalence, severity, and consequences of childhood obesity across race/ethnicity in the U.S.?

— Childhood obesity with its associated metabolic complications is emerging as a major global health challenge of the 21st century. Despite ef-

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DOI: 10.2337/dc08-9024

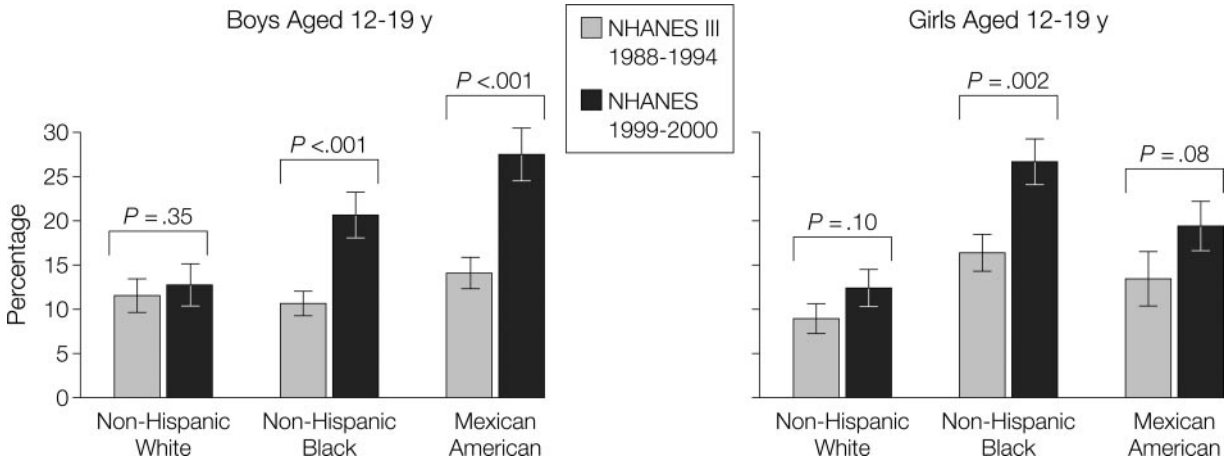

Figure 1—*Overweight prevalence by race/ethnicity for adolescent boys and girls. Error bars represent SEs. (Reprinted with permission.* JAMA *288:17281–732, 2002, ©2002, American Medical Association. All rights reserved.)*

forts by government and public health officials, researchers, health care providers, and the media to bring attention to this growing health problem, the number of overweight and obese youth continues to increase. About 110 million children worldwide are now classified as overweight or obese. Even in some developing countries, where undernutrition has traditionally been one of the major health concerns in children, overweight and obesity are now more prevalent.

Prevalence and severity

Obesity has reached epidemic proportions in the U.S. It has increased in both sexes and in all racial, ethnic, and socioeconomic groups. The prevalence of obesity has tripled since 1980 among children 6–11 years of age and adolescents 12–17 years of age, according to the National Health and Nutrition Examination Survey (NHANES) (5). The overall prevalence of obesity in children in the U.S. was 17% in 2004 (6). A subsequent analysis (7) suggested that the prevalence may have reached a plateau, although further tracking of data will be needed to confirm or refute this.

The prevalence of childhood obesity among African Americans, Mexican Americans, and Native Americans exceeds that of other ethnic groups. The Centers for Disease Control reported that in 2000 the prevalence of obesity was 19% of non-Hispanic black children and 20% of Mexican American children, compared with 11% of non-Hispanic white children. The increase since 1980 is particularly evident among non-Hispanic black and Mexican American adolescents (Fig. 1).

Although the overall prevalence of childhood obesity continued to increase during the first half of this decade (17% in 2004 vs. 14% in 2000), the differences by race/ethnicity appear to be diminishing, in part due to rapid increases in obesity in white children: in 2004 the prevalence of childhood obesity was 20% in non-Hispanic blacks, 19% in Mexican Americans, and 16% in non-Hispanic whites, and prevalence was highest in Mexican American boys (22%) and African American girls (24%). Disparities were found in children of other race/ethnicities. In adolescents, the prevalence of severe obesity (BMI ≥30 mg/kg [2]) was 39% in Native American boys compared with 14% in both non-Hispanic white boys and black boys; it was 14% in Native American girls compared with 10% in non-Hispanic white girls and 18% in black girls. The prevalence of obesity in Asian American boys and girls was 10 and 4%, respectively (8).

Pubertal maturation is known to impact on obesity development. Girls who mature early have higher BMI and sum skinfolds during their teenage years than girls who mature later (9), and this interaction is strongest in black girls (10). Because black girls undergo pubertal maturation earlier on average than white girls, differences in pubertal maturation stage can account for some racial differences in adolescent obesity.

The significant rise in obesity in children has been accompanied by an increase in the severity of obesity, and there are differences in the degree of obesity among racial groups. The prevalence of severe obesity (BMI >30 kg/m^2) in female adolescents was ~10% in non-Hispanic whites, 20% in non-Hispanic blacks, and 16% in Mexican Americans (5).

Many researchers have placed the origin of the childhood obesity epidemic at the beginning of the 1980s. There have been dramatic changes in the nutrition and physical activity habits of U.S. children, along with changes in demographics and societal norms, concurrent with the increase in childhood obesity prevalence.

Consequences

Obesity has deleterious associations in childhood and adolescence that increase morbidity and contribute to risk for cardiovascular disease and diabetes. The clustering of cardiovascular risk factors related to obesity in children includes hyperglycemia, dyslipidemia, inflammation, and hypertension, which are predictive of adult-onset cardiovascular disease. Additionally, childhood obesity is associated with obstructive sleep apnea, asthma, fatty liver, orthopedic problems, ovarian hyperandrogenism, and chronic kidney disease. From the child's standpoint, an important consequence of obesity may be psychosocial, including social isolation, poor school performance, and poor self-image.

Obesity in childhood is a significant predictor of obesity in adulthood. The Bogalusa Heart Study tracked ~2,400 5- to 14-year-old children for a mean of 17 years and found that obese black children were even more likely to remain obese as adults (83%) than obese white children (68%) (11).

The association of obesity in childhood with the emergence of type 2 diabetes is also disproportionately seen in Hispanic, Native American, and African

American adolescents. The SEARCH for Diabetes in Youth Population Study found that the proportion of all diabetes that was diagnosed as type 2 varied by ethnicity among 10- to 19-year-olds: 6% for non-Hispanic whites, 22% for Hispanics, 33% for African Americans, 40% for Asians/Pacific Islanders, and 76% for Native Americans (12).

The prevalence of type 2 diabetes in youth is low but increasing, especially in some racial and ethnic groups. In Pima Indians, 2.2% of 10- to 14-year-olds and 5% of 15- to 19-year-olds had type 2 diabetes in the 1990s, an increase from none in the younger group and <1% in the older group 20 years earlier (13). Impaired fasting glucose, a risk factor for type 2 diabetes, was found in 13% of Mexican American adolescents, 7% of non-Hispanic white adolescents, and 4% of non-Hispanic black adolescents in the 1999–2002 NHANES (14).

The prevalence of hypertension is increased in obese youth, with no clear racial/ethnic disparities when data are controlled for obesity. The prevalence of dyslipidemia (higher triglyceride and lower HDL cholesterol levels) also increases with obesity in youth. Triglycerides are highest in obese Mexican Americans and lowest in obese African American children. HDL cholesterol levels inversely mirror triglyceride levels.

Liver disorders in obese youth vary from simple steatosis to steatohepatitis to cirrhosis. Fatty liver is more common in obese boys than in obese girls and differs significantly by race/ethnicity. In a study of obese children ages 2–19 years (15), fatty liver disease was present in 50% of Hispanics, 35% of whites, and 10% of blacks (J.B. Schwimmer, unpublished data).

Obesity in children is associated with severe impairments in quality of life. Although differences by race may exist in some domains (16), the strong negative effect is seen across all racial/ethnic groups and dwarfs any potential racial/ethnic differences (17).

QUESTION 2: How might socioeconomic factors influence racial/ethnic differences in childhood obesity?

— Socioeconomic factors are likely to exert a profound influence on health, although there are conflicting points of view on their link to childhood obesity. Data on household SES are often limited to self-reported parental education and income levels. Percent poverty and poverty-to-income ratios have also been used to stratify survey participants by income groups. These twin indexes of parental education and household income levels, however, fail to fully convey the complexities of SES and social class.

One definition of social stratification is unequal distribution of privileges among population subgroups. The focus on current incomes can mask major underlying disparities in material resources (e.g., car, house) and accumulated wealth. Access to resources and services may not be equivalent for a given level of education or income. Neighborhood of residence may influence access to healthy foods, opportunities for physical activity, the quality of local schools, time allocation, and commuting time.

There are major racial differences in wealth at a given level of income. Whereas whites in the bottom quintile of income had some accumulated resources, African Americans in the same income quintile had 400 times less or essentially none. There are further race-dependent differences in income by different levels of education, as well as differences in neighborhood poverty at different levels of income. An SES gradient for self-reported health status for adults has been observed within each racial and ethnic group, while differences by race/ethnicity within each socioeconomic stratum were less pronounced (18).

Childhood experiences of SES can be defined by race/ethnicity, household economic resources, or some combination of both. Across school districts, the proportion of children eligible for free school meals, one index of SES, is a reliable predictor of childhood obesity rates. Additional indexes of social class, social capital, or social context are rarely obtained in research surveys on diets and health. Measures of accumulated wealth and access to resources and services are usually not included in studies of children's diets and childhood obesity. Causal relations between SES factors and obesity rates cannot be convincingly inferred from cross-sectional studies. To complicate matters, data on education and income tend to be treated as confounding factors in analyses and not as independent variables of interest.

Socioeconomic position and social class permeate every aspect of life and have a cumulative (sometimes generational) effect on health status throughout the life cycle. Controlling for SES variables, however, is very difficult because many, if not most, of these variables are unobserved. Thus, some researchers have cautioned against resorting to default explanations based on race/ethnicity or culture (18). One caution is that the construct of race in the U.S. is tied to many factors, such as a past history of disadvantage and discrimination (19). The construct of culture may represent in part adaptation to limited options or the prevailing economic conditions.

The present approach is to define SES variables and their potential impact on childhood obesity rates in terms of three critical intermediate constructs: money, place, and time.

The role of money

One hypothesis linking SES variables and childhood obesity is the low cost of widely available energy-dense but nutrient-poor foods. Fast foods, snacks, and soft drinks have all been linked to rising obesity prevalence among children and youth (20). Fast food consumption, in particular, has been associated with energy-dense diets and to higher energy intake overall. Calorie for calorie, refined grains, added sugars, and fats provide inexpensive dietary energy, while more nutrient-dense foods cost more (21), and the price disparity between the low-nutrient, high-calorie foods and healthier food options continues to grow. Whereas 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 (22).

Lower-cost foods make up a greater proportion of the diet of lower-income individuals (23). In U.S. 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. Healthy Eating Index scores are inversely associated with body weight and positively associated with education and income (24).

The importance of place

Knowing the child's place of residence can provide additional insight into the complex relationships between social and economic resources and obesity

prevalence. Area-based SES measures, including poverty levels, property taxes, and house values, provide a more objective way to assess the wealth or the relative deprivation of a neighborhood (25). All these factors affect access to healthy foods and opportunities for physical activity.

Living in high-poverty areas has been associated with higher prevalence of obesity and diabetes in adults, even after controlling for individual education, occupation, and income. In the Harvard Geocoding Study, census tract poverty was a more powerful predictor of health outcomes than race/ethnicity (25). Childhood obesity prevalence also varies by geographic location. The California Fitnessgram data showed that higher prevalence of childhood obesity was observed in lower-income legislative districts. In Los Angeles, obesity in youth was associated with economic hardship level and park area per capita. Thus, the built environment and disadvantaged areas may contribute in significant ways to childhood obesity.

The poverty of time

The loss of manufacturing jobs, the growth of a service economy, and the increasing number of women in the labor force have been associated with a dramatic shift in family eating habits, from the decline of the family dinner to the emerging importance of snacks and fast foods (26). The allocation of time resources by individuals and households depends on SES.

The concept of "time poverty" addresses the difficult choices faced by lower-income households. When it comes to diet selection, the common trade-off is between money and time. One illustration of the dilemma is provided by the Thrifty Food Plan (TFP), a recommended diet meeting federal nutrition recommendations at the estimated cost of $27 per person per week (27). While this price is attractive, it has been estimated that TFP menus would require the commitment of 16 h of food preparation per week. By contrast, a typical working American woman spends only 6 h per week, whereas a nonworking woman spends 11 h per week, preparing meals (28). Thus, TFP may provide adequate calories at low cost but requires an unrealistic investment in time.

QUESTION 3: What are the biological and cultural factors associated with racial/ethnic differences in childhood obesity?

Biology

Biological factors may, in part, mediate racial/ethnic and SES differences in childhood obesity. For example, low SES or discrimination by race or ethnicity may result in increased stress. Stress has a direct effect on the hypothalamic-pituitary-adrenal axis, resulting in elevation of plasma cortisol, which has been implicated in the development of obesity (29). The relationships between stress and illness differ markedly by race/ethnicity, in part due to differences in exposure to social and environmental stressors; the degree to which the environment, SES, and discrimination are appraised as stressful; culturally appropriate strategies for coping with stress; biological vulnerability to stress; and the expression of stress as illness (30). While these relationships are plausible, they are not fully understood.

Race/ethnicity may have underlying genetic components; however, self-identified race/ethnicity is complicated by genetic admixture (31). Whether genetic differences across populations are associated with obesity development also remains unclear. A "thrifty genotype" may confer an advantage in an energy-poor environment, which would become disadvantageous in an energy-dense environment because it would predispose to increased accumulation of adipose tissue. The genes or gene variants that would support this hypothesis have not been identified.

One possible contributor to racial/ethnic disparities in the metabolic comorbidities of obesity may be related to different patterns of fat distribution. African American adults and children have less visceral and hepatic fat than white and Hispanic individuals (32). Another possibility is that there are fundamental metabolic differences by race or ethnicity. Racial and ethnic differences in resting metabolic rate have been found (33) but may partly be due to differences in fat-free mass or organ mass and have not been shown to account for weight gain over time within populations (34). Some differences in insulin secretion and response among racial/ethnic groups have been found. African American and Hispanic children have lower insulin sensitivity than white children. African Americans have higher circulating insulin levels than whites, due to not only a more robust β-cell response to glucose but also decreased clearance of insulin in the liver. Hispanics also have lower insulin sensitivity than whites, after controlling for BMI and body composition, and have higher insulin levels in compensation for their relative insulin resistance (35).

There are differences in lipids and lipoproteins related to race/ethnicity (36). African Americans have lower rates of basal lipolysis than whites (37). This could be a metabolic risk factor for both the development of obesity and the risk of obesity-related comorbidities. African Americans also have lower levels of adiponectin than white subjects during childhood and adolescence, which may help explain their increased risk of diabetes and cardiovascular disease despite having less visceral adiposity (38). In summary, there is circumstantial evidence for biological differences in obesity development and the occurrence of comorbidities by race/ethnicity; however, the relationships are far from definitive.

Culture

Culture is a system of shared understandings that shapes and, in turn, is shaped by experience. Culture provides meaning to a set of rules for behavior that are normative (what everyone should do) and pragmatic (how to do it). Culture, unlike instinct, is learned; is distributed within a group in that not everyone possesses the same knowledge, attitudes, or practices; enables us to communicate with one another and behave in ways that are mutually interpretable; and exists in a social setting. Among the shared understandings embodied by a culture are those pertaining to obesity, including understanding of its cause, course, and cure, and the extent to which a society or ethnic group views obesity as an illness. Illness is shaped by cultural factors governing perception, labeling, explanation, and valuation of the discomforting experiences (39). Because illness experience is an intimate part of social systems of meaning and rules for behavior, it is strongly influenced by culture.

As with race and ethnicity, culture is a dynamic construct in that shared understandings change over time as they are shaped or informed by the experience of individual members of a group or the entire group. For instance, beliefs relating the normative and pragmatic rules for en-

gaging in health-promoting behavior (diet and exercise) or leisure activity (watching television or playing video games) will change as individual members of an ethnic group experience and come to value innovative practices, while losing interest in and thereby disvaluing traditional practices.

Cultural variation in the population is maintained by migration of new groups, residential segregation of groups defined by their culture and ethnicity, the maintenance of language of origin by the first and, to a lesser degree, the second generation of immigrants, and the existence of formal social organizations (religious institutions, clubs, community or family-based associations). In contrast, globalization and acculturation simultaneously promote cultural change and cultural homogeneity. Globalization, a social process in which the constraints of geography on social and cultural arrangements recede, can affect obesity through the promotion of travel (e.g., migration of populations from low-income to high-income countries), trade (e.g., production and distribution of high-fat, energy-dense food and flow of investment in food processing and retailing across borders), communication (promotional food marketing), the increased gap between rich and poor, and the epidemiologic transition in global burden of disease (40). Acculturation (changes of original cultural patterns of one or more groups when they come into continuous contact with one another) can affect obesity by encouraging the abandonment of traditional beliefs and behaviors that minimize the risk of overweight and the adoption of beliefs and behaviors that increase the risk of overweight.

With both acculturation and globalization there are changes in preferences for certain foods and forms of leisure/physical activity, as well as educational and economic opportunities. These changes may differ by ethnic groups. For instance, first-generation Asian and Latino adolescents have been found to have higher fruit and vegetable consumption and lower soda consumption than whites. With succeeding generations, the intake of these items by Asians remains stable. In contrast, fruit and vegetable consumption by Latinos decreases while their soda consumption increases, so that by the third generation their nutrition is poorer than that of whites (41). Acculturation to the U.S. is also significantly associated with lower frequency of physical activity participation in 7th-grade Latino and Asian American adolescents (42).

In much of the world, traditional diets high in complex carbohydrates and fiber have been replaced with high-fat, energy-dense diets. Rural migrants abandon traditional diets rich in vegetables and cereal in favor of processed foods and animal products. In the U.S. and abroad, globalization has been linked to fewer home cooked meals, more calories consumed in restaurants, increased snacking between meals, and increased availability of fast foods in schools (43). Similarly, there have been changes in patterns of physical activity linked to risk of obesity in both adults and children worldwide, including increased use of motorized transport, fewer opportunities for recreational physical activity, and increased sedentary recreation (44).

Culture is believed to contribute to disparities in childhood obesity in numerous ways. First, body image development occurs in a cultural context, and ethnic/cultural groups differ in their shared understandings as to valued and disvalued body image. For instance, perceived ideal body size for African American women is significantly larger than it is for white women, and African American men are more likely than non-Hispanic white men to express a preference for larger body size in women (45). The mean BMI at which white women typically express body dissatisfaction is significantly lower than that for African American women (46).

Given that women typically assume primary responsibility for the care, feeding, and education of children, including the transmission of shared cultural understandings, the beliefs that women possess with respect to their own body image have implications for their perception of and response to the body image of their children. This pattern may vary by ethnicity. For instance, non-Hispanic white mothers' dietary restraint or their perceptions of their daughters' risk of overweight can influence their young daughters' weight and dieting behaviors (47). In contrast, Latinas tend to prefer a thin figure for themselves but a plumper figure for their children (48). Even within the Latino population in the U.S., however, there are important cultural variations, with Latinas from the Caribbean preferring a thinner body size than Latinas from Mexico and Central America (49).

Culture influences child-feeding practices in terms of beliefs, values, and behaviors related to different foods (43). Affordability, availability of foods and ingredients, palatability, familiarity, and perceived healthfulness prompt immigrant families to retain or discard certain traditional foods and to adopt novel foods associated with the mainstream culture. Bilingual school-age children from immigrant Mexican households serve as agents of dietary acculturation by rejecting the lower-calorie traditional foods prepared at home and favoring the higher-calorie foods, beverages, and snacks they consume at school or see advertised on television (50) and may resist efforts by their parents to restrict the availability of foods from the mainstream culture.

Cultural patterns of shared understandings influence food consumption in several ways. These shared understandings define which types of food are healthy and which are unhealthy. For instance, Hmong immigrants in California believe that only fresh food is healthy, that anything frozen or canned is not, that school meals are unhealthy for children, and that fruits and vegetables are totally different domains (51). Food is both an expression of cultural identity and a means of preserving family and community unity. While consumption of traditional food with family may lower the risk of obesity in some children (e.g., Asians) (52), it may increase the risk of obesity in other children (e.g., African Americans) (53).

Differences in levels and types of exposure to nutritional marketing may also account for cultural differences in patterns of nutrition. For instance, exposure to food-related television advertising was found to be 60% greater among African American children, with fast food as the most frequent category (54). Marketing strategies for food often target specific ethnic groups. This marketing, in turn, may produce alterations in belief systems as to the desirability of foods high in calories and low in nutrient density.

Culture influences preferences for and opportunities to engage in physical activity. As with nutrition, children model the types of physical activity undertaken by their parents; thus, a parent in a culture that views rest after a long workday as more healthy than exercise is less likely to have children who understand the importance of physical activity for health and well-being (55). Compared with their white counterparts, African American adolescents have greater declines in levels of physical activity with

Table 1—*Consensus recommendations for the prevention and treatment of childhood obesity: implications of race, culture, and ethnicity*

Prevention
- Prevention efforts should fall within the framework of the socio-ecological model, which views children in the context of their families, communities, and cultures.
- The primary care provider should routinely discuss obesity risk with children and families. These discussions need to vary in frequency based on the child's risk of obesity (which is particularly high in African American girls and Hispanic boys), should be culturally sensitive, and should take into account the education level and SES of the child/family.
- Efforts should be made to prevent GDM and low birth weight. Breastfeeding should be encouraged.
- Health care providers should play an active role in advocacy for local and national policies that foster a healthy environment for all children, including:
  - Restriction of youth-targeted television advertising of foods of low nutritional value
  - Promotion of regular physical activity and healthy food choices in schools
  - Provision of safe places for children to play and access to healthy food choices in poor and minority neighborhoods

Treatment
- Treatment should begin early, targeting children at increased risk for long-term obesity and its complications.
- The health care team, child, and caregivers should mutually agree on treatment goals. Health care providers should be aware of racial/ethnic and sex differences in the perception of obesity that may influence these goals.
- Consider cultural, individual, and family preferences and the realities of time and money in advice about meal planning.
- Consider cultural and gender preferences with regard to advice about physical activity.
- Evidence for the benefits of comprehensive lifestyle interventions including behavioral modification, currently based primarily on studies of white middle-class children, needs to be expanded through more studies targeting children of lower SES and non-white race/ethnicity.
- Although some evidence suggests that the effects of weight loss medications or bariatric surgery may differ among racial or ethnic groups, decisions about the use of these interventions in children should not be based on race or ethnicity.

increasing age and are less likely to participate in organized sports (56). A study by the Kaiser Family Foundation (57) found longer periods of television viewing among African American children than among non-Hispanic white children, with Hispanic children in between. The relationship between television watching and obesity may vary by race. Henderson (58) found that white girls who watched more television at baseline showed a steeper increase in BMI over early adolescence than girls who watched less, while television viewing was not associated with adolescent BMI change in black girls.

Culture can influence the perception of risk associated with obesity. Studies of Latinos have found that many mothers of obese children believe their child to be healthy and are unconcerned about their child's weight, although these same parents are likely to believe that obese children in general should be taken to a nutritionist or physician for help with weight reduction (50). Among African American parents, there is greater awareness of acute health conditions than of obesity. A study by Katz et al. (59) found that both obese African American girls and their female caregivers were unaware of the potential health consequences associated with their current body size.

Culture can influence the utilization of health services, affecting the likelihood that childhood obesity can be prevented or effectively treated in specific ethnic groups. While ethnic differences in access to services can be attributed to differences in SES (e.g., higher proportions of Latinos lack health insurance or transportation to health care providers), several studies have pointed to differences in use of services even when access is available. Among Latino families, differences in patterns of service use have been found to be related to different beliefs about the cause, course, and cure of an illness, the stigma attached to particular illnesses, and interactions between patients and providers (60).

Finally, culture may influence the manner in which the risk for obesity varies by social status. For instance, cultures vary with respect to which body type is associated with wealth and health, with low-income societies generally believing that a larger body size and high-income societies generally believing that a thinner body is an indicator of wealth and health. Individuals with low SES in low-income countries are at risk of undernutrition. This risk creates a cultural value favoring larger body shapes, a value that may accompany immigrant groups upon their arrival to the U.S. With globalization, however, this cultural value may be diminishing, as low-income countries become increasingly exposed to media images linking wealth with thinness.

QUESTION 4: What are the implications of race/ethnicity in the prevention of childhood obesity?

— The panel's consensus recommendations for the prevention and treatment of childhood obesity, accounting for the influence of race, culture, and ethnicity, are summarized in Table 1. A "socio-ecological" framework should be used to guide the prevention of childhood obesity (Fig. 2). This model views children in the context of their families, communities, and cultures, emphasizing the relationships among environmental, biological, and behavioral determinants of health. The socio-ecological model also focuses on interactions between a person's physical, social, and cultural surroundings, and therefore we believe it to be the best approach in efforts to prevent obesity in all ethnic groups.

Most interventions have used only health education, awareness, and behavior change approaches to improve individual and small-group behaviors, with minimal long-term success. The socio-ecological approach requires not only knowledge transfer but also peer support, supportive social norms, and private and public sector collaboration. To foster sustainable behaviors, the environments and policies that promote sedentary activities and unhealthy eating must also be addressed.

The primary care provider should routinely discuss obesity risk during encounters with children and families. The duration of this brief, focused discussion may need to vary not only based on the

Figure 2—*The socio-ecological framework. Health behaviors of the individual (inner oval) are influenced by interpersonal, organizational, community, and public policy domains represented by the progressively larger ovals. Many influencers span more than one domain.*

child's risk of obesity but also on the child's culture and the education level and SES of the child/family. It is important to plot BMI, to show the child/family the plot of BMI over time, and to explain the meaning of BMI, BMI percentile, and upward crossing of percentiles. For health care providers to have a meaningful interaction about energy intake and energy expenditure with children/families, providers should have training in cultural competency in order to understand the specific barriers patients face and the influence of culture and society on health behaviors. Providers should offer anticipatory guidance and give specific information about the health benefits of physical activity and good nutrition and how to diminish sedentary behavior. Motivational interviewing can be used to engage patients and understand barriers to change.

Behavior change tools that are culturally sensitive should be used. Being aware of community resources may help with healthy lifestyle adaptations. Discussion should include factors such as televisions in bedrooms, eating while watching television, lack of family meals, quality of snacks, frequency of eating at fast food restaurants, skipping breakfast, drinking soda versus water, and consuming fruits and vegetables. Clinicians should be aware that Hispanic boys and African American girls are at greatest risk for obesity.

The risk for obesity begins early in life, if not in the prenatal period. Race/ethnicity and SES influence the timing of pregnancy, number of pregnancies, interval between pregnancies, and risk for gestational diabetes mellitus (GDM). Minority women, particularly those who are obese, do not lose weight between pregnancies, gain excessive weight during subsequent pregnancies, and are at increased risk for GDM. GDM is associated with high birth weight and higher percent body fat of the neonate, both of which are risk factors for obesity during childhood and adolescence. Hence, efforts should be made to prevent GDM and excess maternal weight gain during pregnancy; otherwise, this vicious cycle may continue and affect subsequent generations in a family.

Low birth weight is also a risk factor for obesity and obesity-related diseases in childhood, particularly in poor populations. Prevention of future obesity is yet another reason to assure that pregnant women have access to prenatal care, optimal nutrition, efforts to reduce prenatal stress, and counseling to avoid alcohol, drugs, and cigarettes.

Breastfeeding may decrease the incidence of obesity in childhood as well as the weight of the nursing mother. A meta-analysis (61) demonstrated an inverse relationship between the duration of breastfeeding and the risk of becoming overweight. There is evidence that minority women and those from low socioeconomic backgrounds can succeed in breastfeeding if they are adequately supported.

Food habits can be established early in life, which makes it important to counsel parents of toddlers about appropriate food intake. It is important to promote self-regulation, allowing young children to determine their intake, which may naturally vary from meal to meal and day to day. This may be a difficult concept for cultures that have food beliefs around set meals and predetermined quantities of food. Lifestyle patterns are influenced by parental role modeling, and the child's environment must provide access to healthy foods and encourage appropriate physical activity. Health care providers should convey the caloric needs of children, concepts of healthy eating, and importance of physical activity.

The public health approach to the prevention of childhood obesity must take into account race/ethnicity, culture, and SES within a socio-ecological framework. The child and family are influenced by a wide variety of factors such as economic resources, geography, the built environment, available grocery/food stores, community resources, transportation, media/messaging, the work site, and schools. Public health strategies for prevention of childhood obesity must address these factors along with other disparities.

The food industry exerts an enormous influence on children through advertising on television and in the community. Children who watch an excess of television are exposed to advertisements for sweetened drinks, fast food restaurants, and high-caloric snacks. A 2006 Institute of Medicine report (62) cited television advertising as influencing children and adolescents to adopt unhealthy lifestyle choices. The panel agrees with the report's call to restrict television advertising of food items of low nutrient density to children.

School is also an important social environment for youth and a major venue for interventions. Numerous studies have been done in schools to determine whether obesity-prevention educational programs lead to improvements in food choices, physical activity, and health knowledge, with mixed results. A large middle school–based trial involving mainly minority, low-SES students is currently assessing whether a comprehensive environmental approach involving food services, physical education, a classroom curriculum, and a social marketing campaign will reduce rates of physiologic out-

comes such as overweight/obesity and risk factors for type 2 diabetes.

A barrier to children achieving the recommended 60 min of physical activity per day is that most primary, middle, and secondary schools across the country do not provide even 30 min of daily physical activity to students. Policies must be put in place to insure that students have a requisite number of minutes of physical activity each week and that schools have adequate equipment and facilities and trained physical education teachers.

Of the 58 million schoolchildren in this country, about 28 million take part in the subsidized National School Lunch Program (NSLP) and eight million in the School Breakfast Program. These children are disproportionately minority and residents of low-SES areas. The average child who participates in the school lunch program consumes one-third of the recommended daily caloric and nutrient intake in school and three-fifths if breakfast is also taken in school (63). Although federal regulation requires that these meals must meet certain nutritional standards, the NSLP relies upon foods purchased and donated by the USDA. The most popular USDA-donated foods are cuts of beef, pork, chicken, and turkey that are often high in fat. Fresh fruit, which is not generally subsidized, is offered in about only one-half of meals in the NSLP (64).

The positive role of the NSLP is compromised by other foods that schools now make available to students. School snack lines, vending machines, and in-school stores typically offer less-than-optimal food choices, including sweetened soft drinks, candies, fried chips, and bakery goods. In addition, about 20% of schools offer brand-name fast food items.

Similar to issues with physical education in school, existing school food policies need to be reevaluated. To help prevent obesity, particularly in minority and low-SES students who are most impacted by school food policies, optimal nutrition, calories, and food behaviors must be offered and promoted.

The manner in which communities are organized, with regard to both physical and social aspects, may play a role in the prevention of childhood obesity. Community planners need to design and organize communities to maximize opportunities for safe walking or cycling to school, recreational activities, and neighborhood shopping as means to encourage greater physical activity. Communities need to provide places where children can play outside, particularly within their neighborhoods. Also, parental concern about neighborhood crime and, therefore, their children's safety may lead to children remaining at home after school (particularly if no adult caretakers are available) and engaging in sedentary rather than physical activity. There is an association between parents' perceptions of neighborhood safety and childhood obesity (65).

There are few full-service supermarkets in poorer neighborhoods but many convenience stores selling calorie-dense less nutritious foods. Urban stores tend to stock fewer healthier foods and have less variety of foods. The effect of the federal government's farm subsidy program may also be contrary to sound dietary practices. Although the government advises more consumption of fruits and vegetables, these are relatively expensive items.

Clinicians need to understand the social and physical context in which children live, attend school, and play. They must also play a role in advocacy, policy setting locally and nationally, and schools to help develop a healthy environment to prevent obesity.

QUESTION 5: What are the implications of race/ethnicity on the treatment of childhood obesity?

— Guidelines exist to identify, evaluate, and treat obese children (66), but there is insufficient evidence to recommend a specific treatment approach according to the race/ethnicity of the child. Racial/ethnic differences in body fat distribution, insulin dynamics, fatty liver, dyslipidemia, and diabetes, and the influence of SES and culture on health, suggest that optimal treatments could well differ according to the race/ethnicity of the obese child. Although the implication of a given BMI is known to differ by race and ethnicity in adults, analogous data are lacking in children.

A strategy of early intervention targets children at increased risk for long-term obesity and obesity-related disease at a time when treatment may prevent the complications of obesity. After diagnosis of obesity, the next step is to consider the possibility of identifying the cause(s) and to determine the presence of comorbid conditions.

It is critical from the outset that the physician, parent, and child have mutually agreed upon goals. There are racial/ethnic and sex differences in the perception of obesity that may influence the motivation for treatment. An open dialogue is needed to assure that everyone is working toward the same end. Goals should be realistic, of specific duration, and revised as needed. The appropriate end point will vary greatly by age, severity of obesity, and associated comorbid disease (66).

A major concern is disparities in access to health care and the availability and affordability of treatment for obesity. Hispanic children are more likely to be uninsured than black children, who are more likely to be uninsured than white children. Optimal outcomes occur with high intensity and long duration of treatment. Inadequate reimbursement is a significant barrier to the treatment of obesity in children. For those who are insured, there may still be disparities in the availability and quality of health care. In addition, a certain degree of sophistication is required in order to navigate the health care system.

Depending on the severity of obesity, dietary interventions may range from minor modifications to major changes. The best available data from studies of weight loss in adults suggest that total calorie intake, not diet composition, determines long-term weight loss. Whether diet composition in ad libitum conditions leads to differences in long-term energy intake remains an open question. Meal planning should take into consideration cultural, individual, and family preferences and the realities of time and money.

Although physical activity is obviously important in energy balance, intensive physical activity interventions in obese children have produced only small changes in body weight, with somewhat greater changes in metabolic and cardiovascular indexes (67). When recommending a physical activity program, it is important to take into account cultural and sex preferences. For example, a dance program for African American girls (68) and resistance training for Latino boys (69) have shown good acceptance.

Behavioral modification focuses on successive changes using family support for the practice and reinforcement of lifestyle changes. The integration of the family as an agent of change may be especially important in the treatment of childhood obesity. Comprehensive lifestyle interventions including behavior modification produce significant treatment effects in children (70). However, the evidence is primarily derived from white, middle-class, mildly to moderately obese children

with intact families. Studies expanding such interventions to African American and Hispanic children are ongoing.

Two medications are labeled for use in weight loss in adolescents when combined with an intensive lifestyle intervention program. Sibutramine, an appetite suppressant that inhibits the reuptake of norepinephrine and serotonin, is labeled for those age 16 years and older. In a group of severely obese adolescents, treatment with sibutramine in conjunction with behavioral therapy resulted in a mean weight loss of 8.4 kg after 12 months (71). Side effects of this drug include increased heart rate and blood pressure. The second medication, orlistat, is an inhibitor of fat absorption and is labeled for use in children aged 12 years and over. A large 1-year randomized controlled trial was conducted with orlistat in moderately to severely obese adolescents, leading to a net decrease in BMI of only 0.86 kg/m^2 compared with placebo (72). The side effects of this drug include the sequelae of fat malabsorbtion. Neither of these drugs has been widely adopted because of their cost, side effects, and absence of data regarding long-term efficacy in adolescents. Another drug used for the treatment of obesity, although not labeled for that purpose, is metformin. Weight loss achieved with metformin is typically modest, and therefore its primary benefits may be for obesity-related consequences such as hyperglycemia and ovarian hyperandrogenism.

Studies of weight loss medication in adolescents have included black and Hispanic subjects but have not been adequately powered to be evaluated for differences in effects by race or ethnicity. One secondary analysis of a single-center trial of sibutramine suggested that obese white adolescents may have better weight loss with the combination of behavioral therapy and sibutramine than obese black adolescents (73). No mechanistic explanation was provided for this finding. Another study suggested that metformin was more effective for weight loss in white adolescents than black adolescents, perhaps due to differences in insulin secretion and sensitivity (74).

In adults, whites experience more weight loss following gastric bypass surgery or gastric banding surgery than blacks or Hispanics (75,76). Notably, the rate of improvement of obesity-related comorbidities was equivalent among race/ethnic groups, despite differences in weight loss. In children, bariatric surgery has been largely limited to white adolescents, and there are no data to inform whether race/ethnicity influences outcomes.

WHAT QUESTIONS REMAIN? — Additional studies with better measurements are needed to help resolve the current uncertainty about the effect of SES on health outcomes and the interplay between SES and race/ethnicity. More objective ways to assess SES, such as relying more on area-based measures, as shown in online appendix Table 2 (available at http://dx.doi.org/10.2337/dc08-9024), and better analytical methods are needed to evaluate the influence of complex SES variables on diseases such as childhood obesity.

More research is needed to better understand the stressors associated with race/ethnicity and SES, and better measures are needed to quantify the biological effects of stress. We need more systematic study of biological factors that may differ among racial/ethnic groups and whether these biological changes have a direct effect on obesity development through changes in energy balance.

Culture influences the risk of obesity in children, and cultural differences may account, in part, for the disparities in childhood obesity. The dynamic nature of culture and increasing pace of cultural change suggest that additional research is needed to determine whether cultural patterns of shared understandings are the causes or consequences (or both) of childhood obesity.

The influence of race/ethnicity and culture on preventive efforts in the clinical health care setting and in the public health domain requires further understanding and evaluation. We need to better understand how to translate the socioecological model into practice. Culturally sensitive tools are needed to effect behavior change.

Fundamental questions regarding childhood obesity treatments remain and should be a research priority. The majority of pediatric obesity interventions have been conducted in obese preadolescent children with mild to moderate obesity and without significant comorbidities. To better determine whom to treat and with what strategies, studies need to include more adolescents, subjects with severe obesity, and nonwhites. These studies will need to address the influence of culture and genetics on treatment efficacy. The optimal diet for successful long-term weight loss in children is controversial and requires controlled clinical trials to resolve. Future studies will need to address the timing and long-term effects of pharmacotherapy on clinically relevant end points.

We need to identify robust markers of risk for poor outcomes and determine whether such markers differ by race or ethnicity. We also need to determine how to effectively deliver the appropriate care, including ways to tailor behavioral interventions to suit an individual's culture and environment. Such findings could have important implications for personalized and predictive strategies in both the prevention and treatment of childhood obesity. A major barrier to the treatment of obese children is the lack of insurance reimbursement. Future research will need to document the real lifetime costs of childhood obesity and to demonstrate the cost-effectiveness of intervention on multiple outcomes including disease and quality of life.

Acknowledgments— The consensus conference was sponsored by unrestricted educational grants from Campbell Soup Company and GlaxoSmithKline.

The authors thank the researchers who presented their work at the conference: Silva Arslanian, MD; Robert Branson, PhD; Paula Braveman, MD, MPH; John Elder, PhD, MPH; Jose Fernandez, PhD; Michael Freemark, MD; Elizabeth Goodman, MD; Michael Goran, PhD; Bernard Gutin, PhD; Gail Harrison, PhD; David Ludwig, MD, PhD; Teresia O'Connor, MD, MPH; Roland Sturm, PhD; and Denise Wilfley, PhD.

Authors' dualities of interest
S.C. reports none. S.R.D. has served as a consultant for Abbott Laboratories and Merck. A.D. has received speaker fees or honoraria from Edelman, Dairy Management Inc., Coca Cola, Food Minds, and Oldways and research support from Tate & Lyle, Glaceau, General Mills, Sudzucker, and the National Cattlemen's Beef Association. F.R.K. has served on advisory boards of Lifescan, NovoNordisk, Medtronic Minimed, Nutrition 21, Clinical Products, Nestle, Amylin, Abbott, Kinexium, McNeil Nutritionals, Insulet, Health Maintenance Corporation, and DLife; has received research support from Medtronic Minimed, Lifescan, Johnson & Johnson, Nutrition 21, Eli Lilly, Glaxo Smithkline, and Pfizer; is a stockholder in Amylin, Diabetes Prevention Source, Clinical Products, Mannkind, and Insulet; and has family members who are principle shareholders of Diabetes Prevention Source. L.A.P. reports none. A.L.R. is a stockholder in Johnson & Johnson. J.B.S. reports none.

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