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Patterns of Physical Activity, Sedentary Behavior, and Diet in U.S. Adolescents

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A B S T R A C T

Objective: To identify patterns in adolescents' obesogenic behaviors and their relations to physical and psychological health.
Methods: A nationally representative sample of 9,174 U.S. adolescents ages 11 to 16 years was surveyed on physical activity (PA), screen-based sedentary behavior (SB), frequency of consumption of healthy and unhealthy food items, weight status, weight control behavior, depression, physical symptoms, body dissatisfaction, overall health, and life satisfaction. Latent class analysis was used to identify patterns of PA, SB, and diet.
Results: A model with three latent classes best fit the data: Class 1 with high PA and high fruit and vegetable intake and low SB and intake of sweets, soft drinks, chips, and fries; Class 2 with high SB and high intake of sweets, soft drinks, chips, and fries; and Class 3 with low PA, low fruit and vegetable intake, and low intake of sweets, chips, and fries. Membership in the three classes was related to age, gender, race/ethnicity, and socioeconomic status. In addition, members of Class 1 (26.5%) were more likely to be of normal weight status and to fare well on most of the other health indices; of Class 2 (26.4%) were less likely to be trying to lose weight but scored poorly on the mental health indices; and of Class 3 (47.2%) were less likely to be underweight and reported greater body dissatisfaction.
Conclusions: Three prevalent patterns of adolescent obesogenic behaviors were identified and these patterns related to weight status, depression, and other indicators of physical and psychological health.

IMPLICATIONS AND CONTRIBUTION

Three patterns of obesogenic behaviors were identified in a nationally representative sample of U.S. adolescents including two unhealthful patterns reported by approximately 74%. Each obesogenic pattern suggests different targets for interventions that should also address issues of weight status, depression, physical symptoms and other indicators of physical and psychological health.

Lack of physical activity (PA), excess sedentary behavior, and unhealthful diets contribute to adolescent obesity and early development of cardiovascular risk factors [1–3]. In addition, each of these behaviors has other health consequences. Child and adolescent physical activity has been related to adiposity; elements of Metabolic Syndrome; physical, mental and social health; and academic and cognitive performance [1,2,4–6]. Adolescent screen-based sedentary behavior (SB), particularly television viewing (TV), has been related to subsequent adiposity, risk for cardiovascular disease, metabolic syndrome, health complaints, physical aggression, and tobacco and alcohol use, and negatively related to quality of life, psychological well-being, and quality of family relationships [1,5–9]. A diet high in energy-dense foods, such as sugar-sweetened beverages, sweets, chips, and French fries has been positively associated with adiposity, waist circumference, total cholesterol, low density lipoproteins, diastolic blood pressure, and plasma triglycerides and glucose and negatively related to psychological functioning,

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while diets high in fiber from consumption of fruits and vegetables have been negatively related to adiposity and indicators of the Metabolic Syndrome [10,11].

Pediatric recommendations for reducing the risk of cardiovascular disease suggest that the optimum approach is a combination of increased PA, reduced SB, and improved diet quality [1]. Establishment of healthful patterns during childhood and adolescence is important because physical activity and dietary habits track during adolescence and from adolescence to adulthood [4].

Although adolescent PA, SB, and diet may not be strongly related to each other, there is evidence that these behaviors are interrelated within individuals [9]; that is, that there might be a limited number of individual patterns of adolescent PA, SB, and diet. In small regional samples, obesogenic behavior patterns combining PA, SB, diet, and weight consciousness have been identified in fourth-grade children [12] and combining PA and SB in adolescents [13,14]. However, to our knowledge, no studies have examined obesogenic behavior patterns in a nationally representative sample of U.S. adolescents or examined how these patterns relate to physical and psychological health. Identifying these patterns could foster understanding of their development and maintenance, their broader health consequences, and potential avenues for intervention. The purpose of this study was to identify patterns in adolescents' obesogenic behaviors, demographic differences across these patterns, and the relationship of these patterns to indicators of physical and psychological health.

Methods

Sample and procedure

A nationally representative sample of U.S. students in grades 6 to 10 was recruited from 230 schools in 39 states with census regions and grades as strata and classrooms as the primary sampling units. African-American and Hispanic students were oversampled to obtain better estimates for those groups. Participants completed the 2005/2006 Health Behavior in School-aged Children (HBSC) [15] survey anonymously with a response rate of 87%. Youth assent and, depending on requirements of participating school districts, active or passive parental consent were obtained. The study protocol was reviewed and approved by the Institutional Review Board of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development.

Measures

Sociodemographic variables. Sociodemographic variables included gender, age, race/ethnicity (Caucasian, African-American, Hispanic, and others) and family affluence. Family socioeconomic status was estimated with the Family Affluence Scale (FAS): the adolescent having his/her own bedroom, frequency of family traveling vacations, and number of family computers and motor vehicles [16]. The FAS produced a continuous scale from 0 to 9.

Physical activity (PA). A definition of physical activity was provided, "any activity that usually increases your heart rate and makes you get out of breath some of the time," and examples of activities preceded the question, "How often over the past 7 days have you been physically active for a total of at least 60 minutes per day?". The measure has reasonable validity ($r = .37$ with 5-day accelerometer data) and reasonable accuracy for classifying adolescents meeting recommendations for 60 min/day of PA for at least 5 days/week (sensitivity = 83%) [17,18]. PA was dichotomized: <5 days/week; and ≥5 days/week, the threshold for decreasing odds of obesity in adolescents [19].

Screen-based sedentary behaviors (SB). Students were asked how many hours a day, in their free time, they usually (1) watched television (including videos and DVDs); (2) played games on a computer or games console (Playstation, Xbox, GameCube, etc); and (3) used a computer for chatting online, Internet, e-mailing, homework, etc. Separate questions were asked for weekday and weekend. Response categories ranged from "none at all" to "about 7 or more hours a day." These HBSC items have acceptable test-retest reliability (*ICC*s ranging from .76 to .81) and validity (*r*s ranging from .36 to .54) [20]. For each SB, a weighted average of weekdays and weekend days was dichotomized: >2 hr/day; and ≤2 hr/day, consistent with the recommendations of the American Academy of Pediatrics [21].

Dietary intake. As part of a validated brief food frequency questionnaire [22], participants indicated how many times a week they usually ate fruits, vegetables, sweets (chocolates and candy), sweetened soft drinks, chips, and French fries. The response options were "never," "less than once a week," "once a week," "2 to 4 days a week," "5 to 6 days a week," "once a day, every day," and "every day, more than once." For each food category, a dichotomous variable was created: ≥1/day; and <1/day.

Weight status. Adolescents reported their heights and weights. Using body mass index percentiles derived from the gender- and age-specific growth charts of the Centers for Disease Control and Prevention [23], a four-category weight status variable was created: underweight or at risk for underweight (≤15th percentile); normal weight (16th to 84th percentile); overweight or at risk for obesity (85th to 94th percentile); and obese (≥95th percentile).

Weight loss behavior. Adolescents were asked whether they were currently on a diet or doing something else to lose weight. Four categories of weight loss behavior were generated from the four choices: "No, my weight is fine."; "No, but I should lose some weight."; "No, because I need to put on weight."; and, "Yes."

Body dissatisfaction. Five items from the body image subscale of the Body Investment Scale [24] ("I am frustrated with my physical appearance," "I am satisfied with my appearance," "I hate my body," "I feel comfortable with my body," and "I feel anger toward my body.") assessed body dissatisfaction on a 5-point scale ("strongly agree" to "do not agree at all"). A higher mean score across items indicated greater body dissatisfaction.

Physical symptoms. Adolescents indicated how often in the last 6 months they experienced: (1) headache; (2) stomach-ache; (3) backache; and (4) feeling dizzy. Responses were coded from one to five: "rarely or never," "about every month," "more than once a week," "about every week," and "about every day" (Cronbach's *alpha* = .70). A higher mean score indicated more physical symptoms [25].

Depression. Participants indicated how often in the past 30 days they (1) were very sad; (2) were grouchy or irritable, or in a bad