

Relationship of Physical Activity and Television Watching With Body Weight and Level of Fatness Among Children

Results From the Third National Health and Nutrition Examination Survey

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Context.—Physical inactivity contributes to weight gain in adults, but whether this relationship is true for children of different ethnic groups is not well established.

Objective.—To assess participation in vigorous activity and television watching habits and their relationship to body weight and fatness in US children.

Design.—Nationally representative cross-sectional survey with an in-person interview and medical examination.

Setting and Participants.—Between 1988 and 1994, 4063 children aged 8 through 16 years were examined as part of the National Health and Nutrition Examination Survey III. Mexican Americans and non-Hispanic blacks were oversampled to produce reliable estimates for these groups.

Main Outcome Measures.—Episodes of weekly vigorous activity and daily hours of television watched, and their relationship to body mass index and body fatness.

Results.—Eighty percent of US children reported performing 3 or more bouts of vigorous activity each week. This rate was lower in non-Hispanic black and Mexican American girls (69% and 73%, respectively). Twenty percent of US children participated in 2 or fewer bouts of vigorous activity per week, and the rate was higher in girls (26%) than in boys (17%). Overall, 26% of US children watched 4 or more hours of television per day and 67% watched at least 2 hours per day. Non-Hispanic black children had the highest rates of watching 4 or more hours of television per day (42%). Boys and girls who watch 4 or more hours of television each day had greater body fat ($P < .001$) and had a greater body mass index ($P < .001$) than those who watched less than 2 hours per day.

Conclusions.—Many US children watch a great deal of television and are inadequately vigorously active. Vigorous activity levels are lowest among girls, non-Hispanic blacks, and Mexican Americans. Intervention strategies to promote lifelong physical activity among US children are needed to stem the adverse health consequences of inactivity.

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THE PREVALENCE of overweight continues to increase in the US adult population.¹⁻³ In the 12 years between the Second National Health and Nutrition Examination Survey (NHANES II, 1976 through 1980) and NHANES III (1988 through 1991), the prevalence of overweight in US adults increased from 25% to 33%.² The prevalence of overweight also increased by similar magnitudes among all sex and age groups of children

and adolescents.¹ Obesity in children has been associated with subsequent morbidity and mortality in adulthood.⁴ These trends have persisted despite our nation's intense preoccupation with weight.⁵

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Similarly, the prevalence of obesity in England has doubled in the past decade, yet daily energy intake and fat consumption have actually been reduced in that country during this time period.⁶ A change in the volume of daily physical activity may account for this apparent discrepancy. Increasingly, leisure time activities are more sedentary, with television watching, video games, and personal computing among the most popular pastimes. Further, people in industrialized countries are expending less energy in activities of daily living, and at work.^{6,7}

Several studies suggest that an active lifestyle during childhood and adolescence can play an important role in optimizing growth and development.^{7,8} The Centers for Disease Control and Prevention recently recommended that comprehensive school and community programs be developed to promote physical activity among children and adolescents.⁹ The goals of these programs are to increase knowledge about activity and exercise, develop behavioral and motor skills that promote lifelong activity, and encourage physical activity outside of physical education classes.

Using data from NHANES III, this article provides estimates of daily television watching habits and weekly bouts of vigorous physical activity in a nationally representative sample of US children aged 8 through 16 years. We also examined the

relationship between body mass index (BMI), body fatness, and bouts of vigorous activity and television watching.

METHODS

Sample Design

The NHANES III was conducted by the Centers for Disease Control and Prevention, National Center for Health Statistics. The plan and operation of NHANES III have been described elsewhere.^{10,11} Briefly, the survey was designed to produce a nationally representative sample of the US population. One of its main goals was to estimate the national prevalence of selected health conditions and risk factors.

The NHANES III represents a 6-year study from 1988 through 1994 and consists of two 3-year phases: phase I, 1988 through 1991; and phase II, 1991 through 1994. Although the entire 6-year survey constitutes a national survey, the survey was designed so that each phase was also a nationally representative sample. The NHANES III oversampled Mexican Americans, non-Hispanic blacks, and young children to ensure weighted, reliable estimates for these groups. Approximately 16% of those interviewed ranged in age from 8 through 16 years. Combined data from phases I and II are reported in this article.

The interview was conducted in the child's home and a detailed clinical examination was performed in a mobile examination center. During the home interview part of NHANES III, 5365 children were interviewed and the analytic sample consisted of 4063 children aged 8 through 16 years who completed the physical activity questionnaire and the body measurement component at the mobile examination center. Children who were mentally retarded or had a proxy answer questions for them were excluded from the analyses, as were those with cerebral palsy, muscle weakness, or paralysis of the arms or legs.

Interviewing staff consisted of experienced persons, many of whom were of Hispanic origin or bilingual in English and Spanish. Interview forms were available in both languages. All staff attended yearly training sessions to ensure maintenance of effective interviewing skills.

Information on self-reported race and ethnicity was used to classify persons as non-Hispanic white, non-Hispanic black, or Mexican American (persons of Mexican origin living in the United States). Age was defined as age in years at the time of the household interview, which preceded the examination by 2 to 3 weeks.

Dependent Variables

Participating children were asked how many times per week they "played or ex-

Table 1.—Unadjusted and Age-Specific Prevalence (per 100) of the Number of Reported Sessions of Weekly Play or Exercise That Results in Sweating or Hard Breathing Among US Children, 1988 Through 1994

Population Group, Age 8-16 y	Sample Size, No.	Prevalence (SE)		
		≤1 Time Weekly	2 Times Weekly	≥3 Times Weekly
Total	4056	8.8 (0.4)	11.6 (0.6)	79.6 (0.7)
Boys, age group, y	1985	5.2 (0.5)	10.3 (1.0)	84.6 (1.2)
8-10	794	8.9 (0.9)	11.5 (1.2)	79.6 (1.6)
11-13	650	4.0 (0.8)	8.3 (0.9)	87.7 (1.4)
14-16	541	2.6 (0.5)	11.0 (1.9)	86.4 (1.8)
Girls, age group, y	2071	12.5 (0.6)	13.0 (0.7)	74.5 (0.7)
8-10	748	8.5 (0.9)	14.6 (1.3)	76.9 (1.3)
11-13	706	8.7 (1.0)	9.5 (0.8)	81.8 (1.4)
14-16	617	20.1 (1.3)	14.9 (1.5)	65.0 (1.7)
Non-Hispanic white				
Boys	506	3.4 (0.5)	8.8 (1.2)	87.9 (1.4)
Girls	557	10.9 (0.9)	12.0 (0.9)	77.1 (1.1)
Non-Hispanic black				
Boys	708	9.4 (0.8)	13.0 (0.9)	77.6 (1.0)
Girls	716	15.8 (1.0)	14.8 (1.1)	69.4 (1.5)
Mexican American				
Boys	682	7.4 (1.1)	12.4 (1.1)	80.2 (1.4)
Girls	704	15.4 (1.2)	11.9 (1.3)	72.6 (1.9)

ercised enough to make them sweat or breathe hard." These activities did not exclude school-related involvements such as physical education. The interview also included a question on the number of hours of television watched the day before the interview was administered. Body composition was estimated by calculating the BMI [the weight (in kilograms) divided by the height (in meters, squared)], since it has been found to be significantly related to the percentage of body fat and total body fat in boys and girls.¹² We also calculated the sum of the subscapular and suprailiac skinfolds as an index of trunk fat.

Statistical Analysis

Statistical analyses were carried out using SAS¹³ and WesVarPC.¹⁴ For each survey, sampling weights were calculated that took into account the unequal selection probabilities resulting from the cluster design and from planned oversampling of certain subgroups. All analyses incorporated the sampling weights. For variance estimation, the balance repeated replication method in the software package WesVarPC¹⁴ was used. Statistical differences were determined using 2-tailed *t* tests taking the sampling weights and the complex sample design into account.¹⁴ Furthermore, the General Linear Model procedure in SAS¹³ was used to calculate the least square means to adjust for Tanner stages¹⁵ in estimating physical activity and hours of television watching.

RESULTS

The cross-sectional prevalence estimates of the number of bouts of vigorous activity per week for US children aged 8 through 16 years from 1988 through 1994 are shown in Table 1. Overall, 80% reported participating in play or exercise that

made them sweat or breathe hard 3 or more times per week; the rate was higher in boys (85%) than in girls (74%). Among non-Hispanic white boys, 88% reported exercising vigorously 3 or more times per week, whereas 78% of non-Hispanic black boys and 80% of Mexican American boys met this criterion; 72.6% of Mexican American girls and 69% of non-Hispanic black girls reported performing 3 or more bouts of vigorous activity each week, whereas only 12.2% of non-Hispanic white boys reported fewer than 3 bouts of vigorous activity per week. Table 1 also presents prevalence rates of bouts of vigorous physical activity among various age groups of US children. Boys and girls reported similar patterns of vigorous play in both the 8 through 10 years and the 11 through 13 years age groups with the boys reporting slightly more physical activity in each group. However, only 65% of girls aged 14 through 16 years reported 3 or more bouts of vigorous activity per week, whereas 86% of age-matched boys achieved this level. Few boys or girls reported 1 or less bouts of vigorous activity per week, with the exception of 20.1% of 14- to 16-year-old girls reporting this level of inactivity. Further analyses (data not shown) revealed that 8.7% of the 14- to 16-year-old girls reported less than 1 bout of vigorous activity per week.

The cross-sectional prevalence rate estimates of hours of television watched per day among US children are presented in Table 2. Overall, 26% of American children reported watching 4 or more hours of television per day; the rate was lower in girls (23%) than in boys (29%). Forty-three percent of non-Hispanic black boys and girls reported watching television for more than 4 hours per day. In contrast, non-Hispanic white boys

Table 2.—Unadjusted and Age-Specific Prevalence (per 100) of Hours of Television Watched per Day Among US Children, 1988 Through 1994

Population Group, Age 8-16 y	Sample Size, No.	Prevalence (SE)		
		≤1 h Daily	2-3 h Daily	≥4 h Daily
Total	4063	39.1 (0.9)	35.1 (1.0)	25.9 (0.7)
Boys, age group, y	1987	36.3 (1.1)	34.8 (1.3)	28.9 (1.0)
8-10	793	41.0 (1.8)	32.0 (1.7)	27.0 (1.5)
11-13	653	33.1 (1.9)	35.6 (2.1)	31.3 (1.4)
14-16	541	34.8 (1.9)	36.8 (2.2)	28.3 (2.0)
Girls, age group, y	2076	41.9 (1.42)	35.3 (1.2)	22.7 (1.1)
8-10	753	47.7 (1.9)	34.0 (1.8)	18.3 (1.1)
11-13	706	34.3 (1.7)	39.4 (1.8)	26.3 (1.6)
14-16	617	43.6 (2.5)	32.7 (2.1)	23.7 (2.1)
Non-Hispanic white				
Boys	507	39.7 (1.5)	36.0 (1.8)	24.3 (1.2)
Girls	555	49.5 (2.0)	34.9 (1.7)	15.6 (1.1)
Non-Hispanic black				
Boys	705	27.9 (1.1)	29.2 (1.1)	42.8 (1.3)
Girls	721	23.8 (1.1)	33.1 (1.0)	43.1 (1.6)
Mexican American				
Boys	684	30.1 (1.7)	36.6 (1.7)	33.3 (1.5)
Girls	706	33.8 (1.6)	37.9 (2.1)	28.3 (1.4)

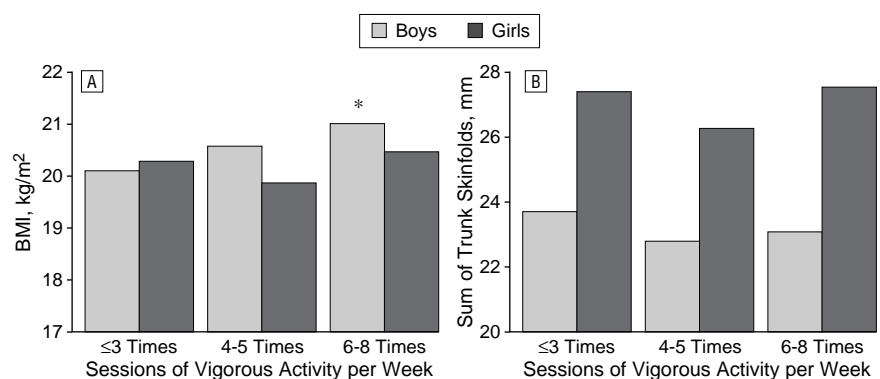


Figure 1.—Mean body mass index (BMI) (A) and the mean sum of the subscapular and suprailiac skinfolds (B) in relation to the number of vigorous activity sessions completed weekly among US children aged 8 to 16 years, 1988 through 1994. Asterisk indicates significantly different ($P < .001$) from 3 or less times per week.

and girls had the lowest prevalence of watching television more than 4 hours per day (25% of boys and 18% of girls).

Boys and girls reported similar patterns of television watching across age groups (Table 2). The highest prevalence of watching 4 or more hours of television per day occurred in 11- to 13-year-old children. Both boys and girls in this age group also had the lowest prevalence of watching 1 or less hours of television per day.

Figure 1 shows the Tanner-score adjusted mean BMI (A) and the sum of the trunk skinfolds (B) in relation to the number of bouts of vigorous activity completed weekly. Boys who reported 6 to 8 sessions of vigorous activity per week had the highest BMIs, whereas those who reported 3 or fewer sessions of vigorous activity per week had the lowest. In the girls, no clear trend occurred.

Figure 2 shows the Tanner-score adjusted mean BMI (A) and the sum of the trunk skinfolds (B) in relation to the number of daily hours of television

watched. Boys and girls who watched 4 or more hours of television per day had the highest skinfold thicknesses and highest BMIs; conversely, children who watched less than 1 hour of television per day had the lowest BMIs.

We cross-tabulated thirds of daily television watching and thirds of weekly bouts of vigorous activity to examine the interaction that these measures may have on Tanner score-adjusted BMI and the sum of trunk skinfolds (Figure 3). We observed that television watching was more closely related to skinfolds and BMI than was vigorous activity. Multivariate analyses revealed no interaction between television watching and physical activity. Furthermore, significant effects were seen for television watching but not for physical activity.

COMMENT

We found that US children are currently more active than their adult counterparts, with almost 80% reporting 3 or

more bouts of vigorous activity each week.¹⁶ However, there are several worrisome trends among adolescent females and ethnic minority groups. Of concern, 26% of all girls and 31% of non-Hispanic black girls report 2 or fewer bouts of vigorous activity per week. Our data reconfirm that vigorous activity among ethnic minority children is lower than in non-Hispanic white children.^{17,18} Such information must be considered when developing physical education curricula and community-based intervention strategies aimed at increasing physical activity among different target populations.

One of the objectives of *Healthy People 2000* is to increase vigorous physical activity to at least 3 days per week for 20 minutes or more per occasion in at least 75% of children and adolescents.¹⁹ Boys of all ages appear to be meeting this criterion. However, a decrease in physical activity seems to occur as girls move from the 11- to 13-year age group to the 14- to 16-year age group. Moreover, 20.1% of girls aged 14 to 16 years reported 1 or fewer bouts of vigorous physical activity each week. These data are consistent with the 1992 National Health Interview Survey - Youth Risk Behavior Survey, which reported that 8.7% of 15-year-old females reported no participation in moderate or vigorous activity,¹⁶ and that 18.5% of 17-year-old females were sedentary. Malina²⁰ has suggested that the adolescent decline in physical activity that occurs after the growth spurt is probably related to the social demands of adolescence, changing interests and the transition from school to work or school to college. However, the level of physical activity in our study may be optimistically high because children who lived in northern states were surveyed during the summer when physical activity is known to be at its peak. Furthermore, the question about physical activity did not assess moderate activity or duration of vigorous activity, so a brief bout of vigorous activity could have been reported as a single bout of exercise.

Because a sedentary lifestyle is considered a risk factor for coronary artery disease,²¹ parents and health care professionals need to encourage adolescent females in particular to maintain active lifestyles throughout adolescence. The International Consensus Conference on Physical Activity Guidelines for Adolescents recommends that "all adolescents . . . be physically active daily, or nearly every day, as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities" and that "adolescents engage in three or more sessions per week of activities that last 20 minutes or

more at a time and that require moderate to vigorous levels of exertion.”²²

We also found that non-Hispanic white children were the most active, with 77% of girls and 88% of boys reporting 3 or more bouts of vigorous activity per week. However, only 69% of non-Hispanic black girls and 73% of Mexican American girls reached this threshold. Concerns about crime may present a major barrier to some children becoming more physically active.⁷ In a survey of parents, 46% of US adults believed that their neighborhoods were unsafe.²³ Parents in minority populations are twice as likely as non-Hispanic white parents to report that their neighborhoods were unsafe. This information may partially explain the lower bouts of vigorous activity and higher prevalence of television watching reported in non-Hispanic black and Mexican American children. Successful implementation of policies to address this problem may help to increase physical activity in these 2 groups. For example, neighborhood watch programs and increased policing in high crime areas may help alleviate fears and foster an environment where parents feel it is safe for their children to play. Furthermore, *Healthy People 2000* calls for increased community availability and accessibility of physical activity and fitness facilities.¹⁹ Thus, studies that specifically attempt to promote enjoyable, lifetime activities among ethnic minorities should receive high priority in the public health arena.

Troiano and colleagues¹ reported that the prevalence of overweight is increasing among boys and girls of all age groups and suggested increasing physical activity as a means to address this important health problem. Physical activity is inversely related to body weight, body composition, and the waist-to-hip ratio in adults. Sedentary leisure time activities such as television watching, playing video games, and personal computing have contributed to the increasing prevalence of overweight in America.²⁴⁻²⁷ Our report shows that television watching was associated with increased skinfold thickness and BMI among US youth.

Overall, we found high rates of television watching, with 26% of US children (and 43% of non-Hispanic black children) watching 4 or more hours per day. Strasburger²⁸ has calculated that the average high school graduate will likely spend 15 000 to 18 000 hours in front of a television but only 12 000 hours in school. Next to sleeping, television watching occupies the greatest amount of leisure time during childhood.²⁷ We found that skinfold thicknesses increased in both boys and girls as the amount of television watched increased. This finding is consistent with an earlier study that found a significant relationship between

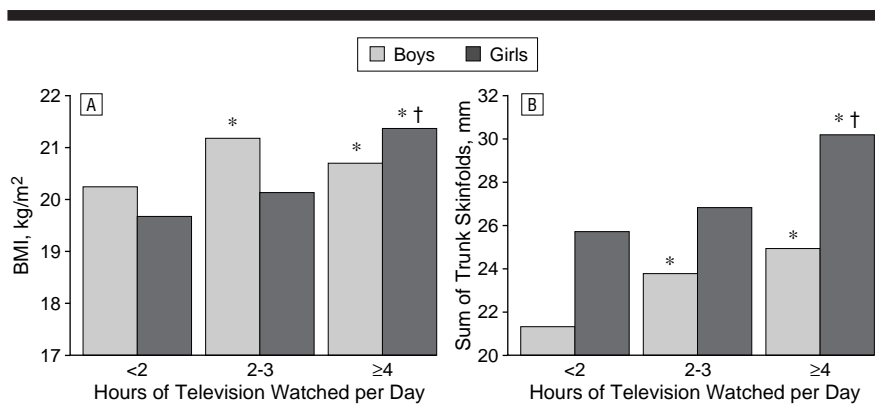


Figure 2.—Mean body mass index (BMI) (A) and the mean sum of the subscapular and suprailliac skinfolds (B) in relation to daily hours of television watched among US children aged 8 to 16 years, 1988 through 1994. Asterisk indicates significantly greater ($P<.001$) than the less than 2-hour group; dagger indicates significantly greater ($P<.001$) than the 2- to 3-hour group.

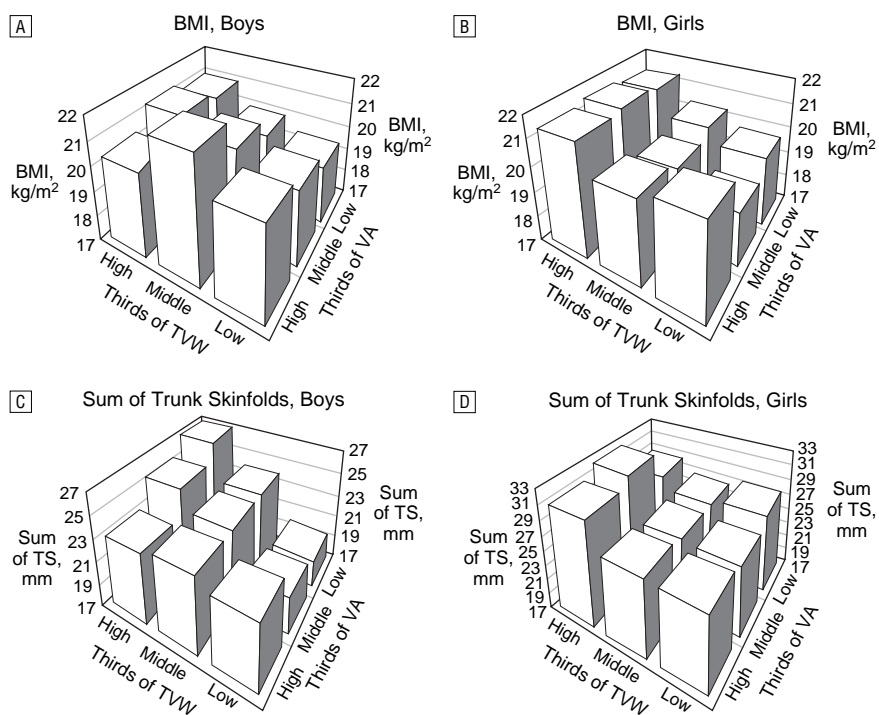


Figure 3.—Mean body mass index (BMI) (A, B) and the sum of the subscapular and suprailliac skinfolds (C, D) by combinations of daily hours of television watched (TVW) and weekly sessions of vigorous play or exercise (VA) among US children aged 8 to 16 years, 1988 through 1994.

television watching and the prevalence of obesity in children.²⁶

We also found a relationship between television watching, physical activity, and body composition. Children who watched more television and were less likely to participate in vigorous activity tended to have higher BMIs. This is consistent with the findings of Durant et al.²⁹ Two studies have reported strong inverse relationships between television watching and physical activity after television was introduced into small communities in Canada³⁰ and Scotland.³¹ Additional research is needed to further iden-

tify types of physical activities that could serve as alternative activities, especially for minority children, among whom television watching is greatest. Studies among persons of low socioeconomic status and among certain racial groups have demonstrated specific determinants and activity preferences. This information has been used to effectively tailor culturally appropriate physical activity promotion programs.

Currently, 45% of Mexican American and 49% of non-Hispanic black adult women are overweight.² Low levels of vigorous activity and increased televi-

sion watching most likely are contributing to this trend. Overweight children are more likely to become overweight adults than their leaner counterparts.³²⁻³⁴ It appears that overweight in adulthood can more accurately be predicted from the body weight in late adolescence as opposed to younger ages.^{33,34} Furthermore, the risks of obesity in adulthood appear to be greater in persons who were overweight during childhood and adolescent years.^{35,36} Thus, increased efforts must be placed on preventing excessive weight gain in older children.

In our study, BMI and the sum of trunk skinfolds were similar in boys and girls who were highly active compared with those who participated in little activity. Conversely, children who watched the most television had more body fat and greater BMIs than those who watched less than 2 hours per day. This underscores the work of Epstein and colleagues,³⁷ who reported that decreasing sedentary behaviors is a key ingredient to the successful treatment of childhood obesity. Moreover, repeated exposure to television commercials for food may prompt children to increase food consumption, which ultimately leads to weight gain.³⁸ Sedentary activities that are regularly associated with eating also can become conditioned cues for eating, such that a child who is not hungry and begins television watching may find that the television watching cues eating.³⁹

For young people, learning to be physically active may be a more potent motivator for physical activity than the knowledge about why being physically active is important.^{40,41} Health care professionals, parents, and educators should encourage children and adolescents to be active before, during, and after the school day. Recent guidelines for the promotion of lifelong physical activity recommend that health care professionals routinely assess levels of physical activity in their young patients. Physicians can play a key role in encouraging sedentary children and their families to adopt more active lifestyles.^{42,43} Inactive children and adolescents should be guided toward school or community programs that encourage physical activity. Children and adolescents who regularly participate in physical activity should be encouraged to continue and maintain their active ways.

In summary, although many American children (80%) are regularly active, rates of inactivity among adolescent girls, non-Hispanic blacks, and Mexican Americans are cause for concern. One quarter of all US children watch 4 or more hours of television each day, as do 43% of non-Hispanic blacks. Hours of television watching is related to both BMI and skinfold thickness.

Physicians and other health care professionals should counsel children and their caregivers on the importance of regular physical activity and decreasing sedentary activities. Intervention strategies designed to promote lifetime physical activity represent a major public health challenge and priority.

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