# Ethnic Differences in Physical Activity and Inactivity Patterns and Overweight Status

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**Abstract**

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***Objective:*** To examine the relationship between physical activity and inactivity patterns and overweight in U.S. adolescents using baseline and 1-year change in activity and inactivity data.

***Research Methods and Procedures:*** Nationally representative data from 12,759 participants (6997 non-Hispanic whites, 2676 non-Hispanic blacks, 2185 Hispanics, and 901 Asians) in the National Longitudinal Study of Adolescent Health (1995 and 1996). Data on moderate to vigorous and low-intensity physical activity, TV/video viewing, and video game/computer use were obtained from questionnaires. Multivariate models assessed the association of overweight (body mass index ≥ 95th percentile Centers for Disease Control and Prevention/National Center for Health Statistics 2000 curves) with initial (and 1-year change) activity and inactivity levels, controlling for age, ethnicity, socioeconomic status, urban residence, cigarette smoking, and region of residence.

***Results:*** Overweight prevalence was positively associated with high level TV/video viewing among white boys (odds ratio [OR] = 1.52; 95% confidence interval [1.08 to 2.14]) and girls (OR = 2.45 [1.51 to 3.97]). The odds of overweight decreased with high levels of moderate to vigorous physical activity among white boys (OR = 0.81 [0.76 to 0.87]), non-Hispanic black boys (OR = 0.86 [0.76 to 0.98]) and girls (OR = 0.88 [0.78 to 0.99]), and Hispanic boys (OR = 0.90 [0.83 to 0.97]) and girls (OR = 0.91 [0.84 to 0.99]).

***Discussion:*** Predicted probabilities generated from the logistic regression models, which examined the experimental effects of altering hours of TV/video viewing and bouts of moderate to vigorous physical activity, show lower overweight among adolescents who watched less TV per week combined with frequent moderate to vigorous physical activity than those who watched more TV per week combined with fewer bouts of weekly moderate to vigorous physical activity. Predicted probabilities suggest important sex and ethnic differences in these associations.

**Key words: metabolic equivalents, U.S. adolescents, television, ethnicity**

## Introduction

Recent surveys show an alarming trend of increased overweight prevalence in U.S. adolescents (1). Childhood and adolescent overweight are major health problems for American youth because of their associated morbidities (2,3) and tendency to persist into adulthood (4,5).

Physical activity and inactivity have been shown to be related to obesity, but exert influence through different behavioral pathways (6). Evidence suggests that physical activity is inversely associated with overweight (7–9), although results are inconsistent (10,11). Researchers have found that inactivity, specifically television viewing, is an important risk factor for obesity development (6,12–14), although these results are inconsistent as well (7,15,16). Physical activity and inactivity track into adulthood, although inactivity shows better tracking (17). A substantial body of research by Epstein and colleagues (16,18–21) has shown that reducing physical inactivity of children can increase physical activity and reduce obesity.

Cumulative research has shown a positive relationship between TV viewing and obesity among children and adolescents in national samples (12–14,22–24). However, little work has explored the relationship among physical activity, inactivity, and overweight in large samples, which include substantial ethnic subpopulations, specifically Asian and Hispanic Americans. Moreover, analyses of physical activ-

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ity have not included adequate measures of both low- and moderate/vigorous-intensity physical activity. Furthermore, there is little in the literature on the role of changes in physical activity and inactivity and their association with overweight among any national sample of U.S. adolescents.

The purpose of this study was to examine the association among physical activity, inactivity, and overweight to inform interventions to reduce overweight. This study aimed to document the prevalence of overweight and assess the association of initial status of (and 1-year change) TV and video viewing, computer/video game use, moderate to vigorous physical activity, and low-intensity physical activity with overweight among U.S. adolescents. This study makes three important and unique contributions to the activity literature: use of baseline and dynamic measures of physical activity and inactivity, use of broad physical activity measures, including moderate to vigorous and low-intensity physical activity data, and the opportunity to investigate the association of physical activity and inactivity with overweight in a large nationally representative sample of adolescents of diverse ethnic backgrounds.

## Research Methods and Procedures

### *Survey Design*

The study population includes more than 20,000 adolescents enrolled in The National Longitudinal Study of Adolescent Health (Add Health), a longitudinal, nationally representative, school-based study of adolescents in grades 7 to 12 (ages 12 to 22 years) in the United States. Add Health included a core sample plus subsamples of selected minority and other groupings collected under protocols approved by the Institutional Review Board of the University of North Carolina at Chapel Hill. We used the wave 1 (20,747 eligible adolescents measured April to December, 1995) and wave 2 samples (14,438 eligible adolescents who would be still enrolled in high school during 1996, including dropouts, measured April to August, 1996). Exclusions included the following: adolescents who used a walking aid (e.g., cane, crutches, or wheelchair); Native Americans ($N = 178$), due to small sample size; adolescents without complete physical activity, height, and weight data; and adolescents older than 19 years of age. Our final sample includes 12,759 adolescents, 11 to 19 years of age ($\bar{X} = 15.9 \pm 0.11$), 49.3% boys (sample sizes are shown in Table 1), for prevalence estimates and logistic regression analysis. The survey design and sampling frame have been described elsewhere (25,26).

In-home surveys of adolescents provided the physical activity and inactivity, body mass index (BMI), and smoking data. In-home surveys of parents and adolescents provided income and educational data. Race and ethnicity were determined using self-reported data from a combination of all the surveys.

### *Body Mass*

Height and weight were measured in wave 2. For multivariate analysis, overweight is defined as a BMI $\geq$ 95th percentile of age- and sex-specific cut-points from the Centers for Disease Control and Prevention/National Center for Health Statistics 2000 growth charts (27) as recommended by expert panels (28,29).

### *Physical Activity and Inactivity*

Add Health questionnaires included a standard physical activity behavior recall that is similar, although not identical, to other self-report questionnaires that have been used and validated in other large-scale epidemiological studies (12,30–33). Information was elicited on participation in moderate to vigorous physical activity (5 to 8 metabolic equivalents [METs], skating and cycling, exercise and active sports) and low-intensity activity (2 to 3 METs; house cleaning, hobbies, and hanging out with friends) in units of times per week. There were no 4 MET level activities reported. One MET represents the resting metabolic rate or 3.5 mL $O_2$/kg body per minute. TV viewing, video viewing, and computer/video game use were recorded as hours per week over the past week. These methods have been described in detail elsewhere (26). Quantifying inactivity has received far less attention than physical activity (34) and little, if anything, is published in the literature regarding the reliability and validity of inactivity data.

### *Study Variables*

We examined initial status of physical activity and inactivity measured in wave 1 of the study and the change between waves 1 and 2. We categorized initial status of TV and video viewing as low ($\leq$7 h/wk, reference); medium (8 to 35 h/wk), and high (36+ h/wk); and computer/video game use as $<$4 or 4+ h/wk. We used these categories to correct for non-normal distributions and for comparative purposes, based on the recommendation of the American Academy of Pediatrics Committee on Public Education (35) to watch no more than 1 to 2 hours of TV per day.

We used categories of change in inactivity for the multivariate analyses: TV and video viewing (increase of $\geq$7 h/wk) and computer/video games (increase of $\geq$1 h/wk). Categories of inactivity (TV, video viewing, and computer/video game use) were initially analyzed separately; however, final models combined TV- and video-viewing hours because of absence of a separate video effect on overweight and similarity in MET values for watching TV and videos. This strategy ignores the separate effect of TV advertising.

### *Statistical Analysis*

Statistical analyses were carried out using STATA, Version 6.0 (StataCorp, College Station, TX) (36). Descriptive analysis used post-stratification sample weights to allow results to be representative of adolescents attending U.S.

**Table 1.** Baseline levels and 1-year change in physical activity and inactivity among U.S. adolescents [mean (SE)]*

| Initial status and 1-year change | Non-Hispanic whites | Non-Hispanic blacks | Hispanics | Asians | Total sample |
|---|---|---|---|---|---|
| | | | Boys | | |
| Sample size | 3546 | 1253 | 1101 | 478 | 6288 |
| TV/video (h/wk) | 20.3†§ (0.54) | 29.5¶ (0.71) | 22.0†** (0.79) | 18.0 (1.06) | 21.8‡ (0.53) |
| Games (h/wk) | 4.3†§ (0.23) | 6.3†¶ (0.53) | 3.8†** (0.34) | 4.5† (0.63) | 4.3‡ (0.18) |
| Moderate to vigorous physical activity (bouts/wk) | 4.4† (0.08) | 4.2† (0.07) | 4.2† (0.12) | 4.4† (0.15) | 4.2‡ (0.04) |
| Low-intensity physical activity (bouts/wk) | 5.7§ (0.04) | 5.5 (0.07) | 5.1**††‡‡ (0.09) | 5.5 (0.16) | 5.5 (0.04) |
| Increase in TV/video ≥7 h/wk (%) | 21.5†§ (0.65) | 31.7 (1.49) | 28.0†‡‡ (1.33) | 26.6§§ (1.73) | 25.0‡ (0.73) |
| Increase in games ≥1 h/wk (%) | 30.4†§ (0.73) | 35.6† (1.56) | 33.7† (1.42) | 35.8†§§ (1.53) | 32.4‡ (0.63) |
| Change in moderate to vigorous physical activity (bouts/wk) | −0.24 (0.05) | −0.22 (0.07) | −0.23 (0.09) | −0.25§§ (0.11) | −0.25 (0.03) |
| Change in low-intensity physical activity (bouts/wk) | 0.14 (0.05) | −0.06 (0.08) | 0.17 (0.10) | 0.18 (0.14) | 0.06 (0.03) |
| | | | Girls | | |
| Sample size | 3541 | 1423 | 1084 | 423 | 6471 |
| TV/video (h/wk) | 16.8§ (0.51) | 26.8¶ (0.73) | 19.9**‡‡ (0.83) | 16.0 (1.40) | 18.7 (0.52) |
| Games (h/wk) | 1.3§ (0.09) | 2.0 (0.22) | 1.8** (0.25) | 1.2 (0.23) | 1.4 (0.07) |
| Moderate to vigorous physical activity (bouts/wk) | 3.5§ (0.07) | 3.0 (0.12) | 3.1††‡‡ (0.12) | 3.5 (0.19) | 3.3 (0.05) |
| Low-intensity physical activity (bouts/wk) | 5.6§ (0.04) | 5.3¶ (0.07) | 5.2††‡‡ (0.09) | 5.6 (1.39) | 5.5 (0.03) |
| Increase in TV/video ≥7 h/wk (%) | 18.2§ (0.84) | 32.0 (1.33) | 23.6**‡‡ (1.07) | 26.2§§ (2.31) | 22.7 (0.77) |
| Increase in games ≥1 h/wk (%) | 21.5 (1.00) | 22.4 (1.25) | 19.7†† (1.16) | 26.5 (2.22) | 21.8 (0.62) |
| Change in moderate to vigorous physical activity (bouts/wk) | −0.11 (0.05) | −0.21¶ (0.08) | −0.09†† (0.11) | −0.57 (0.15) | −0.17 (0.03) |
| Change in low-intensity physical activity (bouts/wk) | 0.15 (0.05) | −0.11 (0.06) | 0.24 (0.18) | −0.04 (0.09) | 0.07 (0.03) |

* Results weighted to be nationally representative. SE terms adjusted for complex survey design effects.
† Within-ethnicity: sex differences statistically significant ($p \leq 0.01$).
‡ Total sample: boy–girl differences statistically significant ($p \leq 0.001$).
§ Within-sex, non-Hispanic white and non-Hispanic black significant differences ($p \leq 0.01$).
¶ Within-sex, non-Hispanic black and Asian significant differences ($p \leq 0.01$).
** Within-sex, non-Hispanic black and Hispanic significant differences ($p \leq 0.01$).
†† Within-sex, Hispanic and Asian significant differences ($p \leq 0.01$).
‡‡ Within-sex, non-Hispanic white and Hispanic significant differences ($p \leq 0.01$).
§§ Within-sex, non-Hispanic white and Asian significant differences ($p \leq 0.01$).

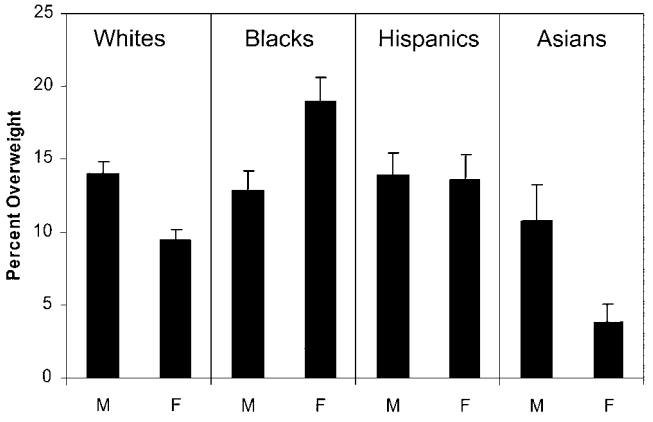


*Figure 1:* Mean percentage of overweight (body mass index ≥ 95th percentile Centers for Disease Control and Prevention/National Center for Health Statistics 2000) for U.S. adolescents by ethnicity and sex. Source: National Longitudinal Survey for Adolescent Health, Wave II 1996. *Results were weighted to be nationally representative. SE terms were adjusted for complex survey design effects.

middle- and high-schools. All analyses used multiple stages of cluster sampling to allow for survey design effects. We used logistic regression models of overweight (BMI ≥ 95th percentile; Centers for Disease Control and Prevention/National Center for Health Statistics) to investigate the effects of initial (and 1-year change) activity and inactivity status, and the interaction between initial status and 1-year change in activity and inactivity. Conceptually, use of change in activity/inactivity adds knowledge and increases confidence that the associations between activity/inactivity and overweight represent causal relationships. The interaction between initial status and change variables was not significant and, therefore, was excluded from final models.

Sociodemographic correlates of activity and inactivity were used as control variables. These correlates included age, total household income, parental education, urban residence (urban, rural, and suburban), cigarette smoking, presence of mother in household, and presence of father in household. Models were stratified by sex and ethnicity.

## Results

### *Overweight Status*

Overweight prevalence (Figure 1) was highest among non-Hispanic black girls, non-Hispanic white boys, and Hispanic boys and girls. Mean BMI values of those classified as overweight ranged from 31.6 at age 12 years to 35.2 at age 18 years.

### *Initial Status of Inactivity and Activity*

In the total sample, TV/video viewing was higher among boys. By ethnicity, non-Hispanic blacks had the highest levels (Table 1). Overall, boys, particularly non-Hispanic black and Asian boys, spent considerably more time playing computer/video games.

In the total sample, boys had more bouts per week of moderate to vigorous physical activity than girls (Table 1). Moderate to vigorous activity was highest for Asian and non-Hispanic white boys and lowest for non-Hispanic black and Hispanic girls. Boys and girls engaged in identical total mean low-intensity physical activity per week.

### *One-Year Changes in Inactivity and Activity*

The total sample had a 1-year decrease in the hours per week of TV/video (mean = −1.49; SE = 0.26 h/wk), with sex and ethnic variation shown in Table 1. Overall, adolescents decreased the number of hours per week of video/computer game use (mean = −0.41; SE = 0.11) over the 1-year period. Boys had significantly higher increases in TV/video viewing and games than girls.

On average, adolescents decreased weekly moderate to vigorous physical activity, with a sample mean of −0.19 (SE = 0.03) bouts per week. There were greater decrements among boys, and specifically Asian and non-Hispanic white boys. On average, adolescents increased their low-intensity physical activity over the 1-year period (mean = 0.13; SE = 0.03) bouts per week. It is likely that adolescents are replacing TV/video viewing with low-intensity physical activity, such as talking on the telephone, hanging out with friends, and driving or riding in cars.

### *Association of Physical Activity and Inactivity with Overweight*

Initial status and change in physical activity and inactivity were modeled in sex- and ethnicity-stratified models controlling for age, maternal education, family income, presence of mother in the household, urban residence, cigarette smoking, region, and cluster sampling (Table 2).

For the total sample of U.S. boys (fifth column of Table 2), odds of overweight were nearly 50% higher with high TV viewing and 14% lower with high moderate to vigorous physical activity. A 1-year decrease in moderate to vigorous physical activity was associated with a 10% decrease in odds of overweight. For the total sample of U.S. girls (fifth column of Table 2), odds of overweight were 43% higher with high TV/video viewing and 10% lower with high moderate to vigorous physical activity. In addition, girls had 8% higher odds of overweight with 1-year change in low-intensity physical activity.

The pattern of results by sex and ethnic groups (the first four columns of Table 2) showed substantial variation in the association between levels of inactivity and activity by sex and ethnicity. For example, greater TV/video viewing was significantly associated with increased risk of overweight only among white adolescents. Computer and video game

**Table 2.** Relationship of activity and inactivity to overweight among U.S. adolescents: odds ratios (confidence intervals) of initial status and 1-year change variables from logistic regression models of overweight (body mass index ≥ 95th percentile Centers for Disease Control and Prevention/National Center for Health Statistics 2000) stratified by sex and ethnicity*†‡

| Initial status and 1-year change | Non-Hispanic whites | Non-Hispanic blacks | Hispanics | Asians | Total sample |
|---|---|---|---|---|---|
| | | | Boys | | |
| TV/video (>35 h/wk) | 1.52§ (1.08–2.14) | 0.90 (0.49–1.66) | 1.89 (0.75–4.74) | 1.42 (0.39–5.23) | 1.49¶ (1.14–1.97) |
| 1-year change-TV/video ≥7 h/wk | 1.14 (0.88–1.46) | 0.95 (0.65–1.38) | 1.13 (0.64–1.99) | 0.80 (0.37–1.69) | 1.08 (0.89–1.30) |
| Computer/video games (≥4 h/wk) | 1.10 (0.86–1.41) | 1.30 (0.92–1.85) | 1.27 (0.95–1.69) | 0.49§ (0.26–0.91) | 1.11 (0.95–1.30) |
| Moderate to vigorous physical activity (bout/wk) | 0.81¶ (0.76–0.87) | 0.86§ (0.76–0.98) | 0.90¶ (0.83–0.97) | 1.14 (0.93–1.40) | 0.86¶ (0.81–0.91) |
| 1-year change in moderate to vigorous physical activity | 0.88¶ (0.84–0.92) | 0.92 (0.83–1.02) | 0.90¶ (0.83–0.98) | 1.06 (0.96–1.17) | 0.90¶ (0.87–0.94) |
| 1-year change in low-intensity physical activity | 1.01 (0.95–1.07) | 1.05 (0.93–1.18) | 1.08 (0.98–1.19) | 0.91 (0.81–1.02) | 1.01 (0.96–1.07) |
| | | | Girls | | |
| TV/video (>35 h/wk) | 2.45¶ (1.51–3.97) | 0.74 (0.48–1.16) | 1.23 (0.70–2.16) | 2.58 (0.75–8.86) | 1.43§ (1.07–1.90) |
| 1-year change in TV/video ≥7 h/wk | 1.24 (0.92–1.68) | 1.05 (0.79–1.40) | 0.94 (0.65–1.35) | 1.57 (1.31–4.87) | 1.15 (0.96–1.39) |
| Computer/video games (≥4 h/wk) | 1.17 (0.77–1.78) | 0.92 (0.62–1.36) | 0.76 (0.40–1.42) | 2.53¶ (1.31–4.87) | 1.08 (0.85–1.37) |
| Moderate to vigorous physical activity (bout/wk) | 0.91 (0.82–1.00) | 0.88§ (0.78–0.99) | 0.91§ (0.84–0.99) | 1.06 (0.93–1.22) | 0.90¶ (0.85–0.96) |
| 1-year change in moderate to vigorous physical activity | 0.92§ (0.86–0.99) | 0.93 (0.85–1.03) | 1.06 (0.95–1.18) | 1.08 (0.86–1.35) | 0.96 (0.91–1.01) |
| 1-year change in low-intensity physical activity | 1.07 (0.98–1.16) | 1.10 (0.99–1.21) | 1.05 (0.94–1.18) | 1.27§ (0.99–1.62) | 1.08¶ (1.02–1.14) |

Note: low-intensity physical activity = composite measure of number of low-level physical activity events; moderate to vigorous physical activity = composite measure of high-level physical activity events.

* Controlling for age, maternal education, family income, presence of mother in the household, urban residence, cigarette smoking, and region.

† SE terms corrected for complex design effects.

‡ Baseline low-intensity physical activity included in model but not shown due to lack of statistical significance.

§ $p \leq 0.05$.

¶ $p \leq 0.01$.

**Table 3.** Predicted overweight probabilities. U.S. adolescents (BMI ≥ 95th percentile Centers for Disease Control and Prevention/National Center for Health Statistics 2000) at selected physical activity and inactivity levels*†

| | Non-Hispanic whites | | Non-Hispanic blacks | | Hispanics | | Asians | | Total sample | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls |
| Adjusted mean overweight‡ | 14.0 | 9.4 | 12.9 | 19.0 | 13.9 | 13.6 | 10.8 | 3.8 | 13.4 | 11.0 |
| ≤7 hours of TV/video/wk | 13.1 | 9.0 | 13.7 | 17.0 | 14.4 | 11.4 | 7.5 | 3.8 | 13.3 | 10.2 |
| >35 hours TV/video/wk | 18.5 | 19.0 | 12.6 | 13.3 | 23.6 | 13.6 | 10.0 | 8.1 | 18.6 | 13.8 |
| 7 bouts M-V PA/wk | 9.3 | 8.5 | 7.5 | 12.9 | 13.1 | 9.7 | 10.0 | 4.8 | 10.5 | 8.7 |
| 1 bout M-V PA/wk | 21.8 | 13.0 | 17.9 | 21.7 | 19.8 | 14.2 | 5.7 | 3.7 | 19.8 | 13.5 |
| High inactivity/low M-V PA§ | 27.8 | 21.5 | 18.7 | 17.0 | 27.6 | 15.3 | 8.0 | 5.2 | 25.4 | 15.8 |
| Low inactivity/high M-V PA¶ | 9.1 | 7.6 | 10.9 | 12.3 | 12.3 | 9.1 | 10.9 | 3.4 | 10.5 | 7.9 |

Note: M-V PA = bouts of moderate to vigorous level physical activity per week.

* Based on logistic regression models from Table 2.

† SE terms are adjusted for complex survey design effects.

‡ Adjusted using regression models controlling for age, urban residence, socioeconomic status, presence of mother and father in household, region, and cluster sampling.

§ Greater than 35 hours of TV/video viewing per week, 1-year increase of ≥7 h/week of TV/video viewing, and 1 bout of moderate-vigorous physical activity per week.

¶ Seven or fewer hours of TV/video viewing per week, 1-year increase of <7 h/week of TV/video viewing, and 7 bouts of moderate to vigorous physical activity per week.

use was significantly associated with decreased risk of overweight among Asians. Moderate to vigorous physical activity was significantly associated with decreased risk of overweight except among non-Hispanic white girls and Asians, with levels ranging from 19% lower among non-Hispanic whites to 9% lower among Hispanic girls.

Models were run with and without change variables to determine the effect of using the more dynamic models. Models of overweight using baseline measures without the change variables showed similar patterns as those with change variables, although significance level of baseline measures was moderately higher for the models including change measures.

### *Predicted Probability of Overweight by Level of TV Viewing and Moderate to Vigorous Physical Activity*

An alternative strategy for interpreting the relative importance of activity and inactivity involves predicting the prevalence of overweight at different, researcher-specified levels of activity and inactivity. To accomplish this, we used coefficients derived from the fully adjusted logistic regression models described above to calculate predicted probability of overweight for low vs. high levels of TV/video viewing (≤7 vs. >35 h/wk), moderate to vigorous activity (1 vs. 7 bouts/wk) and combinations of high inactivity with low moderate to vigorous activity vs. low inactivity with high moderate to vigorous activity. Results are presented in Table 3.

Predicted probability of overweight was higher (5.3 percentage points, boys and 3.6 percentage points, girls) with >35 h/wk of TV/video viewing vs. ≤7 h/wk. For moderate to vigorous activity, the predicted probability of overweight was 9.3 percentage points (boys) and 4.8 percentage points (girls) higher among those who engaged in one bout of moderate to vigorous physical activity per week, compared with those who engaged in seven bouts per week. The combined effects of high inactivity and low moderate to vigorous physical activity is particularly evident in boys: the predicted probability of overweight was nearly 15 percentage points higher for those with high TV/video time and low moderate to vigorous activity. For girls, the comparable difference was 7.9 percentage points.

The greatest impact of additional hours of TV/video viewing on overweight was for non-Hispanic white girls (10 percentage points higher) and Hispanic boys (9.2 percentage points higher), whereas negative effects were seen for non-Hispanic black boys (1.1 percentage points lower) and girls (3.7 percentage points lower). Higher levels of moderate to vigorous physical activity had comparatively stronger effects on non-Hispanic white boys (12.5 percentage points higher) and non-Hispanic black boys (10.4 percentage points higher).

## Discussion

These results are consistent with previous research showing an association of overweight prevalence with TV view-

ing among U.S. children and adolescents (12–14,22–24) and in smaller studies (37,38). Researchers found a larger 1-year increase in BMI among youths who reported more time viewing TV, videos, and games (39). However, other researchers found no association between TV viewing and obesity (15,40,41). In fact, the point has been made that the positive findings cited above represent weak associations (15,42). Behavioral studies show that reductions in inactivity result in increases in physical activity and reduced obesity (16,18–21). The discrepancy in published findings may reflect the difficulty in accurately measuring television viewing and physical activity (13,42).

On average, the odds of overweight in this study were nearly 50% higher with greater TV/video viewing. Similarly, other researchers found increased odds of overweight for American youth with higher TV viewing (13,14,43). Results from the predicted probabilities for the total study sample suggest that reducing TV-viewing time will likely result in a dramatic reduction in overweight prevalence. Related to this result, Epstein et al. (19–21) have shown that reducing TV viewing was successful in decreasing obesity among children. In addition, intervention research has shown TV-viewing reductions decreased BMI among girls (16,44). Furthermore, research has shown a greater association between overweight and TV viewing than physical activity (24). Our findings indicate that reducing inactivity might be less successful among selected ethnic groups (e.g., non-Hispanic black adolescents, Asians and Hispanic girls) and this is disconcerting given high-inactivity/low-physical activity patterns among minority adolescents (26).

At the other end of the activity spectrum, we found a negative association between greater moderate to vigorous physical activity and overweight among non-Hispanic white boys, non-Hispanic blacks, and Hispanics of both sexes. Results suggest that increasing moderate to vigorous physical activity will likely result in dramatic reductions in overweight for all groups, except Asians, with greatest potential among non-Hispanic white and black boys. Evidence from other studies also suggests that physical activity is inversely associated with overweight (7–9). Despite the fact that a cross-sectional analysis of a national sample found no relationship between overweight and moderate to vigorous physical activity, researchers did find a negative relationship between overweight and participation in sport teams and exercise programs in boys and 14- to 16-year-old girls (23).

Our findings demonstrate a significant association between moderate to vigorous physical activity and overweight. Few studies have examined this association and even fewer have found that moderate to vigorous physical activity influences overweight status [e.g., two national studies found no relationship between physical activity and body composition (12,13)]. Moreover, the work of Epstein et al. (19–21) has highlighted the importance of reductions in inactivity for obesity intervention efforts. Lack of a positive effect on weight (despite positive changes in moderate to vigorous physical activity) (45) in the Child Adolescent Trial for Cardiovascular Health study also emphasized a greater focus on inactivity (46). Importantly, we have shown that moderate to vigorous physical activity is far more amenable to environmental interventions than inactivity (47).

In terms of methodology, we separately tested low-intensity physical activity, a dimension of physical activity heretofore ignored. We found a modest effect of change in low-intensity physical activity on overweight status for girls, in general, and specifically in Asian girls. In addition, we found that using both baseline and 1-year dynamic change in activity and inactivity were important. On average, using the dynamic measures does not dramatically change the association of overweight with our baseline values, perhaps due to the limited 12-month length of the measurement period. Future research should use longitudinal analyses over longer periods to fully understand these longitudinal relationships.

The ethnic differences found in this study likely resulted from a complex interaction between socioeconomic, environmental, and cultural factors. For example, previous results from the Add Health study suggest that environmental influences exert an important positive influence on physical activity levels, whereas socioeconomic factors exert an influence on inactivity (47). It may also be possible that the ethnic differentials observed in this study could be the result of differential reporting of physical activity and inactivity, perhaps due to cultural influences and expectations that may differentially lead to over- or underreporting of activity and inactivity. Future work will help to elucidate the complex interactions between these factors and how they relate to overweight among U.S. adolescents.

In summary, these findings suggest that overweight prevalence is high and adolescents are engaging in high levels of inactivity and low levels of moderate to vigorous physical activity. We find that reductions in television and video viewing are likely to reduce overweight of U.S. adolescents. In addition, we find that an increase in moderate to vigorous physical activity represents another potentially successful strategy for reducing overweight among U.S. adolescents. Both approaches, and particularly an approach that combines reductions in inactivity and promotion of physical activity, are likely to result in marked reductions in overweight prevalence among our nation's youth. However, we must begin to consider the differences in behavior in different ethnic subpopulations, as well as differences in underlying factors that influence behavior differentials, as we devise intervention strategies.

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