Healthy Habits Among Adolescents: Sleep, Exercise, Diet, and Body Image

Kathleen Mullan Harris
University of North Carolina and
Carolina Population Center

Rosalind Berkowitz King
Nation Institute for Child Health and Development

Penny Gordon-Larsen
University of North Carolina and
The Carolina Population Center

Paper prepared for the Indicators of Positive Development Conference, March 12-13, 2003 at the Bureau of Labor Statistics Conference Center, Washington, D.C. Results presented are preliminary. We are grateful to the National Institute of Child Health and Human Development for their support through grant P01 HD31921 as part of the Add Health project, a program project designed by J. Richard Udry (PI) and Peter Bearman, and funded by NICHD to the Carolina Population Center, University of North Carolina at Chapel Hill, with cooperative funding participation of 17 other federal agencies. We also acknowledge support to Harris through the Family and Child Well-being Research Network, grant U01 HD37558, of the National Institute of Child Health and Human Development. We thank Annie Latta for her assistance with the tables and Shannon Cavanagh for her thoughtful contributions on the background and analyses of body image.

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Introduction

Healthy habits among children lay the groundwork for positive youth development (Danner 2000; Ge et al. 2001; Siegel et al. 1999; USDHHS 1996). Most fundamental to the developing child are health habits involving sleep, diet, and exercise. This paper reviews the literature on physical activity, diet, and sleep among adolescents, and explores available indicators of these health habits using data from the National Longitudinal Study of Adolescent Health (Add Health).

We focus on adolescents because this is the life stage when youth begin to exercise their independence from parental control and monitoring and when parents begin to grant children more autonomy to make their own decisions and judgements about what they eat, how long they sleep, and in what forms and level of intensity they engage in physical activity. Adolescence also marks the stage of rapid physical development when notions of an ideal body image become especially salient in young people's lives as they develop self-conceptions of their own body image. With unique data from Add Health we explore body image indicators which can be both a consequence and a cause of healthy habits involving diet and exercise during adolescence. Finally, adolescence is the life stage when individuals begin to formulate their healthy habits, setting patterns that continue into adulthood (Andrade et al. 1993; Must et al. 1992; Serdula et al. 1993).

Attention to healthy habits in adolescence has heightened as obesity has become a serious public health problem affecting nearly 25 percent of all North American children (USDHHS 1996). Concern over adolescent obesity has mounted due to its rapid increase in prevalence, its persistence into adulthood, and its associated health consequences, including morbidity and mortality (Must et al., 1992; NIH 1995;

Serdula 1994). For example, there has been a dramatic increase in the incidence of Type II diabetes ("adult-onset") in adolescents in parallel with the national increase in prevalence of obesity (Pinhas-Hamiel & Zeitler 1996). Adolescent obesity is a major antecedent of adult obesity, CHD risk, and increased morbidity and mortality (Bao et al. 1997; Must et al. 1992; NIH 1995) and even increased risk of breast cancer (Hulka et al. 1994). Moreover, the consequences of adolescent obesity extend beyond its health effects to impacts on SES status and reduced chances for marriage (Averett and Korenman, 1999).

Literature Review

Exercise and Diet

Physical activity has been associated with a wide range of beneficial health outcomes in adults, including bone and cardiovascular health and reduction of selected cancers (NIH 1987). Physical activity during childhood and adolescence may have a positive impact on growth and development and psychological and emotional outcomes that may continue into adulthood (Ross and Hayes, 1988; USDHHS 1996). Inactivity, in particular TV viewing, has been associated with obesity in cross-sectional studies of children, adolescents, and adults (Gortmaker et al., 1996). Physical activity habits, and specifically inactivity, track significantly from adolescence to young adulthood (Raitakari et al. 1994). Minority adolescents have consistently high levels of inactivity and low levels of activity, and these trends are exaggerated for females (Gordon-Larsen et al. 1999; Andersen et al. 1998; Wolf et al. 1993; Sallis et al. 1996).

Body composition is ultimately affected by total energy expenditure (TEE) relative to energy intake. Physical activity accounts for 15-40% of TEE, more for children than for adults (Bouchard et al. 1993). Resting metabolic rate (RMR) and the thermic effect of food are relatively invariant to most voluntary behaviors. In contrast, level of physical activity is voluntary, more easily modified, and is the component of TEE most linked with child obesity (Johnson et al. 1956 were among the first to show this).

Adolescent physical activity includes work at school or home, travel-related activity, activity during work for those with jobs, participation in individual and team sports, and leisure activities (play).

Adolescent inactivity typically includes sedentary pastimes associated with energy expenditure near or only marginally above the RMR (e.g., television viewing, reading). The intervention and epidemiology literature generally differentiates physical activity and inactivity when studying their relationship to obesity, and there is evidence that reducing inactivity is more important than increasing more vigorous activity (Epstein et al. 1995). While activity and inactivity are obviously related (particularly at the extremes given the allocation of a finite amount of time during a day), there are sufficient grounds to study them separately.

Methods for measuring physical activity/inactivity include questionnaires, heart rate monitors, and accelerometers (Janz 1994; Mathews & Freedson 1995; Pereira et al. 1997). Each has strengths and weaknesses. Questionnaires typically collect information on only one or two activities that take up a great deal of time (e.g., viewing television), while a few use more detailed recall or historical measures of multiple activities (Matsudo 1996). Despite these weaknesses, questionnaires remain the most feasible method for large samples, and have been validated with more precise measures of physical activity/inactivity (Pereira et al. 1997). While they do not measure physical activity with enough accuracy to quantify total energy expended in activity, questionnaires are nonetheless useful for ranking individuals by activity level with reasonable reliability and validity.

Diet, especially energy and fat intake, is theoretically a key determinant of energy balance and consequently, obesity. There is great difficulty measuring diet and relating it to adolescent obesity in the US, because of the difficulties with measurement of diet in large, population studies in general and because of differential misreporting related to obesity. While human clinical studies support a diet-obesity relationship (Obarzanek et al. 1994), there is a surprisingly meager population literature to confirm these findings. Shah and Jequier (1991) reviewed 11 studies on food intake in youth, and noted that only three reported a positive relationship of food intake and obesity. Furthermore, no study in the

US or Europe has been able to adequately measure and then study how diet affects the onset of overweight and/or changes in the level of body fatness. The Add Health data can not add much, as they are inadequate to provide meaningful measures of total energy, energy density, or proportion of energy from fat, the latter being viewed as a key determinant of total energy intake (Bray and Popkin 1998). However, we do explore healthy and unhealthy food intake as part of adolescents' diet in this chapter.

Body Image

One of the defining features of adolescence is rapid physical development brought on by puberty. Puberty typically involves rising levels of the hormones related to reproductive capability, estrogen and testosterone. In addition to triggering changes directly related to that capability, such as menarche, rising hormonal levels trigger the development of secondary sex characteristics such as breast development in girls and facial hair in boys. Both boys and girls also experience a height spurt and weight gain. However, the nature of the weight gain tends to differ - for boys, the increase is typically in the form of increased muscle mass, while girls see an increasing portion of their body composition shift toward fat (Petersen and Taylor 1980).

These physiological changes take place within a socially defined structure of norms and expectations about the meanings of womanliness and manhood (Martin 1996). For boys, increasing muscle mass fits with the high value currently placed on a powerful muscular male body type (Bordo 1999). In contrast, girls whose bodies are adding fat encounter an ideal female image that emphasizes thinness and angularity (Brumberg 1997). The majority of past research has focused on documenting this ideal among middle-class white girls; recent explorations among other groups such as African American girls has shown this ideal to be less pervasive but gaining influence (Duke 2002; Story, French, Resnick, and Blum 1995). Some studies have suggested that mass media may play a role in influencing the development of weight concerns and weight control practices among preadolescents and adolescents (Field et al. 2001; Milkie 1999).

Not living up to these ideals is linked to detrimental outcomes for both boys and girls.

Adolescents who are dissatisfied with their body image are at increased risk for physical and emotional problems such as excessive dieting and depression (Ge et al. 2001; Siegel et al. 1999). Girls, especially white girls, are at greatest risk of developing eating disorders (Lovejoy 2001).

A preference for thinness is prevalent in middle and upper-SES white-American culture (Rand & Kuldau 1990), and this preference may affect behaviors such as eating habits, dieting and activity patterns. The cultural obsession with thinness may be less pervasive among blacks, Asians or Hispanics compared to non-Hispanic whites. In general, perceptions of overweight and weight-reduction activities are less common in black than white women (Felts et al. 1992).

The relationship between body image, diet, and exercise is a reciprocal one. Adolescents' body weight and stature is a function of biological factors and eating and exercise behavior; in turn, diet and physical activity have direct effects on body weight and risks of obesity. Body image, however, incorporates the individuals' interpretation of their own body weight and stature compared to cultural norms and messages about the ideal weight and stature. This added component of self-perception can therefore impact eating and physical activity behavior independent of actual body weight. We therefore explore indicators of body image with important implications for understanding adolescent behaviors involving diet and exercise.

Sleep Habits

While the relationship between exercise, diet, and body image is widely studied, the relationship between sleep and other healthy habits has not received much attention. Research on sleep is mainly focused on changing patterns across age and by gender, predictors of changing patterns of sleep, especially as they relate to sleep problems, and the relationship between sleep problems and other outcomes. Much of the research on youth sleep habits focuses on sleep problems and sleep deprivation (e.g., Guilleminault 1987;

Morrison et al. 1992). The development of good sleep habits in adolescence is critical as many adult insomniacs report that their problem began in adolescence (Hauri et al. 1980). A few studies have examined how sleep deprivation is related to school performance and daytime functioning in adolescence, documenting negative effects on mental and physical health (Danner 2000; Wolfson and Carskadon 1998). Clearly, it is impossible to sort out the direction of influence here, but concern over chronic sleep deprivation among adolescents in particular has targeted school start times as one important cause of sleep deprivation and an avenue for policy intervention (Danner et al. 2001; Manber et al. 1995).

Sleep patterns of adolescents have been investigated by means of electrophysiological recordings (Coble et al. 1984) and questionnaire-based surveys, mainly self-reports (Lee et al. 1999; Wolfson and Carskadon 1998). During childhood, the sleep schedule on schooldays and weekends is generally constant, wake times in particular (Petta et al. 1984). When children enter adolescence, major changes in sleep patterns occur, mainly characterized by a delay in the sleep period. Adolescents tend to stay up later at night and to sleep later in the morning than do prepubescent children (Dahl and Carskadon 1995). This delay in the sleep period is especially pronounced on weekends than schooldays.

While age is the key determinant of changing sleep patterns, gender and puberty status are also associated with the timing of sleep, especially on weekends (Laberge et al. 2001). In prepubertal children there is generally no gender difference in sleep patterns (Wolfson 1996). However, numerous studies based on self-reports have noted significant gender differences in adolescent sleep patterns, with girls reporting longer sleep hours, and sleeping later on weekends (Wolfson and Carskadon 1998; Lee et al. 1999). There is evidence that puberty status, and the fact that girls start puberty earlier than boys, may explain the longer sleep patterns of girls (Laberge et al. 2001). Surprisingly, most sleep research has been done on white samples, or where there is racial and ethnic diversity in the sample, race differences have not been investigated (e.g., Danner 2000). Our exploratory work on sleep habit indicators will document both the age and race and ethnic differentials.

Data

Our data come from the National Longitudinal Study of Adolescent Health (Add Health). Add Health is a nationally representative study of adolescents in grades 7 through 12 in the U.S. in 1995. As detailed in Bearman, Jones, and Udry (1997), Add Health was designed to help explain the causes of adolescent health and health behavior with special emphasis on the effects of multiple contexts of adolescent life. The study used a school-based design to select a stratified sample of 80 high schools with selection probability proportional to size. For each high school, a feeder school was also selected with probability proportional to its student contribution to the high school. The school-based sample therefore has a pair of schools in each of 80 communities.

An in-school questionnaire was administered to every student who attended each selected school on a particular day during the period of September 1994 to April 1995 and was completed by more than 90,000 adolescents.

In a second level of sampling adolescents and parents were selected for in-home interviews. From the school rosters, a random sample of some 200 students from each high-school/feeder school pair was selected, irrespective of school size, to produce the core in-home sample of about 12,000 adolescents. A number of special over-samples were also selected for in-home interviews, including ethnic samples, physically disabled adolescents, and a genetic sample. The in-home interviews were conducted between April and December 1995, yielding "Wave I data." The core plus the special samples produced a total sample size of 20,745 adolescents in Wave I. A parent, generally the mother, was also interviewed in Wave I. All adolescents in grades 7 through 11 in Wave I (plus 12th graders who were part of the genetic sample) were targeted roughly one year later for the Wave II in-home interview. The content of the Wave II interview was similar to that of Wave I.

We limit our sample to adolescents aged 12 through 19 at Wave I to capture the typical school ages of 7th through 12th graders, eliminating the handful of 11- and 20 and 21-year olds in these grades.

Due to small sample sizes, we also eliminate Native American youth and non-Hispanic youth who designate their race as "other." In our analysis of physical activity indicators we eliminate disabled youth (adolescents who use a walking aid). We use Wave I data to maximize our sample size for our indicator analysis with the exception of diet (questions only available at Wave II) and body image when we must use Wave II data when measured height and weight were taken (as opposed to self-reported height and weight in Wave I). Sampling weights that adjust for the differential sampling probabilities of adolescents responding to the two in-home interviews have been developed and are used throughout our analysis. Sample sizes for Wave I data with valid sample weights are over 18,000 adolescents; Wave II sample size with valid weights for the body image analysis is about 13,000.

Measurement

Measures of healthy habits in adolescence do not lend themselves to the development of constructs or scales of "healthy habits," because the measures are so specific to the particular health habit, and it would be difficult to decide how or whether to weight each habit or cluster of behaviors representing the habit. We therefore do not attempt to develop such constructs (using factor analysis for example); although we note in the discussion that an index of "healthy habits" might be possible, where points are assigned for engagement in "good habits" in each realm of diet, physical activity, sleep, and body image. Below we define each measure of healthy habits, followed by our key stratifying variables of gender, race and ethnicity, and age.

Sleep Habits are measured by responses to three questions in the Wave I Add Health survey. Sleep hours are reported in response to the question, "How many hours of sleep do you usually get?" We examine both the continuous measure of sleep hours and a categorical measure with four categories: <7 hours; 7-8 hours; 9 hours; and 10+ hours. We measure bedtime hour by responses to the question, "What time do you usually go to bed on week nights?" We categorize bedtime hour into four categories: < 10:00pm; 10:00-10:59pm; 11:00-11:59pm; and > 12:00am. A final question, "Do you usually get enough sleep?" with a yes/no response, we use to validate our bedtime and sleep hours indicators.

Physical activity is measured by a standard physical activity behavior recall in Add Health that is similar, although not identical, to other self-report questionnaires that have been used and validated in other large scale epidemiological studies (e.g., Andersen et al. 1998). A series of questions ask about participation in moderate to vigorous physical activity, including skating and cycling, exercise and active sports (5-8 metabolic equivalents or METs), in units of times per week. One MET represents the resting metabolic rate, or 3.5 ml 0_2/kg body weight/minute. The questions for physical activity are listed below.

Moderate-Vigorous:

1. During the past week, how many times did you go roller-blading, roller-skating, skate-boarding, or bicycling?
2. During the past week, how many times did you play an active sport, such as baseball, softball, basketball, soccer, swimming, or football?
3. During the past week, how many times did you do exercise, such as jogging, walking, karate, jumping rope, gymnastics or dancing?

Respondents indicated the number of times in which they engaged in moderate to vigorous physical activity for each set of activities according to the following four categories: 0; 1-2; 3-4; and 5+ times per week. We create a dichotomous variable indicating a 1 for respondents who engage in any moderate-vigorous physical activity 5+ times per week in line with the Surgeon General's physical activity recommendations.

Inactivity can be measured by TV viewing, video viewing, and computer/video game use, which are reported by the adolescent as hours/week over the past week (i.e., "How many hours a week do you watch television?"). Quantifying inactivity has received far less attention than physical activity (Dietz 1996) and little, if anything, is published in the literature regarding the reliability and validity of inactivity data. We use the hours of TV viewing a week to measure inactivity. Similar patterns are obtained using the video viewing and computer use, but we decided not to combine these with TV viewing because they may also represent educational activities.

Diet measures attempt to capture healthy and unhealthy food choices by adolescents. Unhealthy choices are measured by the number of times the adolescent eats fast food in a week. We create two categories: seldom (0 or 1 time) and often (2+ times). Healthy food choices are measured by the number of servings of fruits and vegetables the adolescent eats in a week. Again, we create two categories: few (0 or 1 serving each of fruit and vegetables) and moderate (2+ servings each of fruit and vegetables/week). We noted earlier that Add Health was not designed to collect detailed diet and nutrition data because that is the sole purpose of several other national surveys, and is therefore limited in this indicator of healthy habits.

Actual Weight Status is based on adolescents' Body Mass Index (BMI). Interviewers measured and weighed adolescents in Wave II to obtain their height and weight. Measurements were in feet and inches and pounds, with the BMI equaling (weight in kilograms/ height in meters^2). We express actual weight relative to height as a categorical variable by comparing adolescents' BMIs to the appropriate percentiles for age (in months) and gender from the most recent reference curves published by the Centers for Disease Control (2002) and the National Center for Health Statistics (Kuczmarksi et al. 2000). We categorized those below the 5th percentile as "underweight" and those at or above the 85th percentile as "at risk for overweight" (abbreviated as "overweight" hereafter). Adolescents in the middle percentile range (at or above 5% and below 85%) were classified as "normal weight."

Perceived Weight is measured in response to the question, "How do you think of yourself in terms of weight?" Response categories included very underweight, slightly underweight, about the right weight, slightly overweight, very overweight. We grouped together the two underweight and two overweight responses to create a three category measure that is parallel to actual weight: underweight, average weight, and overweight.

Weight Concordance is based on the comparison of actual and perceived weight measures. Respondents were categorized as having a perception that is **heavier** than their actual weight ("thinks heavier"), **accurate** for their actual weight ("thinks same"), and **lighter** than their actual weight ("thinks lighter" is the table label). For example, a female adolescent who is underweight but perceives herself as

average weight would fall into the "thinks heavier" category (i.e., thinks she is heavier than she really is), while a male adolescent who is overweight but perceives himself as average weight would fall into the "thinks lighter" category (i.e., thinks he is lighter than his actual weight indicates).

Dieting Behavior is based on the question, "Are you trying to lose weight, gain weight, or stay the same weight?" Responses include 1) lose weight; 2) gain weight; 3) stay the same weight; and 4) not trying to do anything about weight. Because so few girls respond that they are trying to gain weight and so few boys respond that they are trying to lose weight, we analyzed the "lose weight" response (relative to everything else) only for girls and the "gain weight" response (relative to everything else) only for boys.

Gender is measured as female and male, and was precoded by project staff based on the respondent's report from the In-School survey and confirmed by the interviewer at the time of the follow-up interview.

Race/Ethnicity is measured by responses to a racial identification question and an Hispanic origin question. We combined the information on race and Hispanic ethnicity together to create one variable that has four categories: Non-Hispanic white, non-Hispanic black, Hispanic, and Asian. For simplicity in presentation and due to small sample sizes, we eliminated adolescents of "other" race (largely Native American and "other" (unknown) race).

Age is calculated as the elapsed years between the month, day, and year of birth and the month, day, and year of interview. For presentation purposes we categorize age into two groups: pre- and early adolescence, ages 12-15; and older adolescents who are 16-19.

Exploratory Analysis

Our exploratory analysis involves arraying descriptive data on each of the 4 domains of healthy habits

(sleep, physical activity and inactivity, diet, and body image) separately for females and males by race/ethnicity and age. Where we have multiple measures of healthy habits in a domain, we attempt to validate the central measure of interest. We begin our exploratory analysis focusing on sleep habits.

Sleep Habits

The average number of hours that adolescents in grades 7-12 in 1995 usually sleep is 7.84 (N=18,864). In Figure 1 we show the age pattern of sleep hours for females and males. Consistent with the research on age patterns of sleep (Carskadon 1990; Wolfson 1996), we see that sleep hours decline with age across adolescence for both boys and girls. But inconsistent with previous research (Wolfson and Carskadon 1998), we see that girls report getting less sleep than boys, though this appears to even out by age 18.

Table 1 shows the distribution of adolescents according to our categories of sleep hours by race/ethnicity and age. Sleep deprivation is defined at less than 6 hours of sleep a night (Danner 2000) and we have shown that less than 7 hours is about one hour or more below the overall mean, so our <7 category identifies adolescents who are not getting sufficient sleep at night. The 7-8 hours is the modal category, and certainly with the category of 9 hours represents healthy sleep habits for adolescents. The category of 10 hours or more can not necessarily be defined as "unhealthy," but is fairly far above the mean and therefore is non-normative (and as the table indicates is more common for the younger adolescents). This table helps to identify which race and ethnic groups, and which age groups of adolescents fall into these various patterns of sleep.

Among females, non-Hispanic black and Asian youth are more likely to get insufficient sleep at night (<7 hours) and less likely to fall within the healthy sleep habit range of 7-9 hours. Differences within the 10+ sleep hours category are minor, with the exception that Asian girls are the least likely to sleep 10 hours or more a night. The race and ethnic patterns are the same for males, with somewhat smaller differences. In general, non-Hispanic white boys tend to get the most sleep, and Asian boys the least sleep at night. Note, however, that the majority of boys and girls across all race and ethnic groups fall within the healthy range of 7-9 hours a night.

The age patterns in Table 1 confirm our earlier findings. More than 20% of the older girls and boys usually get fewer than 7 hours of sleep a night, compared to 10% of the younger girls and 7% of the younger boys. Moreover, the younger girls and boys are much more likely than the older adolescents to get 9 or 10+ hours of sleep a night.

We also explored the related sleep habit of adolescents' weekday bedtime hour by race/ethnicity and age (not shown). Bedtime hour is categorized into four bedtimes, with < 10:00pm a fairly early bedtime for adolescents and after midnight a rather late bedtime on a weekday. The majority (about 60%) of girls and boys go to bed between 10:00pm and midnight. Over 20% of girls and a little less than 20% of boys go to bed before 10:00pm on the weekdays, and more boys go to bed after midnight than girls. We find black females to have the least healthy bedtime hour, as they are least likely to go to bed before 10:00pm and most likely to go to bed after midnight, consistent with their lower sleep hours in Table 1. Age patterns confirm that girls and boys in pre- and early adolescence have earlier bedtimes than older adolescents. Bedtime hour does a better job of validating sleep hours as an indicator of healthy sleep habits by age than by race and ethnicity because wakeup times vary by age (Danner et al. 2001; Manber et al. 1995), but are likely to vary *within* race and ethnic groups (due to a number of factors in addition to age).

We further validate the sleep hours indicator by exploring the relationship between sleep hours and whether the adolescent reports that he or she gets enough sleep by race/ethnicity and age. The results are rather conclusive, shown in Appendix Table I by race and ethnicity. Among those girls and boys who report that they do not sleep enough in the top panel of Appendix Table I, a larger percentage report less than 7 hours of sleep a night, and this is especially the case for black and Asian girls and boys. Moreover, a very small percentage (3 to 12%) of black and Asian girls and boys get more than 8 hours of sleep (9 and 10+ categories). In contrast, adolescents who perceive that they sleep enough in the bottom panel are

much less likely to report less than 7 hours as their usual sleep hours a night, and more likely to fall within the healthy range of 7-9 hours a night. Note, however, that the race and ethnic pattern is still evident in the bottom panel. Even among black and Asian girls and boys who report that they get enough sleep, their likelihood of getting less than 7 hours a night is higher than it is among white and Hispanic girls and boys who report getting enough sleep.

We find a similar relationship between sleep hours and whether adolescents perceive that they get enough sleep by age (not shown), with the pattern most dramatic for older adolescents. For example, among older adolescent girls who do not sleep enough, 42 percent report less than 7 hours of sleep a night compared to only 13 percent with less than 7 hours among those who report that they get enough sleep. Overall, sleep hours appears to be a valid measure for healthy sleep habits.

Physical Activity and Inactivity

We now turn to physical activity and exercise, continuing to array this set of healthy habits' indicators by race/ethnicity and age. In Table 2 we show the percent distribution of engaging in physical activity according to the categories of 0, 1-2, 3-4, and 5+ moderate to vigorous physical activities a week, where 5+ times per week represents the Surgeon General's physical activity recommendations. We find that boys are more likely to be physically active than girls, but even so, less than 50 percent of boys meet the healthy habit recommendations of 5+ activities a week and a little more than one-quarter of girls engage in 5+ activities a week. The good news is that a small percentage of girls (6%) and boys (4%) get absolutely no exercise on a weekly basis. Modal categories are 1-4 activities a week for girls and 5+ for boys.

Race and ethnic differences are consistent with prior research (Andersen et al. 1998; Wolf et al. 1993). Non-Hispanic black girls are the most likely to get no exercise (9.8%) and the least likely to engage in 5+ physical activities (19%) per week. Asian girls are among the most physically active. In contrast, race and ethnic differences among boys are relatively minor, with Hispanic boys the most active and black boys the least.

Age differences show an overrepresentation of younger adolescents in the high exercise category of 5+ activities a week and less representation in the less active categories of 0 or 1-2 activities a week relative to older adolescents for both girls and boys. Among older girls, almost 10 percent get no weekly exercise and only 17 percent engage in the recommended 5 or more moderate to vigorous physical activities a week. Although the level of exercise is higher for older male adolescents, the pattern is the same with 7 percent getting no exercise and only one-third engaging in 5 or more physical activities a week. With the exception of pre- and early-adolescent boys, the majority of adolescents exercise less than what is recommended to maintain health in adolescence. The distributions in Table 2 suggest that a simple indicator of healthy habits involving exercise would be the yes/no dichotomy of engaging in 5+ moderate to vigorous physical activities a week.

Table 3 displays our indicator of inactivity, average hours of TV viewing per week for girls and boys by race/ethnicity and age. On average, boys tend to watch about 2 more hours of TV than girls. Consistent with previous research, non-Hispanic black girls and boys spend the most time watching TV (Gordon-Larsen et al. 1999; Sallis 1996). The differential is especially prominent for girls where blacks watch an average of 20 hours a week, compared to Asian girls who watch 15.8 hours, Hispanic girls who watch 13.8 hours, and white girls who watch about 13 hours. Among boys, blacks and Asians watch the most TV, followed by white and Hispanic boys who watch an average of 5 less hours per week.

Inactivity is the one indicator in which younger adolescents do not demonstrate healthier habits than older adolescents. On average, younger girls watch 2 ½ hours more TV than older adolescent girls and younger boys watch about 3 hours more TV than older adolescent boys. Although this measure of inactivity is well accepted in the field, further work to validate this measure in Add Health is needed.

Diet

We next examine our two measures of healthy diet choices. In Table 4, Panel A shows the frequency with which adolescents make the unhealthy diet choice of fast food and Panel B the frequency of the healthy diet choice of fruits and vegetables by race/ethnicity and age. Boys eat fast food more frequently than girls as almost 60 percent of boys eat fast food two times or more a week compared to about 54 percent of girls. Among girls, non-Hispanic blacks make the less healthy choice of fast food more often than the other race and ethnic groups who all have about equal percentages of eating fast food two or more times a week. Among boys, Hispanics choose fast food less often than whites, blacks, and Asians.

Age differences show that older adolescents eat fast food more frequently than younger adolescents. If we acknowledge that adolescents aged 16-19 typically have more independence and autonomy to make their own diet decisions, it appears that this independence is associated with less healthy choices.

Panel B of Table 4 shows the distributions on eating two or more servings of fruit and two or more servings of vegetables a week by race/ethnicity and age. Differences between girls and boys are minor on this diet indicator, perhaps because fruits and vegetables are less subject to adolescent choice and more under the influence of family eating behaviors. About 38 percent of both girls and boys have two or more servings each of fruits and vegetables. Race and ethnic differences are evident, however. Hispanic youth eat fruits and vegetables most frequently, as 51 percent of girls and 47 percent of boys have two or more servings of fruits and two or more servings of vegetables a week. Asian youth eat fruits and vegetables less frequently than Hispanics, but more frequently than whites and blacks. Blacks have the lowest frequency of eating fruits and vegetables. This pattern suggests that perhaps the immigrant diet more often includes fruits and vegetables, even with acculturation of eating behaviors over generations (Gordon-Larsen et al. 2003).

Age patterns indicate that younger adolescents eat fruits and vegetables more frequently than older adolescents, again suggesting that as adolescents gain more independence from family eating norms, their diets tend to be less healthy.

Body Image

Our final domain of healthy habits addresses adolescents' self-perceptions about their body weight, or what we refer to as body image. This indicator represents the degree to which adolescents have a healthy view of their body weight. We begin by first presenting the distributions on actual weight status based on BMI (body mass index). In Table 5 we show the percentage of female and male adolescents that fall into the three categories of underweight, normal weight, and overweight by race/ethnicity and age. Consistent with findings from the obesity research, black girls are more likely to be overweight, followed by Hispanic girls, white girls, and then Asian girls who are the least likely to be overweight and the most likely to be underweight (Popkin and Udry 1998). More than two-thirds of white and Asian girls fall within the normal weight range, while over 30% of black and Hispanic girls fall within the overweight range. Among boys, blacks do not stand out as being overweight, but they are less likely than the other groups to be underweight. Age patterns show decreasing prevalence of overweight status and slightly increasing prevalence of underweight status as girls and boys age into late adolescence.

When we examine perceived weight of adolescent girls and boys by race/ethnicity (not shown), we find that race and ethnic differences in perceptions of overweight status are dissimilar to the race and ethnic differences in actual weight for girls in Table 5. In particular, a similar percentage of Hispanic girls (44%), black girls (40%) and white girls (39%) perceive their body weight to be overweight, indicating that black girls have more accurate perceptions of their overweight status than the other groups who all overestimate their overweight status, especially whites and Asians. Perceptions of underweight status are also overestimated by all race and ethnic groups. Among whites, Asians, and Hispanics, almost a third of the girls who have BMIs in the normal range perceive that their weight is not normal.

Among boys the distribution of perceptions tends to move downward towards lower weights,

relative to the actual weight distributions. For example, a larger percentage of boys perceive their weight to be underweight than is actually the case, and this is especially true for black boys. Such results confirm previous research on body image showing that girls tend to aspire to the cultural ideal of thinness as they are especially likely to perceive that they are overweight, with the exception of black girls who seem to be less sensitive to this ideal (Felts et al. 1992; Dawson 1988; Duke 2002). Boys, on the other hand, aspire to muscular body images and tend to therefore perceive their weight to be too low than it actually is. In contrast, girls' and boys' perceptions of weight do not vary as much by age (not shown).

Next we compare actual with perceived weight to construct concordance measures. Among girls across all race and ethnic groups, perceptions of overweight status seem to match actual weight status the best. Among girls who are either underweight or normal weight and whose perceptions do not match their actual weight, they typically tend to perceive their weight to be heavier than it is. The only exception to this pattern is that black girls of normal weight are less likely than girls of other race and ethnic groups to perceive their weight to be overweight. Among girls of normal weight whose perceptions do not match their actual weight, 28% of whites, 29% of Hispanics, and 31% of Asians perceive that they are overweight compared with only 20% of black girls. Figure 2 illustrates this pattern for normal weight girls.

Among boys the concordance of perceived with actual weight is highest for boys of normal weight, with the exception of Asian boys where concordance is highest among boys who are underweight. In contrast to girls, boys of normal weight whose perceptions do not match their actual weight more often perceive their weight to be underweight than overweight, and this is fairly consistent across race and ethnicity. Figure 3 shows this pattern graphically.

We also find that girls' tendencies to perceive their weight to be heavier than it is is more pronounced among older adolescents, suggesting that the cultural ideal of thinness increases in later adolescence for girls (not shown). The pattern for boys is relatively the same across age categories.

Table 6 shows these patterns of body image for girls and boys. Here we present the distribution

of actual and perceived weight concordance for girls and boys by race/ethnicity and age. White, Hispanic, and Asian girls are more likely to think they are heavier than they are compared to black girls, who are more likely to think they are lighter than they are. Asian girls express the lowest concordance with especially high percentages thinking they are either heavier or lighter than they actually are. Boys generally think they are lighter than they are, especially black boys. Similar to earlier age patterns, we see lower concordance as adolescents age, with older girls more likely to think they are heavier than they are and older boys more likely to think they are lighter than they are. As an indicator of healthy body image, these concordance measures in Table 6 are probably the most illustrative and parsimonious.

We validate these healthy body image indicators by exploring their associations with dieting behavior for girls and with attempts to gain weight for boys, and these results are included in Appendix Table II. A strong linear relationship is observed for all race and ethnic groups and across adolescent age groups such that girls who think they are lighter than they are are less likely to try to lose weight and girls who think they are heavier than they are are more likely to try to lose weight than girls who perceive their weight correctly (Panel A). Given that our earlier results show that girls tend to perceive their weight to be heavier than it actually is, such dieting behavior is not healthy. A linear relationship also emerges across race/ethnicity and age such that boys who think they are lighter than they are are more likely to be trying to gain weight and boys who think they are heavier than they are are less likely to be trying to gain weight compared to boys who perceive their weight correctly (Panel B). The age pattern indicates that a muscular body image becomes more salient in later adolescence for boys.

Relationship between Healthy Habits Indicators

A final step in this exploratory work is an assessment of the extent to which these indicators are related to one another and are capturing an underlying concept of "healthy habits." If adolescents adopt healthy

habits in general, then they should engage in healthy habits across the array of indicators that we have examined here and adoption of one healthy habit should be correlated with adoption of other healthy habits. In Table 7 we show the degree and direction of the statistical association between the various healthy habits indicators we have employed in our analysis. We present results from a number of regression equations in which we regress the various healthy habits indicators on each other, adjusting for age and sex (with the exception of body image in which we run separate male and female models). We display the regression coefficient for each equation as a measure of the degree of relatedness between the two habits. The size of the coefficients can not be compared because the measurement scales of both the independent and dependent variables vary across indicators as do the estimation procedures. Because some of the indicators are only available at Wave II, we use the Wave II sample.

The results are reassuring as they show fairly consistent and significant associations between our healthy habits indicators in the expected directions. For example, results in the first row indicate that body mass index (BMI) is highly correlated with activity and inactivity. Adolescents who engage in 5 or more moderate to vigorous bouts of physical activity a week have a lower body mass index. Similarly, inactive adolescents who watch more hours of TV tend to have higher BMIs than adolescents who watch less TV. Diets that frequently include fast food have lower BMIs, an unexpected result; but perhaps this reflects highly active adolescents with little time to eat. Healthy sleep habits (hours and reports that adolescents sleep enough) are associated with greater physical activity and healthy diets that include more fruits and vegetables and less fast food. In addition, adolescents who are physically active and have healthy diets tend to watch fewer hours of TV, and physically active adolescents eat more fruits and vegetables. Having an unhealthy body image by perceiving one's weight to be heavier than it actually is is correlated only with less exercise among boys (bottom two rows of Table 7). We suspect that boys who are not physically active feel that their weight is higher than it should be given they get little exercise. Because those with an unhealthy body image may behave in different ways (either increasing their physical activity or improving their diet to lose weight, or their low levels of physical activity and poor diets make them feel heavier than they are), opposite behaviors probably cancel out any systematic

association between body image and our healthy habits indicators.

Across the array of 19 associations among the healthy habits of exercise, diet, and sleep that we examine, 16 are statistically significant and in all but one coefficient (fast food and BMI), the relationship is in the expected direction. That is, engagement in a healthy habit in one domain is correlated with engagement in a healthy habit in another domain. We suspect that these associations might be even stronger if we were able to use Wave I data for all indicators which contains an additional young cohort of 7th graders since younger adolescents are more likely to engage in healthy habits. Thus, we conclude that the indicators of healthy habits that we have developed here are highly interrelated and capture the same underlying concept of "healthy habits."

Discussion and Conclusion

This analysis of healthy habits is a first step towards identifying effective and practical measures of healthy habits as indicators of positive youth development. Our work identified a number of useful indicators of healthy habits. Sleep hours as an indicator of sufficient sleep or sleepiness and sleep deprivation can be used to represent healthy sleep habits. Whether adolescents engage in the Surgeon Generals' recommended level of physical activity of 5 or more moderate to vigorous physical activities a week is our choice for a healthy exercise indicator. Hours of TV viewing is an effective proxy for inactivity among youth. Add Health does not really have the data to develop a healthy diet indicator, but the two we examined were clearly related to other healthy habits (Table 7) and therefore serve as useful proxies for healthy diet choices, with the frequency of consuming fruits and vegetables a better barometer of healthy habits than consumption of fast food. Finally, body image represents a unique healthy habits indicator that captures the various dimensions of healthy habits including exercise, weight, and eating and dieting behavior, and blends in the psychological component of self-perception and self-image. The body

image indicator we recommend is our measure of concordance between actual and perceived weight.

Our exploratory analysis and validation of indicators provided evidence in support of previous research on differentials in healthy habits by race/ethnicity and age. In particular, we find that black adolescents, and especially black girls, are particularly disadvantaged in their healthy habits. Blacks tend to sleep fewer hours a night (black girls have the latest bedtime hour), have lower levels of physical activity, higher levels of inactivity watching TV, less healthy diets, especially black girls, and tend to be more likely to be overweight. The one exception is that blacks, and black girls in particular, tend to have a more healthy body image, which puts them at lower risk of eating disorders and depression.

Although we only use cross-sectional data, the age cohort trends seems to suggest that adolescent developmental trajectories in healthy habits are discouraging. As adolescents age they get less sleep, less exercise, make less healthy food choices, and tend to have less healthy body images. Maintaining the healthy habits that younger adolescents display remains an ambitious goal for parents and health policy workers alike, as adolescents carry these habits with them into the early formative educational and career years of young adulthood.

Our analysis indicated that our sleep, diet, and physical activity indicators are valid measures of the concept of healthy habits, and although we argue that an index of "healthy habits" does not make conceptual sense, these indicators are interrelated and capture an underlying dimension of healthy habits in adolescence. Future work needs to examine the statistical relationships between our healthy habits indicators and developmental outcomes for youth, analysis that is beyond the scope of the work presented here. It is possible that different healthy habits may be associated with different developmental outcomes.

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