Factors Associated with Overweight among Urban American Indian Adolescents: Findings from Project EAT

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Objectives: To determine the prevalence of overweight in a sample of urban American Indian adolescents and identify associated behavioral, personal, and socioenvironmental factors.

Design and Participants: Participants were 246 American Indian boys and girls from the Saint Paul–Minneapolis metropolitan area of Minnesota who completed classroom surveys and anthropometric measurements as part of Project EAT (Eating Among Teens), a population-based study of adolescent nutrition and weight.

Measures: Survey items assessed behavioral factors (physical activity, television/video viewing, snacking and meal patterns, weight control behaviors), personal factors (body satisfaction, nutrition knowledge, nutrition/fitness attitudes, self-efficacy to make healthy food choices, perceived benefits/barriers to healthy eating), and socioenvironmental factors (family meal routines, family connectedness, parental attitudes regarding nutrition/fitness, availability of household foods, peer attitudes about weight and fitness).

Results: Overweight prevalence (body mass index ≥85th percentile) was 43% and 39% for American Indian boys and girls. Compared to nonoverweight American Indian youth, overweight American Indian youth reported watching more hours of television/videos, greater use of weight control behaviors, less frequent snacking, caring less about fitness, lower body satisfaction, and greater parental concern about weight.

Conclusion: Obesity prevention programs targeting American Indian adolescents should focus on reducing time spent watching television/videos, screening for unhealthy weight-control behaviors, improving body satisfaction, and providing support for families to integrate healthy eating into their busy lifestyles. (*Ethn Dis*. 2008;18:317–323)

Key Words: American Indian, Adolescent, Overweight, Body Mass Index (BMI)

Introduction

Obesity disproportionately affects low-income and minority youth, such as American Indians.[1,2] A study conducted on reservations in South Dakota, North Dakota, Nebraska, and Iowa, found that nearly 40% of American Indian youth aged 5–17 years were either overweight or obese.[3] A recent follow-up study on these same reservations in 2002 found that prevalences of overweight and obesity were increasing among the youth.[4] During the seven years between measurements, the prevalence of overweight increased by 4.5% and the prevalence of obesity by 4.3%.[4] Rates of overweight and obesity among American Indian youth were further determined to be higher than corresponding rates for the overall national population at almost every age.[4] Other research in population-based samples of American Indian youth have similarly reported high prevalences of overweight.[5,6]

Medical complications of childhood obesity include hypertension, dyslipidemias, insulin resistance, type 2 diabetes, orthopedic problems, sleep apnea, and social discrimination.[7] For American Indian youth, type 2 diabetes is of paramount concern.[8–13] A 2001 US population-based study of physician-diagnosed diabetes estimated the prevalence of type 2 diabetes to be 1.7 cases per 1000 American Indian adolescents (ages 10–19 years), accounting for 76.4% of all diabetes diagnoses among this group (2.3 cases per 1000 adolescents).[13] In contrast, type 2 diabetes accounted for only 12.0% (.2 cases per 1000 adolescents) of all diabetes diagnoses in the overall population (1.8 cases per 1000 adolescents).[13] Relatively little is known about the factors associated with overweight in American Indian youth. A better understanding of these factors is essential for the development of effective interventions to reduce obesity.

Most studies regarding obesity in American Indians report on individuals living on or near reservations. However, today more than half of American Indians live outside of reservations in urban areas, and some research suggests lifestyle behaviors may differ according to residence.[14–17] For example, studies in American Indian adolescents have found that, when compared with youth living on reservations, urban youth eat more fried foods, initiate alcohol use later, and have more neighborhood or school problems.[15–17] This study assesses the prevalence of overweight among

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an urban sample of American Indian adolescents. In addition, the study examines differences in behavioral, personal, and socioenvironmental factors for overweight and nonoverweight American Indian youth.

METHODS

Study Sample

The survey was administered during the 1998–1999 school year to adolescents from 31 public middle schools and high schools located in the Saint Paul–Minneapolis metropolitan area of Minnesota.[18,19] Participants in Project EAT (Eating Among Teens) (N=4746) were ethnically diverse. The present study focused on the subset of adolescents who self-identified as American Indian (n=282, 6.0% of the total sample). Ethnicity/race was assessed with the question "Do you think of yourself as: 1) White, 2) Black or African American, 3) Hispanic or Latino, 4) Asian American, 5) Hawaiian or Pacific Islander, or 6) American Indian or Native American?" Youth were given the option of choosing multiple responses. Youth who indicated that they were American Indian or were American Indian in addition to any other race/ethnicity were coded as American Indian.

Design and Procedures

Study procedures were approved by the University of Minnesota Human Subjects' Committee and the research boards of the participating school districts. Consent procedures adhered to the requests of the participating school districts; in some sites passive consent procedures were used, and in others active consent procedures were required. All parents received a letter explaining the study and were given the option of refusal. At sites requiring active consent, parents also returned a letter giving written permission for their child to participate.

Trained research staff measured students' weight and height in a private area of the school with standardized equipment and procedures. Staff administered the EAT surveys during health, physical education, or science classes. The overall response rate for student participation was 81.5%. The main reasons for lack of participation were absenteeism and failure to return consent forms at schools that required active consent.[18]

Survey Development

The EAT survey is a 221-item self-report instrument that assesses a range of factors that are relevant to nutritional health and obesity among adolescents. The instrument's development was previously described.[18] Survey development was guided by focus group discussions with youth, a theoretical framework (social cognitive theory) for understanding factors that influence eating behavior,[20] and a literature review to identify suitable existing instruments.[21–23] The instrument was pilot-tested by a diverse group of youth including American Indian adolescents. Revisions were made as needed to the survey instrument.

Measures

Variables were selected from the full Project EAT survey as potential correlates of weight status on the basis of their predictive ability in prior research and the guiding framework of social cognitive theory. Table 1 presents 28 factors selected from the domains of behavioral, personal, and socioenvironmental influence along with the specific survey items used to measure each of the factors and properties of each item.

Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Respondents were classified according to sex- and age-specific cut-off points as underweight (BMI <5th percentile), nonoverweight (BMI 5th to <85th percentile), or overweight (BMI ≥85th percentile).[24]

Statistical Analysis

The prevalence of overweight among American Indian students was compared to that of White students in the Project EAT sample by using the χ^2 statistic. Descriptive statistics (means, percentages) were used to examine the distribution of BMI among American Indian boys and girls. For further analyses, underweight students with a BMI <5th percentile for age and sex (n=3) were excluded. Associations of behavioral, personal, and socioenvironmental factors with weight status among American Indian students were examined by using the t test. In this descriptive phase, no consideration was given to the issue of multiple comparisons. Initially, tests for associations between the factors and weight status were analyzed separately for boys and girls. In general, associations were similar for boys and girls. Because of the similarity between boys and girls and the relatively small sample size after stratification by weight status, data for boys and girls were combined for the final analyses that examined associations of behavioral, personal, and socioenvironmental factors with weight status, which are presented here.

After the separate t tests for each proposed factor, three multivariate logistic regressions (adjusted for sex) were fit, with each of the behavioral, personal, and socioenvironmental factors entered as a block. Predictive powers of the three blocks were assessed by a generalized R^2 statistic and the area (c) under the receiver operating characteristic curve. A final logistic model included the behavioral and personal blocks to examine their combined ability to discriminate between nonoverweight and overweight American Indian adolescents. Socioenvironmental factors were not included in this final model because their combined predictive ability was poor.

RESULTS

A total of 282 American Indian adolescents completed the classroom

Table 1. Description of measures used to assess behavioral, personal, and socioenvironmental factors among adolescents who completed the Project EAT (Eating Among Teens) survey

Variable	Description of survey item(s)
Behavioral factors	
Physical activity	Modified version of the Leisure Time Exercise Questionnaire.[21] Three questions assessed hours spent in strenuous, moderate, and mild physical activity behaviors in a usual week. (range 0–24)
TV/video watching	''In your free time on an average weekday (Monday–Friday), how many hours do you spend watching TV and videos?'' (range 0–5)
Healthy weight-control behaviors	''Have you done any of the following things in order to lose weight or keep from gaining weight during the past year?'' Four items (eg, ''ate more fruits and vegetables'' and ''exercise''). Number of methods used was calculated. (Cronbach α = .81, range 0–4)
Unhealthy weight control behaviors	''Have you done any of the following things to lose weight or keep from gaining weight during the past year?'' Nine items (eg, ''took diet pills'' and ''made myself vomit''). Number of methods used was calculated. (Cronbach α = .70, range 0–9)
Snack frequency	''How many times did you snack (eat in-between meals) yesterday?'' (range 0–6)
Breakfast frequency	''During the past week, how many days did you eat breakfast?'' (range 0–7)
Lunch frequency	''During the past week, how many days did you eat lunch?'' (range 0–7)
Dinner frequency	''During the past week, how many days did you eat dinner?'' (range 0–7)
Personal factors	
Nutrition knowledge	For each question below, please select the food you think is better for your health.'' Seven pairs of food items (eg, pretzels and potato chips). (Cronbach α = .63; range −7 to 7)
Self-efficacy to make healthy food choices	''If you wanted to, how sure are you that you could eat healthy food when you are…?'' Nine statements (eg, ''at a fast food restaurant''). Six responses ranged from ''not at all sure'' to ''very sure.'' (Cronbach α = .83, range 9–54)
Perceived benefits of healthy eating	''The types of food I eat affects… a) my health, b) how I look, c) my weight, d) how well I do in sports, e) how well I do in school.'' Four response categories ranged from ''strongly disagree'' to ''strongly agree.'' (Cronbach α = .83, range 5–20)
Perceived convenience barriers to healthy eating	''How strongly do you agree with the following statements?'' Four statements (eg, ''I am too busy to eat healthy foods.''). Four response categories ranged from ''strongly disagree'' to ''strongly agree.'' (Cronbach α = .69, range 4–16)
Perceived taste barriers to healthy eating	''How strongly do you agree with the following statements?'' Six statements (eg, ''Most unhealthy foods taste better than healthy foods.''). Four response categories ranged from ''strongly disagree'' to ''strongly agree.'' (Cronbach α = .58, range 6–24)
Care about eating healthy foods	''How much do you care about eating healthy foods?'' Four responses ranged from ''not at all'' to ''very much.'' (range 1–4)
Care about staying fit and exercising	''How much do you care about staying fit and exercising?'' Four responses ranged from ''not at all'' to ''very much.'' (range 1–4)
Depression	Kandel and Davies' (1982)[22] six-item scale assessing depressive mood. (Cronbach α = .82, range 7–21)
Self-esteem	Shortened six-item version of Rosenberg's (1965)[23] Self-esteem Scale. (Cronbach α = .79, range 6–24)
Body satisfaction	Body satisfaction scale including 10 items assessing satisfaction with different body parts. Five responses ranged from ''very dissatisfied'' to ''very satisfied.'' (Cronbach α = .92, range 10–50)
Socioenvironmental factors	
Family socioeconomic status	Composite variable based primarily on parental level of education, defined by the higher level of either parent.[19] Other supplemental variables included family eligibility for public assistance, eligibility for free or reduced-cost school meals, and maternal and paternal employment status. (range low to high, 1–5)
Family communication and caring	''How much do you feel you can talk to your mother about your problems?'' ''How much do you feel your mother cares about you?'' Similar questions were asked for fathers. Five response categories ranged from ''not at all'' to ''very much.'' (Cronbach α = .69, range 4–20)
Priority of family meals	''How strongly do you agree with the following statements?'' Four statements (eg, ''I am often just too busy to eat dinner with my family.'') Four response categories ranged from ''strongly disagree'' to ''strongly agree.'' (Cronbach α = .82; range 5–20)
Family meal frequency	''During the past 7 days, how many times did all, or most, of your family living in your house eat a meal together?'' (range 0–9)
Healthy food availability at home	''How often are the following true? a) Fruits and vegetables are available in my home; b) Milk is served at meals at my home; c) We have fruit juice in my home; d) Vegetables are served at dinner in my home.'' (Cronbach α = .63, range 4–16)

Table 1. Continued

Variable	Description of survey item(s)
Unhealthy food availability at home	''How often are the following true? a) We have ''junk food'' in my home; b) Potato chips or other salty snack foods are available in my home; c) Chocolate or other candy is available in my home; d) Soda pop is available in my home.'' (Cronbach α = .80, range 4–16)
Parental dieting behaviors and weight concerns	''My mother… a) diets to lose weight or keep from gaining weight; b) encourages me to diet to control my weight.'' Similar questions were asked about weight concerns and behaviors of fathers. Four response categories ranged from ''not at all'' to ''very much.'' (Cronbach α = .77, range 4–16)
Parent attitudes regarding healthy eating	''My mother… a) cares about eating healthy food; b) encourages me to eat healthy foods.'' Similar questions were asked about attitudes of fathers. Four response categories ranged from ''not at all'' to ''very much.'' (Cronbach α = .79, range 4–16)
Parent attitudes regarding fitness	''My mother… a) cares about staying fit and exercising; b) encourages me to be physically active.'' Similar questions were asked about attitudes of fathers. Four response categories ranged from ''not at all'' to ''very much.'' (Cronbach α = .77, range 4–16)
Peer attitudes regarding weight, health, and fitness	''Many of my friends… a) care about eating healthy food; b) care about staying fit and exercising; c) diet to lose weight or keep from gaining weight.'' Four response categories ranged from ''not at all'' to ''very much.'' (Cronbach α = .73, range 3–15)

survey. The mean age was 14.0 years (standard deviation 1.6 years). Although the adolescents' tribal affiliations were not reported on the survey, in the St. Paul-Minneapolis area most American Indians come from Minnesota Ojibway bands. The distribution of socioeconomic status among American Indian adolescents was low (22.8%), low-middle (19.4%), middle (31.7%), upper-middle (17.1%), and high (9.0%). Observed BMI data were available for 87.2% of these adolescents. Therefore, the final sample included 246 American Indian adolescents, of which 97 were boys (39.4%) and 149 (60.6%) were girls.

Prevalence of Overweight

The overall prevalence of overweight among American Indian boys and girls was 40.6%. Among boys, the prevalence of overweight was 43.3% (mean [standard error] BMI was 23.2 [.5] kg/m^2). Among girls, the prevalence of overweight was 38.9% (23.9 [.5] kg/m^2). Prevalence rates for adolescents with a BMI $\geq$95th percentile were 23.7% for boys and 20.8% for girls.

Overweight was significantly more prevalent among American Indian adolescents than among White adolescents in the Project EAT sample. Among American Indian boys, the prevalence of overweight was 43.3% (n=42) compared with 30.4% (n=357) among White boys (χ^2=6.94, P=.008). Among American Indian girls, the prevalence of overweight was 38.9% compared with 29.7% (n=307) among white girls (χ^2=5.13, P=.02).

Associations of Behavioral, Personal, and Socioenvironmental Factors with Overweight Status among American Indian Adolescents

Behavioral Factors

Compared with nonoverweight (BMI 5th to <85th percentile) American Indian adolescents, overweight (BMI $\geq$85th percentile) adolescents reported watching more hours of weekday television/videos and using more healthy and unhealthy weight-control behaviors during the past year (Table 2). Nonoverweight adolescents also reported more frequent snacking on the previous day than did overweight adolescents. Hours of physical activity and meal frequency during the past week were not associated with overweight status.

Personal Factors

Overweight American Indian adolescents had significantly greater nutrition knowledge than did their nonoverweight counterparts (Table 2). They also cared less about fitness and had lower body satisfaction. Self-efficacy to make healthy food choices, perceived benefits/barriers to healthy eating, depression, and self-esteem were not associated with overweight status.

Socioenvironmental Factors

In general, overweight status and socioenvironmental factors were not associated (Table 2), and family socioeconomic status was not correlated with adolescent BMI (Spearman r=−.01, P=.83). One exception was parental dieting behaviors and weight concerns. Overweight adolescents reported that their parents dieted more and encouraged them to diet more than did the parents of nonoverweight adolescents.

Multivariate Models of Behavioral, Personal, and Socioenvironmental Factors

The combined predictive ability of behavioral factors to determine weight

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status was limited (generalized R^2=.17, c=0.74). The combined predictive ability of personal factors to determine weight status was similar (generalized R^2=.18, c=.76). Together the behavioral and personal factors had greater predictive ability (generalized R^2=.29, c=.83), but their power to discriminate between nonoverweight and overweight adolescents was still only modest. Socioenvironmental factors were not added to the combined model of behavioral and personal factors because their sum predictive ability was poor (generalized R^2=.09, c=.68).

DISCUSSION

A high percentage (41%) of urban American Indian adolescents were overweight. This rate is comparable to that previously reported for youth living on or near reservations[3,5,6] but significantly higher than that of White adolescents in Project EAT and other national, ethnically diverse samples (eg, data from the 1999–2000 National Health and Nutrition Examination Survey indicated that 30% of 12- to 19-year-old adolescents of all ethnicities have a BMI ≥85th percentile).[25]

Of the three domains examined in this study, behavioral and personal factors were most different between overweight and nonoverweight American Indian adolescents. Overweight American Indian adolescents reported spending more weekday hours watching television/videos than did nonoverweight adolescents. Television/video watching is the most prevalent sedentary activity among youth.[26] In one study, Pima Indian children spent more time watching television and had less involvement in sports than did White children.[27] In a large nationally repre-

Table 2. Associations of behavioral, personal, and socioenvironmental factors with overweight among American Indian boys and girls who completed the Project EAT (Eating Among Teens) survey

Factor	Mean ± Standard Error		
	Nonoverweight adolescents* (*n*=143)	Overweight adolescents† (*n*=100)	*P* value
Behavioral Factors			
Physical activity (hours/week)	9.7±.6	10.7±.7	.24
TV/video watching (hours/weekday)	2.7±.1	3.1±.2	**.04**
Weight-control behaviors			
Healthy (number used in past year)	1.8±.1	2.9±.1	**<.001**
Unhealthy (number used in past year)	1.0±.1	1.4±.1	**.02**
Snack frequency (times/day)	2.4±.1	1.7±.1	**<.001**
Breakfast frequency (meals/week)	3.6±.2	3.6±.3	.99
Lunch frequency (meals/week)	5.4±.2	5.3±.2	.73
Dinner frequency (meals/week)	6.1±.1	5.7±.2	.13
Personal Factors			
Nutrition knowledge	2.7±.3	3.7±.3	**.01**
Self-efficacy to make healthy food choices	32.5±.9	31.2±1.0	.32
Perceived benefits of healthy eating	14.5±.3	15.0±.3	.27
Perceived convenience barriers to healthy eating	8.0±.2	8.4±.2	.20
Perceived taste barriers to healthy eating	13.4±.2	13.1±.2	.29
Care about eating healthy foods	3.2±.1	3.0±.1	.07
Care about staying fit and exercising	3.4±.1	3.1±.1	**.02**
Depression	12.0±.3	11.7±.3	.50
Self-esteem	18.1±.3	17.6±.4	.36
Body satisfaction	37.4±.7	31.9±1.0	**<.001**
Socioenvironmental Factors			
Family socioeconomic status	2.7±.1	2.7±.1	.95
Family communication and caring	14.9±.3	15.0±.4	.83
Priority of family meals	11.7±.3	11.5±.3	.72
Family meal frequency (past week)	4.2±.2	4.6±.3	.35
Healthy food availability at home	12.3±.2	12.1±.2	.59
Unhealthy food availability at home	11.2±.2	10.8±.3	.24
Parental dieting behaviors and weight concerns	6.6±.3	8.1±.4	**.003**
Parental attitudes regarding healthy eating	11.7±.3	11.4±.3	.57
Parental attitudes regarding fitness	11.8±.3	11.5±.3	.44
Peer attitudes regarding weight, health, fitness	9.0±.3	8.9±.4	.81

* Body mass index (BMI) 5th to <85th percentile for age and sex.
† BMI ≥85th percentile for age and sex.

sentative sample, minority adolescents engaged in less physical activity and more inactivity than their non-Hispanic White counterparts.[28] Inactivity such as television/video watching can be modified. In a randomized controlled trial of an intervention to reduce television viewing, children in the intervention group watched less television and videos, and after seven months this group had significant decreases in BMI.[29]

In the present study, unhealthy weight-control practices were associated with being overweight. Similar findings have been reported in other studies of American Indian youth[18,30] and more ethnically diverse samples.[31] Based on these findings, health visits could systematically screen for unhealthy weight-control practices among adolescents. Screenings might simultaneously detect other health-related risks; in American Indian adolescents, dieting frequency and purging status are associated with negative psychosocial factors and health risk behaviors such as emotional stress, substance use, and suicidal ideation.[30]

Despite the finding that overweight American Indian adolescents cared less about staying fit and exercising than did nonoverweight American Indian adolescents, no association was found between physical activity and overweight status in the present study. This finding is contrary to those of other published reports of adolescent weight status and behaviors.[25,32] Our null finding can likely be attributed, at least in part, to the difficulty of measuring physical activity with a questionnaire. In a recent study that objectively measured physical activity with an accelerometer, insufficient vigorous physical activity was associated with overweight in boys and girls.[32]

Few studies have documented the effect of being overweight on the psychosocial well-being of American Indian adolescents.[1] In our sample, depression and self-esteem were not associated with overweight status. Data from the Indian Adolescent Health Survey indicated that overweight adolescents were concerned and dissatisfied with their weight, but they did not appear to have any negative psychosocial sequelae, such as suicidal ideation, peer concerns, and future job concerns.[33] Findings regarding an association between global self-esteem and overweight status in children and adolescents have been inconsistent across studies, suggesting the complexity of the issue.[34]

In our study, the only socioenvironmental factor associated with overweight in American Indian adolescents was parents' dieting behaviors and weight concerns. Parents' report of their own dieting behaviors and weight concerns was not assessed, and the parents of overweight adolescents may have also been more likely to be overweight, since obesity tends to run in families.[35] Alternatively, a home atmosphere that emphasizes dieting may be counterproductive to positive weight outcomes in children. Talking about weight and dieting at home may increase the likelihood that children will engage in unhealthy weight-control behaviors, which longitudinally predict risk for overweight in adolescents.[36,37] Effective adolescent intervention programs must include the family and begin as early as possible, especially programs designed for an American Indian population in which obesity begins early in childhood.[4] Food preferences, dietary habits, and physical activity patterns that influence weight status are developed during childhood and adolescence within the context of the family.[35]

Strengths of this study include its focus on the understudied population of urban American Indian adolescents and the large number of behavioral, personal, and socioenvironmental variables assessed. The survey's focus on nutrition and weight-related issues is a major strength; most surveys of adolescents address a broad range of health-related issues and include only a limited number of questions that assess influences on eating and physical activity. However, the design was cross-sectional, and we can infer only that overweight status is associated with certain factors, not caused by them. The population consisted of American Indian adolescents living in the Saint Paul–Minneapolis area of Minnesota; because of the heterogeneity of the American Indian population across the nation, these results may not be generalizable to other American Indian youth living off or on a reservation.

Future research is needed to expand our understanding of factors that contribute to overweight among American Indian adolescents and to develop culturally sensitive intervention programs. The results of this study suggest that programs targeting American Indian adolescents should focus on reducing time spent watching television/videos, screening for unhealthy weight-control behaviors, improving body satisfaction, and providing support for families to integrate healthy eating into their busy lifestyles.

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REFERENCES

1. Story M, Stevens J, Himes J, et al. Obesity in American-Indian children: prevalence, consequences, and prevention. *Prev Med*. 2003;37:S3–12.
2. Acton KJ, Burrows NR, Moore K, Querec L, Geiss LS, Engelgau MM. Trends in diabetes prevalence among American Indian and Alaska native children, adolescents, and young adults. *Am J Public Health*. 2002;92(9):1485–1490.
3. Zephier E, Himes JH, Story M. Prevalence of overweight and obesity in American Indian school children and adolescents in the Aberdeen area: a population study. *Int J Obes Relat Metab Disord*. 1999;23(Suppl 2):S28–30.
4. Zephier E, Himes JH, Story M, Zhou X. Increasing prevalences of overweight and obesity in Northern Plains American Indian

children. *Arch Pediatr Adolesc Med*. 2006; 160(1):34–39.
5. Jackson MY. Height, weight, and body mass index of American Indian schoolchildren, 1990–1991. *J Am Diet Assoc*. 1993;93(10): 1136–1140.
6. White LL, Ballew C, Gilbert TJ, Mendlein JM, Mokdad AH, Strauss KF. Weight, body image, and weight control practices of Navajo Indians: findings from the Navajo Health and Nutrition Survey. *J Nutr*. 1997;127:2094S–2098S.
7. Daniels S, Arnett D, Eckel R, et al. Overweight in children and adolescents: pathophysiology, consequences, prevention, and treatment. *Circulation*. 2005;111:1999–2012.
8. American Diabetes Association. Type 2 diabetes in children and adolescents. *Diabetes Care*. 2000;23(3):381–389.
9. Young TK, Reading J, Elias B, O'Neil JD. Type 2 diabetes mellitus in Canada's first nations: status of an epidemic in progress. *CMAJ*. 2000;163(5):561–566.
10. Rosenbloom AL. Increasing incidence of type 2 diabetes in children and adolescents: treatment considerations. *Paediatr Drugs*. 2002;4(4):209–221.
11. Fagot-Campagna A, Pettitt DJ, Engelgau MM, et al. Type 2 diabetes among North American children and adolescents: an epidemiologic review and a public health perspective. *J Pediatr*. 2000;136(5):664–672.
12. Fagot-Campagna A. Emergence of type 2 diabetes mellitus in children: epidemiological evidence. *J Pediatr Endocrinol Metab*. 2000;13:1395–1402.
13. SEARCH for Diabetes in Youth Study Group. The burden of diabetes mellitus among US youth: prevalence estimates from the SEARCH for Diabetes in Youth Study. *Pediatrics*. 2006;118:1510–1518.
14. Indian Health Service. Indian population. Available at: http://www.ihs.gov/publicinfo/publicaffairs/ihsbrochure/people/people1.pdf. Accessed 9/12/07.
15. Yu M, Stiffman A. Culture and environment as predictors of alcohol abuse/dependence symptoms in American Indian youths. *Addict Behav*. 2007;32:2253–2259.
16. Yu M, Stiffman A, Freedenthal S. Factors affecting American Indian adolescent tobacco use. *Addict Behav*. 2005;30:889–904.
17. Di Noia J, Schinke S, Contento I. Dietary patterns of reservation and non-reservation Native American youths. *Ethn Dis*. 2005; 15:705–712.
18. Neumark-Sztainer D, Croll J, Story M, Hannan PJ, French S, Perry C. Ethnic/racial differences in weight-related concerns and behaviors among adolescent girls and boys: findings from Project EAT. *J Psychosom Res*. 2002;53:963–974.
19. Neumark-Sztainer D, Story M, Hannan P, Croll J. Overweight status and eating patterns among adolescents: where do youths stand in comparison with the Healthy People 2010 objectives? *Am J Public Health*. 2002;92: 844–851.
20. Baranowski T, Perry C, Parcel G. How individuals, environments and health behavior interact: social cognitive theory. In: Glanz K, Rimer B, Lewis F, eds. *Health Behavior and Education: Theory, Research and Practice*. San Francisco: Jossey-Bass, 2002;165–184.
21. Godin G, Shepard R. A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci*. 1985;10(3):141–146.
22. Kandel D, Davies M. Epidemiology of depressive mood in adolescents. *Arch Gen Psychiatry*. 1982;39(10):1205–1212.
23. Rosenberg M. *Society and the Adolescent Self Image*. Princeton (NJ): Princeton University; 1965.
24. Himes JH, Dietz WH. Guidelines for overweight in adolescent preventive services: recommendations from an expert committee. The Expert Committee on Clinical Guidelines for Overweight in Adolescent Preventive Services. *Am J Clin Nutr*. 1994;59(2):307–316.
25. Boutelle K, Neumark-Sztainer D, Story M, Resnick M. Weight control behaviors among obese, overweight, and non-overweight adolescents. *J Pediatr Psychol*. 2002;27(6): 531–540.
26. Bar-Or O, Foreyt J, Bouchard C, et al. Physical activity, genetic, and nutritional considerations in childhood weight management. *Med Sci Sports Exerc*. 1998;30(1):2–10.
27. Fontvieille AM, Kriska A, Ravussin E. Decreased physical activity in Pima Indian compared with Caucasian children. *Int J Obes Relat Metab Disord*. 1993;17(8):445–452.
28. Gordon-Larsen P, McMurray RG, Popkin BM. Adolescent physical activity and inactivity vary by ethnicity: The National Longitudinal Study of Adolescent Health. *J Pediatr*. 1999;135(3):301–306.
29. Robinson TN. Reducing children's television viewing to prevent obesity: a randomized controlled trial. *JAMA*. 1999;282(16): 1561–1567.
30. Story M, French S, Neumark-Sztainer D, Downes B, Resnick M, Blum R. Psychosocial and behavioral correlates of dieting and purging in Native American adolescents. *Pediatrics*. 1997;99(4):E8.
31. Neumark-Sztainer D, Story M, French S, Hannan P, Resnick M, Blum RW. Psychosocial concerns and health compromising behaviors among overweight and non-overweight adolescents. *Obes Res*. 1997;5(3):237–249.
32. Patrick K, Norman GJ, Calfas KJ, et al. Diet, physical activity, and sedentary behaviors as risk factors for overweight in adolescence. *Arch Pediatr Adolesc Med*. 2004;158(4):385–390.
33. Neumark-Sztainer D, Story M, Resnick MD, Blum RW. Psychosocial concerns and weight control behaviors among overweight and non-overweight Native American adolescents. *J Am Diet Assoc*. 1997;97(6):598–604.
34. French SA, Story M, Perry CL. Self-esteem and obesity in children and adolescents: a literature review. *Obes Res*. 1995;3(5): 479–490.
35. Birch LL, Davison KK. Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. *Pediatr Clin North Am*. 2001;48(4): 893–907.
36. Neumark-Sztainer D, Wall M, Guo J, Story M, Haines J, Eisenberg M. Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents: how do dieters fare 5 years later? *J Am Diet Assoc*. 2006;106(4): 559–568.
37. Field A, Austin S, Taylor C, et al. Relation between dieting and weight change among preadolescents and adolescents. *Pediatrics*. 2003;112(4):900–906.

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