

Childhood Obesity in Minority Populations in the United States

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Introduction

Obesity became a public health crisis in the United States, which affects both adults and children.^{1,2,24,25} Approximately 31% of U.S. children and adolescents aged 2-19 years were overweight or obese, and almost 17% were obese in 1999-2004.^{3-5,24} Studies suggest that increased consumption of more energy-dense, nutrient-poor foods with high levels of sugar and saturated fats, combined with reduced physical activity, have contributed to the rising obesity epidemic among children.^{6,21,28} Childhood obesity increased the risk of many diet-related chronic diseases, including type 2 diabetes, cardiovascular disease, hypertension, stroke, and certain forms of cancers.⁷ It is important to prevent or control the epidemic across all racial/ethnic groups. However, minority children have a higher prevalence rate of obesity than non-Hispanic white children. This current paper reviews the trends and factors that may contribute to the racial/ethnic disparity.

National Databases Available to Examine Ethnic Disparities in Childhood Obesity

Rich data have been collected that allow for examining ethnic disparities in childhood obesity in the United States, although data regarding some smaller minority groups remain limited. Among these data sources, in particular, the National Health and Nutrition Examination Survey (NHANES) data are the best, as they provide direct anthropometric measures which are better than self-reported measures. However, a main limitation of NHANES is that it does not provide adequate number of subjects from other ethnic groups other than white, black, and Mexican American. Another good database is the National Longitudinal Study of Adolescent Health (also called "Add Health"), which included a large number of Asian adolescents.⁶

The National Health and Nutrition Examination Surveys (NHANES): NHANES provides excellent data to help examine the ethnic disparities and time trends in the prevalence of childhood obesity in the United States. NHANES is a series of cross-sectional surveys that provide nationally representative information on the nutrition and health status of the U.S. civilian population, which have many strengths compared with other local surveys and those that are based on self-reported anthropometric measures. The first, second, and third NHANES surveys (NHANES I, II, and III) were collected in 1971-1975, 1976-1980, and 1988-1994, respectively. Since 1999, NHANES has been a continuous survey. The data were recently made available for the first six years of that period (1999-2004). All rounds of NHANES surveys have used a stratified, multistage probability cluster sampling design. In each survey, standardized protocols have been used for all interviews and examinations. Participants' weight and height were directly measured based on standardized protocols.⁴

The National Longitudinal Study of Adolescent Health (Add Health): Add Health is a nationally representative study that explores the causes of health-related behaviors of adolescents in grades 7 through 12 and their outcomes in young adulthood. Add Health seeks to examine how social contexts (families, friends, peers, schools, neighborhoods, and communities) influence adolescents' health and risk behaviors. Add Health is the largest, most comprehensive survey of adolescents ever undertaken. Data at the individual, family, school, and community levels were collected in two waves between 1994 and 1996. In 2001 and 2002, Add Health respondents, 18 to 26 years old, were re-interviewed in a third wave to investigate the influence that adolescence has on young adulthood. In the second wave of survey in 1996, the adolescents were measured about their weight and height.⁶

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Definition of Obesity and Overweight and Classification of Race/Ethnicity

Body Mass Index (BMI = weight(kg) / height(m)²) is now widely used among children as well as adults since it is closely correlated with body fat. It is also directly related to health consequences as a result of childhood obesity.^{15,28} Centers for Diseases Control and Prevention (CDC) used two sets of age-gender-specific BMI reference points from 2000 Growth Chart to define childhood obesity:¹⁸ "Obesity" is defined as a BMI greater than or equal to the 95th percentile point, while "overweight" is defined as a BMI greater than or

equal to the 85th percentile but less than 95th percentile. These definitions were recommended by CDC to screen obese and overweight children aged between 2 to 19 years. For children younger than 2 years, there is no effective BMI reference point for screening obesity.

Note that in the CDC's original 2000 Growth Chart, the CDC recommend to use the terms of "overweight" and "at risk for overweight" but not "obesity" and "overweight" respectively, partly in order to avoid stigma toward overweight children. However, this terminology has caused a lot of confusion, and a recent expert committee recommended the use of "obesity" and "overweight" respectively to replace the CDC's terms.¹

According to CDC's related recommendations, race/ethnicity for NHANES subjects was coded as non-Hispanic white, non-Hispanic black, Mexican American, and other ethnic groups.

The Growing Childhood Obesity Epidemic in the United States and the Racial/Ethnic Disparity

Table 1 shows the estimated national prevalence of overweight (BMI \geq 85th percentile) and obesity (BMI \geq 95th percentile) based on the most recent NHANES 2003-04 data. In 2003-2004, over one third (33.6%) of American older children and adolescents aged 2-19 years were overweight or obese, and almost 17.1% were obese; the figures were lower in young children aged 2-5 years (26.2% and 13.9%, respectively). The prevalence was similar in older children and adolescents. The overall national average prevalence is similar in boys and girls, however, large gender differences exist in some racial/ethnic groups (**Table 1**).

Minority children had higher prevalence rates of overweight and obesity than non-Hispanic white children in most age groups. Mexican American boys aged 2-5 had 44.4% higher rates of overweight and 78.0% higher rates of obesity than white boys. However, the racial/ethnic disparity was reduced among older boys. Mexican American male adolescents had one percentage point lower rates of obesity and overweight. Interestingly, black boys had significantly lower rates of obesity or overweight especially among the 2-5 years age group and 12-19 age groups.

Black girls had the highest rates of obesity and overweight among three racial/ethnic groups (namely white, black and Mexican Americans). On average, the rates of overweight among black girls were 27.0% greater than that among white girls, while the rates of obesity were 60.8% higher. Although Mexican girls aged 2-5 had higher rates than white girls, the prevalence of obesity and overweight were similar between Mexican girls and white girls in other age groups. Therefore, the racial/ethnic disparity in childhood obesity is most severe between black and white girls.

Available data show that among all US minority children, Native American children probably have the highest prevalence of obesity and average level of adiposity. For example, the PATHWAY study, a large school-based

childhood obesity prevention study, assessed a total of 1704 children (mean (+/- SD) age was 7.6 +/- 0.6 y) in 41 schools; and found that their mean BMI (SD) was 18.8 (3.9), and mean percentage body fat was 32.6 (6.8) %. The prevalence of obesity (\leq 95th percentile) was 30.5% in girls and 26.8% in boys; while the combined prevalence (\geq 85th percentile) was 51.5% in girls and 46.5% in boys.²

Other national survey data indicate that Asian children and adolescents have the lowest prevalence of obesity. According to the Add Health Study 1996 survey data, Asian adolescents had the lowest prevalence of overweight among the 4 ethnic groups examined (**Figure 1**).¹⁴ The study shows that among female adolescents, African American girls had the highest prevalence of overweight (BMI $>$ 85th percentile, 37.9%) and Asian girls had the lowest rate (10.4%), which is only approximately 1/4 of that in black girls; while in boys, overall the ethnic differences were much smaller than those in girls. Hispanic boys had the highest rate (27.9%) and Asian boys had the lowest (22.78%), but it doubled that in Asian girls.

Trends in Racial/Ethnic Disparity in Childhood Obesity

Using the NHANES data collected since 1971-74 we have assessed changes over time in the ethnic disparities in childhood obesity.^{24,26,29,30} In all race/ethnic groups, the prevalence of childhood obesity had increased since the 1970s (**Figure 2**). The increasing trend became faster since NHANES II (1976-1980). Between 1976-1980 and 1999-2000, the average annual rate of increase in obesity was approximately 10 percent in Mexican and black children aged 6 years and older, while the same rate was 8 percent in white children. The trend was noticeably steeper among adolescents than young boys and girls. Thus, it is appropriate to say that the racial/ethnic disparity in childhood obesity has been expanding during the last three decades of the 20th century.

The prevalence of childhood obesity seemed to become stable after 2000. The obesity rate among Mexican boys aged 6-11 years was reduced to approximately 5.2%, while the rates among black and white boys aged 6-11 years increased by 2.3% and 55.5%, respectively. Among adolescent boys, the rate of obesity among minority children was reduced: 32.0% among Mexican adolescent boys and 13.5% among black adolescent boys. Only white adolescent boys had a 61.8% increase in the prevalence of obesity during 2000-2004. Except for Mexican girls, both white and black girls aged 6 years and older had increased obesity rates. White girls aged 6-11 years observed a 45% increase in obesity rates, while black girls aged 6-11 had an 18% increase. White adolescent girls had a similar increase rate of obesity (40.0%), while the rate among black adolescent girls only increased slightly 0.2 percentage point. The rate of obesity among Mexican girls aged 6-11 years was reduced slightly by 0.4 percentage point during 2000-2004, while Mexican adolescent girls had 5.2 percentage points reduction in obesity rates. Although the small sample sizes for minority children in NHANES 2001-2002 and 2003-2004 may not provide accurate estimates, ethnic disparities became smaller compared with those during 1976-2000, i.e., the disparities

declined due to the faster increase in obesity among white children and slower increase among minority children.

Average Annual Increase in the Prevalence of Obesity and Future Projection in Racial/Ethnic Disparity

Based on the 1976-2004 NHANES data and using linear regression models, we estimated the average annual increase in prevalence of obesity (BMI \geq 95th percentile) and projected the future trends among US children aged 6 years and older (**Table 3**).^{24,25} In children, the prevalence of obesity (BMI $>=$ 95th percentile) is expected to be doubled to reach 23% by 2015. In children aged 6-11 years, black girls and Mexican-American boys have the fastest annual increase (0.564 vs. 0.548, respectively) in the prevalence. By 2015, the prevalence is expected to reach 31.1% and 32.9%, respectively; and the overall prevalence in all American children will reach 22.7%. The similar patterns are observed in American adolescents aged 12-19 years. In summary, if the obesity trends observed in the past three decades are not reversed, the racial/ethnic disparity in childhood obesity will persist which can result in racial/ethnic disparity in health status and other social consequences.

Discussion

Growing research consistently shows considerable ethnic disparities in the prevalence of obesity and overweight among American children and adolescents. On the other hand, longitudinal data also show considerable changes over time in the ethnic disparities. Compared to Caucasian children and adolescents, some minority groups such as African Americans, Mexican Americans and Native Indians have a higher prevalence while other minority groups such as Asians have a lower prevalence. Native Indians have the highest prevalence while Asians have the lowest prevalence. The ethnic differences in young people are similar to those in adults, although there are some small differences.

Current understanding of the underlying causes of the ethnic disparities in obesity in the U.S. remains limited. The fundamental cause of obesity is an imbalance between energy intake and energy expenditure. A growing body of evidence shows some disparities in energy intake and expenditure (physical activity) across race/ethnic groups. Low socioeconomic status among minority population groups may promote consumption of energy-dense food.^{8,9} Maternal education and household income can also help explain part of the racial/ethnic disparity in childhood obesity.^{12,13}

However, socioeconomic status alone cannot fully explain the disparity in childhood obesity across race/ethnicity.^{23,27} Moreover, there were no significant changes in socioeconomic factors across race/ethnicity that can explain the trends in racial/ethnic disparity in obesity.¹⁶ Although cultural and other individual characteristics may contribute to racial/ethnic disparity in childhood obesity, it has been argued that environmental factors may play a pivotal role in obesity across race/ethnicity groups.^{10,17} For example, African-American and Hispanic neighborhoods had up to 70% fewer supermarkets that provided fresh and low-priced fruits and vegetables compared with white communities.²²

Low income and minority communities also had fewer local physical fitness facilities that reduced the physical activities among minority children.¹³ Therefore, the “obesogenic” environment may be an important contributing factor to the racial/ethnic disparities in childhood obesity.¹⁷ More importantly, proliferation of the “obesogenic” environment to higher income and white communities may reduce racial/ethnic disparity over time.^{26,29}

Due to the severe health consequences of childhood obesity, it is necessary to take immediate action to reverse the trend of childhood obesity in the U.S. Childhood and adolescence are two critical periods for one to form lifelong eating habits and physical activity. Intervention programs that target “obesogenic” environment are most promising to prevent childhood obesity in the future. For example, promoting physical activity among school children should receive a public health priority, since children spend most of their day in school. As most minority groups have higher prevalence, have fewer family resources, and have less access to health care service, they need greater support to combat the obesity epidemic. To reduce the racial/ethnic disparity in childhood obesity, culturally sensitive and comprehensive programs, which involve efforts from government agencies, local communities, and parents, will be more effective to promote healthy eating and active life style among minority children.

References

1. Barlow SE. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics*. 2007;120(Suppl 4):S164-S192.
2. Caballero B, Himes JH, Lohman T, et al; Pathways Study Research Group. Body composition and overweight prevalence in 1704 schoolchildren from 7 American Indian communities. *Am J Clin Nutr*; 2003;78(2):308-312.
3. Carolina Population Center (CPC, 2006) - The National Longitudinal Study of Adolescent Health. <http://www.cpc.unc.edu/addhealth>. September 25, 2006.
4. CDC (1996). The third national health and nutrition examination survey (NHANES III 1988-1994) reference manuals and reports (CD-ROM), 1996, Bethesda, MD.
5. CDC (2008) - NHANES 1999-2004 data files: data, docs, codebooks, sas code. <http://www.cdc.gov/nchs/about/major/nhanes/datalink.htm>. July 11, 2008.
6. CDC (2006) - YRBSS: Youth Risk Behavior Surveillance System. <http://www.cdc.gov/healthyyouth/yrbss>. September 2, 2006.
7. Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics*. 1998;101(3 Pt 2):518-525.
8. Drewnowski A, Darmon N. The economics of obesity: dietary energy density and energy cost. *Am J Clin Nutr*. 2005;82(Suppl 1):S265-S273.
9. Drewnowski A, Specter SE. Poverty and obesity: the role of energy density and energy costs. *Am J Clin Nutr*. 2004;79(1):6-16.
10. Egger G, Swinburn B. An “ecological” approach to the obesity pandemic. *Br Med J*. 1997;315(7106):477-480.
11. Goodman E, Adler NE, Daniels SR, Morrison JA, Slap GB, Dolan LM. Impact of objective and subjective social status on obesity in a biracial cohort of adolescents. *Obes Res*. 2003;11(8):1018-1026.
12. Goodman E, Slap GB, Huang B. The public health impact of socioeconomic status on adolescent depression and obesity. *Am J Public Health*. 2003;93(11):1844-1850.
13. Gordon-Larsen P, Nelson MC, Page P, et al. Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics*. 2006;117(2):417-424.
14. Gordon-Larsen P, Adair LS, Popkin BM. The relationship of ethnicity, socioeconomic factors, and overweight in US adolescents. *Obes Res*. 2003;11(1):121-129.
15. Guillaume M. Defining obesity in childhood: current practice. *Am J Clin Nutr*. 1999;70(1):126S-130S.

16. Harris KM, Gordon-Larsen P, Chantala K, et al. Longitudinal trends in race/ethnic disparities in leading health indicators from adolescence to young adulthood. *Arch Pediatr Adolesc Med.* 2006;160(1):74-81.
17. Hill JO, Peters JC. Environmental contributions to the obesity epidemic. *Science.* 1998;280(5368):1371-1374.
18. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. *Advanced Data.* 2000;314(1):1-27.
19. McDowell A, Engel A, Massey JT, Maurer K. Plan and operation of the Second National Health and Nutrition Examination Survey, 1976-1980. *Vital And Health Statistics. Ser. 1, Programs and Collection Procedures,* 1981:1-144.
20. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and Trends in Overweight among US Children and Adolescents, 1999-2000. *JAMA.* 2002;288(14):1728-1732.
21. Popkin BM, Duffey K, Gordon-Larsen P. Environmental influences on food choice, physical activity and energy balance. *Physiol Behav.* 2005;86(5):603-613.
22. Powell LM, Slater S, Mirtcheva D, et al. Food store availability and neighborhood characteristics in the United States. *Preventive Medicine.* 2007;44(3):189-195.
23. Wang Y. Cross-national comparison of childhood obesity: the epidemic and the relationships between obesity and socioeconomic status. *Int J Epidemiol.* 2001;30(5):1129-1136.
24. Wang, Y. and Beydoun, M. The obesity epidemic in the United States--gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiol Rev.* 2007;29:6-28.
25. Wang Y, Beydoun MA, Liang L, Caballero B, Kumanyika SK (2008). Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. *Obesity (Silver Spring).* 2008;16(10):2323-2330.
26. Wang Y, Zhang Q. 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.* 2006;84(4):707-716.
27. Whitaker RC, Orzol SM. Obesity among US urban preschool children: relationships to race, ethnicity, and socioeconomic status. *Arch Pediatr Adolesc Med.* 2006;160(6):578-584.
28. WHO. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. In: *World Health Organization Technical Report Series,* 2000:Vol. 894.
29. Zhang Q, Wang Y. Trends in the association between obesity and socioeconomic status in U.S. adults: 1971 to 2000. *Obes Res.* 2004;12(10):1622-1632.
30. Zhang Q, Wang Y. Using Concentration Index to Study Changes in Socioeconomic Inequality of Overweight among U.S. Adolescents between 1971 and 2002. *Int J Epidemiol.* 2007;36(4):916-925.

Table 1. Current prevalence (%) of at risk for overweight and overweight in US children and adolescents: NHANES 2003-2004*

	Age (year)	Overweight or At Risk of Overweight (BMI \geq 85th Percentile)				Overweight (BMI \geq 95th Percentile)			
		All	Non-Hispanic White	Non-Hispanic Black	Mexican American	All	Non-Hispanic White	Non-Hispanic Black	Mexican American
Boys and girls	2 – 19	33.6	33.5	35.1	37.0	17.1	16.3	20.0	19.2
	2 – 5	26.2	25.0	24.0	32.6	13.9	11.5	13.0	19.2
	6 – 11	37.2	36.9	40.0	42.9	18.8	17.7	22.0	22.5
	12 – 19	34.3	34.7	36.5	34.3	17.4	17.3	21.8	16.3
Boys	2 – 19	34.8	35.4	30.4	41.4	18.2	17.8	16.4	22.0
	2 – 5	27.3	26.6	21.0	38.3	15.1	13.0	9.7	23.2
	6 – 11	36.5	35.6	34.5	47.9	19.9	18.5	17.5	25.3
	12 – 19	36.8	38.7	31.4	37.3	18.3	19.1	18.5	18.3
Girls	2 – 19	32.4	31.5	40.0	32.2	16.0	14.8	23.8	16.2
	2 – 5	25.2	23.5	27.0	26.7	12.6	10.0	16.3	15.1
	6 – 11	38.0	38.2	45.6	37.4	17.6	16.9	26.5	19.4
	12 – 19	31.7	30.4	42.1	31.1	16.4	15.4	25.4	14.1

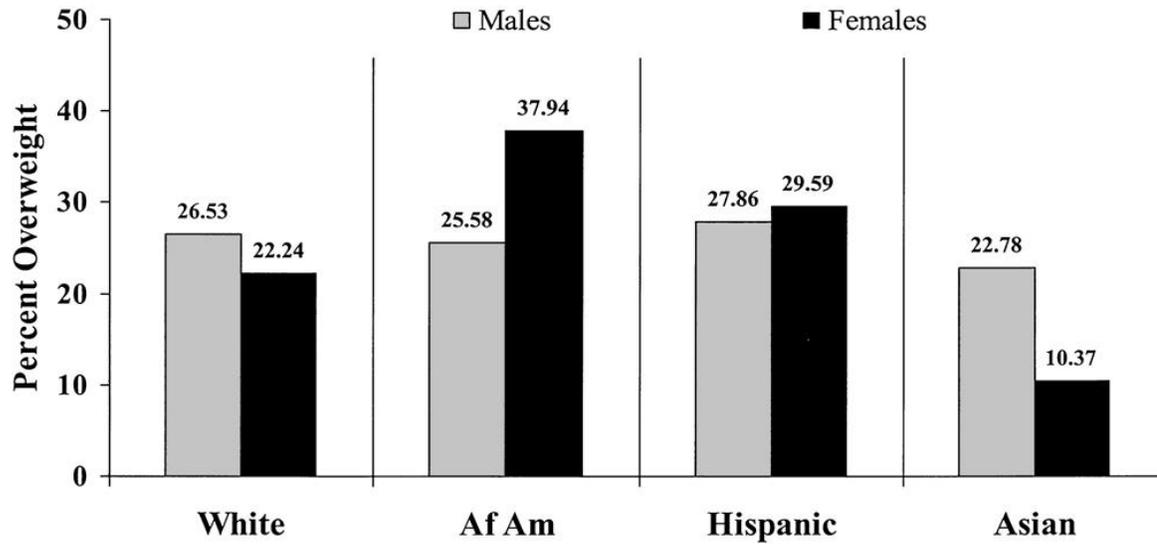
* (Adapted from Ogden et al, 2006)

Table 2. Average annual increase in the prevalence of overweight among US children and adolescents and future projections *

Age	Gender	Ethnicity	Average annual increase (percentage points)	Prevalence (%) projection	
				2010	2015
Children, 6-11 y Overweight (BMI\geq95th percentile)	All	All	0.462	20.42	22.73
	Boys	All	0.492	20.82	23.28
	Girls	All	0.406	19.76	21.79
	Boys	Non-Hispanic White	0.400	19.70	21.70
		Non-Hispanic Black	0.441	21.41	23.62
		Mexican-American	0.548	30.18	32.92
	Girls	Non-Hispanic White	0.403	17.03	19.05
		Non-Hispanic Black	0.564	28.24	31.06
		Mexican-American	0.314*	20.24	21.81
	Adolescents, 12-19 y Overweight (BMI\geq95th percentile)	All	All	0.492	21.12
Boys		All	0.528	21.08	23.72
Girls		All	0.449	18.79	21.04
Boys		Non-Hispanic White	0.526	19.96	22.59
		Non-Hispanic Black	0.537	22.07	24.76
		Mexican-American	0.589	25.29	28.24
Girls		Non-Hispanic White	0.391	16.91	18.87
		Non-Hispanic Black	0.581	29.51	32.42
		Mexican-American	0.360*	20.40	22.20

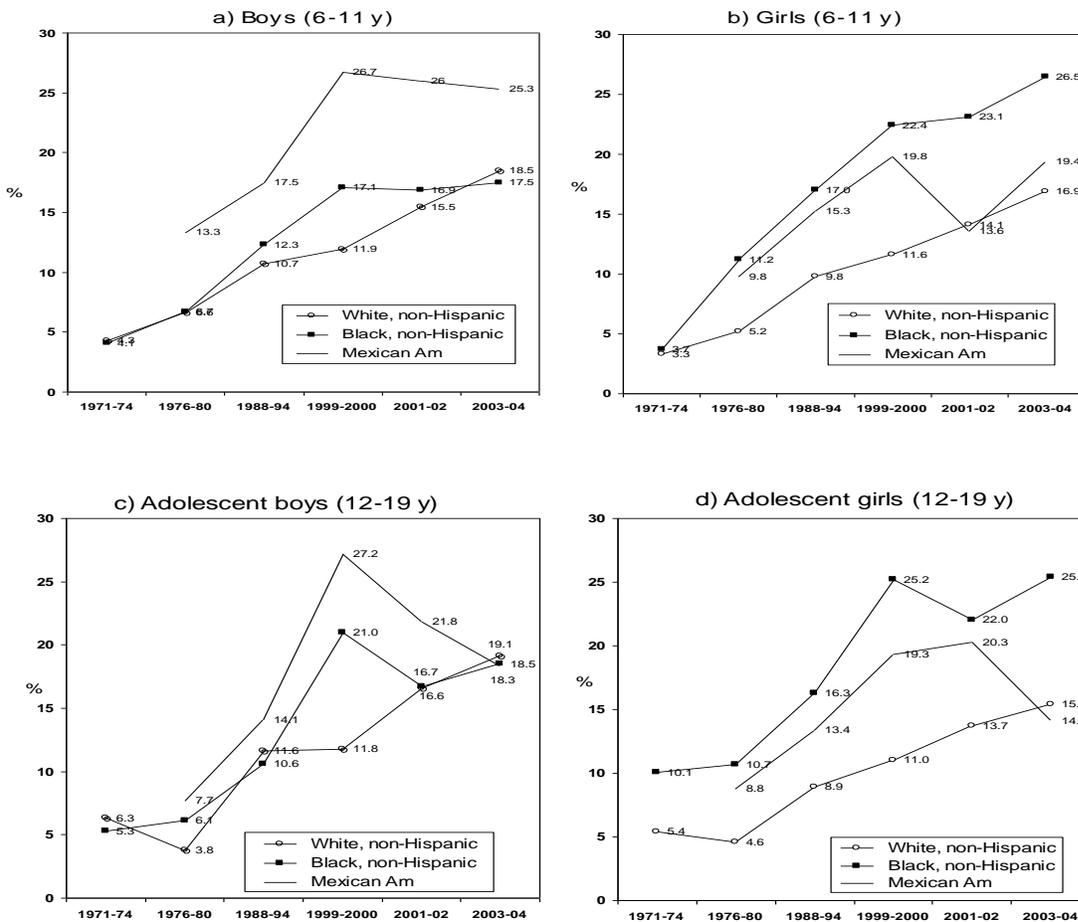
*The annual change rate in the prevalence is estimated based on linear regression models that included prevalence for each year per age/gender/ethnicity stratum as a function of time as the predictor. NHANES data collected between 1976-80 and 1999-2004 were used in most models, but for Mexican-American, only NHANES data collected between 1988-94 and 1999-2004 were used as the sample size is too small in previous waves. (Adapted from Wang and Beydoun, 2007)

Figure 1. Overweight prevalence (%) among US adolescents: the National Longitudinal Study of Adolescent Health (Add Health) *



*Nationally representative data collected from 13,113 U.S. adolescents enrolled in the National Longitudinal Study of Adolescent Health Wave 2, who were measured between April and August, 1996. (Adapted from Gordon-Larsen et al, 2003)

Figure 2. Trends in the prevalence (%) of overweight (BMI ≥ 95th percentile) in US children and adolescents, by gender, age, and ethnicity: NHANES 1971-2004



*We suspect that the dramatic decline in the prevalence between 2001-2004 among Mexican American Adolescents may be due to sampling problems. (Data sources: CDC, 2002; Ogden et al, 2006) (Adapted from Wang and Beydoun, 2007)