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Bridging the Gap
Research Informing Practice and Policy for Healthy Youth Behavior

Guest Editors

Frank J. Chaloupka, Lloyd D. Johnston, Ross C. Brownson, and Antronette K. Yancey

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Bridging the Gap
Research Informing Practice and Policy for Healthy Youth Behavior

Frank J. Chaloupka, PhD, Lloyd D. Johnston, PhD

Background: Bridging the Gap (BTG) is a collaborative research initiative supported by the Robert Wood Johnson Foundation. Ten years ago, BTG was created to assess the impact of policies, programs, and other environmental influences on adolescent alcohol, tobacco, and illicit drug use and related outcomes. This multidisciplinary, multisite initiative examines these factors at multiple levels of social organization, including schools, communities, and states. More recently, the significant increases in obesity among children, adolescents, and adults led BTG to expand its efforts to include research on the role of policies, programs, and other factors on adolescent obesity and the physical inactivity and dietary habits that contribute to this growing problem. Eleven papers resulting from BTG's obesity-related research are contained in this supplement, along with two papers describing the National Cancer Institute–supported efforts to track relevant state policies.

Methods: Bridging the Gap involves a variety of data-collection efforts built largely around the Monitoring the Future (MTF) surveys of 8th-, 10th-, and 12th-grade students. These include: surveys of administrators in the MTF schools that gather extensive information on the school food environment, physical education in schools, and other relevant information; collection of contextual information from the communities in which the MTF schools are located; tracking of relevant state policies; and gathering of a wide variety of data from archival and commercial databases. These databases are analyzed individually and in various combinations.

Discussion: Bridging the Gap's extensive research has shown the importance of a range of school, community, state, and other influences in affecting adolescent substance use and related outcomes. BTG's early research on adolescent diet, physical activity, and obesity—much of which is contained in this supplement—similarly demonstrates the role of environmental factors in influencing these outcomes and in explaining observed racial/ethnic and socioeconomic-related disparities in them.

Conclusions: The growing recognition of the public health and economic consequences of childhood, adolescent, and adult obesity has led to a variety of policies, programs, and other interventions to stimulate healthy eating and physical activity, often despite the lack of evidence on their impact. BTG and others are working to build the evidence base for effective interventions to address this significant problem, but much remains to be learned.
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Introduction

A decade ago, youth tobacco use, drinking, and illicit drug use were on the rise, perceived risk from and disapproval of regular substance use was falling, and perceived availability of various licit and illicit substances was generally rising. These trends raised significant concerns in the public health community, among policymakers, and in the general public, given the significant health, social, and economic consequences caused by substance use and abuse. A wide variety of policy, programmatic, and other interventions were developed and implemented in efforts to reverse these trends, often with little or no evidence on their potential impact. To address this lack of knowledge and to build the evidence base on the effectiveness of various policies, practices, and programs, the Robert Wood Johnson Foundation (RWJF) created a new initiative, Bridging the Gap: Research Informing Practice and Policy for Healthy Youth Behavior (BTG). In the 10 years since its inception, BTG has considerably improved the understanding of the impact of policies, programs, practices, and other environmental

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influences on youth smoking, drinking, illicit drug use, and their related outcomes.

More recently, as evidence has emerged about the sharp increases in obesity rates among children, adolescents, and adults, a similarly wide variety of interventions with even less evidence on their effectiveness have begun to be adopted and implemented. Concurrently, it became apparent to both the BTG investigators and those working with them at the Foundation that the approaches successfully employed by BTG in its work on youth substance use could be adapted quite well to examining the policies, programs, and other environmental determinants of obesity among adolescents and of the physical inactivity and poor dietary practices that contribute to this growing problem. Of particular importance, many of the relevant outcome measures for this class of behaviors (such as height, weight, exercise habits, and eating habits) had been included for some years in the same study that provided most of the outcome measures on substance abuse—the Monitoring the Future (MTF) study—and relevant contextual measures could be added at little marginal cost to the ongoing surveys of school administrators that were underway as part of BTG.

This supplement to the *American Journal of Preventive Medicine* includes this introduction and a set of eleven papers[1–11] containing some of the first findings from BTG's research on the environmental determinants of adolescent physical activity, healthy eating, and obesity, as well as two papers[12,13] from the National Cancer Institute (NCI)'s related efforts to identify, rate, and track state policies potentially affecting these behaviors. This paper provides an overview of this body of work, beginning with a brief description of BTG and the surveys and other data sets from which it has drawn its data, and it highlights some of the initiative's research on adolescent substance abuse by way of illustrating its potential for parallel contributions to the childhood obesity issue. This is followed by a discussion of the conceptual framework that underlies BTG's more recent work on youth physical activity, healthy eating, and obesity. Finally, the key findings from the papers contained in this supplement are briefly reviewed.

Bridging the Gap: An Overview

Bridging the Gap is a multidisciplinary, multisite collaborative endeavor intended to substantially improve knowledge of the impact of policies, programs, practices, and other environmental influences on adolescent health behaviors. The initiative consists of two integrated components: the Youth, Education, and Society (YES) project based at the University of Michigan's Institute for Social Research (ISR) and the ImpacTeen project based at the University of Illinois' Health Policy Center. From its inception, BTG has focused on alcohol, tobacco, and other drug use, given the significant public health, social, and economic consequences caused by these behaviors. Due to the addictive nature of these behaviors and the fact that substance use begins largely before adulthood, effective interventions to reduce initiation and uptake during adolescence can have a crucial and lasting impact.

Cigarette smoking is the nation's leading cause of preventable morbidity and mortality, accounting for between 400,000 and 500,000 premature deaths each year.[14–16] Nearly all smoking is initiated during adolescence and, at the time BTG was begun, smoking among adolescents was rising, with prevalence up by about 50 percent during the early/mid-1990s.[17] Alcohol use is estimated to cause over 75,000 premature deaths annually, including many violent deaths among young people in traffic crashes, homicides, suicides, and other accidents.[16,18] As with cigarette smoking, most drinking begins in adolescence; in the mid-1990s, almost three in four high school seniors reported drinking in the past year, while over half reported having been drunk.[17] Illicit drug use accounts for many fewer premature death than does licit drug use—an estimated 17,000 in 2000.[16] The other health, social, and economic consequences are considerable: damaged family and other interpersonal relationships; crime; addiction; HIV/AIDS and other diseases; impairment of social and psychological maturation; and diminished performance in school, work, and other settings. As with youth tobacco use, the use of nearly all illicit drugs rose sharply in the early/mid-1990s.

Bridging the Gap focuses on assessing the impact of laws, regulations, policies, practices, and programs on youth behavior, while accounting for other environmental influences (e.g., marketing) that potentially affect these behaviors. These factors are examined at multiple levels of social organization, including schools, communities, and states. Similarly, multiple perspectives are represented by BTG investigators, including economics, social and developmental psychology, sociology, public health, political science, epidemiology, law, public policy, and community health. Working across these various behaviors, multiple levels, and diverse disciplines has provided opportunities for a unique degree of integrated, interdisciplinary research.

Monitoring the Future Data on Student Behaviors

Much of the initiative's efforts are built around the Monitoring the Future study, directed by Lloyd Johnston and colleagues at the University of Michigan's ISR, and supported by the National Institute on Drug Abuse (NIDA). MTF has been conducting school-based surveys of high school seniors since 1975 and of 8th- and 10th-grade students since 1991. A nationally representative sample of approximately 45,000 to 50,000 adolescents in about 420 schools is surveyed each spring, with

extensive information collected about their substance use, related attitudes and beliefs, perceived availability of various substances, exposure to anti-drug and anti-tobacco advertising, tobacco-related purchase experiences, and much more. Given the extensive information collected in these surveys, multiple, randomly distributed, forms are employed, with all forms including a core set of questions on the key substance use and background/demographic measures; and a set of form-specific questions collecting more detailed information on substance-use–related attitudes, risk perceptions, perceptions of availability, and a variety of other issues. Six forms are used in the 12th-grade survey and four forms are used in the 8th- and 10th-grade surveys. Schools participate in MTF for 2 years, with half of the schools cycling in each year. In addition, the surveys collect a variety of socioeconomic and demographic data from all respondents. Surveys are nationally representative at each grade level for each of the half-samples of schools, with schools selected through a multistage random sampling procedure.[17] Both public and private schools are eligible for selection. The first stage is the selection of primary sampling units defined by geographic location in the coterminous United States. The second stage is the selection of one or more middle and/or high schools within those locations, with probability of selection proportionate to size. The final stage is the selection of students at the targeted grade level within each school. For schools with fewer than 350 students in the targeted grade, all students are sampled; for those with more, a subset is sampled (typically by randomly sampling entire classrooms). Weighting is used to correct for unequal probability of selection at any and all of these stages. More information on MTF may be found at www.monitoringthefuture.org.

The YES Surveys of School Administrators

The YES project, which is supported entirely by grants from the RWJF, annually surveys school administrators in the nationally representative half-sample of MTF schools cycling out of the MTF study that year. Beginning with the 1997–1998 school year, and each year since, a survey instrument—the School Policies and Programs Questionnaire—has gathered detailed information on each school's alcohol, tobacco, and illicit drug–related policies and their implementation, the various prevention and cessation programs and curricula offered by the schools, and other information on the school and its environment (e.g., student composition, staff and other resources, school structure). The survey consists of multiple modules and is designed to be completed by one or more administrators. In addition, a separate observational form is completed by the MTF survey administrators on their last visit to each school; this form assesses various physical characteristics of the school campus and school building(s). Response rates for the YES survey of school administrators, who are paid for their participation, have averaged about 85 percent. More information on the YES study may be found at www.YESresearch.org.

ImpacTeen Data on Community, State, and Commercial Influences

In order to assess the effects of policies, programs, and practices at the community and state levels on adolescent substance use and related outcomes, a substantial amount of new information had to be developed or gathered from archival sources and then integrated with the MTF data on youth and the YES data on schools. This work was conducted as part of the ImpacTeen component of BTG and included information on state and community policies and other environmental factors, as well as on commercial influences in the larger environment. The University of Illinois at Chicago (UIC) has worked with or currently collaborates with researchers at several other institutions in these activities, including Roswell Park Cancer Institute (tobacco); Andrews University (illicit drugs); RAND (illicit drugs); University of Minnesota (alcohol); MayaTech Corporation (tobacco and illicit drugs); and Battelle (tobacco, alcohol, and illicit drugs). In addition to its core funding from RWJF, additional funding from the NCI, National Institute on Justice, Centers for Disease Control and Prevention (CDC), National Institute on Alcohol Abuse and Alcoholism (NIAAA), NIDA, and others have allowed for extensions of the work done as part of the initiative. For more information on the projects, see their website: www.impacteen.org.

ImpacTeen gathers a range of data on state- and community-level environmental influences through a combination of original data-collection activities and accumulation of data from various archival sources. From 1999 through 2003, this included a significant original data-collection effort in the approximately 210 communities each year in which the MTF 2nd-year half samples of schools were located. Communities were defined by the school "catchment area" (the geographic area from which each school draws its students). The data collected in these communities included four broad components: observational data collection in retail outlets selling tobacco products and/or alcoholic beverages; general community observations; onsite and online collection of local tobacco, alcohol, and/or illicit drug-related ordinances and regulations; and telephone surveys of community key informants. Information on prices, advertising, promotion, and placement of cigarettes, other tobacco products, and various alcoholic beverages were collected from up to 30 retail stores in each community (a census of these outlets in most) through the store observa-

tions. The general community assessments included observable measures such as outdoor advertising (including pro-tobacco and alcohol advertising and anti-tobacco and anti-illicit-drug advertising), social and recreational space, social disorganization, and safety. Local ordinances and regulations were collected from city and county offices and from local health departments. Key informants surveyed included local police chiefs and officers, local health department officials, local coalition leaders, and others identified as actively working to reduce youth substance use and its consequences. These respondents provided information on the implementation and enforcement of state and local policies, their organization's activities addressing youth substance use, after-school and other programs/activities for local youth, and more.

In addition, separate state-level policy databases have been constructed for each substance. The tobacco database includes detailed information on tobacco product taxes; restrictions on smoking in a variety of places; limits on youth access to tobacco products; and policies targeting youth purchase, possession, or use of tobacco products; as well as a variety of state-level measures of tobacco use and its consequences. These data are regularly updated and are available on the ImpacTeen website. The alcohol policy database includes information on alcoholic beverage excise taxes; drinking and driving policies (including zero-tolerance laws targeting underage drinking and driving); various limits on youth access to alcoholic beverages (e.g., server training and keg registration policies); and more. These data have been integrated into the NIAAA's Alcohol Policy Information System (APIS), available online at www.alcoholpolicy.niaaa.nih.gov. The illicit drug policy database includes information on state policies related to the manufacture, distribution, sale, or possession of various illicit drugs, medical marijuana policies, policies addressing drug treatment, and more. These data are also available on the ImpacTeen website.

In addition, ImpacTeen gathers archival data from multiple publicly available and commercial databases, as well as other surveys containing information on youth and young adult substance use, abuse, and related outcomes. These databases include information on community population characteristics (e.g., age and racial/ethnic composition, household income, and poverty rates); business lists (for construction of outlet density measures); exposure to televised advertising; and prices for alcohol, tobacco, and other products. Finally, as coordinating center for BTG, ImpacTeen engages in a range of communications activities to disseminate the findings from BTG research to diverse audiences, including policymakers, public health and school officials, advocacy organizations, and other researchers.

Bridging the Gap's Research Findings on Alcohol, Tobacco, and Illicit Drug Use

These databases, individually and in various combinations, have been used in numerous analyses that have improved the understanding of the extent of, and changes in, policies, programs, practices, and other environmental influences and their associations with adolescent substance use and abuse. Over 100 peer-reviewed articles, book chapters, chart books, and other publications have resulted from BTG's research to date. These are listed, and in a number of cases directly available, on the websites for ImpacTeen and YES. The brief synopsis below of some of BTG's research on substance use illustrates the range of issues that also can be addressed in the domain of childhood obesity.

In the tobacco area, BTG research using retail store observation data showed that cigarette companies increased their marketing efforts at the point-of-sale after the elimination of billboard advertising under the Master Settlement Agreement,[19] documented how the extent of these marketing efforts varied by type of outlet[20] and changed over time,[21] and showed that these marketing efforts were associated with greater smoking prevalence and increased smoking uptake among adolescents.[22] Others have used the MTF survey to describe methods and ease of access to tobacco products for youth,[23] adolescent recall and appraisal of anti-smoking advertising,[24] and the role of smoking history and intentions in predicting future smoking.[25] Still others have employed state, local, and/or school tobacco-related policy and other data to examine the role of cigarette prices in youth smoking initiation[26]; the effects of home, school, community and/or state restrictions on smoking on youth smoking prevalence[27,28]; the impact of funding for comprehensive state tobacco control programs on overall smoking and youth smoking[29,30]; and the influence of televised anti-smoking advertising on youth smoking behavior, attitudes, and beliefs.[31,32]

Similar analyses have been completed for alcohol and/or illicit drug use. Variations in alcohol marketing at the point-of-sale have been described[33] and related to various community characteristics.[34] Comprehensive chart books summarizing state alcohol and illicit drug-related policies have been produced,[35,36] key state policies and their evolution documented,[37–39] and the local implementation of state and federal drug control policies described.[40] Analyses also have raised questions about whether school drug testing has a significant impact on student drug use[41,42] and showed that marijuana prices and related attitudes are significantly associated with youth marijuana use.[43] Others have shown that states' zero-tolerance laws targeting underage drinking and driving reduce youth drinking and driving while having no impact on youth drinking[44] and that higher alcoholic beverage prices reduce the

likelihood of moving from abstention to moderate and from moderate to heavy drinking among young adults.[45] Evidence also has been reviewed on the effects of price on alcohol use and related problems.[46] Still others have looked across substances at, for example, the relationships between community- and nonclassroom-based substance-use prevention strategies and adolescent alcohol, tobacco, and illicit drug use,[47] and at the relationships between young adults' use of marijuana and alcohol[48] and youth marijuana use and cigarette smoking.[49]

These are a few examples from BTG's extensive research on the effects of policies, programs, practices, and other environmental influences on adolescent substance use, abuse, and related outcomes. In the 10 years since BTG began, states, communities, and schools have adopted new and/or strengthened existing tobacco, alcohol, and illicit drug control policies; improved the implementation and enforcement of these policies; implemented a variety of school- and community-based programs; and taken other steps to reduce adolescent substance use. While numerous factors have prompted this action, it is likely that the growing evidence base on the importance of these and other environmental influences on youth behavior has helped to enhance the effectiveness of these interventions. The significant declines in adolescent substance use that began in the late 1990s—in particular cigarette use—may be, in part, the result of this work.

Bridging the Gap Turns to Adolescent Obesity

While BTG's research on adolescent substance use continues, the initiative's more recent efforts increasingly have focused on the role environmental factors play in determining adolescent physical activity, diet, and obesity-related outcomes. This additional emphasis has resulted from the emerging evidence of a rapid rise in obesity, particularly among children and adolescents; the scramble by national, state, and school policymakers and public health professionals to adopt policies and implement programs that address these problems; and a serious absence of evidence on the impact of most of these interventions. These factors parallel many of the characteristics of the substance abuse epidemic of recent decades; in addition, both substance abuse and obesity involve sets of adolescent behaviors that are preventable, meaning that all of the many adverse consequences associated with each are likewise preventable.

In the 2003–2004 National Health and Nutrition Examination Survey, 17.4% of adolescents aged 12 to 19 were overweight, based upon the CDC's definition of overweight as having a body mass index (BMI) greater than or equal to the 95th percentile for age and gender based on earlier surveys, up nearly 18% from 1999–2000 and more than triple the rate from the late 1970s.[50,51] This trend echoes the rise in overweight among younger children as well as obesity among adults.[50,51] Significant socioeconomic and racial/ethnic differences in the prevalence of overweight among youth have been reported, with the highest rates among non-Hispanic African-American youth and among youth from lower socioeconomic groups.[51,52] Significant physical and emotional health problems have been linked to childhood overweight, including type 2 diabetes, hypertension, sleep apnea, cholelithiasis, low self-esteem, negative body image, and depressive symptoms.[52] Moreover, there is a strong link between being overweight during childhood and adolescence and being obese in adulthood.[52,53] While there is some uncertainty over the numbers, it is clear that obesity causes many thousands of premature death,[16,54] as well as imposes significant economic costs.[55]

The recognition of this growing epidemic has prompted actions by policymakers, the public health community, and other organizations. Many of these actions have focused on environmental changes targeting the physical inactivity and poor diets that are the leading causes of overweight and obesity. In many cases, however, the evidence base to demonstrate the effectiveness of these interventions in promoting physical activity and healthy eating, and in reducing overweight and obesity, is almost non-existent.

To address this gap and to inform the development of more effective interventions, BTG has begun to apply the research strategies that it used to address adolescent substance use to examine the impact of policies, programs, practices, and other contextual influences on adolescent physical activity, diet, and weight. BTG is in a unique position to do this, given its distinctive combination of data sources and analytic efforts. Figure 1 contains the general conceptual framework that underlies BTG's research on adolescent obesity. This framework draws on the multiple disciplines represented by BTG and highlights the importance of contextual factors and the interaction of these factors with individual and social factors in affecting healthy eating and physical activity and, ultimately, BMI and weight status.

Monitoring the Future Surveys and Adolescent Obesity

The MTF surveys continue to be a primary source of information on the relevant youth outcomes, other relevant behaviors, and socioeconomic and demographic factors. Since 1986, the MTF survey of high school seniors has included questions on student height and weight, allowing the construction of BMI and other indicators reflecting overweight and at-risk-for-overweight youth. Comparable questions specific to

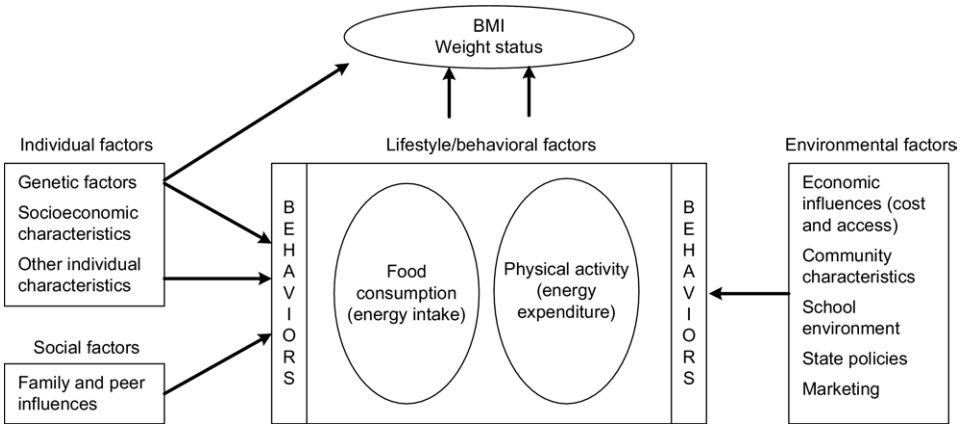

Figure 1. Conceptual model.
BMI, body mass index.

particular questionnaire forms were included when MTF added its 8th- and 10th-grade surveys in 1991. In addition to the height and weight questions, various forms include questions on dietary habits (frequency of consumption of green vegetables or fresh fruits, frequency of eating breakfast); physical activity (frequency of vigorous exercise; frequency of participation in sports, athletics, or exercising; participation on a school athletic team); sedentary behavior (frequency of television watching, separately for weekdays and weekends; frequency of nonschool/work computer use); and sleep (frequency of getting 7 or more hours of sleep each night; frequency of getting less sleep than respondents think they should).

Most of these questions were added to the surveys at the same time as the height and weight variables as part of an effort by the MTF investigators to assess healthy lifestyle as a correlate and possible determinant of substance use. A few were added earlier.

Consistent with the trends observed in other data, Johnston and O'Malley's examination[56] of the MTF data showed that BMI has risen at all grade levels for both boys and girls, with the exception of a possible leveling-off among 8th-grade girls in the mid-1990s. Similarly, the prevalence of at-risk-for-overweight or overweight has risen steadily for both boys and girls, again with the exception of 8th-grade girls for whom there has been little change over time since the surveys began in 1991. Particularly notable are the increases in the prevalence of overweight among 12th graders, where prevalence rose from 3.3% and 1.9% in 1986 among boys and girls, respectively, to 11.2% and 7.0% in 2002—more than a tripling over that period. Trends in the various behaviors asked about in the MTF surveys suggest that the increases in BMI and unhealthy weight may well result from concurrent reductions observed in physical activity, healthy eating, and sleep, along with increased screen time. For example, there has been a clear downward trend in the percentage of 10th- and 12th-grade youth reporting frequent vigorous exercise, as well as of those reporting frequent participation in sports, athletics, or exercise. Similarly, the prevalence of youth who eat breakfast, green vegetables, and/or fruit nearly every day has generally declined in all three grades for both boys and girls. Perhaps most striking are the sharp declines over time in the percentage of youth reporting 7 or more hours of sleep nearly every day and the increases in those reporting that they get less sleep than they should.

Youth, Education, and Society Survey

As BTG's efforts have increasingly focused on adolescent obesity, the annual YES surveys of middle and high school administrators have been modified to encompass relevant measures. For example, extensive physical education and other physical activity–related items were introduced in 2003; extensive items on the school food and beverage environment and on commercial contracts in schools were added in 2004; and extensive questions on school wellness policies, programs, and practices were added in 2006. These added to questions on the availability of after-school activities that have been a part of the survey since it was first conducted in 1998. As noted above, a wide range of information is collected through the survey, including basic information about the school and student population; parent involvement in the school; school policies targeting alcohol, tobacco and/or illicit drugs; the prevention curricula used by the school; other school programs targeting substance use; the school food environment; and school physical education policies and practices. To facilitate completion and to ensure reliability, the survey consists of several color-coded modules that can be completed by different school personnel; instructions indicate, for example, that the school's Food Service Manager is likely to be best suited to answering the module on the school's food and beverage offer-

ings, and that section is, in fact, usually completed by the person in that role.

With respect to physical education and physical activity, the YES survey collects information on students in the grade surveyed in MTF—that is, those in grades 8, 10, or 12—on:

- Physical education requirements
- Frequency and duration of physical education classes
- Percentage of students participating in physical education classes
- Percentage of students participating in interscholastic or varsity sports (separately for boys and girls)
- Percentage of students participating in intramural sports or physical activity clubs (separately for boys and girls)
- Percentage of students walking or biking to school
- Physical fitness testing and whether the results are provided to parents
- Other significant school-based efforts in the district or the school to promote student physical activity or more-healthy eating (open-ended)

The YES survey includes a module focused on school food and nutrition policies and practices that gathers a variety of information, including:

- Whether or not the school offers breakfast and/or lunch to students
- Participation in the U.S. Department of Agriculture (USDA)'s National School Lunch Program and, if participating, the average full price of the meal
- School menu planning systems
- Level at which school food service decisions are made
- Participation in the USDA's Team Nutrition program
- Availability of brand name fast-food items, either á la carte or as part of the school lunch meal
- Availability of a variety of food products (e.g., candy, lowfat and other salty snacks, lowfat and other baked goods, fruits, vegetables, salads, bread products, lowfat or regular ice cream, and sandwiches)
- Availability of various beverages (e.g., diet soft drinks, regular soft drinks, bottled water, milk [lowfat, skim, and/or whole; 2% or flavored], and 100% fruit or vegetable juice)
- Times during the school day when these foods/beverages are available (before classes, during nonlunch school hours, during lunch, and/or after school)
- Locations from which these foods/beverages are available (vending machines, school/student stores, snack bars/carts, á la carte at school cafeteria)
- Composition of the school lunch meals
- Availability of a salad bar in the school cafeteria
- Provision of menu and nutrition information to students and/or parents
- Use of differential pricing strategies to encourage healthier eating and drinking behaviors

In an effort to capture information on school-level implementation of the school district "wellness policies" mandated by the 2004 National School Lunch Act, the YES survey also includes a set of questions about these policies and other school-based health-related activities, including:

- Whether or not the district has a school wellness policy addressing student nutrition and/or physical activity
- Whether or not the school has developed (or is developing) explicit goals to improve student wellness through nutrition education, physical activity, and/or other activities
- School or district nutrition guidelines for all foods available to students during school hours
- School or district plans for monitoring the implementation of wellness policies
- Involvement of key stakeholders (e.g., parents, students, teachers, and others) in developing the wellness policy
- Formal classroom instruction on nutrition and dietary behavior and/or physical activity, exercise, and health-related fitness and the percentage of students exposed to this instruction
- Other significant school-based activities intended to promote healthier eating and drinking practices among students (asked in an open-ended answer format)

Finally, the YES survey collects other relevant information, including whether student BMI is measured and whether it is reported to the parent; presence of and revenues generated from contracts between schools and soft-drink companies; and school start time. As described briefly below, many of the measures contained in the YES survey are the focus of several of the papers contained in this supplement.

ImpacTeen Data Collections

The ImpacTeen community data collections were conducted annually from 1999 through 2003 in the communities around the 2nd-year half-sample of schools cycling out of the MTF surveys. "Communities" were defined by the geographic area from which the MTF schools drew the vast majority of their students; in less-urban settings, this could include several towns and small cities, while in highly populated urban settings, it could be a relatively small section of a large city. As part of the general community observations, information was collected on a variety of items potentially related to physical activity, including the availability of social and

recreational spaces (e.g., sports areas, parks, public pools, and beaches); the availability of walking/biking paths; availability of bike lanes on roads; the availability of street lights/safe lighting; presence of curbs and sidewalks in residential neighborhoods; and traffic density. ImpacTeen researchers have used these data to look at the relationships between various community characteristics and the availability of opportunities for physical activity in communities.[57] As might be expected given the racial/ethnic and socioeconomic differences in obesity rates, significant differences were observed across communities. Those with higher minority populations, lower median household incomes, and higher poverty rates generally had fewer of these physical activity opportunities available. The lack of these opportunities is likely to be an important factor in explaining the lower rates of physical activity and higher rates of obesity in these populations.

Similarly, the ImpacTeen community key informant surveys collected a variety of information from respondents on the availability of various opportunities for adolescent physical activity, including school- and nonschool-based after-school sports activities; other after-school activities (e.g., dance and theater, Boy and Girl Scouts); supervised activity centers (e.g., YMCA and YWCA, community centers); indoor sports facilities; and other settings for physical activity (e.g., ice/roller rinks, skateboard parks, playgrounds). Analyses linking the availability of these opportunities and those collected in the community observations of the MTF survey on adolescent physical activity and weight-related outcomes are ongoing. In addition to the questions asked of all respondents, local health department respondents (in 2003) were asked about their efforts to promote physical activity and/or healthy eating among adolescents and adults, as well as the importance they placed on these efforts in comparison to their other activities. The health department survey data are the focus of one of the papers contained in this supplement.

In addition, the ImpacTeen project is developing information on state-level policies that potentially affect youth physical activity, healthy eating, and obesity, building on experiences developing comparable databases on tobacco, alcohol, and illicit drug-related policies. This endeavor complements the ongoing efforts of the NCI to track state policies targeting the school food environment and student physical activity which are described briefly below and in more detail in two of the papers[12,13] contained in this supplement. Among the policies not currently included in the NCI's database and likely to be included in the ImpacTeen obesity-related state-level policy database are snack and soda taxes; dedicated funding for school-based nutrition education, physical education, or other obesity prevention programs/activities; regulations targeting school pouring contracts and other contracts affecting the school food environment; mandatory school screening for obesity-related health conditions (e.g., type 2 diabetes); safe routes to school policies; policies supporting sustainable practices (e.g., farm-to-school requirements); state-mandated wellness policies; policies requiring the provision of nutrition information for foods and beverages available at school; and policies restricting the use of snacks as rewards in schools. Pilot testing of methods for collecting these policies from state statutes and regulations are currently in progress.

Archival Databases

The ImpacTeen component of BTG continues to gather information on numerous factors that may affect youth health-related behaviors, including physical activity, diet, and obesity. These data are drawn from a variety of publicly accessible and commercial databases and are being used in a range of analyses, both individually and in combination with other databases collected originally or obtained by BTG. Archival data of the following types have been used in several of the papers contained in this supplement and/or in other BTG papers on adolescent obesity:

- Outlet density measures constructed from the business lists obtained from the Dun and Bradstreet (D&B) MarketPlace database. This database contains a variety of information on over 14 million U.S. businesses and is updated regularly by D&B. Business lists can be developed based on multiple criteria, including type of business, location, size, employment, and sales. For use in BTG, business lists have been developed for different types of businesses based on primary Standard Industry Classification (SIC) codes identifying food or physical activity–related businesses. Food-related businesses include: fast-food restaurants; full-service restaurants; large chain supermarkets; independent supermarkets; grocery stores; and convenience stores. Physical activity–related businesses include physical fitness facilities; membership sports and recreation clubs; and dance studios, schools, and halls. The business lists are developed at the ZIP-code level and matched to other ZIP-code level information, as well as to the MTF survey data based on the ZIP code in which each school is located.
- Prices for assorted healthy and unhealthy foods are taken from the ACCRA quarterly cost-of-living reports. Each quarter, ACCRA, The Council for Community and Economic Research (formerly the American Chamber of Commerce Researchers' Association), collects prices on a variety of goods and services from more than 300 cities. Prices are obtained from a sample of stores, with most items reflecting prices for brand-named products. The

goods and services chosen, and the stores from which prices are collected, are intended to reflect a middle management standard of living. ACCRA uses these prices and weights based on expenditure patterns, to compute a local cost-of-living index. The sample of products includes lettuce, tomatoes, bananas, potatoes, peaches, sweet peas, frozen corn, fast-food hamburgers (McDonald's Quarter Pounder with Cheese); cheese pizza (Pizza Hut or Pizza Inn); and a fried chicken meal (from KFC or Church's). In various BTG analyses, these price data are used to compute a fruit and vegetable price index (with each weighted based on expenditure shares obtained from the Bureau of Labor Statistics' Consumer Expenditure Survey) and a fast-food price index (with each item equally weighted). The individual product prices and the two price indices are matched to the school student survey data based on the proximity of the ACCRA city to the MTF school, along with a set of indicators reflecting the quality of the price match.

- Televised advertising for various food products, as well as public service advertising (PSA) promoting physical activity and healthy eating, acquired from Nielsen Media Research (NMR). NMR tracks television viewing in a nationally representative sample of households and reports overall ratings for television programming (including advertising), as well as ratings for a number of targeted subgroups based on age, gender, race/ethnicity, and other characteristics. To date, BTG has obtained two sets of data from NMR reflecting exposure to TV advertising among children, adolescents, and adults. The first data set, acquired as part of the Youth Smoking and the Media project, examined the impact of exposure to anti-smoking advertising. It included all PSAs from 1999 through 2003, with media-market–level exposure measures for the 75 largest U.S. media markets. These ads included both state-sponsored ads and national ad campaigns, such as the CDC's VERB campaign[58] promoting physical activity. The second data set included exposure to all advertising for the most watched network, cable, and syndicated series and network and cable specials for six population subgroups: 2 through 11 years, 12 through 17 years, and 18 years and older for white and African Americans in each age group.
- Community population characteristics drawn from U.S. Census Bureau databases. These data include information on the age, gender, and/or racial/ethnic composition of communities, median household income, poverty rates, home ownership rates, and other measures of community demographic makeup and socioeconomic status (SES). Measures are constructed at alternative levels of aggregation, including at the ZIP-code and county level.

Table 1 summarizes the key databases BTG researchers employ in their analyses of the impact of school, community, state, and other environmental influences on adolescent physical activity, diet, and obesity.

These data are used alone and in various combinations with other BTG data in several of the papers contained in this supplement. In addition, BTG researchers are working with these data in other analyses. For example, ZIP-code–level outlet density measures constructed from the D&B business list data have been merged with ZIP-code–level data on community population characteristics to examine the associations among community socioeconomic and demographic factors and availability of food and physical activity–related outlets. One recent paper by Powell and her colleagues[59] showed that commercial physical activity–related outlets are less available in lower-income communities as well as in communities with higher racial/ethnic minority populations, confirming BTG's findings with respect to free opportunities for physical activity described above.[57] Similar associations are observed with respect to food stores, with chain supermarkets less available in low-income, high-minority communities, while nonchain supermarkets and grocery stores are relatively more available.[60] Other BTG analyses combine the outlet density measures, food prices, and community characteristics data with the MTF data on adolescent behavior and weight outcomes. For example, Powell and her colleagues[61] found that fast-food prices significantly affected adolescents' fruit and vegetable consumption and BMI, as well as their likelihood of being overweight, while fruit and vegetable prices and the density of fast-food and other restaurants had weaker associations with these outcomes. Likewise, BTG researchers are assessing youth and adult exposure to televised food advertising and differences in exposure across different age and racial/ethnic groups. One of these analyses, for example, found that over one quarter of national advertising exposure for children, aged 2 through 11 years, in the 2003–2004 television season was for food-related products, with greater exposure among African-American children.[62]

BTG and Other Papers in this Supplement

The papers contained in this supplement[1–13] highlight the breadth of BTG's research on the policy and environmental factors that are potentially important determinants of obesity-related behaviors and outcomes among adolescents, along with related efforts to identify and track relevant state policies. Given the significant disparities in the prevalence of physical inactivity, unhealthy eating, and obesity-related outcomes among youth in different racial/ethnic and/or socioeconomic groups, many of these papers seek to

Table 1. Key databases employed in Bridging the Gap obesity research

Database	Brief description	For more information
Monitoring the Future	- Annual school-based surveys of 8th-, 10th-, and 12th-grade students in the coterminus U.S. - 12th grade since 1975; 8th/10th grade since 1991 - Approximately 45–50,000 youth in 420 schools each year - Alcohol, tobacco, and illicit drug use and related knowledge, attitudes, and beliefs - Height, weight, physical activity, diet, and related behaviors - Supported by the National Institute on Drug Abuse	www.monitoringthefuture.org
Youth, Education, and Society	- Annual surveys of middle and high school administrators in MTF schools (second-year half-sample) since 1998 - School food environment, physical education requirements, student physical activity, beverage contracts - School ATOD-related policies, programs, and prevention curricula - Supported by the Robert Wood Johnson Foundation	www.yesresearch.org
ImpacTeen community observations	- Annual community observations in catchment areas for MTF second-year half-sample schools from 1999 through 2003 - In-store observations of tobacco and alcohol prices, placement, advertising, and promotion - Outdoor advertising and counter-advertising - Collection of local ATOD and youth-related ordinances - Indicators of community social capital, availability of opportunities for youth physical activity - Supported by the Robert Wood Johnson Foundation	www.impacteen.org
ImpacTeen Key informant interviews	- Annual interviews with local health department officials, police chiefs and police officers, local coalitions, and others actively working to address youth substance use - Conducted in communities in which MTF second-year half-sample schools were located, 1999 through 2003 - After-school opportunities for local youth, enforcement of state and local policies, support for efforts targeting youth substance use and, in last year, adolescent obesity - Supported by the Robert Wood Johnson Foundation	www.impacteen.org
ImpacTeen state policy databases	- Major state tobacco control policies, illicit drug-related policies, policies addressing alcohol and drug treatment (various years) - New efforts to track state policies with potential to impact on physical activity, diet, and obesity-related outcomes - Supported by the Robert Wood Johnson Foundation	www.impacteen.org
Alcohol policy information system	- Major state alcohol-related policies, various years - Supported by the National Institute on Alcohol Abuse and Alcoholism	www.alcoholpolicy.niaaa.nih.gov
State obesity policy rating system	- Policies targeting physical education/physical activity in schools - Policies addressing the school food environment - Supported by the National Cancer Institute	Two papers by Mâsse and colleagues contained in this supplement; data will eventually be posted on NCI's web site
Television advertising	- Exposure to televised food and beverage advertising ○ Nationally, by age and race - Exposure to televised public service advertisements promoting physical activity or healthy eating ○ By market over time, by age - Proprietary data produced by Nielsen Media Research	www.nielsenmedia.com
Food and beverage prices	- Quarterly prices for variety of foods and beverages, including fast foods, fruits and vegetables, and more - Local cost-of-living index - Quarterly for more than 300 U.S. cities - Produced by ACCRA (formerly the American Chamber of Commerce Researchers' Association)	www.coli.org

(continued on next page)

Table 1. (*continued*)

Database	Brief description	For more information
Outlet density	- Business lists for over 14 million U.S. businesses - Based on standard industrial classification (SIC) codes - Uses both primary and non-primary SIC codes, as reported by businesses, to the eight-digit level - Obtained from Dun & Bradstreet's MarketPlace database	www.dnb.com
Community population characteristics	- Age, gender, and racial/ethnic composition of communities - Median household income, poverty rates, home ownership rates - Other community socioeconomic and demographic measures - At multiple levels of aggregation (including school catchment area and zip code) - Obtained from the U.S. Census Bureau	www.census.gov

document and explore disparities in these outcomes and in their potential determinants. This section briefly reviews these papers and highlights some key findings.

Adolescent Behavior and Obesity

Delva and his colleagues[1] use data from the 1998–2003 MTF surveys of 8th and 10th graders to describe differences in the prevalence of overweight and other lifestyle variables by gender, race/ethnicity, and SES. They find that prevalence of overweight is greatest among males, racial/ethnic minorities, and lower-SES youth, along with those in rural, Southern communities. At particular risk are Hispanic boys and African-American girls, reflecting an important gender by race/ethnicity interaction. In a recent article from BTG, by the same authors, it was found that the prevalence of overweight is rising in nearly all subgroups.[63] The authors go on to examine the importance of various possible contributory behaviors—including frequency of eating breakfast, fruits, and vegetables; regular exercise; TV watching; and getting 7 hours of sleep—on prevalence of overweight in these subgroups. As expected, their multivariate analyses showed that these behaviors correlated significantly and in the expected direction with the prevalence of overweight, with the effects of SES on prevalence attenuated by the inclusion of these behaviors. Most of the healthier of these behaviors have been shown to be in decline, with getting exercise declining faster among males than among females.[56,63] Interestingly, Delva and his colleagues found that these behaviors are more important than the family and parenting variables they examined in explaining the prevalence of overweight among adolescents in the various subgroups.

School Influences on Adolescent Obesity

O'Malley and his colleagues[2] begin the analyses of the importance of school and community influences on adolescent obesity by assessing the extent to which there exist differences among schools in the average BMI and the prevalence of overweight of their students. Using the MTF on 8th-, 10th-, and 12th-grade student data from 1991–2004, they find that between-school differences represent relatively small shares of the observed variances in BMI and the proportion of students that are overweight. Nevertheless, significant differences exist among schools; for example, just over 10% of students are overweight, on average, in the lowest decile of schools based on this measure, while 43.6% are overweight, on average, in the highest decile. Racial/ethnic composition and SES of the student population are relatively important determinants of BMI and overweight, even after controlling for individual race/ethnicity and SES. Other school characteristics, including school type (public, Catholic-private, non-Catholic private); school size; and selected community characteristics (region and population density) explain a relatively smaller share of the observed differences among schools.

Johnston and his colleagues[3] look more closely at physical education and sports participation among students using data from the 2003–2005 MTF and YES surveys. They find that there is a significant drop in both physical education (PE) requirements between 8th and 12th grades, with schools more than four times more likely to require 8th graders to take PE than 12th graders. Consequently, student participation in PE classes falls sharply from 8th grade to 12th grade. In contrast, student participation in varsity sports differs little across grades, while participation in intramural sports is much lower than in varsity sports and falls somewhat between middle school and high school. There are minor differences in PE requirements and participation across student subgroups based on gender, race/ethnicity, and SES. There are, however, more significant subgroup differences in both varsity sports and intramural sports participation; with girls, racial/

ethnic minority youth, and low-SES students less likely to participate in them.

Two papers[4,5] describe various aspects of the school food and beverage environment and differences in these factors across schools, based on data from the 2004 and 2005 YES and MTF surveys. In the first of these, Johnston and his colleagues[4] find that the vast majority of high school students and most middle school students attend schools that have contractual agreements with soft drink bottlers. As a result, the vast majority of students have access to soft drinks either through vending machines or in the school cafeteria, with middle school students having somewhat less access than high school students and having diet beverages less available than regular soft drinks. Soft drink availability is greatest for Hispanic students, while advertising and promotion of soft drinks is more prevalent in schools with lower-SES students. The revenues received by schools from these contracts are more than nine times higher per student in high schools than in middle schools, with overall revenues highest in schools with a greater proportion of Hispanic students.

In the second of these papers, Delva and his colleagues[5] assess the availability to students of healthy and less-healthy foods in schools. They find that nearly all U.S. middle and high schools offer lunches to students, while more than four fifths offer breakfast (with low-SES and/or high-minority schools more likely to offer breakfast). About three quarters of middle school students and nearly two thirds of high school students regularly eat the school lunch, making the school an important source of food and beverages consumed by adolescents. A wider variety of both healthy and unhealthy food options is available to high school students than to middle school students. There are modest racial/ethnic differences in the availability of healthy and less-healthy products. For example, Hispanic students are more likely to have access to brand-name fast foods at lunch and to ice cream through vending machines, while African-American students are less likely to have access to the healthier lowfat salty snacks, fruits, and vegetables through vending machines. Both healthier and less-healthy snacks are more likely to be available to high-SES students than to low-SES students, but the ratio of unhealthy to healthy snacks is greater among low-SES students.

Community Influences on Adolescent Obesity

Four papers[6,7,10,11] highlight different aspects of the community environment in affecting adolescent behaviors and obesity. The first of these adds to BTG's earlier research assessing differences in the availability of physical activity opportunities and food-related outlets across communities. Using ZIP-code–level data from the 28,050 ZIP codes in which the vast majority of the U.S. population resided in 2000, Powell and her colleagues[6] describe the associations between community demographic and socioeconomic characteristics and the availability of fast-food and full-service restaurants. Fewer restaurants of all types are found in high-minority and/or low-income communities. However, the proportion of all restaurants accounted for by fast-food restaurants is higher in these communities, suggesting that the choices available in low-income, high-minority communities are relatively less healthy (a finding consistent with that observed for the ratio of healthy to unhealthy snacks available to low-SES students in schools, as described above).

The second paper[7] uses data from the 2003 ImpacTeen community key informant surveys of local health departments with jurisdiction over the communities in which the 2nd-year half-samples of MTF 8th-, 10th-, and 12th-grade schools were located. Given BTG's increasing focus on obesity, that year's health department survey included a module on the relative importance of, and on each department's activities aimed at, increasing physical activity/healthy eating and preventing obesity among adolescents. While respondents generally indicated that efforts to promote healthy eating and physical activity and to control obesity were relatively important compared to other efforts, relatively few provided or supported activities/programs targeting these outcomes.

The remaining two papers[10,11] link outlet density measures from the D&B business list data and community characteristics from census data to the MTF surveys to assess the relationships among availability of various types of businesses, community income, and adolescent behavior and/or weight-related outcomes. The first[10] of these uses the 1997–2003 8th-, 10th-, and 12th-grade student data to examine the associations among the availability of commercial physical fitness facilities and student physical activity. Increased availability of these facilities is found to have a statistically significant, albeit small, impact on the likelihood that youth report frequent sports participation and/or frequent vigorous exercise. The magnitude of these associations falls substantially when controlling for community income (given the greater availability of these outlets in higher income communities), which itself has a positive association with physical activity.

The second[11] of the papers using the merged business list, census, and MTF data looks at the relationships between access to food stores (chain and nonchain supermarkets, convenience stores, and other grocery stores) and adolescent BMI among 8th- and 10th-grade students from 1997 through 2003. Greater availability of chain supermarkets is negatively and significantly associated with BMI, while greater availability of convenience stores has a positive and significant impact. Interestingly, the impact of availability on the likelihood of overweight is substantially larger than on BMI, suggesting that youth on the margin between

healthy and unhealthy weight are most affected. Similarly, relatively larger associations are observed for African-American adolescents and for those in households in which the mother works full time.

Media Influences on Adolescent Obesity

Two of the papers in this supplement use NMR data to describe youth exposure to televised advertising. In the first of these,[8] Powell and her colleagues assess exposure to food-related advertising on the most watched network, cable, and syndicated programs among youth aged 12–17 years during the 2003–2004 TV season. Nearly a quarter million 30-second equivalent advertising spots shown on 170 top-rated shows during this 9-month period are examined. About one fifth of these spots (nearly 50,000 ads) are food-related, accounting for almost one quarter of product advertising (advertising after excluding TV program promotions and PSAs). In contrast, all PSAs account for less than 2% of the ads seen by adolescents. Food products account for a proportionately larger share of the product ads seen by African-American adolescents. Given this and given racial/ethnic differences in TV watching, African-American youth are exposed to about 1.6 times as many food ads than their white counterparts. Of the overall food product advertising seen by adolescents, the food products most heavily advertised to them include fast food, sweets, and beverages, accounting for 23%, 22%, and 17%, respectively.

The second paper[9] focuses on obesity-related PSAs, comparing and contrasting adolescent exposure to these messages with exposure to anti-smoking ads sponsored by public health agencies and organizations (e.g., state tobacco control programs and the American Legacy Foundation). The success of the anti-smoking ads in reducing youth smoking[31] suggests that similar efforts to promote physical activity and healthy eating may be effective in preventing childhood and adolescent obesity. Emery and her colleagues[9] show that while exposure to obesity-related PSAs increased from 1999 to 2003, exposure to these ads was well below exposure to the anti-smoking ads. Most of the exposure is accounted for by the CDC's national VERB campaign[58] targeting youth and promoting physical activity, launched in 2002. State-sponsored ads were relatively rare, beginning in California in 2000 and spreading to seven other states by 2003; most of these ads focused on healthy eating and targeted a general audience.

State Policies Targeting Obesity

The NCI's ongoing efforts to identify, rate, and track state-level policies targeting obesity are described in two papers by Mâsse and her colleagues.[12,13] To date, these efforts have focused on policies targeting student physical education (PE) and the school food environment, building on the NCI's extensive experiences in rating state tobacco control policies. Separate policy ratings have been developed for each area, and state policies in effect as of December 31, 2003 have been collected and rated. The processes for developing and applying these two ratings systems to state policies for schools are described in these papers—PE-related policies in one and the other for policies related to the school nutrition environment. The development of both ratings systems was informed by reviews of the scientific and other relevant literatures and through consultations with expert panels and other selected experts. Policies, both statutes and regulations, were obtained from the Westlaw database for all 50 states and Washington DC.

The PE-related state policy ratings focused on five areas: PE time requirements, staffing requirements, curriculum standards, the assessment of health-related fitness, and recess time. The school nutrition policy rating system was more extensive, consisting of eleven topics, including competitive food policies targeting availability of á la carte items in cafeterias, vending machines, or other venues; reimbursable school meals and the school meal environment; food service director qualifications; nutrition education; food/beverage marketing; preferential pricing strategies; BMI screening; and mandated or recommended coordinating/advisory councils and/or plans. Policies in each topic area were given more points based on whether the policies were more extensive/comprehensive in ways expected to increase physical activity or improve student nutrition. For the physical activity–related policies, those setting staffing requirements were most extensively implemented across states, followed by those establishing PE time requirements, while those addressing recess time (for elementary schools only) were least extensive. On the nutrition side, most states had policies requiring some nutrition education, while a few, about one third, had policies targeting competitive foods. State policies addressing other topics were less prevalent, with no states having policies in effect at the end of 2003 focused on some areas (e.g., food/beverage marketing and preferential pricing of healthier foods and beverages). It is likely that both state policies adopted in these areas, and their degree of implementation, will expand in the coming years. The continued tracking/rating of these policies by NCI; the identification, tracking, and rating of other potentially relevant policies in the ImpacTeen project; and the continued assessment of their implementation in schools through the YES survey should help both to measure and stimulate progress in this area.

Discussion

Extensive research has demonstrated the importance of a range of policy, programmatic, and other environmental influences in affecting health behaviors. The

Bridging the Gap program created 10 years ago and supported by the Robert Wood Johnson Foundation—and other spin-off projects from this effort—have made numerous contributions to the evidence base on the impact of these factors on adolescent tobacco, alcohol, and illicit drug use and related outcomes. The accumulation of this evidence has been a critical factor in the development and implementation of effective strategies to reduce youth substance use and abuse. More recently, BTG has been applying a similar approach to adolescent obesity and the physical inactivity and/or poor dietary habits that are its primary causes. This supplement features some of BTG's early research on these issues, along with other important work on the policy and environmental determinants of obesity.

The papers contained in this supplement highlight the importance of contextual influences as determinants of adolescent physical activity, healthy eating, and weight. Moreover, they emphasize the disparities that exist in these factors and outcomes among different racial/ethnic and socioeconomic groups. BTG research suggests that interventions targeting obesity will be particularly effective among the subgroups most at risk. Adolescents in high-minority, low-income areas have fewer opportunities for physical activity and more limited options for healthy foods (and relatively more for unhealthy foods), both in schools and throughout their communities and, consequently, are more likely to be at unhealthy weight. Minority youth also are more exposed to food advertising on television and in their schools.

While awareness of the obesity epidemic is growing, state policymakers and local health departments have been slow to adopt comprehensive policies and programs targeting the environments and behaviors that cause obesity. Nevertheless, actions to address the obesity epidemic are being taken at all levels of government, as well as throughout the private sector. Clearly the issue has grown in the national consciousness. The evidence base to which BTG and many others are contributing should reinforce these efforts and help shape them in ways that maximize their effectiveness. They will also help to track progress that is, or is not, being made in changing key contextual influences in the schools, in communities, in the states, and in the media. Clearly, there are multiple influences that help to account for the growing obesity epidemic, as well as for the disparities in overweight as a function of race/ethnicity and SES. An effective societal response will depend on the recognition of what these complex and multiple influences are, an understanding of their levels in the population of youth and disparities in those levels, hopefully followed by a demand for change in many of them and for the reduction of the disparities found.

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Building the Evidence to Reverse an Epidemic

Risa Lavizzo-Mourey, MD, MBA

The basic facts of the problem are increasingly well-known, but bear repeating: childhood obesity rates in the United States have risen dramatically over the past 4 decades. Today, more than 33% of children and adolescents—approximately 25 million kids—are overweight or obese.[1] Overweight and obese children are being diagnosed with health problems that previously were considered to be "adult" illnesses, such as type 2 diabetes and high blood pressure.[2] Many studies have confirmed that the rates of overweight, obesity and related health problems are highest and rising fastest for African-American, Latino, Native American, Asian American, and Pacific Islander children living in low-income communities.[1,3]

These disturbing trends point to the real and pressing need for solutions. For some time now, our country has sought to solve the obesity crisis by placing the burden on individuals to change their diet and exercise practices. But the pervasive and entrenched nature of childhood obesity suggests that approaches focused merely on individual behavior will not solve the epidemic. To stop childhood obesity, we have to commit ourselves to comprehensive policy and environmental changes that benefit all of our children and our families.

Reversing the epidemic will require the nation's most massive mobilization ever to protect the health of the public. And that means we all have a role to play. We believe it is critical to work in partnership with other funders—to support research, programs, and policies that will make a difference. At the Robert Wood Johnson Foundation (RWJF) we already have begun to develop important collaborations with other organizations and funding partners, such as The California Endowment, the W.K. Kellogg Foundation, Kaiser Permanente, and Nemours Health and Prevention Services. We also are working with the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), the U.S. Department of Agriculture (USDA) and other government agencies to prevent childhood obesity and develop real measures of progress.

Along with philanthropy and government, the public also has awakened to the threat of childhood obesity. A survey conducted by the Harvard School of Public Health in 2006 found that 92% of Americans said that childhood obesity is a serious national problem.[4] Fortunately, many schools, communities, businesses, youth and advocacy organizations, and public health agencies are working fervently to find ways to disrupt the trend. At RWJF, our goal is to galvanize the nation to work together in reversing the epidemic by 2015, and we are committed to spending at least $500 million over the next 5 years to begin achieving that goal.

While awareness of the problem is at an all-time high, we are early in efforts to understand its modifiable causes and identify and implement replicable solutions for an epidemic that took all us by surprise. Until we more fully comprehend the complexities and root causes of this epidemic and undertake a coordinated effort to address childhood obesity using strategies that work, we will be left to respond to it with guesswork and inefficiency. And we don't have time for that.

The Foundation's approach to reversing the epidemic includes three interlocking strategies: (1) building solid evidence to unravel the epidemic's root causes and discover how best to address them; (2) putting the most successful strategies into action across the country; and (3) educating parents, public health advocates, schools, and community and national leaders about the problem and solutions, and furnishing the resources and tools to help them implement and sustain effective action. We seek, with the help of others, to accelerate and spread learning from each of these three strategies in order to make our nation healthier and save countless lives.

We are focusing our efforts in two ways: (1) on the low-income and racial/ethnic minority children and families who are at highest risk, and (2) on the environmental and policy factors that place limits on the choices families and children can make. To reverse the childhood obesity epidemic, we have to change the environments in which our children live, learn, and play, and we have to change policies in ways that support parents in their efforts to raise healthy kids. Without giving families and whole communities ubiquitous access to healthy choices by engaging parents and community leaders in efforts to call for that access, we will deal with this epidemic for decades and decades to come.

Many of the Foundation's earliest research investments focused on building a solid evidence base for the widespread policy and environmental factors contributing to the "energy gap" that exists for too many

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children. Claire Wang, Steve Gortmaker, and their colleagues[5] have described this energy gap as the taking in of far more calories than we burn, which leads to unhealthy weight gain. Today's obese teenagers consume between 700 and 1000 calories more per day than what's needed for the growth, physical activity, and body function of a normal-weight teen. Closing the energy gap for American youth will require changing policies and shaping environments in ways that make it easy for children to eat well and be active. This will be especially critical for children at greatest risk for childhood obesity.

Of course, knowing **which** policy and environmental changes to make will require significant and sustained investments in research and a focus on quickly translating the findings from that research into action. Fortunately, such a research movement is coalescing with support from foundations and, increasingly, federal agencies. One need only look to the NIH's Economics of Diet, Activity, and Energy Balance Research Program for an example of an intensive effort to enhance knowledge of how economic factors contribute to obesity and to build scientific evidence to inform decision-making on public health interventions that may reduce obesity in our country.

The research papers in this supplement to the *American Journal of Preventive Medicine*,[6–14] mostly from the Foundation's Bridging the Gap program, are among the first to clarify the powerful role of school, community, and information environments and policies in contributing to the energy gap and thereby fueling the obesity epidemic. These papers provide important information about sociodemographic disparities in overweight and obesity and help define possible solutions to this ongoing problem.

A number of the supplement papers use the school setting to explore important aspects of the childhood obesity epidemic, with particular emphasis on racial/ethnic and socioeconomic disparities. O'Malley et al.[6] found that, beyond individual-level factors, characteristics of school environments—perhaps cultural factors, peer role modeling and/or differences in school food and beverage policies—facilitate obesity in schools with a high concentration of lower socioeconomic students. And two papers by Johnston, Delva, O'Malley and their colleagues[7,8] found that racial/ethnic minority and low-income youth get less exercise at school from participating in physical education (PE) and school sports, have greater access to soft drinks and to soft drink ads and promotions in their schools, and have less access to certain healthy school foods and snacks. Delva et al.[9] add more to this research vein by documenting that differences in diet and physical activity (both regular exercise and sedentary behavior) are associated with overweight and help to explain higher rates of obesity among 8th and 10th graders in low-income and racial/ethnic minority populations. They conclude that these factors appear to be more important than the family/parenting variables they examined. These findings, among the first of their type, are helping to guide us towards effective broad-based school policy and environmental solutions focused on closing the energy gap and encouraging a healthy balance of nutrition and physical activity.

In similar fashion, several of the papers in this supplement provide a clearer understanding of sociodemographic disparities for childhood obesity at the community level. Powell et al.[10] found that low-to-middle income neighborhoods and black or racially mixed neighborhoods have higher numbers and proportions of fast-food restaurants than higher-income and predominantly white neighborhoods. According to another Powell et al. paper,[11] increased availability of chain supermarkets is associated with lower adolescent body mass index (BMI) and overweight, and greater availability of convenience stores is associated with higher BMI and overweight. And Slater et al.[12] found that less than half of a national sample of local health departments provide programs targeting obesity, physical activity, and healthy eating. These and other key studies in this supplement and elsewhere provide the impetus, direction and mandates needed by government, the public health field, advocates and others at the community level to call for and develop policies and programs that will reverse the childhood obesity epidemic.

Another crucial factor in the epidemic is the information environment, and a final set of Bridging the Gap papers explore certain elements of that environment, particularly food advertisements and health-promoting ads on television. Powell et al.[13] report that African-American boys, who are more likely to be obese, watch more television and are exposed to 1.6 times the number of food ads compared with their peers, and that fast food is the most frequently viewed food product category among adolescents. Emery et al.[14] compare exposure to state and national anti-tobacco and anti-obesity ads and find that lessons learned from tobacco counter-advertising could apply to obesity counter-campaigns and their evaluation. These papers and others highlight the fact that media, advertising, and other elements of the information environment disproportionately affect those with the highest and fastest-rising childhood obesity rates, and they underscore the need for our attention to disparities, as outlined in the Yancey and Kumanyika[15] commentary in this supplement.

In sum, Bridging the Gap—as well as two of the Foundation's other obesity-related research programs, Active Living Research and Healthy Eating Research (see Sallis, Story and Orleans[16] commentary in this supplement)—are identifying the underlying policy and environmental determinants of the childhood obesity epidemic in schools, neighborhoods and communities across the country. The Foundation is committed

to supporting these creative research programs and their rigorous evaluations of promising childhood obesity prevention initiatives.

Earlier in this paper, I noted that we are in the early stages of fully understanding all of the causes of the childhood obesity epidemic. While this is true, the strength of the research presented in this supplement and the growing body of evidence about the factors that drive this epidemic lead us to believe that there are policies that have the potential to make a real difference in the lives of our children and that we need to move on enacting these policies now.

For instance, given what research shows us about the school environment, one could argue that the No ChildLeftBehindAct(http://www.ed.gov/policy/elsec/leg/esea02/107-110.pdf) should make physical education mandatory every day at every grade level and that the USDA should develop and implement nutritional standards for all competitive foods and beverages sold or served in schools. Why not try these approaches as a means to addressing both sides of the energy gap our kids face daily?

At the state and local level, policymakers need to build incentives to bring supermarkets back into underserved communities. The federal government could help local communities by increasing the Food Stamp allowance so people can afford to buy healthy foods.

As for the information environment, the Institute of Medicine (IOM) has called on the food and beverage industry to use their creativity, resources, and full marketing muscle to promote and support more healthful diets for children and youth. Among other recommendations, the IOM has said that, if voluntary efforts to shift advertising during children's television programming toward more healthful foods and beverages are unsuccessful, Congress should enact legislation mandating the change on both broadcast and cable television. RWJF fully supports that recommendation.[17]

Without significant policy changes, our efforts to reverse this epidemic will fail. But those policy changes must be rooted in research that shows us the most effective means for making change. This supplement represents a major achievement—it contributes significantly to our research knowledge in a host of environments that play critical roles in reversing the epidemic. We commend all of the supplement authors for their contributions to the childhood obesity evidence base. Their work is a reminder that sustained and coordinated funding of research, as well as action and advocacy, will be critical to stopping the epidemic in its tracks and improving the health of generations of children.

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Preventing Childhood Obesity
The Power of Policy and Political Will

U.S. Senator Tom Harkin

It is beyond dispute that Americans are severely burdened by the medical and social costs of childhood obesity and resulting chronic diseases. Likewise, there is broad acknowledgement that steps must be taken to promote wellness and prevent avoidable illness and disease. However, there is incomplete consensus as to the optimum course that should be taken to address these challenges. In part, this is due to the fact that we are still assessing which interventions are most effective, and which can be successfully implemented on a mass scale. To address these challenges, I commend the authors in this supplement to the *American Journal of Preventive Medicine*.[1–14]

Perhaps the biggest challenge of all is the political one. Powerful interests and legions of lobbyists are arrayed against even commonsense proposals to encourage healthy choices and behaviors. And Americans themselves are generally wary of government—the "nanny state"—telling them what they should eat and drink, and how they should manage their own health. Given these challenges, if we are serious about wellness and disease prevention, and breaking with the status quo, several things need to happen.

First, we must move beyond the fruitless blame game as to who or what is responsible for America's epidemic of childhood obesity and related chronic diseases. Are individuals at fault? Corporations that relentlessly advertise unhealthy foods? Public schools that slight recess and physical education? A changing society that is increasingly sedentary? Isn't it obvious that there is plenty of blame to go around? And isn't it equally obvious that any successful effort to combat obesity, diabetes, heart disease, and other preventable conditions must mobilize all sectors of our society and economy: individuals, families, corporations, employers, schools, and government at all levels?

Second, as we continue to investigate the causes of childhood obesity as well as the behaviors that can prevent or reverse related chronic diseases, we need a more robust effort to translate the research findings into workable, sustainable interventions in our communities, schools, and workplaces. To that end, it is critical that we strengthen the ties between researchers who strive to identify evidence-based practices to promote public health, and policy makers and elected officials who are in a position to create public-information campaigns, incentives, and mandates in order to implement best practices on a broad scale.

Third, if our aim is obesity prevention, we must begin at the earliest possible age, with infants and children. Fortunately, there is a high degree of consensus and urgency with regard to the health needs of America's children. The shocking rise of childhood obesity and associated conditions such as type 2 diabetes is a fact beyond reasonable dispute. Moreover, it is clear that children, given their limited cognitive development, are uniquely vulnerable to manipulation by the advertising and marketing of less-healthy foods and beverages. There is strong consensus among policy makers, parents, and the public at large that, when it comes to protecting the health of children, robust public health interventions are appropriate and necessary. Moreover, there are several areas where we are obviously falling short at present.

For instance, because of outdated laws, our public schools, today, are awash in junk foods and sugary beverages, utterly undermining the aims of the nutritionally balanced National School Lunch Program. We need to implement updated federal nutrition standards for foods sold through school vending machines, snack bars, and other sources outside the cafeteria at lunchtime. Legislation, for which I am the chief sponsor, the Child Nutrition Promotion and School Lunch Protection Act, would update school nutrition standards and give the U.S. Department of Agriculture authority to regulate all foods and beverages sold in schools.

We also need to promote physical activity among our kids. It's unconscionable that we build elementary schools without playgrounds and that kids can't walk to a school just blocks away because busy roads lack sidewalks. Leading experts have set guidelines that children should participate in 60 minutes of physical activity everyday. The PLAY Every Day Act (www.playeveryday.org/Bill%20s651.pdf), which Senator Hillary Clinton and I introduced earlier this year, provides resources to communities to create coalitions that work to remove

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barriers that prevent children and families from living healthy, active lives. My vision is to have every community in America focused on promoting health and preventing disease—instead of just dealing with the bad consequences of obesity, diabetes, and heart disease.

Another area that needs to be examined is food marketing to kids. In recent reports, the Kaiser Family Foundation[15] and the Institute of Medicine[16] have detailed the incredible pressure that our children face today due to the marketing of junk food. The food industry spends more than $12 billion a year on marketing campaigns through television, movies, cell phones, and the Internet. Sadly, the majority of the advertising is for candy and foods high in sugar, salt, and fat and inconsistent with national dietary recommendations. Only 2% of advertising is for fruits and vegetables. I am hopeful that the FCC Task Force on Media and Obesity that I co-chair with Senator Brownback will develop and implement real solutions that effectively deal with this public health problem.

The papers in this supplement highlight many of the most pressing topics for policy makers and practitioners who are addressing childhood obesity. My hope is that Americans can come together around commonsense policies to protect and promote the health of our children, and that this will lead to a broader discussion of the role of public policy in promoting better health for all Americans. We must fundamentally shift our healthcare system toward preventing disease, promoting good nutrition, and encouraging physical activity—in other words, recreating America as a "wellness society." This will be good for the physical and mental health of the American people. And it will be good for the fiscal health of government, corporate, and family budgets. In an era of skyrocketing healthcare costs, this is the only sustainable course for America's future.

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Preventing Obesity in Children
The Time Is Right for Policy Action

U.S. Senator Lisa Murkowski

Increasingly, research shows that chronic aliments, such as obesity, are affecting more and more of our children each year. Throughout our nation, people are demanding action to combat rising obesity rates in children and in controlling healthcare costs. But we need to look to prevention first. And where do we start? With living healthy lifestyles, eating right, and getting regular exercise. While changing these behaviors sound simple, doing so is complex, as illustrated in the excellent set of articles in this supplement to the *American Journal of Preventive Medicine*.[1–14]

I have been a strong advocate for finding ways to improve the food offerings in our schools, so that parents can know that their children have healthy food options available to them. As both a Senator, and more importantly, a parent of two school-aged boys, I know first-hand of the poor dietary temptations that are readily available to them each day at school.

We all know the problem, and we all know that eating the right amount of healthy foods and getting enough exercise are the answers to preventing overweight, obesity, and all the related serious health problems and costs.

Recent studies show that between 1980 and 2000, the prevalence of obesity among children and adolescents nearly tripled. And in my home state of Alaska, recent estimates show that obesity kills nearly 500 Alaskans each year—that is simply an unacceptable figure.

Last month, the Institute of Medicine[15] reported findings that the rise in obesity over the past 2–3 decades has been accompanied by an increase in the number of alternative food options available on school campus—especially vending machines. And yet another disturbing report has found that of all the babies born in 2000, 1 in 3 will become overweight.

But where do we begin in our effort to fight these terrible statistics? Certainly we look to the habits learned at home, but we also must take a look at the nutritional options our kids have at school. These statistics should cause us to pause . . . to reflect on our policies on foods sold in schools.

At school, our children learn in health class to eat five fruits or vegetables a day. But then they go to the cafeteria where they are able to buy soda, potato chips, and a candy bar for lunch. Not exactly a "well balanced" meal. And despite major changes in nutritional science, the current federal laws defining nutritional standards for what can be sold in school vending machines and school stores have not been updated in almost 30 years.

I believe Congress has an obligation to see to it that there is an update of these standards and to help ensure that our children have healthy food options readily available in schools.

That is why Senator Tom Harkin and I have reintroduced The Child Nutrition Promotion & School Lunch Protection Act. This legislation would require the Secretary of Agriculture to update the definition of "foods of minimal nutritional value" based on the recommendations from scientific and nutritional experts so that all foods that are sold in school—whether in the cafeteria or in a vending machine—meet high nutritional standards.

Now this doesn't mean that mom cannot bring in a birthday cake to celebrate her son's birthday—or that the school band or chess club cannot hold a fundraiser with baked treats.

What it does is ensure that our kids are receiving a consistent, simple message: They should be eating healthy foods. These foods need to be available in their schools.

And parents around the nation are showing their support for our efforts. A national poll by the Robert Wood Johnson Foundation[16] found that 90% of teachers and parents support the conversion of school vending machine contents to healthy beverages and foods.

But it's more than just the food we provide for our kids . . . It's also about healthy lifestyles.

And when it comes to promoting active lifestyles for our kids, we need to ask ourselves—Are we sending the right messages? Just last week, I was told about a new trend in "playing" that is increasingly becoming popular with children. Rather than going outside to run around, hit the playground, or ride a bike—all great, physical activity—more and more kids are setting up "virtual playgrounds" online. They are "playing" through their computers, never leaving the confines of their home, let alone their computer chair. What kind of message does it send to our children for us to allow them to forgo normal childhood activities, activities

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that we all enjoyed as kids and ones that kept us physically active, and replace that with a computer.

Simply put, we are seeing more and more of our children with exercise deficits.

As parents, we want our children to be healthy and to grow up with healthy habits. Part of our responsibility to them is to help them make good nutritional decisions and engage in active lifestyles. I believe that through Senator Harkin's and my legislation and by setting the right examples, we can take a vital step forward to combat the overweight and obesity epidemic that is afflicting so many of our children.

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A Research Perspective on Findings from Bridging the Gap

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Bridging the Gap, Healthy Eating Research, and Active Living Research are the primary national research programs funded by the Robert Wood Johnson Foundation (RWJF) to identify environmental and policy strategies with promise to reverse the childhood obesity epidemic by 2015. These programs are designed to provide complementary information that can be used by policymakers and practitioners to improve youth dietary and physical activity behaviors, to prevent childhood obesity. All three programs examine policy and environmental factors with an emphasis on low-income populations and communities of color at highest risk for childhood obesity, but they use different methods. Bridging the Gap conducts national studies using original data collection integrated with archival databases, and both Healthy Eating Research and Active Living Research support a variety of investigator-initiated studies and policy analyses aimed at understanding and reversing childhood obesity among children aged 3–18, including "rapid response" studies of "natural experiments" that are taking place in schools, preschools, parks, and communities. All three programs share a common goal of building the evidence base to identify environmental and policy influences and strategies that have the greatest potential to increase physical activity and improve healthy eating to reverse childhood obesity, and to communicate these findings effectively to inform policy debates, public health action, and advocacy. The purpose of this commentary is to highlight some of the contributions of Bridging the Gap's results to advancing science and to illustrate the areas of collaboration among RWJF's three research programs.

A seminal contribution of Bridging the Gap is the ability to explore trends in physical activity and dietary behaviors over time, based on questions in the nationally representative Monitoring the Future Study of 8th, 10th, and 12th graders, and to explore national trends in school food and physical activity policies and environments over the past several years. These data, which supplement the Centers for Disease Control and Prevention's (CDC) Youth Risk Behavior Survey by including slightly younger children (and soon, much younger children), demonstrate not only that declines in physical activity and healthy eating habits parallel the rise in youth obesity, but also that there are links between school food and physical activity policies and programs and students' self-reported diet, activity, and body mass index (BMI) levels.[1] Several of these papers show limited access to "healthy" foods as well as limited opportunities for physical activity in school environments that are all too often mirrored in the communities surrounding schools. There also has been a disturbing lack of obesity control initiatives from public health departments.[2] Powell, Szczypka, and Chaloupka[3] found that powerful media influences are almost all in the direction of promoting unhealthy behaviors. These research results show some of the fundamental forces that may be shaping the obesity epidemic and imply that multi-level, multi-component policy-based approaches will be required to bring the epidemic under control.

One of the most tragic realities of the youth obesity epidemic is that the problem is most severe and rising fastest in low-income populations and communities of color, which have the fewest resources to intervene or cope with the consequences. Several papers[1–6] indicate environmental and policy disparities may explain part of the disparities in obesity, eating, and physical activity. Low-income students and schools were found to have less participation in intramural and varsity school sports, more soft drink pouring contracts, more soda ads in schools, less access to healthy foods in schools and communities, less access to physical activity facilities, and more exposure to TV food ads.[1] Examining potential policy and environmental solutions to these inequities are priorities for Healthy Eating Research and Active Living Research, as guided by Robinson and Sirard's[7] dictum to pursue solution-oriented research.

Building on the provocative findings of Bridging the Gap, Healthy Eating Research and Active Living Research will be able to examine in more detail the behavioral and economic effects of specific policy and environmental factors, not only in middle and high school students, but also in the elementary and preschool-aged groups. Healthy Eating Research and

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Active Living Research are able to move relatively quickly to evaluate innovative interventions that are not yet in wide use to identify promising strategies for further analysis and dissemination. For instance, in 2005–2006, both Healthy Eating Research and Active Living Research solicited proposals to evaluate school wellness policies mandated by the Child Nutrition and Women, Infants, and Children (WIC) Reauthorization Act of 2004. There are over a dozen studies in the field now seeking to identify effective uses of school wellness policies to improve children's nutrition and physical activity. Other studies are needed to identify the policies and economic factors that account for Johnston, Delva, and O'Malley's[4] findings of disparities in participation in school sports and intramurals.

Bridging the Gap findings highlight community-level disparities related to supermarkets and fast-food outlets in low income communities. The paper by Powell, Auld, Chaloupka, O'Malley, and Johnston[5] found that increased access to chain supermarkets was associated with lower adolescent BMI. Analyses by Powell, Chaloupka, and Bao[6] found that low-income and minority neighborhoods have a higher proportion of fast-food restaurants compared to high-income and predominantly white communities. Healthy Eating Research and Active Living Research will be able to further explore community environment associations with weight-related outcomes and evaluate policy and environmental strategies to reduce disparities in access to healthy foods and opportunities for active living in low-income and minority communities.

Healthy Eating Research and Active Living Research are probing the outer layers of the "ecologic model" to identify powerful state and federal policies. For instance, Healthy Eating Research recently co-funded, with the W.K. Kellogg Foundation and the Johnson Foundation of Racine, Wisconsin, a multidisciplinary meeting to examine the impact of federal agricultural and food policies on public health and to identify opportunities for the food system and agriculture policy to contribute to healthier eating and childhood obesity prevention (report available at www.healthyeatingresearch.org). The Active Living Research Program supported an analysis of schools' liability for public use of their recreation facilities. Recommendations for state tort immunity legislation, the nature of joint-use agreements, and insurance coverage provide guidance to reduce real and perceived liability threats for school officials.[8] Active Living Research grants are examining school siting policies, community design, and land-use policies, policies that account for disparities in access to parks, and perceived and actual crime and traffic safety as they are related to playground use, children's walking to schools, and overall physical activity—especially in low-income communities.

There are other opportunities for synergy among RWJF's three childhood obesity–related research programs. As policy and environmental variables are found by Healthy Eating Research and Active Living Research investigators to be related to obesity and obesity-related behaviors, those variables can be incorporated into Bridging the Gap for long-term monitoring. Observational measures of food environments and physical activity environments developed through Active Living Research and Healthy Eating Research can be used to supplement Bridging the Gap measures. For example, measures of park quality,[9,10] design of streetscapes,[11,12] and the presence and cost of healthy foods in stores and restaurants[13,14] could be valuable additions to Bridging the Gap community measures in a subset of locations. Bridging the Gap, Active Living Research, and Healthy Eating Research already are working in concert with one another and the National Cancer Institute and U.S. Department of Agriculture (USDA) to develop valid and reliable measures of school food and physical activity policies to strengthen the quality and comparability of school obesity policy research. The resulting measures can give concerned parents, principals, and public health advocates the tools they can use to assess their schools and use the findings to improve the healthfulness of school environments.

According to the U.S. Surgeon General[15] and the Institute of Medicine (IOM),[16,17] policy and environmental changes will be needed to control the childhood obesity epidemic, but the evidence base to guide those changes is lacking. The need for evidence is rising as government, philanthropy, communities, schools, and health professionals implement new programs and policies to address the childhood obesity crisis. All of this activity will generate new demands for information, new ideas for solutions that need to be evaluated, and new questions to be answered by research. There is a heightened sense of urgency, creating the need for more rapid methods of translating research to policy and practice. Bridging the Gap, Healthy Eating Research, and Active Living Research are developing innovations in funding, research implementation, and dissemination that we hope will quickly identify promising solutions to childhood obesity, especially solutions that will meet the needs of low-income communities of color that are at highest risk.

Although the RWJF research programs are rapidly building a literature on policy and environmental solutions to obesity, healthy eating, and active living, the range of research questions and the need to ensure that the research is relevant to the communities at highest risk requires a long-term commitment from multiple funders. The Healthy Eating Research and Active Living Research programs are working closely with major federal funders at the National Institutes of Health (NIH) and CDC. Staff from NIH, CDC, and USDA, as well as private funders (e.g., W. K. Kellogg Foundation,

The California Endowment, Kaiser Permanente, Blue Cross of Minnesota) contribute to Healthy Eating Research and Active Living Research by advising and playing important roles in grantee meetings and conferences.

We celebrate the pioneering scientific contributions that fill the pages of this timely Bridging the Gap supplement to the *American Journal of Preventive Medicine*. Researchers will find many ideas for studies that build on these findings. Policymakers as well as community, school, and public health leaders will find the seeds of promising interventions to reverse current childhood obesity trends and disparities. Bridging the Gap has accomplished something rarer than good science; they have produced findings that point toward solutions to one of the nation's and the world's most pressing health concerns.

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Bridging the Gap

Understanding the Structure of Social Inequities in Childhood Obesity

Antronette K. Yancey, MD, MPH, Shiriki K. Kumanyika, PhD, MPH

The challenges of addressing childhood obesity include the need to close the gap in obesity rates between children and adolescents of ethnic minority and/or lower socioeconomic status (SES) backgrounds and their white or more affluent counterparts.[1–4] In low-income, urban, African-American and Latino communities, rates of overweight or obesity (using the Centers for Disease Control and Prevention 85th percentile cut-off) surpassing 40% of elementary school populations have been documented.[5] As noted in the Institute of Medicine (IOM) report assessing progress in childhood obesity prevention, some risk factors are relatively ubiquitous across all settings, but most are more concentrated in low-income communities of color.[2] This excess risk produces staggering disparities in obesity-related co-morbidities. For example, the lifetime odds of developing type 2 diabetes for Latinos or African Americans are nearly one in two at birth, twice that of white newborns.[6] Consequently, addressing the inequities underlying these disparities has become a priority within the Robert Wood Johnson Foundation's (RWJF) focus on childhood obesity. Their national research programs, such as Bridging the Gap, elucidate important links to needed solutions.

Several papers in this supplement to the *American Journal of Preventive Medicine* point to widespread environmental attributes that may be "obesogenic" for low-income and/or ethnic minority youth. The proportion of high-calorie–low-nutrient–density school food choices and fast-food restaurants was found to be higher in communities with higher poverty rates, lower household median incomes, and higher concentrations of ethnic minority residents.[7,8] Exposure to food-related television advertising was found to be 60% greater among African-American children, with fast food as the most frequent category, because of both targeted marketing and higher TV viewing rates.[9] In schools, lower rates of participation in varsity and intramural sports were observed among female, racial/ethnic minority and lower-income students, while revenues from "pouring rights" contracts and soft drink availability were highest in schools with proportionately more Latinos.[10,11] The contribution of under-resourced school environments to obesity is underscored by the finding that school SES and racial/ethnic composition are inversely correlated with body mass index (BMI) even after controlling for individual race/ethnicity and SES.[12]

Taken together, these studies tell a story about the ways in which the lives of children in ethnic minority and low-SES communities differ from those of other children. The findings point to reasons for the less favorable status of children in these communities on the established behavioral determinants of obesity—fruit and vegetable consumption, fast-food intake, breakfast frequency, soft drink and low-nutrient–density snack intake, television watching, sleep, physical activity frequency and intensity, sports participation, and time spent outdoors. But understanding the key lessons in this story is more complicated than these descriptive data reflect. When we ask **why** the environments of minority and low-income children are relatively less conducive to healthy eating and physical activity, we confront the all-too-familiar reality that people who are socially and politically disadvantaged with respect to the larger social structure are, in fact, socially and politically disadvantaged in many respects. We discover that food availability, food advertising, school policies, recreational facilities, and opportunities for safe, affordable, physical activity—environmental factors that directly and indirectly influence health and survival—are not exempt from the forces of racial or ethnic and economic stratification and that, in fact, they may help to define it.[13] The effective cost, economically and behaviorally, of healthy eating and active living is higher and the feasibility lower, in low-income or ethnic minority communities compared to others.

For example, crime rates and perceptions of danger are higher in low-income neighborhoods.[14] Unsafe neighborhoods deter walking to school and playing outdoors after school, at home, or in parks.[15] Less time spent outdoors not only displaces physical activity but also increases television viewing and, thereby, exposure

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to ethnically targeted commercials for fast food and fatty and/or sugary snacks. Neighborhood noise and discord, and the distress they produce, also may disrupt sleep. Low-income families with high costs for housing and other necessities may have little money left over to buy food.[16,17] Such financial challenges may promote reliance on inexpensive, but high-calorie food. Fast-food restaurants are much more accessible than full-service ones, just as convenience stores that sell high-calorie packaged or prepared foods are more prevalent than chain supermarkets that offer a healthier mix of foods including fresh fruits and vegetables. Longer working hours and commuting times may absorb precious parenting resources needed to shop for and prepare food, transport children to extracurricular active recreation, and pay registration fees and equipment costs.[15]

Environmental constraints limit choices, but the perceived range of choices and ability to find alternatives increase as economic and social capital increase.[18] Therefore, people with the most limited choices are also the most constrained by their immediate environments. This could mean that changes in the environment would have a bigger payoff for the highest-risk populations and, indeed, this is sometimes the case. For example, it was noted that lowering the price of fruit produced greater increases in consumption among students in an urban, socioeconomically and racially diverse school than among those in a suburban, middle-income, primarily white school.[19] On the other hand, to the extent that people—particularly in populations undergoing chronic ecologic stress—have adapted to their circumstances, isolated environmental changes cannot be expected to break longstanding eating and physical activity patterns conditioned by functioning and survival in generally adverse contexts. This is especially relevant when the very attitudes and behaviors targeted for change are those identified with heavily commercially marketed social status or prestige, important traditions, or emotional satisfaction. Cars are status symbols, with public transportation or walking only for those who can't afford cars. Being able to treat your children to a meal at a popular fast-food restaurant may be more meaningful to parents who have to work harder to afford this. Getting enough rest to recover from the stresses of the day may be seen as more important than going out to exercise.[20] Large heavy meals at church or celebrations may form the core of family or social interactions. High-fat and high-calorie "soul foods," for example, although part of the legacy of slavery, have taken on positive cultural connotations and help to define African-American ethnic identity.[21] In addition, some health advice perceived as coming from the majority culture may be met with distrust generalized from experiences with discrimination in other realms.[22]

In this sense, models for policy and environmental interventions that improve food intake and physical activity in the population at large may be too weak or insufficiently focused to curtail the obesity epidemic in African-American, Latino, or Native-American children. Even worse, one can imagine that efforts to attack obesity-promoting forces in the population at large may aggravate the situation in minority communities. For example, the targeted marketing of high-calorie, low-nutrient–density foods to black television audiences[23,24] might be aggravated by a decreasing demand for such foods in the general market, much as the tobacco industry has shifted its marketing efforts to ethnic minority communities domestically and to developing countries internationally.[25]

It is critical that findings such as those in this supplement be used to motivate studies within minority and low-income communities of how to create environments that support favorable health outcomes. How do we focus the thinking and priorities of key decision makers and gatekeepers at the systemic or structural level rather than at the more customary and seemingly more manageable individual level? How, particularly, do we make it easier in populations of color or low-SES communities to make the healthy choice and harder to make the unhealthy one, without making life harder or less satisfying? Applied intervention research can elucidate how people in high-risk communities actually are interacting with their environments so that the "mechanisms of action" of obesity-promoting factors can be better understood. In addition, and most critically for advancing solutions, future research can identify ways in which existing strengths and assets in minority and low-income communities can be leveraged to engender the social changes that are needed.[26] Embedding the collectivist values characterizing most communities of color in family-directed versus individually-directed intervention approaches, for instance, has improved recruitment, adherence, and retention among Latina mothers.[27]

Which changes will be most effective in reducing disparities is uncertain. Obviously, to be effective, changes must extend far beyond the settings frequented by youth, into many societal sectors.[2,28,29] Opportunities and options do not translate into behavior at an individual level unless the relevant cultural values and social norms support and embrace these actions. Nor do policy mandates manifest in institutional implementation unless organizational leadership, incentives, and resources align. Even capturing the data necessary to assess progress can be challenging, given the need for sufficient sample size to examine key issues with attention to gender, SES, and other sources of diversity **within** ethnic minority and low-income populations. These challenges must begin to be addressed by well-funded, broad-based solution-focused research[30] that builds upon these studies, in order to ensure that the promise of the Bridging the Gap initiative is fulfilled.

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Childhood Obesity on the Front Lines

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In the United States, the significant morbidity and mortality burden due to rising obesity rates is well known,[1] and the financial toll is substantial. Among adults, obesity-attributable direct health care costs in 2000 were estimated at over $75 billion,[2] which is likely only half the actual costs once lost work productivity is counted.[3]

Early childhood and youth are clearly strategic life stages for primary prevention and for forming long-term behaviors needed to change this picture. Obesity begins early: In New York City by age 2 years, nearly half of children are overweight or obese, while only half of daycare and elementary school children are at a healthy weight.[4] The rising incidence of type 2 diabetes in children and youth,[5] and the expectation that—if unchecked—rising obesity rates will lower by decades the age of onset for many chronic diseases, highlight the urgency of reversing this epidemic. Fortunately, societies are often more willing to change deeply held values and practices when the health of children is at stake.[6]

To reverse the obesity epidemic we need a much better understanding of its basic causes and of the effectiveness of interventions to prevent and treat it. Three types of information are urgently needed: (1) high-quality descriptive and analytic studies of our food and physical activity environments and their influence on obesity, (2) well-designed studies to document the impact of intervention strategies and policies to address environmental characteristics and risk factors, and (3) a practical monitoring system that provides timely, valid information about "upstream" measures such as changes in the environmental, community, and organizational conditions that drive poor diet and physical inactivity.

Bridging the Gap takes on the first and third of these pressing questions. This supplement to the *American Journal of Preventive Medicine* looks at the Monitoring the Future (MTF) and Youth, Education, and Society (YES) studies beyond their original focus on tobacco, alcohol, and substance abuse. These new analyses of a large, representative national profile of physical activity and nutrition characteristics in schools and their communities constitute an important step toward answering the first type of information—descriptive and analytic studies—for school-aged children and teens. Work such as that by Powell and colleagues,[7] which documents the relationship between access to a supermarket and adolescent body mass index (BMI), strengthens the arguments for government to expand access to supermarkets in underserved communities, a policy already in use in Philadelphia, under study in New York City, and proposed in California. Simply documenting, as Johnston and colleagues[8] do, that in the midst of an obesity epidemic, 88% of our high schools are plying their students with concentrated sugar syrups, and less than one third of high school students report physical education or participation in sport, is itself a clarion call to policy action by local and state governments. Since these findings pre-date the federal mandate for school wellness policies that became effective in 2006, they provide a baseline against which to set national goals and measure success. Papers by Mâsse et al.[9,10] from the National Cancer Institute deepen our understanding of challenges facing the development of measurement systems for school nutrition and physical activity policies and practices.

Powell's group demonstrates how commercial databases and geocoding can be used to expose complex relationships between public health and the physical and marketplace environments.[11] Importantly, this set of papers reinforces the need to address disparities associated with socioeconomic status and race/ethnicity. Together, these studies provide invaluable guidance in the design of effective obesity prevention programs at both the community and state levels.

Of course, better understanding of the obesity problem is just a first step. Three reports from the Institute of Medicine (IOM) recently elucidated the scope, complexity, and interrelationships among factors that contribute to the childhood obesity epidemic.[12–14] The reports highlighted the especially urgent need for action on behalf of low-income and children of color. Conclusions were that the only successful approach would be a comprehensive one that involved virtually every stakeholder group at the national, state, and local levels—government, businesses of all types, and com-

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munity groups serving children—along with healthcare providers and parents. In particular, they called for the President, governors, and local elected officials to assign their official health agencies with responsibility for establishing a focal point, providing visible leadership, and assuring that strong programs are delivered.[12,14]

Marketing practices of the food and beverage industries have been singled out as contributing to the epidemic.[13] Similar to the tobacco-control movement, obesity prevention will require changes in exposure to unhealthy influences, marketing practices, and price incentives that modify the commercial conditions in which obesity flourishes. Unlike tobacco, addressing obesity also offers significant opportunities for voluntary redirection, for shifting to the promotion of healthier foods and physical activity products, and for establishing public/private partnerships to improve the food and activity environments.[15]

The building blocks of this sea change are expected to include community programs, mass communications and public education, and environmental and policy approaches. These efforts must be woven into a balanced, integrated approach that creates new social norms. The California Obesity Prevention Plan is one example of a multi-pronged public health strategy that, in turn, provides a prevention cornerstone within the larger framework of health care reform.[16] For obesity prevention, the goal is to create environments where healthy choices are easy choices and unhealthy choices are made more difficult, while eliminating social and economic disparities. Significant investments of political will and resources will be required.

For those of us on the front line, a host of questions remains. What are the most effective actions we can take? What are the feasible ones? Should health officials support supermarket expansion or zoning controls of fast-food restaurants and convenience stores near schools? How can we make unhealthy foods relatively more expensive, and fruits and vegetables less expensive? Are restrictions on food advertising to children feasible, and how? Should we create new physical activity programs? Build bike paths? What are the most critical changes needed in schools, and how can we in public health promote new school policies and practices? Since public health funding is generally inversely proportional to the burden of disease, and funds for obesity prevention remain quite limited, what can be achieved with current resources? And how will we gauge our progress?

Decisions about funding priorities ideally would be informed by carefully evaluated, data-driven approaches. But in the emerging, complex, and interdependent field of large-scale obesity prevention, evidence as to the best combination of interventions is only starting to emerge. Community-based best practices for physical activity have been provided by the Community Guide.[17] Similar guidance for nutrition policies and the food environment is desperately needed.

On the community intervention side, such evidence is percolating to the surface. While comprehensive approaches such as the recently published multi-level trial in Somerville, Massachusetts[18] hold great promise, much remains to be learned about the optimum mix of interventions. Indeed, many health departments have completed plans[19] and some inventories for state and local obesity prevention policies exist.[20,21] For example, in addition to its effort to promote calorie labeling in restaurants and physical activity in childhood settings, New York City has created a Food Policy Task Force to address access to healthy foods, public food procurement, and food security issues. Rigorous new rules promoting physical activity and better nutrition in day care and restricting television viewing in those settings also went into effect in 2007.

Governors and foundations are stepping up.[22–24] As required by Congress, the Federal Trade Commission will resume its oversight of children's advertising and report on food industry marketing practices to children.[25] A new consensus "blueprint" created by leading practitioners names science and research as cornerstones of the public health response, along with access, collaboration, workforce, and communications.[26]

For health departments the situation is urgent. We must construct our response to the obesity epidemic now, amidst a dearth of definitive best practices. Increasing children's physical activity significantly and improving their access to and consumption of healthy foods clearly are the twin pillars for obesity prevention. In and of themselves, these measures are also fundamental to improving public health. While it would be ideal to know more, studies such as those assembled herein enable us as practitioners to navigate our way safely. As we implement new policies and programs to address these issues using the best available evidence, the obligation to evaluate and learn from our triumphs and failures is clear.

This supplement presents evidence of a scope and scale that is unprecedented. Its breadth reveals that there are more similarities than differences in the conditions that must be addressed across our diverse country. It identifies what many front-line obesity prevention practitioners might view as the biggest public health challenges. And while today's monitoring systems for health outcomes such as health behavior and body weight must be strengthened, the suite of studies provides evidence and suggests the contours of a new toolbox to address population-based, "upstream" drivers of the obesity epidemic.

To reverse the epidemic, the country's nearly 3000 local and state health departments must be able to identify the most significant modifiable contributors, lead the collective efforts of stakeholders, intervene vigorously, evaluate responsibly, and advocate proac-

tively. These papers provide a timely foundation to help all prevention practitioners meet this challenge.

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The Epidemiology of Overweight and Related Lifestyle Behaviors

Racial/Ethnic and Socioeconomic Status Differences Among American Youth

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Background: Differences in the prevalence of youth at or above the 85th percentile of age- and gender-adjusted body mass index (BMI) by race/ethnicity and socioeconomic status were examined among youth in 8th and 10th grades. The possible role of a number of lifestyle behaviors and family/parenting factors in explaining these differences was then explored.

Methods: Cross-sectional survey data were used from nationally representative samples in the Monitoring the Future study from 1998 to 2003 (N=39,011 students). Data were analyzed in 2006.

Results: Minority, low-income males, and male youth were more likely have a BMI at or above the 85th percentile. Frequency of eating breakfast, eating fruits and vegetables, and exercising regularly were inversely associated with being at or above the 85th percentile. The number of hours youth spend per week watching television was positively associated with being at or above the 85th percentile. These lifestyle behaviors proved more important than the family/parenting variables examined.

Conclusions: The overrepresentation of youth at risk of overweight or overweight among racial/ethnic minority and low-income populations mimics the excess morbidity of overweight and obesity-related health conditions in these same populations. Differences in lifestyle behaviors and family characteristics might help to explain these subgroup differences starting at an early age. While there is growing need to modify these behaviors in the population at large, the need is greatest among minorities and low-socioeconomic status youth.

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Introduction

Recent trends in overweight and obesity and related lifestyle behaviors indicate that more youth have become overweight and at risk for overweight and that many more engage in detrimental behaviors that are potentially linked to the current overweight and obesity epidemic.[1–5] Being overweight substantially and negatively impacts the present and future health of American youth.[6–11] Regrettably, the burden of disease is likely to fall more heavily on racial/ethnic minority youth and low-income populations because of the overrepresentation of being overweight in these populations.[12–15]

To enhance an understanding of the epidemiology of overweight among American youth, the present study investigates differences in the prevalence of overweight and of being at risk for overweight among white, black, and Hispanic youth by socioeconomic status (SES). The extent to which the associations among overweight, race/ethnicity, and SES are accounted for by differences in lifestyle behaviors that may be associated with obesity are also examined.[16–19] Prior research has found, for example, that youth from low-income families tend to eat fewer fruits and vegetables,[16] and that African-American youth spend more time watching television than white youth.[19] Also, in light of prior research documenting the importance of family-related factors in relation to risk of overweight,[5] it is also hypothesized that reduced parental supervision, as measured by the number of hours youth spend alone after school, is associated with increased risk of overweight. For example, less parental supervision after school may result in youth spending more time watching television or playing video games, snacking on foods high in fat and calories, not being provided with transportation to participate in after-school

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sports programs, and overall being more sedentary.[20] In turn, these differences in parental supervision may account for overweight differences between racial/ethnic groups and SES.[21]

Among minors, overweight is defined as being at or above the 95th percentile based on an age- and gender-adjusted body mass index (BMI), while being at risk for overweight is defined as being between the 85th and 95th percentile on the same scales. The current study examines whether the percentage of students who are at or above the 85th percentile (that is being at risk of overweight or overweight) differs by race/ethnicity and SES, controlling for population density, region, and the frequency with which students eat breakfast, fruits, and vegetables; get seven hours of sleep each night; exercise vigorously; and watch television; hereafter referred to as lifestyle behaviors. Whether the percentage of youth at or above the 85th percentile differs by race/ethnicity and SES is also examined controlling for the number of hours they spend after school each day at home with no adult present, whether or not they live with both parents, and whether the students' mothers have paid jobs, hereafter referred to as family/parenting variables. The study is based on large national representative samples of 8th and 10th graders living in the United States.

Methods

Sample

Data are utilized from 1998–2003 for 8th- and 10th-grade students who participated in the University of Michigan's Monitoring the Future project. Data for 12th-grade youth are not included in this study because several variables under investigation are not asked in the same format of a multiple-forms questionnaire, precluding multivariate analyses with all relevant variables. Data were analyzed in 2006.

The design and methods are summarized briefly below; a detailed description is available elsewhere.[22,23] The study employs a multistage sampling design to obtain nationally representative separate samples of 8th- and 10th-grade students from the 48 contiguous states, collected annually since 1991. The annual sampling procedures involve three stages[24]: (1) geographic regions are selected; (2) schools are randomly selected with probability proportionate to size (approximately 290 each year); and (3) roughly 31,000 to 33,000 students are sampled from within those schools. Sample weights are assigned to each student to take into account variations in selection probabilities that occur at the various stages of sampling. From 1991 to 2004, an average of 55% of the original schools agreed to participate, and either an original school or a replacement school was obtained in 98% of the sample units, or "slots." Students complete a self-administered, machine-readable questionnaire during a normal class period. Student response rates average 90% for 8th graders and 86% for 10th graders. Absence on the day of data collection was the primary reason that students were missed.

Measures

Overweight. Data on weight and height are based on students' self-reports. These data were used to calculate BMI by dividing weight (in kilograms) by height (in meters) squared (weight/height^2). Then, age- and gender-specific growth curves produced by the Centers for Disease Control and Prevention (CDC) were used to create the "at risk of overweight" or "overweight" category, defined here as a youth whose BMI was greater than or equal to the 85% percentile.[25,26] These growth curves were normed on data from several national health examination surveys conducted by the National Center for Health Statistics between 1963 and 1994.

Eating behaviors. Three separate questions meant to be indicative of the frequency of healthy eating behaviors were measured in the present study: How often do you eat breakfast? How often do you eat at least some green vegetables? and How often do you eat at least some fruit? The response categories were: (1) never, (2) seldom, (3) sometimes, (4) most days, (5) nearly every day, and (6) every day. A composite score was created by summing the students' responses to these questions with scores ranging from 3 to 18. Chronbach's alpha was 0.71 for girls and 0.75 for boys.

Exercise behaviors. A variable on frequency of exercising was created using the following question: How often do you exercise vigorously (jogging, swimming, calisthenics, or any other active sports)? The response categories were the same as for eating behaviors.

Sleeping behaviors. The question, How often do you get at least 7 hours of sleep? had the same answer scale as the eating behaviors questions.

Television viewing. The average number of hours that youth watch television in a week was determined based on the following two questions: How much TV do you estimate you watch on an average WEEKDAY? and How much TV do you estimate you watch on an average WEEKEND (both Saturday and Sunday combined)? The number of hours youth watch TV in a week (5 days) and weekend were added and could range from none to over 34 hours. The total was divided by seven to obtain the average number of hours youth watch TV in a given day.

Parenting-related variables. Three variables were included: The first variable was the number of hours youth spend after school each day at home with no adult present, counting the hours between the end of school and the time when the youth goes to bed. The response categories were none or almost none, less than 1 hour, 1–2 hours, 2–3 hours, 3–5 hours, and >5 hours. Also included was a dichotomous variable that measured whether or not youth lived with both parents and a variable that measured whether the students' mothers have paid jobs. The response categories were no, yes, part-time job, and full-time job.

Demographic characteristics. Gender was measured by the question What is your sex? with the following response categories: 1=male, 2=female. Race/ethnicity was measured by the question How do you describe yourself? For the present study, three groups were distinguished: (1) white, (2) black or African American, and (3) Hispanic; all other youth were excluded from the analyses due to inadequate

sample sizes for the proposed analyses. Parental education (as a proxy for SES) was defined as an average of father's and mother's educational attainment (with one missing data case permitted). Educational attainment for each parent was coded as follows: 1=completed grade school or less, 2=some high school, 3=completed high school, 4=some college, 5=completed college, 6=graduate or professional school after college. An ordinal measure of parental education, which serves as a proxy for SES, was created. However, the relationship between SES and the dependent variable overweight was not linear for black and Hispanic youth. These analyses indicated that a linear term would not capture the interaction between the race/ethnicity and SES variables. Thus, an SES variable with three levels—low, mid, and high—was created. Low SES corresponded to neither (or the only) parent having no more than a high school degree. High SES corresponded to both parents having a college degree. (No one-parent families were coded as high SES.) Remaining students were coded as having mid SES. Subsequently, nine dummy-coded variables were created to capture all the interactions between the three racial/ethnic groups and three levels of SES. Preliminary analyses revealed that the prevalence of overweight and obesity tended to be lowest among white youth of high SES; therefore, this group was defined as the reference category for analysis purposes.

Population density was determined by the U.S. Census Bureau's classification of the area in which the school is located: within a large metropolitan statistical area (MSA), other metropolitan statistical area, or nonmetropolitan statistical area. Region is determined by the geographic region of the country where the school is located (i.e., Northeast, North Central, South, and West).

Analyses

In prior work, it was noted that the prevalence of youth at or above the 85th percentile varied by gender[1,27]; therefore, all analyses were conducted separately for boys and girls. Preliminary analyses indicated that there were no meaningful differences by grade in the prevalence of youth at or above the 85th percentile and in the associations between variables. Therefore, all analyses are based on the 8th- and 10th-grade data combined.

The bivariate association between each predictor and the dependent variable, youth at or above the 85th percentile, was estimated first, followed by multivariate logistic regression analyses to test three different models. Models 1 and 2 examined changes in the bivariate associations between race/ethnicity by SES categories and the dependent variable when the lifestyle behaviors and parenting-related variables were entered, respectively. Model 3 was the full model that includes all the variables in the study. Changes in odds ratios and 95% confidence intervals were examined across models to assess changes in the potential associations between sets of independent variables and the dependent variable. Also, because Models 1 and 2 were nested within the Full Model, the chi-square statistic was used to compare improvements in model fit. All analyses adjust for grade level and year in which the survey took place.

All analyses were conducted with the Stata 8.0 statistical program to weight the data to permit generalizations to the general population of youth and to take into account the design effects in calculating standard errors resulting from the complex sampling design of the study.

Results

Sample Characteristics

Table 1 provides the numbers of cases for the demographic variables separately for each gender and the percentage of youth in the various categories who are at or above the 85th percentile. Across the 6 years, 1998–2003, there were a total of 39,011 participants completing the relevant questionnaire forms, 20,913 girls and 18,098 boys. The sample of youth was approximately 75% white, 13% black, and 12% Hispanic. The percent of students who are of low, mid, and high SES was approximately 15%, 58%, and 27%, respectively. Across all studied years, nearly 25% of youth were at or above the 85th percentile. Although comparable data from other national studies are not available, the percent of boys and girls in 10th grade who are at or above the 85th percentile was compared with data from the 2003 CDC Youth Risk Behavior Survey (YRBS). In the present study, the percent of boys and girls in 10th grade who were at or above the 85th percentile were 30.4% and 23.5%, respectively. The corresponding percents for boys and girls in 10th grade in the YRBS study were 30.3% and 23.0%, respectively.

Figure 1 shows the percentage of students at or above the 85th percentile by measure of race/ethnicity and SES. It indicates that higher percentages are found among boys, minority youth, and youth of lower SES. Table 1 indicates that for boys, there is a significantly greater proportion of youth at or above the 85th percentile living in nonmetropolitan areas and in the South.

Bivariate Results

For girls, the odds ratios associated with being at or above the 85th percentile were significantly higher for all race/ethnicity by SES interactions when compared to white girls of high SES (see Table 2). Being at or above the 85th percentile was inversely associated with healthy eating, sleeping, and exercise frequency, and positively associated with the number of hours youth watched TV per day. Being at or above the 85th percentile was also positively associated with the number of hours youth spent at home with no adult present and inversely with living with both parents. Also, slightly more youth who live in the South were at or above the 85th percentile.

The findings for boys were similar to those for girls, with the exception that the number of hours they spent at home after school with no adult present was not associated with being at or above the 85th percentile, and there were no significant regional differences (see Table 2). However, boys who live in nonmetropolitan areas had a significantly higher odds ratio associated

Table 1. Percentage of youth at or above the 85th percentile by demographic characteristics among 8th- and 10th-grade students: MTF 1998–2003

Characteristic	N	% at or above 85th percentile	Significance level[a]
TOTAL	39,011	24.9	*
GIRLS	20,913	20.3	
Grade level			
8th	9,857	20.7	
10th	11,056	20.0	
Race/ethnicity by SES			***
White of high SES	4,641	11.9	
White of mid SES	9,147	17.7	
White of low SES	1,791	26.7	
Black of high SES	534	25.7	
Black of mid SES	1,841	34.6	
Black of low SES	548	29.8	
Hispanic of high SES	261	18.8	
Hispanic of mid SES	1,138	25.0	
Hispanic of low SES	1,012	30.7	
Population density			
Large MSA	6,504	19.9	
Other MSA	9,703	20.1	
NonMSA	4,706	21.2	
Region			
Northeast	4,403	19.2	
North Central	5,387	19.7	
South	7,511	21.9	
West	3,612	19.2	
BOYS	18,098	30.1	
Grade level			
8th	8,510	29.8	
10th	9,588	30.3	
Race/ethnicity by SES			***
White of high SES	4,527	21.3	
White of mid SES	8,018	30.7	
White of low SES	1,269	37.6	
Black of high SES	517	31.1	
Black of mid SES	1,423	34.0	
Black of low SES	295	33.0	
Hispanic of high SES	262	32.5	
Hispanic of mid SES	1,048	38.5	
Hispanic of low SES	739	40.3	
Population density			**
Large MSA	5,448	28.9	
Other MSA	8,494	29.5	
NonMSA	4,156	32.3	
Region			**
Northeast	3,791	30.1	
North Central	4,711	28.0	
South	6,430	31.9	
West	3,166	29.5	

[a]Indicates if differences in percent of youth at or above the 85th percentile among the response categories of each variable are statistically significant.
*$p<0.05$; **$p<0.01$; ***$p<0.001$.
MTF, Monitoring the Future; MSA, metropolitan statistical area; SES, socioeconomic status.

with being at or above the 85th percentile when compared to those who live in large cities.

Multivariate Results

A comparison of the results of Models 1 (demographic variables plus lifestyle behaviors) and 2 (demographic variables plus parenting variables) shows that inclusion of the lifestyle behaviors variables reduced the magnitude of the association between being at or above the 85th percentile and race/ethnicity by the SES variable more than did the parenting variables (Table 2, Models 1 and 2). The coefficient for the "black/low SES" group of boys became nonsignificant when lifestyle behaviors were entered in the model (see Table 2, Model 1). In part, this is due to a loss of power to detect significant differences resulting from the small number (N = 295) of low-income black boys in the sample. For girls, all coefficients of the association between being at or above the 85th percentile and race/ethnicity and SES variables remained statistically significant. In subsequent analyses, the lifestyle variables—frequency of eating, exercising, and TV viewing—were identified as the variables that accounted for most of the reductions in the associations of race/ethnicity and SES with being at or above the 85th percentile between models among both boys and girls. The variables region and population density did not have an effect.

For girls, the exercise and TV-viewing variables remained significantly associated with being at or above the 85th percentile in the multivariate context, while eating and sleeping variables became nonsignificant (see Table 2, Model 1). Among boys, all lifestyle behaviors remained significantly associated with being at or above the 85th percentile, though the magnitude of the association decreased.

In the multivariate context, only one of the parenting variables that was significantly associated with being at or above the 85th percentile in the bivariate analyses remained significant. Specifically, girls living with both parents remained significantly less likely to be at or above the 85th percentile (see Table 2, Model 2).

In the full model, where both the lifestyle behaviors and parenting variables were included, the magnitude of the associations between being at or above the 85th percentile and the race/ethnicity by SES variable decreased slightly for both boys and girls when compared to the model that included lifestyle behaviors only. The attenuation of the magnitude of the association between being at or above the 85th percentile and race/ethnicity by SES variables between the bivariate and the full model is shown in Figure 2. It can also be observed that the odds ratios are approximately linearly associated with socioeconomic status among white youth and female Hispanics, but not black youth and male Hispanics.

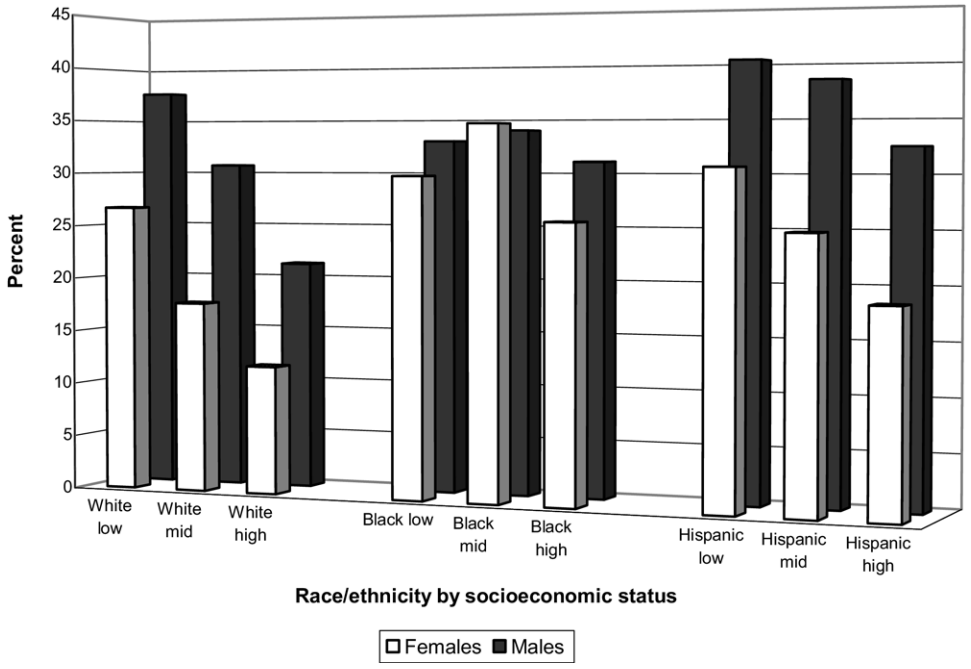

Figure 1. Percentage of students at or above the 85th percentile, 8th and 10th grades, by race/ethnicity and socioeconomic status.

Finally, because Models 1 and 2 are nested within the Full Model, it was possible to test differences in the chi-square statistics of the Full Model with Models 1 and 2. Among female students, the Full Model accounts for variation in being at or above the 85th percentile better than Model 1 (χ^2 difference=37.5, df difference=4, $p<0.001$) and Model 2 (difference in χ^2=321.19, difference in df=4, $p<0.001$) (see Table 2). However, among boys, the Full Model accounts for variation in being at or above the 85th percentile better than Model 2 (difference in χ^2=253.44, difference in df=4, $p<0.001$) but not Model 1 (difference in χ^2=2.14, difference in df=4, $p>0.05$) (see Table 3). This finding suggests that for boys, adding the family/parenting variables did not contribute information that helped account for variation in the dependent variable.

Discussion

A consistent pattern of more black and Hispanic youth being at or above the 85th percentile than white youth was found at every SES level, with only one exception (a slightly lower percentage of black boys of low SES at or above the 85th percentile than white boys of low SES at or above the 85th percentile). These findings are consistent with prior research that has found some health outcomes of educated African Americans to be of lower quality than that of equally educated whites, and to be very similar to that of whites with little or no education.[28] In the present study, evidence is provided of the importance of the individual's social location, the manifestation of health disparities at an early age, the identification of lifestyle behaviors, and parenting (primarily for girls) that can potentially influence the likelihood of youth becoming at risk of overweight or overweight. Clearly, racial/ethnic and SES differences in morbidity and mortality result from the complex interplay of multiple factors acting at many different levels.[29–36]

Before further discussing the study's findings, the following limitations should be considered. First, data on other potential predictors of BMI, such as detailed caloric intake and the family's eating and physical activity routines, were not available nor was information on environmental factors that might influence students' behaviors such as the widespread availability of junk foods and the reduction in physical education classes in schools across the nation. With funding from the Robert Wood Johnson Foundation, school-level data are being collected that should help to monitor and understand the effects of school policies regarding nutrition and physical activity on youth obesity.

Second, the potential effects that school dropouts may have on the findings cannot be determined because they are omitted. It is believed, however, that this is a minimal problem in 8th grade and only a modest one in 10th, because so few students have left school at those early points.

Third, the data are based on self-report. Prior research has found that some adolescents tend to underreport their weight by an average of 3.5 pounds and overreport their height by an average of 2.7 inches, leading to an underestimation of BMI when using self-reports.[37] Therefore, it is possible that the percentages of overweight youth are slightly underestimated in

Table 2. Results of multiple logistic regression analyses predicting being at or above the 85th percentile for female and male students: MTF 1998–2003

	Girls								Boys							
	Bivariate		Model 1		Model 2		Full model		Bivariate		Model 1		Model 2		Full model	
Variables	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Race/ethnicity by SES																
White of high SES	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
White of mid SES	**1.60**	1.42–1.80	**1.42**	1.26–1.61	**1.54**	1.37–1.73	**1.40**	1.24–1.59	**1.64**	1.49–1.81	**1.49**	1.34–1.64	**1.60**	1.45–1.76	**1.48**	1.33–1.63
White of low SES	**2.72**	2.30–3.21	**2.15**	1.81–2.56	**2.56**	2.16–3.02	**2.11**	1.77–2.51	**2.23**	1.92–2.59	**1.77**	1.51–2.07	**2.10**	1.80–2.44	**1.75**	1.49–2.05
Black of high SES	**2.57**	3.02–3.28	**2.09**	1.61–2.71	**2.49**	1.94–3.20	**1.98**	1.52–2.58	**1.67**	1.33–2.09	**1.45**	1.14–1.84	**1.57**	1.25–1.98	**1.41**	1.11–1.79
Black of mid SES	**3.92**	3.36–4.57	**2.88**	2.42–3.43	**3.71**	3.15–4.36	**2.72**	2.28–3.26	**1.91**	1.36–2.23	**1.57**	1.33–1.86	**1.79**	1.52–2.11	**1.53**	1.29–1.82
Black of low SES	**3.16**	2.45–4.08	**2.22**	1.68–2.93	**2.95**	2.29–3.82	**2.09**	1.59–2.76	**1.82**	1.35–2.46	1.37	0.99–1.88	**1.68**	1.23–2.28	1.33	0.96–1.84
Hispanic of high SES	**1.70**	1.11–2.59	**1.55**	1.02–2.36	**1.76**	1.15–2.69	**1.54**	1.01–2.34	**1.79**	1.31–2.44	**1.64**	1.19–2.25	**1.80**	1.32–2.46	**1.63**	1.19–2.23
Hispanic of mid SES	**2.47**	2.02–3.00	**2.11**	1.69–2.63	**2.54**	2.06–3.13	**2.06**	1.65–2.58	**2.32**	1.98–2.73	**2.06**	1.73–2.45	**2.33**	1.97–2.75	**2.03**	1.71–2.42
Hispanic of low SES	**3.34**	2.73–4.08	**2.68**	2.11–3.40	**3.51**	2.80–4.39	**2.65**	2.08–3.36	**2.50**	2.07–3.01	**2.16**	1.77–2.63	**2.58**	2.12–3.13	**2.14**	1.75–2.62
Population density																
Large MSA	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Other MSA	1.01	0.89–1.15	1.09	0.98–1.21	1.09	0.98–1.21	1.09	0.98–1.21	1.03	0.94–1.14	1.04	0.96–1.14	1.03	0.95–1.13	1.04	0.96–1.14
NonMSA	1.08	0.94–1.25	**1.15**	1.04–1.33	**1.18**	1.04–1.33	**1.17**	1.03–1.33	**1.18**	1.06–1.30	**1.16**	1.04–1.28	**1.15**	1.03–1.27	**1.15**	1.04–1.28
Region																
Northeast	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
North Central	1.03	0.89–1.19	1.01	0.89–1.14	0.99	0.88–1.13	1.00	0.88–1.14	0.90	0.81–1.01	**0.87**	0.78–0.96	**0.87**	0.79–0.97	**0.86**	0.78–0.96
South	**1.18**	1.04–1.35	0.90	0.80–1.01	0.92	0.82–1.03	0.90	0.80–1.01	1.09	0.97–1.21	0.97	0.87–1.07	0.97	0.87–1.07	0.96	0.87–1.06
West	1.00	0.84–1.20	0.87	0.73–1.05	0.84	0.70–1.01	0.88	0.73–1.05	0.97	0.85–1.12	**0.86**	0.76–0.98	**0.84**	0.74–0.95	**0.86**	0.76–0.98
Lifestyle behaviors																
Eating frequency	**0.95**	0.94–0.96	1.00	0.99–1.01	—	—	1.00	0.99–1.02	**0.93**	0.92–0.94	**0.97**	0.96–0.98	—	—	**0.97**	0.96–0.98
Sleeping frequency	**0.94**	0.91–0.96	0.97	0.94–1.00	—	—	0.97	0.94–1.00	**0.90**	0.88–0.92	**0.96**	0.94–0.99	—	—	**0.96**	0.94–0.99
Exercise frequency	**0.80**	0.78–0.82	**0.85**	0.83–0.87	—	—	**0.85**	0.83–0.88	**0.85**	0.83–0.87	**0.90**	0.88–0.92	—	—	**0.90**	0.88–0.92
TV viewing frequency	**1.28**	1.25–1.31	**1.15**	1.11–1.18	—	—	**1.15**	1.11–1.18	**1.15**	1.12–1.18	**1.09**	1.06–1.12	—	—	**1.09**	1.06–1.12
Family/parenting																
No. hrs. spent alone	**1.04**	1.01–1.07	—	—	1.01	0.98–1.04	0.99	0.97–1.02	1.01	0.99–1.04	—	—	1.00	0.97–1.03	0.98	0.95–1.00
Lives with two parents																
No	1.00	—	—	—	1.00	—	1.00	—	1.00	—	—	—	1.00	—	1.00	—
Yes	**0.66**	0.60–0.72	—	—	**0.87**	0.79–0.95	**0.88**	0.80–0.97	**0.81**	0.74–0.88	—	—	0.90	0.82–1.00	0.95	0.86–1.04
Mother has paid job																
No	1.00	—	—	—	1.00	—	1.00	—	1.00	—	—	—	1.00	—	1.00	—
Part-time	0.90	0.78–1.03	—	—	0.95	0.83–1.10	0.98	0.85–1.13	**0.87**	0.76–0.99	—	—	0.93	0.82–1.06	0.94	0.82–1.07
Full-time	1.08	0.97–1.20	—	—	1.06	0.95–1.18	1.08	0.97–1.21	1.03	0.93–1.14	—	—	1.05	0.95–1.16	1.05	0.94–1.16
			Wald$\chi^2(23)=802.17$ -Log PL=10059.40		Wald$\chi^2(23)=518.48$ -Log PL=10207.99		Wald$\chi^2(27)=839.67$ -Log PL=10051.94				Wald$\chi^2(23)=523.15$ -Log PL=10747.59		Wald$\chi^2(23)=271.85$ -Log PL=10898.97		Wald$\chi^2(27)=525.29$ -Log PL=10742.39	

Notes: All analyses include grade level and the year (dummy-coded) in which the survey took place. Model 1 includes the following variables: Race/ethnicity by SES, population density, region, and lifestyle habits. Model 2 includes the following variables: Race/ethnicity by SES, population density, region, and family/parenting. The Full model includes all of the variables listed. Odds ratios in bold indicate they are statistically significant with $p<0.05$.

OR, odds ratio; CI, confidence interval; SES, socioeconomic status; MSA, metropolitan statistical area; MTF, Monitoring the Future study.

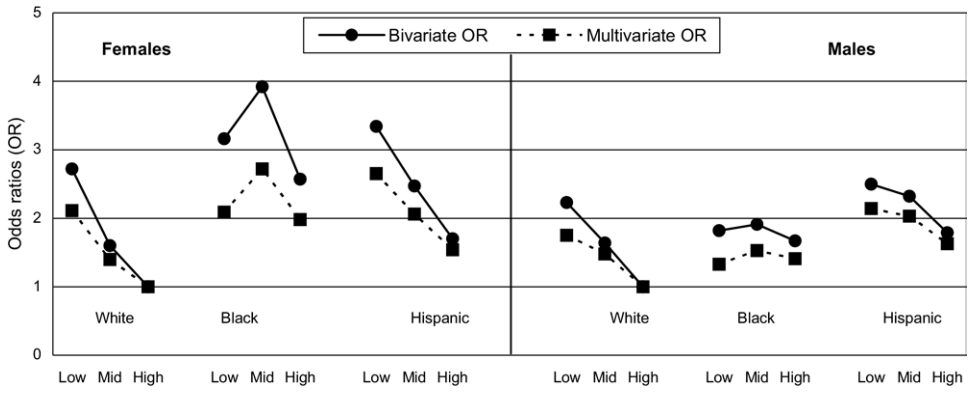

Figure 2. Bivariate and multivariate odds ratios between being at or above the 85th percentile and the interaction of race/ethnicity and socioeconomic status by gender.

this study, although it is not believed that this potential downward bias has had a substantial effect on the associations studied. If present, such biases are believed to be relatively constant across groups. Other studies also conclude that the slight bias towards underreporting weight is sufficiently small to reach reliable conclusions.[37–39] Also, it is believed that because most underreporting occurs among those with the highest BMIs,[37–39] most of these adolescents were probably correctly classified as being at or above the 85th percentile based on the definition utilized in the present study, thus reducing the likelihood that the estimated odds ratios are biased. The slight bias toward underreporting weight appears to be sufficiently small to reach reliable conclusions.[37–39]

Fourth, while the inverse association found between being at or above the 85th percentile and SES, as measured by parental education, is consistent with findings from prior studies,[40] to better understand how SES is associated with being at risk of overweight or overweight differences between racial/ethnic groups, additional research is needed with more comprehensive measures of SES (i.e., parental education, income, occupation), including measures of wealth. A more detailed discussion on the validity of self-reported height and weight to calculate BMI and the use of parental education as a proxy for SES is presented in another paper in this supplement.[41] Notwithstanding these limitations, the current study provides substantial information on the distribution of youth at or above the 85th percentile by racial/ethnic background and socioeconomic levels, and provides evidence of the influence that lifestyle behaviors have on being at risk of overweight or overweight using large national representative samples of youth.

As mentioned earlier, the lifestyle behaviors variables had a stronger effect than the parenting variables in reducing the magnitude of the association between being at or above the 85th percentile and the race/ethnicity by SES variables. This finding may indicate that parents and families who ensure that their children's nutritional and physical needs are adequately met and who regulate the amount of time youth spend watching television can reduce the risk of their children becoming at risk of overweight or overweight, despite familial and parenting circumstances. This finding holds for all racial/ethnic groups and socioeconomic levels under investigation in this study. A caveat of this finding is that the introduction of the lifestyle behaviors into the model attenuated, but did not eliminate, the observed association between being at or above the 85th percentile and race/ethnicity and SES.

The findings that youth who eat breakfast, fruits, and vegetables more frequently are less likely to be at or above the 85th percentile are consistent with recent research demonstrating the positive effects of these behaviors.[42] These positive effects may result from youth receiving the proper nutrients that might prevent them from experiencing hunger that can lead to a pattern of overeating at meals and consuming snacks high in fat, calories, and salt (e.g., candies, sodas). The study also shows that youth who exercise less frequently and those who spend more time watching TV, a sedentary activity, are more likely to be at risk of overweight or be overweight. While the benefits of physical activity are well known,[43] the nation's middle and junior high schools fall short of the *Healthy People 2010* objectives related to physical education,[44] and little is known about the environmental factors that might be conducive to higher physical activity levels among youth in their communities.[45] A recent study indicates that communities with larger proportions of racial/ethnic minorities and individuals of low SES have fewer settings conducive to physical activity.[46] In light of the potential role that the physical environment plays in the development of obesity among youth and our increasing understanding that behaviors leading to obesity result from the complex interaction of individual and environmental factors, future research is needed to better measure the physical environment and to identify how these and other individual factors interact to increase or decrease the risk of obesity among youth.[47] This knowledge will then serve to better inform studies aimed at identifying which changes

in the physical environment can lead to increased physical activity and decreased obesity among youth.

The present study also adds evidence to the potential effect of television viewing on youth being at risk of overweight or overweight, although the magnitude and direction of the association between these variables has not been entirely clear.[18–19] The potential effects of TV may be more serious for individuals of lower SES and racial/ethnic minorities because these groups have been found to watch considerably more TV than individuals of higher SES and white youth.[19,27] The neighborhood context in which youth live may influence the amount of TV they watch, with youth living in dangerous neighborhoods spending more time indoors, safely watching TV. However, further analyses of our data showed that black and Hispanic youth of higher SES watch considerably more TV than white youth of similar status. Recent studies indicate that the overwhelming majority of food and beverage advertisements seen by children and adolescents are for products that are high in fat, processed sugars, and/or sodium.[48] Given these findings, there is a need to further understand the specific role of television marketing, and of the marketing industry in general, in influencing childhood obesity[49] among all youth, and particularly among racial/ethnic minorities and those of low SES, given the overrepresentation of these populations among the overweight and obese. In light of the immediate and long-term health consequences associated with sedentary activities,[50] further research is needed to understand these racial/ethnic differences that manifest themselves across the SES gradient.

The frequency at which youth get at least 7 hours of sleep each night was inversely associated with being at or above the 85th percentile in the bivariate analyses for girls and boys, but not in the multivariate analyses for girls. The change is due to the inclusion of frequency of eating and exercising variables, however, the change in magnitude in the OR is minimal, from 0.94 to 0.97. As is the case with the other lifestyle behaviors studied, significant differences were observed in the percentage of youth who get at least 7 hours of sleep between racial/ethnic backgrounds and levels of SES.[27] These differences, coupled with the steady decline over time in the percentage of youth who sleep at least 7 hours on a regular basis,[1] suggest the need for further investigation into the effects of decreased sleep on youth eating and physical activity patterns.

Finally, the findings are worth noting that male and female youth who spend more hours supervised after school and who live with both parents are less likely to be at or above the 85th percentile. In the multivariate context, however, these variables were no longer significantly associated with being at or above the 85th percentile, with the exception of girls who live with both parents. The Institute of Medicine recently suggested that preventing overweight and obesity among youth will require a strong commitment by parents to meet the nutritional and physical activity needs of youth,[51] a challenging task by itself that is further complicated by the aggressive marketing of non- or less than-nutritious foods aimed at families and children.[48,49] Further research is needed to understand the gender differences observed in this study and the mechanisms by which one- and two-parent households alike can prevent adolescents from becoming obese.

Conclusion

These findings provide evidence of racial/ethnic and SES differences in becoming at risk of overweight or overweight by early adolescence. It also demonstrates that those differences are explainable in part by group differences in dietary and exercise behaviors. The results also show that children in certain family situations are at greater risk of becoming at risk of overweight or overweight.

The prevention of obesity and eventual elimination of racial/ethnic and socioeconomic disparities is likely to require action in multiple arenas, including (1) population-based interventions that can reach a large number of youth to target the potentially modifiable factors investigated in this study (e.g., eating and physical activity practices); (2) changes in the types of food advertising and marketing campaigns aimed at children[52]; (3) changes in the ways communities are built to facilitate more physical activity[46]; (4) changes in the amount of physical activity that schools provide during and after school hours[44]; and (5) changes in the beverage and food offerings provided to students at school.[53,54] A concerted and comprehensive effort is needed both to stop the obesity epidemic and to eliminate disparities related to this health problem.

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Variation in Obesity Among American Secondary School Students by School and School Characteristics

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Background: Body mass index (BMI) is known to vary by individual characteristics, but little is known about whether BMI varies by school and by school characteristics.

Methods: Nationally representative samples of United States schools and students are used to determine the extent to which BMI and percent of students at or above the 85th percentile of BMI vary by school and by school characteristics. Data from the 1991–2004 Monitoring the Future (MTF) study were analyzed in 2006 and 2007.

Results: A relatively small proportion of variance in BMI lies between schools; intraclass correlations are on the order of 3%. Still, this is sufficient variation to provide very different environments for students attending schools that are low versus high in average BMI. There is some modest variation by school type (public, Catholic private, non-Catholic private); school size (number of students in the sampled grade); region of the country; and population density. There is more variation as a function of school socioeconomic status (SES) and racial/ethnic composition of the school. School SES in particular was negatively associated with BMI levels, even after controlling individual-level SES and racial/ethnic status.

Conclusions: The residual differences in BMI by school suggest that some characteristic of the school and/or community environment—perhaps cultural factors or peer role modeling or differences in school food, beverage, or physical education policies—facilitate obesity in schools with a high concentration of lower socioeconomic students, beyond individual-level factors.

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Introduction

The distribution of obesity among American adolescents is known to vary by important individual factors, including gender and race/ethnicity.[1–4] Little is known, however, about the extent to which obesity varies by school factors, and this represents an important gap for scientific and policy-related purposes. This article focuses on a description of: (1) the extent to which student obesity (measured by body mass index [BMI]) and the percentage of students who are at or above the 85th percentile (that is, overweight or at risk of overweight) vary among American secondary schools, and (2) how BMI and percentage of students at or above the 85th percentile vary by certain key characteristics of the schools. That is, this article describes the extent to which these problems cluster by school and by particular characteristics of the school, thereby providing indications of the potential importance of contextual factors in the school and community.

This study focuses on broad-based school characteristics, including school type (public, Catholic private, non-Catholic private); school size (measured by number of students in the sampled grade); school socioeconomic status (SES, as indicated by average parental education reported by students); and racial/ethnic composition (derived from student self-identification). Two other contextual characteristics that vary between schools (but not within schools) are also considered—the region of the country and the population density of the community in which they are located.

The extent to which obesity varies by school is an important issue because it sets outer limits to how much school-level factors could "explain" variations in individual-level obesity at the point in time at which measurement occurs. The degree of variation among schools could change over time to the extent that independent and/or dependent characteristics such as school policies about cafeteria offerings, vending machines, or required physical education become more or

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less homogeneous. The extent to which obesity varies by school characteristics is of interest primarily in a descriptive sense. Knowing whether obesity clusters by certain school characteristics can serve to focus future attention and resources on understanding the mechanisms by which these characteristics contribute to obesity in young people and to develop interventions that target these characteristics in order to prevent and reduce obesity.

Methods

Fourteen years of data (1991–2004) were examined from 8th-, 10th-, and 12th-grade students who participated in the University of Michigan's Monitoring the Future (MTF) project, sponsored by the National Institute on Drug Abuse. Data analyses were conducted in 2006 and 2007.

Design

The design and methods are summarized briefly below; more detailed descriptions are available elsewhere.[5,6] The study employs a multistage sampling design to obtain nationally representative samples of 8th-, 10th-, and 12th-grade students from the 48 contiguous states. Data have been collected annually from 12th graders since 1975 and from 8th and 10th graders since 1991. The sampling procedures involve three stages: first, geographic regions are selected; second, schools are selected—approximately 420 each year; third, between 42,000 and 49,000 students are sampled each year from within those schools. Schools are invited to participate in the study for a 2-year period, and most do. For each school that declines to participate, a similar school (in terms of size, geographic area, urbanicity, for example) is recruited as a replacement for that "slot." From 1991 to 2004, an average of 55% of the original schools agreed to participate, and either an original school or a replacement school was obtained in 98% of the sample units, or slots. University of Michigan representatives collect the data from the students, who complete a self-administered, machine-readable questionnaire during a normal class period. Student response rates have averaged 90%, 86%, and 84% for 8th, 10th, and 12th graders, respectively, during the study. Absence on the day of data collection was the primary reason that students were missed; it is estimated that fewer than 1.5% of students refused to complete the questionnaire.

Measures: School Characteristics

School characteristics used in this study were: (1) school type (public, Catholic private, non-Catholic private); (2) school size (number of students enrolled in the grade that participated in the MTF survey); (3) race/ethnicity of the student body; (4) average parental education (a proxy for socioeconomic status); (5) region, determined by the geographic region of the country where the school is located (Northeast, North Central, South, and West); and (6) population density, determined by the United States Census Bureau's classification of the area in which the school is located: within a large metropolitan statistical area (MSA), other metropolitan statistical area, or nonmetropolitan statistical area. Two measures—race/ethnicity and parental education—are based on an aggregate measure of the individual answers provided by the students.

Measures: Student Characteristics

Students were characterized by their BMI, racial/ethnic group, and parental education. Students report their height (in feet and inches) and weight (in pounds), using pre-coded close-ended response alternatives. BMI was calculated by dividing weight (in kilograms) by height (in meters) squared. The questions about height and weight (used to calculate BMI) were asked of a random half of the 8th- and 10th-grade students and a random sixth of the 12th-grade students, so the numbers of cases available for analysis are less than the total numbers surveyed. The numbers of available cases are further reduced by missing data, which is somewhat above average because the height and weight questions are located toward the end of the questionnaire. Age- and gender-specific growth curves produced by the Centers for Disease Control and Prevention (CDC) were used to determine whether each student's BMI was greater than or equal to the 85th percentile.[7,8] These growth curves were originally normed on data from several national health examination surveys conducted by the National Center for Health Statistics between 1963 and 1994; more recent data, such as the data analyzed here, show that more than 15% of respondents exceed the 85th percentile because of the considerable increase in BMI in recent decades. Racial/ethnic group for each student was measured by the question: How do you describe yourself? The respondent was instructed to answer only one category. The present analysis distinguishes among African-American; Hispanic (which included answers of Mexican-American or Chicano, Cuban-American, Puerto Rican, and other Latin-American students); and white. All other answers were categorized into an "other" category due to limited sample sizes. Parent education is the average of father's and mother's educational attainment (with one missing data case permitted); this individual-level measure is aggregated to the school level, and schools are categorized into three levels. Educational attainment was coded as follows: 1=completed grade school or less, 2=some high school, 3=completed high school, 4=some college, 5=completed college, 6=graduate or professional school after college.

Analysis

SAS PROC MIXED[9] was used to estimate the percentage of variation in BMI and in the proportion of students who are at or above the 85th percentile that lies between and within schools. SAS PROC SurveyReg was used to estimate the bivariate and multivariate generalized least squares models for BMI, and SAS PROC SurveyLogistic was used to estimate the bivariate and multivariate logistic regressions for the dichotomous measure of above the 85th percentile. Sample weights are assigned to each student to take into account variations in selection probabilities that may have occurred at different stages of sampling.

Results

Table 1 shows mean BMI and the proportion at or above the 85th percentile for each grade for each year

Table 1. Trends from 1991 to 2004 in mean BMI and proportion at or above 85th percentile, by grade level

	8th grade		10th grade		12th grade	
Year	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
1991	20.60	0.07	21.77	0.08	22.31	0.09
1992	20.83	0.09	21.94	0.08	22.55	0.12
1993	20.83	0.08	21.99	0.07	22.66	0.11
1994	21.04	0.11	22.15	0.08	22.62	0.09
1995	21.17	0.11	22.09	0.07	22.68	0.09
1996	21.12	0.09	22.09	0.08	22.95	0.12
1997	20.89	0.09	22.32	0.09	22.88	0.11
1998	21.10	0.09	22.33	0.09	23.14	0.12
1999	21.18	0.09	22.45	0.07	23.07	0.12
2000	21.27	0.09	22.47	0.09	23.22	0.14
2001	21.33	0.10	22.69	0.10	22.97	0.14
2002	21.31	0.10	22.79	0.09	23.19	0.14
2003	21.36	0.09	22.72	0.08	23.29	0.13
2004	21.38	0.07	22.91	0.09	23.70	0.11
	Proportion	**SE**	**Proportion**	**SE**	**Proportion**	**SE**
1991	0.197	0.009	0.187	0.006	0.143	0.009
1992	0.215	0.009	0.200	0.009	0.171	0.013
1993	0.205	0.008	0.197	0.007	0.189	0.012
1994	0.230	0.010	0.215	0.009	0.178	0.012
1995	0.232	0.010	0.215	0.007	0.185	0.010
1996	0.236	0.008	0.212	0.008	0.194	0.013
1997	0.212	0.009	0.234	0.008	0.197	0.009
1998	0.240	0.008	0.224	0.008	0.218	0.013
1999	0.241	0.008	0.239	0.008	0.215	0.012
2000	0.251	0.009	0.244	0.009	0.239	0.014
2001	0.249	0.009	0.257	0.010	0.208	0.012
2002	0.241	0.008	0.273	0.009	0.233	0.013
2003	0.261	0.008	0.261	0.008	0.223	0.014
2004	0.260	0.007	0.270	0.008	0.246	0.010

SE, standard error.

from 1991 to 2004. There is a clear general upward trend in both measures, as reported in more detail elsewhere.[10] Table 2 provides the percentage of variance, also called the intraclass coefficient (ICC), that is between schools for BMI and for being at or above the 85th percentile, separately for grades 8, 10, and 12 from 1991 to 2004. Calculations were performed separately for each year, then averaged; Table 2 shows minimum, maximum, and averages. Average ICCs were slightly higher for BMI than for being at or above the 85th percentile. The ICC values for individual years on BMI ranged from 1.3% to 6%, averaging 3.0% across all grades and years. There was no ordinal relationship by grade level, the ICCs being larger in 8th and 12th grades than in 10th grade for both BMI and percentage at or above the 85th percentile. Clearly, most of the variation in these measures lies within schools—that is, most schools have nearly the full range of height-by-weight combinations.

Table 2. BMI and percent at or above 85th percentile: Average percent variance (intraclass correlation coefficient) between schools, 1991–2004

	Grade		
	8th	**10th**	**12th**
BMI (%)			
Minimum	2.0	1.9	1.3
Maximum	4.5	3.3	6.0
Average	3.0	2.3	3.6
Percent at or above 85th percentile			
Minimum	1.5	1.2	0.7
Maximum	3.8	3.0	6.7
Average	2.6	2.0	3.3
Number of schools per year, average	151	132	136
Number of students per year, average	7234	7263	2193

BMI, body mass index.

The amount of variation that does lie between schools is not trivial. Even with a low ICC, schools show considerable variation. For example, in 8th grade, the 2003 ICC for BMI was 3.0%. In the 10% of schools (weighted by number of students) with the lowest BMIs, the average BMI was 19.76; in the 10% of schools with the highest BMIs, the average BMI was 23.21. This is a difference of 3.45 scale points, or about 75% of a standard deviation (which is 4.56). Thus, even though the ICC is only 3.0%, a student in one of the low-BMI schools is in an environment with a considerably lower average BMI than a student in one of the high-BMI

schools. Similarly, the 2003 ICC for being at or above the 85th percentile was 2.9% for 8th grade. In the 10% of these schools (weighted by number of students) with the lowest average proportion of students who were at or above the 85th percentile, the average percent at that level was 10.2%, whereas in the 10% of schools with the highest proportion of students at or above the 85th percentile, the average percent at that level was 43.6%. Again, even though the ICC is relatively low, the school environment in terms of the proportion of students who are overweight or at risk of overweight is quite different (by a factor of about 4) for a student in the low-BMI schools as opposed to a student in the high-BMI schools.

There was no evidence of any systematic trending in ICC values over time in any of the three grades. Thus, in spite of an important increase in BMI that has been occurring in recent years,[10–12] there is no concurrent tendency for schools to become more similar or dissimilar on this dimension.

School Characteristics

The second objective of this study was to provide information on how student BMI and the percentage at or above the 85th percentile vary by selected school characteristics, including school type (public, Catholic private, non-Catholic private); school size (number of students in the sampled grade); school SES (as indicated by an average of parents' education levels, reported by students); racial/ethnic composition (derived from student self-identification); region of the country; and population density.

Table 3 shows the mean BMI and percentage of students at or above the 85th percentile, separately for 8th, 10th, and 12th graders, by various school characteristics. Data for the years 2001 through 2004 are combined to provide a greater number of cases. The columns labeled "Biv" provide for each school characteristic the statistical significance associated with the characteristic in a bivariate model that uses the characteristic by itself, that is, with no other variables predicting to the outcome measure, except for dummy variables indicating year of measurement; asterisks indicate the statistical significance level. The columns labeled "Mult" provide the statistical significance associated with the characteristic in a multivariate model that uses all the school-level variables simultaneously, and dummy variables indicating year of measurement; plus signs indicate the statistical significance level.

Bivariate Results

School type is significantly associated with both BMI and percent at or above the 85th percentile on BMI in all three grades, with the public schools averaging slightly higher on both dimensions than the private schools. The overall standard deviation is about 4.5, so the differences in 8th grade, for example, are on the order of about 14% of a standard deviation.

School size, as measured by the number of students in the grade being surveyed, is marginally significantly ($p<0.05$) associated with BMI and percentage at or above the 85th percentile only for 8th grade, with smaller and larger schools being slightly lower on both measures, compared to mid-sized schools.

School SES, as measured by average parental education at the aggregate level, is very significantly associated with both overweight indicators, with lower SES schools having a distinctly greater proportion of overweight students. The differences are rather impressive, with, for example, low-SES schools averaging 31% of students at or above the 85th percentile, while high-SES schools average 20% in 8th grade. The differences are even larger in 10th and 12th grades.

The racial/ethnic composition of the schools also is significant in terms of BMI and percentage at or above the 85th percentile, with majority African-American and majority Hispanic schools having higher values on both measures in all three grade levels. The differences are particularly strong for 10th graders: 38% of students in majority Hispanic schools and 33% in majority African-American schools are at or above the 85th percentile, compared with 24% of predominantly white schools and 27% of remaining schools. (As noted below, this is more a matter of race/ethnicity as an individual characteristic rather than a school population characteristic.)

Regional differences are strongly significant ($p<0.001$) for both BMI and percentages of students at or above the 85th percentile in 8th grade, with schools in the West being slightly lower than schools in the other regions on both outcome dimensions. Regional differences are slightly significant ($p<0.05$) in the 10th grade, with schools in the South and West being somewhat higher on both measures than schools in the Northeast and North Central regions. Regional differences in 12th grade are not significant.

Variations by population density are significant for both BMI and percentage of students at or above the 85th percentile in 8th grade, with schools in non-MSAs (that is, more rural areas) having a higher percentage of students who are high on both indicators. In this case the same pattern is also evident in both 10th and 12th grades but reaches statistical significance in only the 12th grade.

Multivariate Results

The multivariate analyses shown in Table 3 generally do not differ from these bivariate findings, with the major exception that the school-type variations become nonsignificant. The variable that accounts for virtually all of the reduction of school-type differences to nonsignificance is school SES. Public schools are much more

Table 3. BMI and percent at or above 85th percentile by grade and school characteristics, 2001–2004 (combined)

	Number of cases			Mean BMI						Percent at or above 85th percentile								
				8th grade			10th grade			12th grade			8th grade			10th grade			12th grade		
	8th grade	10th grade	12th grade		Biv	Mult		Biv	Mult		Biv	Mult		Biv	Mult		Biv	Mult		Biv	Mult
School type					***	ns		***	ns		*	ns		***	ns		***	ns		**	ns
Public	24,510	25,019	7037	21.41			22.85			23.36			25.9			27.2			23.2		
Catholic private	1,661	1,429	601	20.74			22.29			22.82			21.3			22.1			18.2		
Non-Cath. private	974	1,070	169	20.79			21.80			22.94			19.6			18.6			14.0		
School size					*	ns		ns	ns		ns	ns		*	ns		ns	ns		ns	ns
<75	6,101	2,857	957	21.24			22.83			23.29			24.3			27.7			23.7		
75-225	9,509	9,993	3213	21.50			22.89			23.44			26.7			26.8			23.5		
>225	11,536	14,668	3637	21.28			22.70			23.20			24.9			26.3			21.5		
SES (parental education)					***	+++		***	+++		***	+++		***	+++		***	+++		***	+++
Low (<3.5)	4,225	5,161	1527	21.97			23.56			23.94			31.4			34.1			28.6		
Medium (3.5-4.2)	14,006	14,085	4137	21.56			22.85			23.36			26.9			27.3			23.4		
High (>4.2)	8,915	8,272	2143	20.73			22.18			22.77			20.2			20.8			16.9		
Majority race/ethnicity					***	+++		***	+++		***	++		***	+++		***	+++		***	ns
≥66% white	14,777	16,710	4892	21.22			22.56			23.25			24.1			24.5			21.9		
≥ 50% African-American	1,843	1,826	433	22.20			23.56			24.17			32.6			32.7			29.4		
≥50% Hispanic	1,001	1,757	393	22.15			23.98			23.76			33.7			38.1			26.0		
Other racial composition	9,525	7,225	2089	21.30			22.81			23.20			25.0			27.2			22.4		
Region					***	+++		*	ns		ns	ns		***	+++		*	++		ns	ns
Northeast	4,795	5,245	1362	21.28			22.64			23.46			25.5			25.2			22.3		
North Central	7,086	7,569	2080	21.35			22.67			23.24			24.6			25.2			22.4		
South	9,898	9,297	2781	21.63			22.94			23.37			27.7			28.3			23.8		
West	5,366	5,406	1584	20.89			22.80			23.19			21.9			27.1			21.1		
Population density					*	ns		ns	ns		ns	ns		**	++		ns	ns		*	ns
Large MSA	7,591	7,928	2240	21.21			22.62			23.16			24.1			25.7			21.6		
Other MSA	12,749	13,461	3559	21.24			22.81			23.29			24.2			26.6			22.1		
Non-MSA	6,806	6,129	2008	21.70			22.93			23.52			28.9			27.9			24.7		

Note: Bivariate association models use one independent variable at a time, plus year dummy variables; multivariate association models use all independent variables simultaneously, plus year dummy variables.

*$p<0.05$; **$p<0.01$; ***$p<0.001$ (bivariate associations).

$^{+}p<0.05$; $^{++}p<0.01$; $^{+++}p<0.001$ (multivariate associations).

BMI, body mass index; ns, not significant.

likely than private schools to be in the lowest SES category, and when SES is included in the model, the school-type effect becomes nonsignificant at all three grade levels. School size, which has some marginally significant bivariate variation at 8th grade, becomes nonsignificant in the multivariate case; it is nonsignificant in both the bivariate and multivariate cases for 10th- and 12th-grade students.

Additional multivariate analyses (not shown) were conducted in which individual-level SES and race/ethnicity were included as predictors. These two variables are known to be associated with BMI.[2,13] With these two variables added, the racial/ethnic composition of the school was no longer significantly associated with BMI or being at or above the 85th percentile (with the sole exception that the percentage at or above the 85th percentile remained significant at a diminished level for 10th grade), suggesting that individual characteristics, and not differences in school environment associated with race/ethnicity, account for most of the differences observed at the aggregate level. With only minor exceptions, the significances of the other school characteristics were generally unchanged (those that were significant remained significant and those that were not significant remained so). The effect of school SES, though it remained significant with the sole exception of 12th-grade BMI ($p=0.08$), was substantially diminished but not eliminated.

Discussion

Although at present the great majority of the variation in BMI resides within schools, there remains enough variation between schools for school characteristics and school policies and programs to have had important effects on their students' BMI. This is about equally true at all three grade levels included in this study. Although the ICC for BMI is only about 3%, it remains true that schools could have substantially more influence in the future. The figure of 3% reflects the maximum impact that policy differences between schools may have had in the interval from 1991 to 2004. Policies that did not differ by school (e.g., policies that encourage drinking of high-calorie soft drinks) could still be having major effects. If all schools were to adopt policies that encourage good nutritional practices, that also could have major effects (in reducing both BMI and between-school variation in BMI). On the other hand, if there were considerable variation in how schools react to the extensive activity that is occurring at the national, state, and local levels regarding childhood obesity, that could produce more heterogeneity among schools.

A major conclusion from this study is that obesity is quite prevalent today among students in all types of schools, but that schools with a high concentration of students from low-SES households are most likely to have higher proportions of overweight students. Public schools and schools with majority racial/ethnic-minority enrollment have higher average BMI, but this appears to be due mostly to the concentration in those schools of students of lower SES, which is strongly correlated with both BMI and race/ethnicity.[2,14] Most, but not all, of the association between school-level SES is also accounted for by individual-level SES. The residual difference suggests that something about the school environment, perhaps differences in school food and beverage policies or in cultural factors or peer role modeling, facilitates obesity in schools with a higher concentration of lower-SES students, beyond individual-level factors. It is also possible that the single measure used here to indicate SES—the average education level of the parents—does not fully correct for individual SES, and that the aggregate measure for the school in essence improves on the accuracy of the individual-level measure.

Limitations

A limitation of this study is its reliance on self-reports for two key variables: BMI and parent education. However, the literature, as described below, shows that both of these have sufficient validity for the present purposes. With respect to BMI, the values used in this study were calculated from students' self-reported height and weight. A number of studies have investigated the use of self-reports of height and weight, and have generally reported that, although there may be modest biases associated with self-reports, they are certainly adequate for research purposes. Brener et al.[15] obtained both objective and self-reported data on height and weight for over 2000 students in grades 9 through 12, and found that ". . . self-reported values of height, weight, and BMI were highly correlated with their measured values." They also noted that surveillance systems can yield "valuable results by using self-reported height and weight to assess trends in the prevalence of obesity." Goodman et al.[16] analyzed data from over 10,000 respondents in the National Longitudinal Study of Adolescent Health, with both self-reported and objectively measured height and weight. They report that "correlations between measured and self-reported anthropomorphic indices (height and weight) were very strong." They conclude that "findings from other studies that have used self-reported BMI should be considered valid, and future studies can use self-reported data to understand adolescent obesity, its correlates, antecedents, and sequelae." To address the question of possible gender and racial differences in biases, Strauss[17] examined self-report and measured data on height and weight from over 1600 adolescents in the National Health and Nutrition Examination Survey Cycle III. They concluded that the influences of gender and racial biases in reporting of height and weight were

relatively small, and that self-reports "were extremely reliable for . . . predicting obesity related morbidities and behaviors."

Although it would clearly be preferable to have a more extensive measure of family SES than students' reports of parent education, the fact is that valid measurement of more extensive indicators is very difficult to obtain in large-scale epidemiologic studies that rely on student reports.[18,19] Parent education is one measure (perhaps the only one in this set) that can be reasonably validly measured. Although there is no direct evidence on the validity of the students' reports of parent education, there are a number of indicators that the measure has reasonable validity. It should be noted that the measure used in the MTF study was based to a considerable extent on our experience in an earlier study called Youth in Transition. In that study, a national sample of young men from the high school class of 1969 was extensively interviewed by professional interviewers. Extensive information was obtained about indicators of family SES, including parental education. Analyses of the various indicators led to the conclusion that student reports of parental education were the best measures that could be obtained in group-administered questionnaires, and that those reports were of acceptable reliability and validity.[20]

Three other factors support the validity of this measure: first, respondents are given an explicit response option of "don't know or does not apply," so those respondents who do not know a parent's education level would be able to say so. Only about 8% failed to provide parent education data. Thus, the great majority appeared comfortable with reporting parent education. Second, this measure has shown trends over time consistent with the (rising) educational level of the adult population in the country and by racial/ethnic groups. Moreover, 8th-grade students reported having parents with higher education than youth in 12th grades, as would be expected given the rising level of education in the adult population. Finally, the measure correlates well in expected directions with (1) students' educational plans, (2) actual college attendance, and (3) several other educational outcomes.

An important limitation of the analyses presented here is that there was no attempt to conduct a full multilevel analysis of all the various factors acting at various levels that affect BMI. Thus, there was no attempt to determine how much between-schools variance in BMI is due strictly to school-related factors as opposed to other factors that vary between schools, including neighborhood factors (including some that are the subject of other articles in this issue) or local- or state-level policies. In effect, the analyses here present descriptive information on how schools vary, and how they vary according to selected school characteristics, but the analyses cannot support causal interpretations of school effects.

Conclusion

Although a fair amount is known about how individual characteristics relate to BMI among adolescents, less is known about the extent to which BMI varies by school and by school characteristics. This study shows that although most variation in BMI lies within schools, there is sufficient between-school variation to be of interest to policymakers. School SES is shown to be of some importance, even after controlling for individual-level SES and race/ethnicity. In sum, the school one attends has implications for one's likelihood of being overweight. This is both good and bad news, but in either case, it suggests that schools can have a direct impact on improving the health of our young people.

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Sports Participation and Physical Education in American Secondary Schools

Current Levels and Racial/Ethnic and Socioeconomic Disparities

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Background: The purpose of this study was to determine the current levels of physical education (PE) and sports participation among American secondary school students, and to establish the extent to which they vary by grade level, racial/ethnic background, and socioeconomic status (SES) of the students.

Methods: Nationally representative data were used from over 500 schools and 54,000 students surveyed in 2003, 2004, and 2005 as part of the Youth, Education, and Society (YES) study and the Monitoring the Future (MTF) study. As part of YES, school administrators completed questionnaires on physical activity (including rates of sports and PE participation) of students in their schools. Students in the same schools completed self-administered questionnaires in the same year as part of MTF, providing individual background data, including their gender, racial/ethnic identification, and parents' education level. Data were analyzed in 2006.

Results: Physical education requirements, and actual student participation rates, decline substantially between 8th and 12th grades. About 87% of 8th graders were in schools that required them to take PE, compared to only 20% of 12th graders. Principals estimate that over 90% of 8th graders actually take PE, compared to 34% of 12th graders. Subgroup differences in PE participation rates were small. Only a fraction of all students participate in varsity sports during the school year, with girls participating only slightly less than boys (33% vs 37%). Participation correlates negatively with SES and was lower among black and Hispanic students than white students, even after controlling for other variables. Participation rates in intramural sports were even lower, declined in higher grades, and were lower among low-SES and Hispanic students (after controlling for other variables).

Conclusions: Physical education is noticeably lacking in American high schools for all groups. Racial/ethnic minorities and low-SES youth, who are at higher than average risk of being overweight in adolescence, are getting less exercise due to their lower participation in school sports. Disparities in resources available to minorities and lower-SES youth may help explain the differences in participation rates.

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Introduction

Involvement in physical activity is considered a primary contributor to preventing youth from gaining weight and becoming overweight.[1–3] Because youth spend much of their time in schools, these settings provide unique opportunities to encourage and facilitate physical activity, including the formation of long-term healthy activity behaviors.[4] Yet, despite the growing prevalence of obesity among the nation's youth,[5–9] schools in the past decade have substantially reduced the opportunities for them to be physically active by shortening or eliminating recess, physical activity classes, and/or intramural and extracurricular sports activities,[10,11] very likely resulting in a substantial decrease in the percentage of youth who are physically active.[6,12,13] These reductions may have resulted largely from a combination of budget shortages that schools and school districts have experienced as well as from the increasing pressure schools have received to direct their resources toward meeting academic standards imposed by the federal government, or face losing funds or suffering other consequences if these standards are not met.

As young people progress into higher grades, participation in physical activity appears to decrease steadily.[14–18] Clearly, attending to the growing problems of over-

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weight and obesity among youth has become a growing challenge facing today's schools and communities. Consistent with the burden of disease falling on racial/ethnic minorities and on economically disadvantaged populations,[19,20] there is an overrepresentation of overweight and obese youth among some racial and ethnic minority youth (e.g., African-American females and Hispanic males) and among youth of lower-socioeconomic backgrounds.[5,7,9,21–24] In light of these concerns, and in order to inform policy, it is important to examine and track what the nation's schools are doing to facilitate youth participation in physical education classes and in athletic activities. Specifically, the purpose of this study was to examine the extent to which students are engaged in physical activities provided by their schools and to examine how their levels of participation vary by grade level, racial/ethnic background, and socioeconomic status (SES). Gender differences in sports participation are also examined.

Methods

Samples and Survey Methods

Data from two studies were utilized—Monitoring the Future (MTF) and Youth, Education, and Society (YES). MTF provides annual surveys of nationally representative samples of 8th-, 10th-, and 12th-grade students located in an average of 410 public and private schools; each school participates for two consecutive years. In YES, administrators in schools that are in the half-sample of schools cycling out of the MTF survey each year (about 205 per year) are asked to complete a lengthy questionnaire describing school policies and programs related to various health issues, including physical education, food services, and substance use. Each such half-sample was a nationally representative replicate sample. Data were analyzed in 2006.

Monitoring the Future design and methods. The design and methods for the MTF project are summarized briefly here; a detailed description is available elsewhere.[25] At each of three grade levels (8th, 10th, 12th), an independent sample was drawn using a multistage sampling design to obtain nationally representative samples of students in each grade from the 48 contiguous states. The stratified random sampling procedure involves three stages[26]: (1) geographic regions are selected, (2) schools are selected within regions with probability proportional to the estimated number of students in the target grade, and (3) students are selected within schools, usually by means of randomly selecting whole classrooms. Between 42,000 and 49,000 students make up the full sample each year across grades. Sample weights are assigned to each student to take into account the variations in selection probabilities that occur at all stages of the sampling procedures. Participating students complete a self-administered questionnaire during a normal class period.

For the current study, the student data included grade level and the self-reported gender, racial/ethnic background, and parental education (a proxy for SES). Gender was measured by the question, What is your sex? Racial/ethnic background was measured by the item, How do you describe yourself? Students were coded as being of white, black, Hispanic, or other background. There were insufficient cases for other racial/ethnic groups to make reliable estimates. Parent education was defined as an average of father's and mother's educational attainment (with one missing data case permitted). The measures were: completed grade school or less, some high school, completed high school, some college, completed college, and graduate or professional school after college. Parent education was utilized as a proxy for SES. (Parent education was chosen as a measure of SES because students are generally unable to provide accurate information on family income and because it has been found to be valid in large-scale surveys when compared to other measures of SES.[27]) Grade refers to the grade in which the student was enrolled: 8th, 10th, or 12th. In this paper, the 10th- and 12th-grade students are sometimes referred to as high school students and 8th graders as middle school students. Region and urbanicity are derived from the sampling data from which the school was drawn. Four regions of the country are distinguished (Northeast, North Central, South, and West) based on United States Census Bureau classifications. Three levels of population density are coded (large metropolitan statistical areas [MSAs], corresponding to the sixteen largest cities; other metropolitan statistical areas, corresponding to other cities as defined by the Census Bureau; and non-MSAs, corresponding to all other areas).

Youth, Education, and Society design and methods. The half-samples of nationally representative schools that were cycling out of the MTF study in 2003, 2004, and 2005 made up the target sample for the current study. School administrators were asked to complete a self-administered questionnaire that contained, among other things, questions related to student participation rates in physical education (PE) classes, varsity sports, intramural sports, and walking or bicycling to and from school. For some of the questions it was recommended that a person other than the school administrator (e.g., health counselor) answer those sections if they were more likely to know the information. Over 85% of respondents were school administrators (e.g., mostly school principals, but also some vice-principals) followed by teachers and other school personnel.

The combined number of secondary schools that participated in the YES nationwide surveys in 2003–2005 was 509, reflecting a combined response rate from school administrators of 83.2%. School and student data were available on the variables of relevance to the present analyses from over 54,000 student respondents surveyed in the same years in those schools. The racial/ethnic composition of the resulting student samples was 67% white, 12% black, 10% Hispanic, and 11% from other racial/ethnic backgrounds. Female students make up 51.6% of the combined samples (Table 1).

The primary data for this study include the answers to questions on physical activity. First, respondents (most of whom were principals) were asked whether students in the target grade surveyed in the school (8th, 10th, or 12th) were required to take physical education, followed by the question, About what percent of students in [target] grade actually took a PE class in [target] grade? For those students who take PE, the respondents were asked how many days a week the students participated in PE. The duration of a PE class in minutes was asked, permitting a calculation of the total

Table 1. Weighted sample sizes and percentage distributions on student characteristics, by grade: 2003–2005

Demographic characteristic	8th	10th	12th	Total
Total	**19,225**	**18,933**	**16,027**	**54,185**
Gender				
Male	48.7	48.8	47.7	48.4
Female	51.3	51.2	52.3	51.6
Race/ethnicity				
White	65.4	64.9	72.4	67.3
Black	11.9	14.7	10.5	12.4
Hispanic	9.4	10.7	8.8	9.7
Other	13.3	9.7	8.3	10.6
SES				
1 (Low)	7.6	8.1	7.2	7.7
2	22.5	22.1	24.1	22.8
3	24.6	27.0	29.2	26.8
4	28.8	27.8	25.8	27.6
5 (High)	16.5	15.0	13.7	15.1
Urbanicity				
Large MSA	30.6	25.6	27.0	27.8
Other MSA	43.7	52.5	46.7	47.7
Non-MSA	25.7	21.9	26.3	24.5
Region				
Northeast	19.3	16.6	18.8	18.2
North Central	24.7	28.3	27.0	26.6
South	36.0	34.9	37.4	36.0
West	20.0	20.2	16.8	19.2

MSA, metropolitan statistical area; SES, socioeconomic status.

number of minutes per week a student would spend in PE. Rates of student participation in both varsity and intramural sports at the school were also determined. Respondents were asked to write in the approximate percentages of boys and girls, separately, who participated during the school year in (1) interscholastic or varsity sports and (2) intramural sports or physical activity clubs. An additional question, also with an open-ended response, asked, About what percent of [target]-grade students would you estimate walk or bike from home to school on an average school day? Finally, a yes–no question was asked about whether the school gives [target]-grade physical fitness tests, and if it does, what groups of students were tested. The answer alternatives to the latter part were: All [target]-grade students are tested, Only [target]-grade students who take PE are tested, and Other, please explain. If the school does give physical fitness tests, the respondent was asked to answer a yes–no question about whether the parents or guardians of the tested students were provided with the results. (Note that only the questions about interscholastic and intramural sports involve separate estimates for boys and girls.)

Data Analysis

A major analytic objective was to determine differences in the proportion of students participating in various physical activities by comparing (1) middle schools versus high schools, (2) different racial/ethnic groups, and (3) different socioeconomic levels as indicated by level of parental education. The distribution (percents and means) of these variables was compared between grades and across racial/ethnic and socioeconomic status groups. Chi-square and t-test statistics were used to determine if the percents and means, respectively, varied according to the students' grade level. Pair-wise comparison tests were also run to see if these variables differ among white, black, and Hispanic youth. While percentages and means for students identified in the "other" racial/ethnic category are presented for completeness, they were not included in the inferential analyses because it was a catch-all category that included very different population groups, which substantially limited the conclusions that could be drawn.

Ordinary least squares regression analysis was used to determine the extent to which a linear association existed between each of the dependent variables and the five-category measure of parents' education. The full set of dependent variables is provided in Table 2. All analyses include weighted data and take into account design effects in calculating variance estimates using Stata version 8.0.

The association of gender, race/ethnicity, SES, and grade was also examined, while controlling for urbanicity and region, with each of the following three dependent variables: (1) the mean time (in minutes) each student spent in PE classes per week, (2) the mean percentage of students who participated in interscholastic or varsity sports during the year, and (3) the mean percentage of students who participated in intramural sports or physical activity clubs during the year. Three models were tested for each of these analyses. The first shows the bivariate association between each characteristic and the dependent variables (Model 1). In the second, gender, race/ethnicity, SES, and grade level were simultaneously entered into the regression analysis. In the third, region of the country and urbanicity were added into the regression analysis. As is the case with all of the analyses, these include weighted data (using weights that take into account any unequal selection probabilities at any stage of sampling) and design effects in calculating variance estimates using Stata version 8.0.

Results

Total and By Grade

Physical education. The requirement that students take PE drops sharply between 8th and 12th grades. In 8th grade, 87% of students attend schools that require PE in that grade; this rate falls to 47% in 10th grade ($p<0.05$) and to 20% by 12th grade ($p<0.05$, Table 2). The mean percentage of students in each grade who were estimated to take PE also decreased significantly with grade ($p<0.05$), from nearly all (91%) in 8th grade to less than two thirds (62%) in 10th grade, to one third (34%) by 12th grade. The mean number of days per week that students have PE, among those who took PE classes, differ very little by grade; however, there was some difference between 8th (3.8 days/week) and 10th graders (4.2 days/week, $p<0.05$), but not between 8th and 12th (3.9 days/week) or 10th and 12th grades (Table 2). Primarily because of their differential participation rates, the mean number of days per week that students take PE in all schools (not just those with a PE requirement) differ significantly across the three

Table 2. Physical education (PE) and other physical activities in all schools, and by grade level: 2003–2005

	Total	8th	10th	12th	Sig. grade level comparisons
Approx N schools	504	186	166	152	
Approx N students	54,185	19,225	18,933	16,027	
PE participation					
Percentage of students in each grade in schools that require PE in that grade	53.2	86.6	47.4	20.1	8v10, 8v12, 10v12
Mean % of students in each grade that take PE	64.5	91.3	62.9	34.1	8v10, 8v12, 10v12
Mean number of days/week students have PE, among those who take PE in each grade	4.0	3.8	4.2	3.9	8v10
Mean number of days/week that students in each grade have PE in all schools	2.6	3.5	2.7	1.4	8v10, 8v12, 10v12
Mean length of PE classes (in minutes) in each grade[a]	56.6	50.8	60.1	59.5	8v10, 8v12
Mean time students in all schools spend in PE classes (in minutes) per week[a]	145.0	172.3	163.9	88.6	8v12, 10v12
Varsity and intramural sports participation					
Mean % of boys who participate in interscholastic or varsity sports	37.4	36.8	38.6	36.6	
Mean % of girls who participate in interscholastic or varsity sports	33.3	33.5	33.8	32.4	
Mean % of boys who participate in intramural sports or physical activity clubs	19.2	24.0	16.9	15.8	8v12
Mean % of girls who participate in intramural sports or physical activity clubs	16.4	20.5	14.9	13.3	8v12
Walking or biking to school					
Mean % of students who walk or bike from home to school on an average school day	13.7	20.1	12.7	7.3	8v10, 8v12, 10v12
Physical fitness tests					
Percentage of students who attend schools that provide physical fitness tests to at least some students[a]	46.5	63.8	47.3	24.5	8v10, 8v12, 10v12
Percentage of students in schools in which at least some parents are provided with the results of physical fitness tests[a]	25.5	39.6	22.0	12.4	8v10, 8v12

Note: Between-grade differences are indicated in the column "Sig. Grade Level Comparison" by noting the particular grades that differ on the particular variable with a minimum significance level of $p<0.05$.
[a]These questions were asked only in 2004 and 2005, thus the sample sizes are about one third less than the numbers shown.

grades. The average number of days per week that 8th, 10th, and 12th graders have PE was 3.5, 2.7, and 1.4, respectively. For those taking PE, there was also a significant difference among grades in the mean length of an average PE class, this time with shorter classes in middle school; there were significant differences between 8th (50.8 minutes) and 10th (60.1 minutes) grades and between 8th and 12th (59.5 minutes) grades (Table 2). Overall, the average time that American students spend in PE classes (in minutes per week) drops by about half as they pass through secondary school, from 172 minutes in 8th grade to 164 minutes in 10th, down to 89 minutes by 12th grade (the overall drop being significant at $p<0.001$, Table 2).

Sports participation. No significant difference was found between grade levels in the percentage of boys or girls who were estimated to participate in interscholastic or varsity sports. Overall, respondents estimate that 37.4% of boys and 33.3% of girls in these three grades of secondary school participate in varsity sports, with negligible between-grade differences (Table 2).

Considerably fewer students were estimated to participate in intramural sports or physical activity clubs than in varsity sports—on average only about 19% of the boys and 16% of girls in secondary school across the three grades combined. Unlike in varsity sports, there was a decline between middle school and high school in the percentage of both boys and girls who were estimated to participate in intramural sports or physical activity clubs. For example, 24% of boys in 8th grade were estimated to participate in these activities compared with 17% of 10th- and 16% of 12th-grade boys. Similarly, while 21% of girls in 8th grade participate in intramural sports or physical activity clubs, by 10th and 12th grades only 15% and 13%, respectively, did so. (For both genders the 8th- to 12th-grade declines were statistically significant at the $p<0.05$ level.) Roughly two thirds of secondary school students were not involved in varsity sports during the school year, and more than 80% were not involved in intramural sports.

Walking or biking to school. Walking or biking to school represents another school-related activity from which students might derive an appreciable amount of exercise. However, the school administrator respondents estimate that only about one in seven (14%) of second-

ary school students walk or bike to school. While 20% do so in 8th grade, this proportion declines by nearly two thirds to 7% by 12th grade ($p<0.05$, Table 2).

Physical fitness tests. A fair proportion of secondary school students—roughly half on average (47%)—attend schools that provide physical fitness tests to at least some of their students. There was a significant decline with grade level, with the proportion attending such schools falling from 64% in 8th grade to 25% in 12th ($p<0.05$, Table 2). The percentage of students in schools in which at least some parents were provided with the results of fitness tests was even smaller (26% on average) and declines with grade level—40% in 8th grade versus only 12% by 12th grade ($p<0.05$, Table 2).

Differences Among Racial/Ethnic Groups

Physical education. Among 8th graders, a lower percentage of Hispanic students (75.9%) than white students (89.3%) attend schools that require PE ($p<0.05$). Among 8th and 12th graders, the estimated percentage of students who take PE was lower in schools attended by Hispanic students than in those attended by white students (Table 3). There were no significant racial/ethnic differences in mean number of days/week that students have PE, nor in mean length of PE classes.

Sports participation. Rates of participation in interscholastic or varsity sports were significantly higher in schools attended by white students than those attended by black and Hispanic students (Table 3 and Figure 1). No significant differences between these groups were observed in the participation rates in intramural sports or physical activity clubs.

Walking or biking to school. The percentage of students estimated to walk or bike from home to school on an average school day was higher in schools attended by black and Hispanic students as opposed to those attended by white students across all three grades. Hispanics have the highest observed rates in all three grades (significantly higher than whites in grades 8 and 10, and across all three grades combined), and blacks were higher than whites in all three grades (although significantly so only in grade 10 and across all three grades combined). The differences at 12th grade were consistent with those at the lower grades, but not substantially, as the rates of walking or biking to school were quite low for all groups.

Physical fitness tests. Across the three grades combined, no racial/ethnic differences were observed in the percentage of students who attend schools that provide physical fitness tests to at least some of their students. In 8th and 12th grades, a slightly higher proportion of blacks than whites attend such schools (not significant), while at 10th grade a somewhat lower proportion of blacks do ($p<0.05$, Table 3). The inconsistencies in the results across grades suggest that the differences may be due to sample fluctuations. Summing across all schools, there were no significant differences in the percentage of white, black, and Hispanic students who attended schools that provide their parents with the results of fitness tests. However, among 8th and 12th graders, a higher percentage of black than Hispanic students attend such schools ($p<0.05$), whereas in 10th grade blacks have the lowest rate of the three groups (not significant, Table 3).

Differences in SES

Physical education. Summing across all schools, there was a significant positive linear association between student SES and the mean percentage of students who were required to take PE ($p<0.01$) and who actually take PE ($p<0.05$, Table 4). These variables were also positively associated with SES at each grade level, but the associations were not statistically significant. (The differences across SES strata, while generally ordinal, were not large.) There was no significant linear association, however, between student SES and mean time per student spent (among all students) in PE classes per week in their school, at any of the three grade levels or summing across grades (Table 4).

Sports participation. Based on all three grades combined, there was a highly significant positive linear association between SES and the estimated percentage of male students participating in varsity sports ($p<0.001$), as well as in the estimated percentage of female students ($p<0.001$, Table 4 and Figure 2). These positive linear associations were also significant at 8th and 10th grades specifically, but not at 12th grade where the trend was less steep. Similarly, there was a significant positive linear association between SES and the mean percentages of both boys and girls estimated to participate in intramural sports or physical activity clubs ($p<0.001$ for all three grades combined for each gender, Table 4 and Figure 2). For boys, these linear associations were statistically significant only at 12th grade, and for girls they were significant at 8th and 12th grade.

Walking or biking to school. There was a negative linear association between SES and the estimated proportion of students in the school who walk or bike to school ($p<0.01$). Nearly all of that association was due to the lowest SES stratum having an appreciably higher rate than the other four strata. Given that minorities have a higher rate of walking or bicycling to school than whites, the question of whether this SES difference reflects a racial/ethnic effect is addressed in the multivariate analyses presented below.

Physical fitness testing. Finally, no significant linear association was observed between SES and attending

Table 3. Physical education (PE) and other physical activities by student race/ethnicity: 2003–2005

	Student race/ethnicity				Significant racial/ethnic comparison
	White	Black	Hispanic	Other	
Approx N total	36,450	6,744	5,247	5,743	
Approx N 8th	12,568	2,285	1,810	2,563	
Approx N 10th	12,277	2,778	2,032	1,845	
Approx N 12th	11,605	1,681	1,405	1,336	
PE participation					
Percent of students in each grade in schools that require PE in that grade					
Total	53.6	48.9	48.6	60.1	
8th	89.3	81.0	75.9	86.3	WH
10th	48.7	37.7	48.4	52.5	
12th	20.3	23.7	13.7	20.5	
Mean % of students in each grade that take PE					
Total	64.7	61.7	60.5	70.0	
8th	93.1	88.5	82.4	91.3	WH
10th	63.2	58.0	64.9	66.7	
12th	35.5	31.6	26.0	33.8	WH
Mean number of days/week students have PE, among those who take PE in each grade					
Total	3.9	4.2	4.2	4.1	
8th	3.8	3.8	4.1	4.0	
10th	4.2	4.4	4.4	4.2	
12th	3.9	4.2	4.1	4.0	
Mean number of days/week that students in each grade have PE in **all** schools					
Total	2.6	2.6	2.6	2.9	
8th	3.5	3.4	3.3	3.6	
10th	2.7	2.6	3.0	2.9	
12th	1.4	1.5	1.1	1.4	
Mean length of PE classes (in minutes) in each grade[a]					
Total	56.3	60.5	55.8	55.5	
8th	49.9	55.1	52.2	51.5	
10th	60.2	61.7	58.3	58.9	
12th	59.1	64.5	57.8	58.3	
Mean time students in **all** schools spend in PE classes (in minutes) per week[a]					
Total	142.4	147.2	147.0	156.8	
8th	171.5	181.2	162.5	177.0	
10th	166.2	148.6	161.5	171.6	
12th	85.4	108.0	91.8	91.3	
Varsity and intramural sports participation					
Mean % of boys who participate in interscholastic or varsity sports					
Total	39.9	31.4	30.3	34.5	WB, WH
8th	40.4	27.6	26.8	33.9	WB, WH
10th	40.5	33.8	35.2	37.1	WB
12th	38.7	32.4	27.4	32.4	WB, WH
Mean % of girls who participate in interscholastic or varsity sports					
Total	36.0	25.3	26.3	31.5	WB, WH
8th	37.3	22.7	23.6	31.1	WB, WH
10th	36.2	25.6	30.4	34.2	WB, WH
12th	34.4	28.3	23.8	28.5	WB, WH
Mean % of boys who participate in intramural sports or physical activity clubs					
Total	19.2	19.9	18.2	19.0	
8th	24.3	20.8	26.0	23.5	
10th	16.9	19.9	14.5	15.8	
12th	15.9	18.8	12.5	14.2	
Mean % of girls who participate in intramural sports or physical activity clubs					
Total	16.8	15.7	15.1	16.3	
8th	21.3	16.3	21.2	20.2	
10th	15.2	16.2	12.3	13.5	
12th	13.5	14.1	10.9	12.2	

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Table 3. (*continued*)

	Student race/ethnicity				Significant racial/ethnic comparison
	White	Black	Hispanic	Other	
Walking or biking to school					
Mean % of students who walk or bike from home to school on an average school day					
Total	10.5	17.1	24.7	20.6	WB, WH
8th	16.4	24.7	31.4	26.5	WH
10th	8.3	15.6	29.3	19.4	WB, WH, BH
12th	6.3	9.1	9.8	11.3	
Physical fitness tests					
Percent of students who attend schools that provide physical fitness tests to at least some students[a]					
Total	47.0	44.5	42.0	49.0	
8th	63.7	74.5	58.9	60.4	
10th	51.3	32.6	39.1	49.1	WB
12th	24.2	31.3	16.8	25.0	
Percent of students in schools in which at least some parents are provided with the results of physical fitness tests[a]					
Total	25.6	25.2	19.0	29.9	
8th	39.8	47.8	27.8	40.9	BH
10th	24.2	11.0	17.3	26.7	
12th	11.5	23.7	6.2	12.1	BH

Note: Between-race/ethnicity differences are indicated in the column "Significant racial/ethnic comparison" with a minimum significance level of $p<0.05$.
BH, black–Hispanic; WB, white–black; WH, white–Hispanic.

schools that provide physical fitness tests to at least some students, or between SES and the percentage of students in schools where at least some parents were provided with the results of these physical fitness tests.

Multivariate Analysis

Multivariate analyses were used to examine the three most important outcome variables—average time spent in PE per week, average rate of participation in varsity sports, and average rate of participation in intramural sports or physical activity clubs. For each of these outcomes, three analyses are presented in Tables 5 through 7: the simple bivariate relationships between each of these outcome variables and gender, race/ethnicity, SES, grade level, region, and urbanicity. Model 1 then presents the first four of those variables regressed against each outcome, while the full model adds region and urbanicity to the set. The obvious objective was to estimate the effect of each predictor variable while controlling simultaneously for the others.

Physical education. Table 5 presents regression results for mean time per student spent in PE classes. The only significant association was with grade level. As shown in Table 2, 12th graders averaged significantly lower in mean time spent in PE classes than 8th graders. The strength of that association was not affected by the

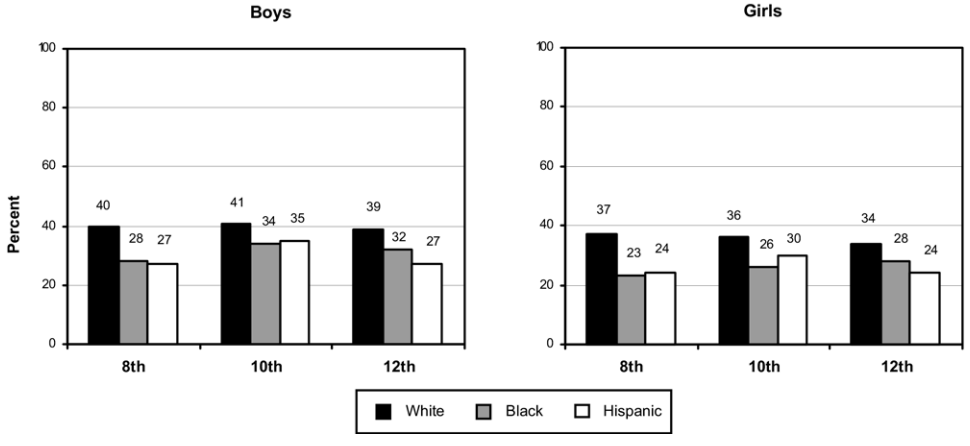

Figure 1. Varsity sports: average percentage of students reported to be participating, by grade, gender, and race/ethnicity of the student.

Table 4. Physical education (PE) and other physical activities by student SES: 2003–2005

	Student SES						Significant linear association
	1 (Low)	2	3	4	5 (High)	b	
Approx N total	4,151	12,369	14,507	14,944	8,214		
Approx N 8th	1,459	4,331	4,725	5,543	3,168		
Approx N 10th	1,541	4,180	5,105	5,260	2,848		
Approx N 12th	1,152	3,859	4,678	4,141	2,198		
PE participation							
Percentage of students in each grade in schools that require PE in that grade							
Total	49.6	51.8	50.2	55.2	59.2	2.33	**
8th	84.4	86.2	85.5	86.8	89.7	1.06	
10th	39.4	45.1	46.9	49.4	52.3	2.76	
12th	19.1	20.5	18.1	20.2	24.1	0.89	
Mean % of students in each grade that take PE							
Total	62.4	63.3	62.2	66.2	68.3	1.59	*
8th	89.8	91.0	90.6	91.7	93.0	0.66	
10th	59.0	60.9	62.8	64.4	65.6	1.64	
12th	32.0	34.9	32.8	34.4	36.1	0.53	
Mean number of days/week students have PE, among those who take PE in each grade							
Total	4.2	4.0	4.0	4.0	3.9	−0.06	
8th	3.9	3.8	3.8	3.9	3.8	−0.01	
10th	4.4	4.3	4.3	4.2	4.1	−0.08	
12th	4.3	4.0	4.0	3.9	3.8	−0.11	*
Mean number of days/week that students in each grade have PE in **all** schools							
Total	2.6	2.6	2.5	2.6	2.7	0.02	
8th	3.5	3.4	3.5	3.5	3.5	−0.002	
10th	2.7	2.7	2.8	2.8	2.7	0.02	
12th	1.4	1.5	1.4	1.4	1.4	−0.03	
Mean length of PE classes (in minutes) in each grade[a]							
Total	57.0	57.2	57.4	56.6	54.3	−0.68	
8th	52.1	52.0	51.3	49.8	49.5	−0.83	*
10th	59.5	59.5	60.1	61.7	58.1	0.04	
12th	60.3	60.8	60.9	58.8	55.8	−1.28	
Mean time students in **all** schools spend in PE classes (in minutes) per week[a]							
Total	144.6	144.7	145.7	146.9	141.1	−0.41	
8th	178.0	173.4	174.9	170.6	167.1	−2.32	
10th	143.9	161.1	168.5	170.3	158.3	2.68	
12th	99.9	93.5	88.1	85.6	81.4	−4.20	
Varsity and intramural sports participation							
Mean % of boys who participate in interscholastic or varsity sports							
Total	31.7	35.9	37.1	39.1	39.7	1.73	***
8th	29.7	35.5	36.6	38.7	38.8	1.83	*
10th	34.9	36.5	37.8	40.3	42.3	1.89	**
12th	30.1	35.8	37.0	38.2	37.7	1.41	
Mean % of girls who participate in interscholastic or varsity sports							
Total	27.4	31.9	33.0	35.0	35.6	1.75	***
8th	26.1	32.0	33.1	35.6	35.9	2.01	**
10th	29.2	31.6	33.0	35.7	38.0	2.17	***
12th	26.7	32.1	33.1	33.5	32.1	0.85	
Mean % of boys who participate in intramural sports or physical activity clubs							
Total	16.8	16.8	18.5	20.4	22.8	1.70	***
8th	20.7	20.3	22.6	25.8	29.2	2.53	**
10th	15.7	15.4	17.1	17.9	17.9	0.79	
12th	13.2	14.4	15.8	16.2	19.1	1.33	

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Table 4. (*continued*)

	Student SES						
	1 (Low)	2	3	4	5 (High)	b	Significant linear association
Mean % of girls who participate in intramural sports or physical activity clubs							
Total	13.8	14.3	15.9	17.9	19.4	1.57	***
8th	16.8	17.5	19.5	22.4	24.6	2.19	**
10th	13.3	13.4	14.9	16.0	15.8	0.85	
12th	10.7	11.8	13.2	13.9	16.1	1.29	*
Walking or biking to school							
Mean % of students who walk or bike from home to school on an average school day							
Total	21.4	13.7	13.0	12.9	12.8	−1.23	**
8th	26.9	19.8	19.5	19.9	18.6	−1.06	
10th	24.5	12.9	12.0	10.6	11.1	−2.17	*
12th	10.5	7.7	7.5	6.3	6.6	−0.78	
Physical fitness tests							
Percentage of students who attend schools that provide physical fitness tests to at least some students[a]							
Total	43.9	48.9	46.8	45.3	46.2	−0.43	
8th	64.0	65.0	67.1	60.9	61.9	−1.23	
10th	36.7	49.5	48.8	47.6	46.4	0.69	
12th	26.3	29.2	22.8	21.9	23.8	−1.71	
Percentage of students in schools in which at least some parents are provided with the results of physical fitness tests[a]							
Total	21.2	26.2	24.7	25.1	28.4	0.94	
8th	33.2	39.5	40.5	37.7	44.2	1.40	
10th	14.0	22.1	21.3	23.5	24.0	1.65	
12th	14.5	14.9	11.7	10.7	12.0	−1.11	

Note: The column labeled "b" refers to the unstandardized regression coefficient obtained from the OLS regression analyses that were utilized to determine if a linear association exists between SES and each of the physical education and other physical activity variables. Significance of regression coefficients is indicated with asterisks in the column "Significant linear association".
*$p<0.05$, **$p<0.01$, ***$p<0.001$.

introduction of any of the other variables included in the full model.

Varsity sports participation. In Table 6, it is noted that black and Hispanic students attend schools where a significantly lower percentage of students participated in varsity sports compared to schools attended by white students. These racial/ethnic differences remained significant and were diminished only modestly after adjusting for SES and grade level. When urbanicity and region were entered into the model, the coefficients for each minority group dropped some, but still remained highly significant. SES was also significantly and positively associated with the level of student participation in interscholastic or varsity sports. In the full model, students who lived in large- and medium-sized cities attended schools with lower varsity sports participation rates than schools in rural areas. Also, students who lived in the Northeast and North Central regions attended schools that had significantly higher varsity sports participation rates than schools in the South, while those in the West had rates not much different from the South (Table 6).

Intramural sports participation. Finally, multivariate prediction of intramural sports participation is provided in Table 7, where it can be seen that high-SES students attend schools where a greater percentage of students participate in intramural sports or physical activity clubs, with the rate of participation increasing about 1.2 percentage points with each step up on the 5-point SES scale, after adjusting for all other variables in the regression. Twelfth graders attended schools where on average there was less participation in these activities than in schools that 8th graders attend—a relationship that was little changed by the inclusion of the other variables in the model. Students who live in the North Central and Western regions attended schools where they were more likely to participate in intramural sports or physical activity clubs than students who live in the South. (The Northeast also shows a higher rate than the South, but the difference does not quite reach the traditional level of significance: $p<0.09$ bivariately and $p<0.10$ multivariately.) Once controls for region and urbanicity were introduced, the lower rate of intramural sports participation by Hispanic students, which was nonsignificant in the bivari-

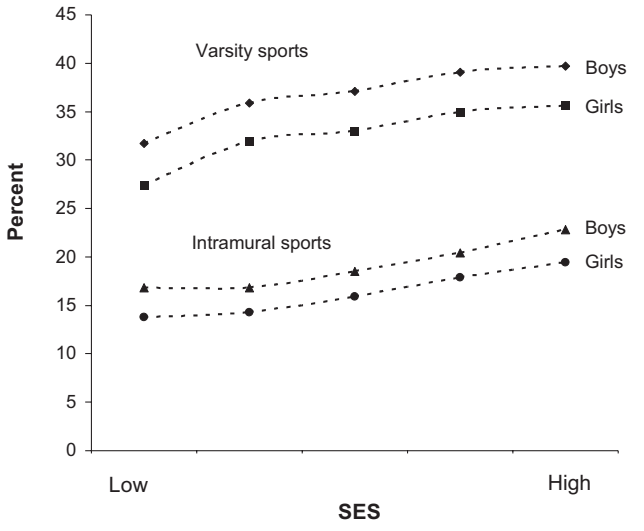

Figure 2. Varsity and intramural sports: average percentage of students in the school reported as participating, by gender and socioeconomic status (SES) of the student.

ate model, became even lower and attained significance in the full model. Apparently, Hispanic students attend schools where sports participation occurs at a lower rate than would be expected, taking into account where they were located geographically.

Table 5. Results of multiple regression analyses predicting mean time per student spent in PE classes (in minutes) per week: 2004–2005

Demographic characteristic	Bivariate	Model 1	Full model
Gender			
Male	Ref	Ref	Ref
Female	2.42	3.28	3.44
Race/ethnicity			
White	Ref	Ref	Ref
Black	4.81	0.58	2.79
Hispanic	4.59	−4.95	−6.50
SES[a]	−0.41	−1.26	−2.03
Grade			
8th	Ref	Ref	Ref
10th	−8.35	−8.68	−10.60
12th	**−83.73*****	**−84.00*****	**−83.85*****
Urbanicity			
Large MSA	10.73		6.55
Other MSA	15.43		17.0
Non-MSA	Ref		Ref
Region			
Northeast	4.22		2.13
North Central	23.63		22.06
South	Ref		Ref
West	23.23		16.10

Note: Data are for 2004 and 2005 only because the question on time spent on PE was not asked in 2003.
[a]SES ranges from 1–5, with higher scores representing higher SES.
*$p<0.05$, **$p<0.01$, ***$p<0.001$.
MSA, metropolitan statistical area; PE, physical education; SES, socioeconomic status.

Table 6. Results of multiple regression analyses predicting mean percent of students who participate in interscholastic or varsity sports: MTF 2003–2005

Demographic characteristic	Bivariate	Model 1	Full model
	β	*β*	*β*
Gender			
Male	Ref	Ref	Ref
Female	−0.87	−0.64	−0.50
Race/ethnicity			
White	Ref	Ref	Ref
Black	**−9.76*****	**−9.46*****	**−6.34*****
Hispanic	**−10.01*****	**−9.09*****	**−5.21*****
SES[a]	**1.81*****	**1.30****	**1.62*****
Grade			
8th	Ref	Ref	Ref
10th	1.40	1.50	1.41
12th	−0.40	−0.61	−0.69
Urbanicity			
Large MSA	−8.65		**−7.64***
Other MSA	−7.07		**−6.60***
Non-MSA	Ref		Ref
Region			
Northeast	**9.31****		**10.20****
North Central	**11.58****		**10.89*****
South	Ref		Ref
West	1.98		3.49

*$p<0.05$, **$p<0.01$, ***$p<0.001$.
[a]SES ranges from 1–5, with higher scores representing higher SES.
MSA, metropolitan statistical area; MTF, Monitoring the Future; SES, socioeconomic status.

Discussion

Physical education in schools. The sharp decline in PE participation between 8th grade and 12th grade—from 91% to 34% participation—should be of serious concern in light of the obesity epidemic affecting the country. More than one third of all students in 10th grade and two thirds of those in 12th, who might be getting regular exercise within the context of the school physical education curriculum, were not. Further, there was no compensatory increase across grades in sports participation that might offset the effects on physical fitness or general well-being.

Summing across all grades, no significant differences exist by race/ethnicity in the proportion who attend schools that require physical education, but among 8th graders specifically, Hispanic youth attended schools in which smaller proportions of students were required to take PE than schools attended by white youth. Lower-SES students were also less likely to have PE required in their schools. It seems likely that their schools have been more affected by budget limitations or a greater need to abandon activities like PE in their pursuit of improved student academic performance. Schools attended by Hispanic students have a significantly smaller percentage actually taking PE in 8th and 12th grades than do those attended by white students, no doubt due

Table 7. Results of multiple regression analyses predicting mean percent of students who participate in intramural or physical activity clubs: MTF 2003–2005

Demographic characteristic	Bivariate	Model 1	Full model
	β	*β*	*β*
Gender			
Male	Ref	Ref	Ref
Female	−0.56	−0.37	−0.29
Race/ethnicity			
White	Ref	Ref	Ref
Black	−0.26	0.25	1.56
Hispanic	−1.44	−0.13	**−3.88*****
SES[a]	**1.63*****	**1.61*****	**1.21*****
Grade			
8th	Ref	Ref	Ref
10th	−6.36	−6.20	−6.38
12th	**−7.37***	**−7.15***	**−6.87***
Urbanicity			
Large MSA	5.67		4.50
Other MSA	4.62		4.10
Non-MSA	Ref		Ref
Region			
Northeast	6.40		5.73
North Central	5.28		**5.29***
South	Ref		Ref
West	**10.78***		**12.31***

[a]SES ranges from 1–5, with higher scores representing higher SES.
*$p<0.05$, **$p<0.01$, ***$p<0.001$.
MSA, metropolitan statistical area; MTF, Monitoring the Future; SES, socioeconomic status.

at least in part to the lower requirements that they do so. Lower SES was also found to be associated with fewer students actually participating in PE, very likely for much the same reason.

Not surprisingly, the average time in minutes per week spent in physical education classes also declines sharply by grade, particularly by 12th grade. Multivariate analyses predicting this outcome variable did not show significant differences associated with any of the other variables in the model, including gender, race/ethnicity, SES, urbanicity, and region (Table 5).

Varsity sports participation. Unlike physical education, participation in interscholastic or varsity sports does not show a decline at higher grade levels for either gender, but it does not show any increase either. Some 37% of male American secondary school students participate in varsity sports in all three grades combined, based on the estimates provided by school administrators. Females average slightly lower overall by about four percentage points, although this difference does not show as statistically significant in the multivariate analyses. What was most impressive was how close the genders were in their rates of varsity sports participation, likely as a result of the effects of Title IX of the Education Amendments of 1972 to the Civil Rights Act of 1964.

Things were less equivalent, however, when differences in sports participation were examined relative to race/ethnicity. Black and Hispanic students, who were at higher risk of being overweight on average, attended schools that have lower rates of varsity sports participation than those that white students attend, a finding that holds for both genders and at all three grades. The differences were quite substantial and remained highly significant, although somewhat diminished, in the multivariate analysis in which other variables were controlled. Those analyses also revealed significant differences in sports participation related to region of the country, urbanicity, and SES, all of which were correlated with race/ethnicity. Contrary to what some may have thought, given the climate difference among them, the Northeast and the North Central turned out to have higher reported rates of varsity sports participation than the South and the West.

Lower-SES students, who are at higher risk for obesity on average, attend schools with the lowest rates of participation in varsity sports (Table 4). Such participation was significantly positively related to SES, even after controlling for other variables, including race/ethnicity. These findings are consistent with the fact that most of these sports require the appropriate facilities (e.g., a swimming pool, football field), personnel, equipment, parental involvement, and travel, all of which may be more affordable to families of higher SES and schools with a higher tax base. Also, it is possible that students of higher SES have the resources to attend schools, especially private schools, or to live in school districts that provide more opportunities for their involvement in interscholastic sports. Prior research has found that a significantly higher percentage of boys and girls were physically active when schools provided students with adequate space, facilities, equipment, and adult supervision[28] and when parents were available to provide youth with encouragement and transportation to attend these activities.[29] It is also possible that less-privileged students lack the means to pay out-of-pocket costs or parental subsidies that may be required to participate on sports teams. School districts and states could as a matter of policy choose to cover such charges for students unable to pay them.

Intramural sports participation. Intramural sports were reported to have considerably lower rates of student participation overall than varsity sports, and unlike the latter, they showed a substantial drop in the participation rate between middle school and high school. In 8th grade, the rates of participation in intramural sports or physical activity clubs during the year were estimated at 24% and 21%, respectively, for boys and girls, indicating that this form of sport may play an important role in providing exercise in middle school; but by 12th grade the rates had fallen to 16% and 13%. The large racial/ethnic differences seen in varsity sports were not observed in intramural sports in the bivariate analyses, but Hispanic students did have a

somewhat lower-than-expected rate of participation than white students in the multivariate model ($p<0.001$), after controlling for things such as grade, region, urbanicity, and SES. As was true for varsity sports, there was a significant positive linear association between SES and the percentage of youth in the school who participated in intramural sports. In the multivariate analyses, the magnitude of the association was attenuated, but remained significant. It is not clear whether this finding means that youth of higher SES have more opportunities for intramural sports presented by their schools, or whether they are more able or willing to take advantage of opportunities than low-SES youth. Possibly both are true, but either way, the outcome was that low-SES students are getting less exercise not only from their lower participation in varsity sports but from their lower participation in PE and in intramural sports as well.

Overall, relatively few students were involved in these extracurricular activities. Averaging across the three grades, less than 38% were estimated to participate in varsity sports at any time during the school year and less than 19% in intramural sports or physical activity clubs. This suggests that roughly half of all secondary students in the country could benefit from the improved cardiovascular fitness and increased calorie expenditure that would result from increased sports participation,[30,31] protective factors against the risk of developing metabolic syndrome and cardiovascular diseases in later years. Increasing participation in physical activities is important for all students, particularly given the upward trends in overweight among American youth generally. Particular attention should be paid to factors that can help increase participation by black and Hispanic students, and students of lower SES, because they represent populations with higher-than-average risk for overweight and the associated medical complications.

Further contributing to the lack of physical activity is the fact that the percentage of students who walk or bike to school on an average day decreases significantly with grade level, from a rather low level of 20% in 8th grade to only 7% by 12th. The decline with age was not unexpected, as high school students on average probably live farther from the school than middle school students, given the larger geographic area that high schools serve, and thus may be more likely to take a school bus or be driven to school. Also, more of them own their own motor vehicles and can drive themselves to school, which may account for the further decline between 10th and 12th grade. Clearly, getting to and from school is no longer an important source of exercise for students. There has, however, been a movement toward encouraging walking and biking to school, which deals with various aspects of the problem from community design to safety.[32] From a health perspective, it is encouraging to see that a greater percentage of black and Hispanic students and students of lower-SES backgrounds walk or bike from home to school, but the overall percentages are still sufficiently modest, so that the benefits reach a quarter or less of these groups. Further, how much exercise these commutes actually entail is not known; some may be very short, such as those in dense urban environments.

Finally, the findings regarding physical fitness tests show that while nearly half (47%) of all students at 8th grade were in schools that conduct at least some physical fitness tests, the prevalence declined sharply thereafter, reaching only 24% by 12th grade. These declines in testing were expected given the decline in PE rates across grades, as testing is likely to take place within the context of PE classes. Even fewer students were in schools where the PE test results were shared with parents. Whether the implementation of physical fitness tests and the communication of these results to parents will result in increased physical activity and a subsequent reduction in body mass index (BMI) among students is an empirical question that remains to be answered. What can be said at present is that the application of this approach is quite limited.

Limitations. As is true for most studies, this study has limitations that should be kept in mind when interpreting the findings. The data were based on the responses from school administrators (mostly principals) or other school staff members who completed a self-administered questionnaire, so there is the possibility of errors in reporting due to lack of knowledge, misunderstanding, and social desirability bias. Some of the information requested may have been derived from records, but much of it is likely based on their best estimates. To minimize some of these errors, research staff recontacted those participants who provided incomplete or inconsistent answers by phone or letter in order to clarify or complete the information requested. Because the questions were generally straightforward, because the answers generally should be known to the respondents, and because the subjects tended to be responsible and educated people who take their task seriously, these data are believed to be largely valid. Confidence in the validity of the data is further enhanced by preliminary analyses that suggest that a reasonable level of agreement exists between what the school respondent reports about the rates of sports participation by students and what students in the same schools report about their own level of participation in school athletics. To be specific, the estimated percentage of boys participating in varsity sports during the school year correlated between 0.44 and 0.64, depending on grade level, with aggregate students' self-reports of the extent to which they participated in school athletic teams during the school year. (The student question did not differentiate varsity from intramural teams, which would reduce the expected level of correlation.) The comparable numbers with the school

respondent's estimate of the percentage of girls participating in varsity sports were between 0.40 and 0.64. (All correlations were significant at $p<0.001$.)

Although the student sample sizes were large, it was not possible to analyze data for the various Hispanic subgroups separately nor to disaggregate the residual racial/ethnic category of "other." The extent to which the findings of the study apply to racial/ethnic groups not distinguished in the present study is unknown. Finally, some of the differences examined were not statistically significant despite what at times appeared to be large and important differences.

Notwithstanding these limitations, this study includes a large nationally representative sample of schools and of students in them. This permitted the simultaneous examination of both school-level variables and several important student-level characteristics in recent years.

Conclusion

This study documents the large differences that exist across grades and across particular population subgroups in participation in school-based physical activities by American students, whether in terms of their PE participation or their participation in interscholastic or intramural sports. Participation rates in PE and intramural (but not varsity) sports fall sharply with increasing grade level. Black and Hispanic youth, as well as students of lower SES—all of whom were overrepresented among the overweight and obese[5,7,9]—were less likely to participate in varsity and intramural sports than were white students and those of higher SES, respectively. Changing the physical activity levels of students should be a goal that is integrated into larger efforts to develop, test, and implement comprehensive, theoretically based interventions supported by evidence, as some have suggested.[33–35] Insofar as some of the differences observed in school-related exercise levels were the result of disparities in the resources available to the schools that serve higher-risk children, it follows that bringing resources into a more equitable distribution may be a necessary part of the solution to the obesity epidemic among children. The authors intend to extend the present work in at least two directions—by continuing to track these conditions in American schools into future years, in order to assess important changes in school environments that increasingly seem likely to occur, and by extending the analyses of the individual- and school-level measures of exercise and sports participation to determine their relationships with self-reported exercise levels more generally, as well as with BMI and overweight among American adolescents.

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Soft Drink Availability, Contracts, and Revenues in American Secondary Schools

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Background: Soft drinks have been widely available in the nation's schools for some years, but recently, in response to rising concern about the epidemic of obesity among youth, concerns have been raised as to whether they should be available, and if so, under what circumstances. This paper looks at how widespread soft drink availability is at present in schools, as well as the availability of other classes of beverages. Because overweight occurs disproportionately among minorities and those of lower socioeconomic status (SES), this paper also seeks to determine to what extent environmental conditions differ for these students. Differences between middle and high schools are also examined.

Methods: Data for 2004 and 2005 were used from two ongoing United States national surveys: the Youth, Education, and Society (YES) study of school administrators (N=345), and the Monitoring the Future (MTF) study of secondary school students in 8th, 10th, and 12th grades surveyed in those same schools (N=37,543). Data were gathered in YES on the availability of various beverages in schools from vending machines and other venues, as well as about the presence and nature of pouring rights contracts with soft drink bottlers. Data were analyzed in 2006.

Results: The vast majority of high school students today have soft drinks available to them in the school environment both through vending machines (88%) and in the cafeteria at lunch (59%), with middle schools providing somewhat less access. Diet soft drinks are less available, particularly at lunch. Most students (67% in middle and 83% in high school) are in schools that have a contract with a bottler. Revenues to schools generated by soft drink sales are quite modest. Hispanics are most likely to have soft drinks available throughout the school day. The SES of the students correlates negatively with whether the school allows advertising and promotion of soft drinks.

Conclusions: Current school practices regarding soft drink availability, advertising, and sales would seem likely to be contributing to the extent of overweight among American young people, and to some extent to the higher risk faced by Hispanic and lower SES youth.

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Introduction

Increasingly, the appropriateness of the beverage and food industries' commercial presence in schools is being questioned and scrutinized, due largely to concern over the obesity epidemic affecting American youth[1] and the potential contribution of soft drink consumption by students in schools.[2–10] Results of a recent meta-analysis of studies that have examined the effects of soft drink consumption on children's health provide further evidence of the health-damaging effects of these products.[11] The beverage and food industries' commercial presence commonly includes the sale of beverage and food items, advertisements in school classrooms and gyms and during school events, training of teachers, and, in some schools, having access to the student population to conduct market research.[12–14] While the beverage industry does not publish the amount of beverage sales to schools, some have estimated it to be less than 1% of their annual sales.[15] Yet, because annual sales in the United States are currently about $70 billion,[16] that amount is not a negligible sum.

In this school–corporate "partnership," schools are able to generate revenue to help offset some of the budget shortfalls that they have experienced in recent years; some argue that the beverage and food industry takes advantage of schools where resources are most scarce,[17] and such schools are more likely to have students at high risk for obesity. Even the American Beverage Association has acknowledged, by implication, that it may play a role in encouraging unhealthful behavior by voluntarily withdrawing soft drink sales from elementary schools, and more recently by with-

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drawing soft drink sales during the school day from middle schools.[18] They argue that high school students are more able to make their own decisions about what to drink and eat. Subsequently, in May of 2006, the Alliance for a Healthier Generation, sponsored by the Clinton Foundation and the American Heart Association, announced an agreement with the American Beverage Association, Coca-Cola, Pepsico, and Cadbury Schweppes, in which the industry agreed to implement a number of changes in the beverage offerings in American schools. A key provision of that agreement was a set of guidelines capping the number of calories in beverages in schools at 100 calories per container, "except for certain milks and juices whose nutritional value warrant the high number of calories . . ."[19] Under the terms of the agreement, the industry "will work to spread these standards to 75% of the nation's schools prior to the beginning of the 2008–2009 school year . . . and will strive to fully implement these guidelines prior to the beginning of the 2009–2010 school year."[19]

The guidelines are most restrictive for elementary schools (only water, 8-oz. calorie-capped servings of certain juices without added sweeteners, and lowfat milk may be sold); followed by middle schools (the same as elementary schools, except that the allowable serving size is 10 oz.); and then high schools (the same as middle schools, except that other low-calorie and no-calorie drinks, including diet soft drinks, may be sold, plus sports drinks and light juices in up-to-12-oz. containers, as long as they contain no more than 100 calories). Interestingly, much of the legislation introduced in various states regarding the availability of beverages in schools also tends to be more restrictive with elementary schools, followed by middle and high schools.[20]

The Alliance for a Healthier Generation clearly has been working to reduce caloric consumption by removing from the beverage offerings those that are high in calories and that have "empty calories" with little nutritional value. Soft drinks are high on both dimensions, as are fruit juice drinks that are less than 100% fruit juice, and sports drinks. Limiting the fat content of milk, as well as the calories, is also a goal. These goals are consistent with ones recommended by the Beverage Guidance Panel in 2006, which urged movement toward the consumption of beverages with no or few calories.[21]

Clearly, this agreement has the potential to alter the landscape under study here, but whether it in fact will do so remains open to question. Many school districts and individual schools are in the middle of multiyear contracts with bottlers of the various soft drink brands—contracts that may continue to be enforced by the bottlers. Also, some districts and schools may not wish to relinquish the funds derived from beverage contracts. Thus, this paper provides a useful picture of the relevant conditions in American middle schools and high schools immediately prior to when the agreement was reached, and should therefore provide a good "before" measure against which progress toward accomplishing the goals of the agreement can be gauged. Because the Youth, Education, and Society (YES) study is designed as an ongoing series of national surveys, it should be able to provide comparable "after" measures as well.

To acquire a greater understanding of the degree of penetration that the beverage industry has had in schools, this study examines the percent of students whose schools have contracts with soft drink bottlers, the amount of revenue generated by these contracts, the types of related advertising and promotion to which students are exposed in schools, and the extent to which students are given access to various types of beverages. Because black and Hispanic students, as well as low-socioeconomic status (SES) students, have higher observed rates of overweight than majority white students or higher-SES students, respectively,[1,22–25] a reasonable question is whether the nature of the food and beverage environment offered to minority students and/or low-SES students differs in ways that may help to explain some of those differences. Therefore, the extent to which these conditions vary by the students' grade level, racial/ethnic background, and SES are examined here.

The current study extends the work done by the Centers for Disease Control and Prevention (CDC) School Health Policies and Programs Study (SHPPS) in several ways.[14] It is conducted annually, rather than every 6 years; can link school information gathered on schools to student outcome measures; and focuses on the percent of students having various environmental characteristics rather than the number of schools having them.

Methods

Samples and Survey Methods

Nationally representative samples of schools and students from the 2004 and 2005 YES study, funded by the Robert Wood Johnson Foundation (RWJF), and the Monitoring the Future (MTF) study, funded by the National Institute of Drug Abuse (NIDA) were used. Data were analyzed in 2006.

Both studies were conducted at the University of Michigan's Institute for Social Research. The schools selected to be surveyed in YES came from the national samples of schools in grades 8, 10, and 12, cycling out of the MTF student surveys conducted in 2004 and 2005. At each grade, an independent sample of schools, drawn with probability proportionate to school size, originally had been selected to participate for 2 years in the MTF study. The design and methods for the MTF project are summarized briefly; a detailed description is available elsewhere.[26] At each of the three grade levels, a multistage sampling design was used to obtain nationally

representative samples of students in both public and private schools from the 48 contiguous states. Data have been collected annually from 12th graders since 1975 and from 8th and 10th graders since 1991. The stratified random sampling procedure involved three stages[27]: (1) geographic regions were selected; (2) schools were selected within region with probability proportional to the estimated number of students in the target grade (approximately 420 schools each year total); and (3) students were selected within schools, usually by means of randomly selecting whole classrooms (between 42,000 and 49,000 students per year across grades). Sample weights were assigned to each student to take into account variations in selection probabilities. The half-samples being recruited for the first time each year, as well as the half-samples participating in their second year were nationally representative replicate samples.

School administrator data for the current study came from questionnaires in 345 schools studied in the 2004 and 2005 half-samples participating in their second year of MTF data collection, in which random samples of over 37,000 students also were surveyed. As a part of the MTF study, students in the same schools completed a self-administered, machine-readable questionnaire during a normal class period. School administrator response rates averaged 85%, while student response rates averaged 90%, 86%, and 84% for grades 8, 10, and 12, respectively. Absence on the day of data collection was the primary reason that students were missed; it is estimated that less than 1% of students refused to complete the questionnaire. Combined across grades, the student sample is 69% white, 11% black, 9% Hispanic, and 11% from other racial/ethnic backgrounds.

Measures

School administrator data. School administrators completed a self-administered questionnaire containing questions related to student levels of physical activity, school and district policies concerning contracts with soft drink bottlers, and detailed questions about the types of foods and beverages available to students. For one section of the questionnaire, it was recommended that a person other than the school administrator (in particular, the food services manager) answer if they would be more likely to know the relevant information. Over 85% of respondents were school administrators (mostly school principals or vice-principals), followed by teachers and other school personnel.

One section of the questionnaire dealt with the types of foods and beverages made available to students in vending machines (including when in the day they were available), in à la carte offerings at lunch, and in the standard school lunch menu. This section was answered by the food service manager or other food worker in 73% of the schools. In the remaining schools, the principal usually answered these questions.

Respondents were also asked whether their schools had contracts with specific soft drink bottlers. Those who responded affirmatively were then asked five questions intended to provide details about the types of contracts: whether the contract was with the individual school or the school district, whether the school received a specified percentage of sales, whether the school received incentives with increased sales, whether the soft drink was advertised on school grounds or during school events, and approximately how much revenue was generated for the school each year through soft drink sales.

Respondents were then asked the source of the revenue sales—(1) vending machines, (2) school/student stores, (3) snack bars/carts, or (4) à la carte sales in the cafeteria. The type of advertising and promotion allowed in the school was also measured. Student access to various beverages through vending machines was determined using a set of questions about whether each class of beverage was available to students from vending machines and, if so, at what times of day. For each beverage class the respondent indicated as being offered in vending machines, he or she was asked to indicate when it was available. Finally, respondents were asked if, during a typical week, the same beverages listed earlier were offered at lunch to students as à la carte selections in the cafeteria (not necessarily from vending machines).

Student data. Student data included self-reported grade, gender, racial/ethnic background, and SES (as indicated by parental education). Students were not asked directly about their beverage consumption. For racial/ethnic background, students were asked "How do you describe yourself?", with students coded as white, black, Hispanic, or other background. (Other racial/ethnic groups provided too few cases to yield reliable estimates.) Parent education (a proxy for SES), an average of father's and mother's educational attainment (with one missing data case permitted), was coded as follows: 1=completed grade school or less, 2=some high school, 3=completed high school, 4=some college, 5=completed college, 6=graduate or professional school after college. Grade refers to the grade in which the student was enrolled. Data for 10th and 12th graders were combined to increase the sample size of high schools available for analyses.

Data Analysis

One major analytic objective was to determine how different the beverage environment was for students (1) in middle schools versus high schools, (2) from different racial/ethnic groups, and (3) of different socioeconomic levels (indicated by level of parental education). Therefore, separate estimates of percents and median values were made for these subgroups at the middle and high school levels. In calculating the overall national averages for students at each grade level, the data from each school administrator were weighted by the (weighted) number of students that were surveyed in that school as part of the national MTF sample of students in the relevant grade. This assures that large schools are weighted more heavily than small schools, because they serve a larger number of students. Separate estimates were made at the middle school and high school levels for subgroups based on race/ethnicity and SES. In the calculation of a value for a subgroup, for example, the proportion of black students in schools that have a beverage contract, each school administrator's answer was weighted according to the (weighted) number of black students who were surveyed in that school as part of the national MTF sample. Thus, schools that serve a larger number and proportion of black students would weigh in more heavily in the overall national estimate for blacks than other schools.

Chi-square and Wilcoxon rank-sum test statistics were used to determine whether the percents and medians vary accord-

Table 1. Food and beverage contracts in grade 8 and in grades 10 and 12 combined: 2004–2005

	8th	10th & 12th	Sig. 8th vs 10th & 12th comparison
Approx N Schools	126	219	
Approx N Students	13,367	24,176	
A. Soft drink contracts			
Percentage of students in **schools or districts** that have a contract with a soft drink bottler	67.0	83.0	**
Percentage of students by source of contract:			
School only	22.8	36.1	*
District only	27.7	25.3	
Both, school & district	16.5	21.6	
B. Overall beverages and food revenues			
Percentage of students in **schools or districts** that receive a specified % of the soft drink receipts	57.1	74.2	**
Percentage of students in **schools or districts** that receive incentives once total soft drink receipts exceed a specified amount	24.5	31.3	
Median revenue **schools** get from soft drink sales per year ($)	500.0	6000.0	***
Median revenue **schools** get **per student** from soft drink sales per year ($)	0.70	6.48	**
Percentage of students in **schools** that receive revenue from foods and/or beverages sold in:			
Vending machines	75.7	95.4	***
School/student store	24.6	33.0	
Snack bars/carts	18.2	24.5	
Á la carte sales in cafeteria	32.9	33.9	
Percentage of students in **school districts** that receive revenue from foods and/or beverages sold in the following locations:[a]			
Vending machines	41.5	42.9	
School/student store	3.7	7.9	
Snack bars/carts	11.5	16.2	
À la carte sales in cafeteria	49.2	54.4	
C. Advertising/promotion in schools			
Percent of students in **schools** that allow the soft drink bottler to advertise in the school building, school grounds, or school buses	7.3	21.0	***
Percent of students in **schools** that advertise or promote meals from fast-food restaurants or soft drinks with:			
Posters or other materials on display in the school	2.2	7.4	*
Ads on textbook covers or school food service menus	5.0	3.8	
Coupons for free or reduced-price products	11.1	17.1	
Sponsorship of school events	14.9	23.4	
D. Availability of beverages			
Percent of students in **schools** that offer the following beverages in **vending machines throughout the day:**[b]			
Diet soft drinks[c]	6.1	21.8	***
Bottled water	17.7	47.1	***
1% or skim milk	2.7	12.3	**
100% fruit or vegetable juice	5.5	25.1	***
Regular soft drinks[d]	9.5	22.9	**
Whole or 2% milk, or flavored milk	4.4	15.8	**
Percent of students in **schools** that offer the following beverages **à la carte in the cafeteria at lunch:**			
Diet soft drinks[c]	8.0	23.7	***
1% or skim milk	71.9	79.3	
100% fruit or vegetable juice	68.6	78.2	**
Regular soft drinks[d]	48.1	59.4	
Whole or 2% milk, or flavored milk	78.3	82.8	
E. Attempts to promote healthier habits			
Mean score on serious/real effort the **school** has made to promote healthy eating and drinking habits among students[e]	3.1	2.9	
Mean score on serious/real effort the **school district** has made to promote healthy eating and drinking habits among students[e]	3.2	2.9	**

(continued on next page)

Table 1. (*continued*)

	8th	10th & 12th	Sig. 8th vs 10th & 12th comparison
Percentage of students in **schools or districts** that have significant activities underway to promote healthier eating and drinking practices among students	48.5	46.3	

Note: Between-grade differences are indicated with asterisks in the column "Sig. 8th vs 10th & 12th comparison."
[a]Data are based on 2005 data only because this question differs considerably from the one asked in 2004.
[b]The number of occasions that items can be available per day ranges from none to four times (all day).
[c]Includes Diet Coca-Cola, Diet Pepsi-Cola, or Diet Dr. Pepper (among others).
[d]Includes Coca-Cola, Pepsi-Cola, or Dr. Pepper (among others), sports drinks that are not 100% juice.
[e]1=Not at all, 2=To a little extent, 3=To some extent, 4=To a great extent, 5=To a very great extent.
*$p<0.05$; **$p<0.01$; ***$p<0.001$.

ing to the students' grade levels (middle versus high) and racial/ethnic backgrounds (white versus black, white versus Hispanic, black versus Hispanic). Multiple regression analysis was used to test the linear association between each of the dependent variables and the five-category measure of parents' education. All analyses included weighted data and took into account design effects in calculating variance estimates using Stata version 8.0.

Results

Because of the considerable amount of information reported in the following tables, and because of their parallel structure, the results in each table are divided into the same five sections: (A) Soft drink contracts, (B) Overall beverages and food revenues, (C) Advertising/promotion in schools, (D) Availability of beverages, and (E) Attempts to improve school environment.

Differences Between Grade Levels

Soft drink contracts. Table 1, Section A shows that the proportion of students in schools or districts that have a contract with a soft drink bottler is significantly higher in high schools (83%) than middle schools (67%) ($p<0.01$). High schools also are somewhat more likely to have a contract directly between the school and the bottler (36% of the students are in such schools) than are middle schools (23%) ($p<0.05$), probably reflecting their larger size on average.

Overall beverage and food revenues. About three quarters of all high school students (74%) attend schools that receive revenues under a pouring rights contract, significantly higher than the proportion of middle school students (57%) (Table 1B). Between one quarter and one third of students attend schools and/or districts that receive incentives once total soft drink receipts exceed a specified amount, with no significant difference by school level. There is a large and significant difference in the median revenue schools get from soft drink sales per year, with high schools receiving a median revenue annually of $6000 and middle schools $500 ($p<0.001$) (Table 1B). The corresponding interquartile ranges (data not shown in the table) for high schools is $14,000 (from $1000 at the 25th percentile to $15,000 at the 75th percentile) and for middle schools it is $4500 (from $0 to $4500, respectively). (The round numbers result because principals tend to answer this question in round numbers and a median value is reported here, not a mean.) On a per-student basis, a considerable difference exists ($6.48 median in high schools versus $0.70 median in middle schools) ($p<0.01$).

Exclusive pouring rights contracts are not the only means by which schools might receive revenue from beverage sales; they may also receive revenues from the foods sold in vending machines. The great majority of secondary school students are in schools that receive revenues from foods *or* beverages sold in vending machines, 76% of those in middle school and 95% of those in high school ($p<0.001$). Many fewer students, about one third, are in middle schools or high schools that receive revenues from à la carte sales in the cafeteria, less from the school/student store (25% and

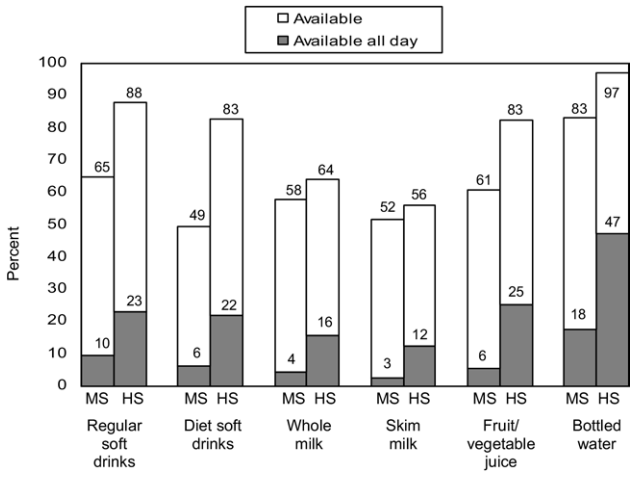

Figure 1. Percent of students who attend schools with different types of beverages available in vending machines at any time, and throughout the day, by grade level.
Note: Percentages are rounded off.
HS, high school; MS, middle school.

Table 2. Percentage of students exposed to various beverages by time of day these beverages are made available to students in schools: 2004–2005

Beverage availability	Regular soft drinks	Diet soft drinks	Whole milk	Skim milk	Fruit and/or vegetable juice	Bottled water
Percentage of students in schools that offer various beverages in vending machines						
8th	64.9	49.4	57.7	51.7	60.8	83.0
10th & 12th	87.9***	82.9***	64.0	56.2	82.6***	97.2***
Percentage of students in schools that offer these beverages in vending machines **at these times:**						
Before classes begin in the morning						
8th	25.3	18.0	30.7	24.1	28.2	40.8
10th & 12th	59.6***	56.8***	42.3	36.4	61.2***	79.1***
During school hours when meals are not being served						
8th	15.7	10.4	6.7	4.1	9.5	25.8
10th & 12th	42.4***	40.9***	21.7***	16.5**	38.3***	63.6***
During school lunch periods						
8th	30.8	16.4	55.7	50.0	54.3	64.5
10th & 12th	47.9**	45.6***	61.1	54.7	69.7**	82.5**
After school						
8th	55.2	45.1	15.3	9.3	19.8	57.3
10th & 12th	76.4***	72.6***	23.8*	18.4**	47.7***	77.4***

Asterisks indicate significant differences by grade level:
*$p<0.05$; **$p<0.01$; ***$p<0.001$.

33%, respectively), or snack bars/carts (18% and 25%), with none of these differences between middle and high schools being significant (Table 1B). The school district may also share in the revenues; about half of secondary school students are in districts that make money on à la carte sales in the cafeteria (49% and 54%) and somewhat fewer (42% and 43%) are in districts that make money from vending machines. Thus, the primary between-grade differences are whether vending machine revenues go to the school and how large those revenues are.

Advertising/promotion in schools. A significantly higher percentage of high school students (21%) than middle school students (7%) attend schools that allow the soft drink bottler to advertise in the school building, school grounds, or school buses, although even the great majority of high schools do not allow such advertising (Table 1C). Of course, a soft drink vending machine is itself usually a highly visible ad.

School administrators were asked whether soft drinks or meals from fast-food restaurants are advertised or promoted by several means. The majority of students are not exposed to most of them. Sponsorship of school events is the most common (23% of high school students and 15% of middle school students; difference not significant) (Table 1C). Advertising through other means (coupons, posters, or ads on textbook covers) reaches only a small minority of students.

Availability of beverages. The great majority of secondary school students attend schools that have soft drinks sold in vending machines—65% of middle school students and 88% of high school students ($p<0.001$) (Figure 1). However, relatively few schools have completely unrestricted access throughout the day to regular soft drinks in vending machines—only 10% of middle school students and 23% of high school students ($p<0.01$) are in schools that do (Table 1D). The corresponding numbers for diet soft drinks are similar (6% and 22%, respectively), likely because both classes of soft drink are located in the same vending machines. Bottled water, on the other hand, is accessible throughout the day through vending machines to only 18% of middle school students but to about half of high school students (47%) ($p<0.001$). All of the beverage classes are significantly less available throughout the day to middle school students compared to high school students, including 1% or skim milk (3% vs 12%, respectively), whole or 2% milk or flavored milk (4% vs 16%), and 100% fruit or vegetable juice (6% vs 25%).

As shown in Table 1D, at lunchtime, when many students make beverage choices, the majority of secondary school students have access to soft drinks in the à la carte offerings in the cafeteria (48% in middle school and 59% in high school), as well as to whole or 2% milk or flavored milk (78% and 83%). Of the various beverages, the lowest availability measured was for diet soft drinks, with middle schools having significantly less access (8% and 24%, $p<0.001$). Modestly higher percentages are observed in high schools for all these classes of beverages, although only fruit and vegetable juices and diet soft drinks reach statistical

significance. (No question was included on the availability of bottled water in the cafeteria.)

Table 2 shows the percentages of students who are in schools offering beverages through vending machines, and more detail on when during the day the different beverages are available. About two thirds (65%) of middle school students attend schools that have vending machines that dispense regular soft drinks versus 88% of high school students ($p<0.001$). Significant proportions attend schools that dispense diet soft drinks (49% and 83%, $p<0.001$). Bottled water is the most widely available beverage from vending machines (83% vs 97% of students have access, $p<0.001$) and 100% fruit or vegetable juice is also widely available (61% vs 83%, $p<0.001$). Whole milk (58% vs 64%) and skim milk (52% vs 56%) are slightly less available (differences by grade not significant). All beverages have lower reported availability in middle schools than in high schools.

Only a minority of students have access to each of these beverages during school hours when meals are not being served (with the one exception of bottled water in high schools, to which nearly two thirds (64%) of students have access) (Table 2). Among high school students, 42% have access to soft drinks in vending machines during this time, and 41% to diet soft drinks, versus only 16% and 10% of middle school students, respectively. During the school day, when meals are not being served, is the period of lowest availability for soft drinks, bottled water, and fruit and vegetable juices. The period of greatest accessibility to soft drinks (55% and 76%) and diet soft drinks (45% and 73%) is after school, again with significantly higher proportions of high school students having access to all beverages. Figure 1 depicts the percentage of students who attend schools with the various beverages available in vending machines at least some time and throughout the day, by grade level.

Attempts to promote healthier habits. Administrators were asked to judge the extent to which the school, and separately the district, had made a serious/real effort to promote healthy eating and drinking habits among students. The average answer for both the school and the district is "to some extent"—the midpoint on the scale (Table 1E). Middle school principals gave a higher rating than high school principals ($p<0.01$ for the district). About half (49% and 46%) of students are in schools or districts that have significant activities currently underway "to promote healthier eating and drinking practices among students."

Racial/Ethnic Differences

Table 3 presents the findings separately for students in the four racial/ethnic subgroups distinguished in this study: whites, blacks, Hispanics, and other racial/ethnic groups. (Pair-wise comparisons of differences did not include the Other category.)

Soft drink contracts. There is no significant difference by race/ethnicity in the percent of youth whose schools or districts have a contract with a soft drink bottler at either the middle school or high school levels (Table 3A).

Overall beverage and food revenues. There are no significant racial/ethnic differences in the percentage of students who are in schools or districts that receive incentives once total soft drink receipts exceed a specified amount (threshold incentives) (Table 3B). However, the estimated median revenue to the school differs considerably among the three groups. Middle schools in which black students are enrolled have a median revenue from soft drink sales estimated at zero, whereas schools in which Hispanics are enrolled have $200 and for whites $1000 (Table 3B). (The black–white difference is significant.) Estimated median revenue on a per-student basis is significantly higher for whites than blacks in both middle and high schools. High schools attended by Hispanic students actually show the highest per-student revenue, but the differences are not significant.

Lower proportions of Hispanic students are in schools and school districts that receive revenues on sales of foods and beverages sold à la carte in the cafeteria. The differences are significant at the district level in both middle schools and high schools and at the school level in high schools. However, Hispanics in high school are significantly more likely than whites to be in school districts that receive revenues from food and beverages sold from snack bars or carts (30% vs. 12%) (Table 3B).

Advertising/promotion in schools. Only a few significant differences exist between racial/ethnic groups for advertising and/or promoting beverages and foods in school, and none are of great importance (Table 3C).

Availability of beverages. Black and Hispanic students generally do not seem to be more likely than whites to be in schools that give access to regular soft drinks sold in vending machines at some time during the day (the only significant difference was the white–black difference among middle school students, showing black students having less availability) (Table 3D). However, Hispanic students appear to have greater access throughout the day to these beverages sold in vending machines, and the black–Hispanic difference reaches significance in middle school, where some 18% of Hispanic students have such access compared to 9% for whites and 6% for blacks (Table 3D). In high school the comparable rates are 32%, 23%, and 16%, all nonsignificant differences.

Attempts to promote healthier habits. Finally, there were no significant differences between the studied

Table 3. School food and beverage contracts by student race/ethnicity: 2004–2005

	Student race/ethnicity				Sig. racial/ ethnic comparison
	White	Black	Hispanic	Other	
Approx N total	25,895	4,113	3,280	4,254	
Approx N 8th	9,002	1,202	1,276	1,887	
Approx N 10th & 12th	16,894	2,911	2,004	2,368	
A. Soft drink contracts					
Percentage of students in **schools or districts** that have a contract with a soft drink bottler					
8th	69.6	56.9	66.0	61.9	
10th & 12th	82.3	82.2	88.0	84.6	
Percentage of students by source of contract:					
School only					
8th	25.4	21.8	19.4	13.8	WH,BH
10th & 12th	38.3	37.2	19.8	32.5	WH,BH
District only					
8th	26.4	23.7	34.2	31.8	WH
10th & 12th	23.5	26.5	34.9	29.0	WH
Both, school & district					
8th	17.9	11.4	12.4	16.3	
10th & 12th	20.5	18.5	33.3	23.2	WH,BH
B. Overall beverages and food revenues					
Percentage of students in **schools or districts** that receive a specified % of the soft drink receipts					
8th	59.4	45.4	59.6	51.8	
10th & 12th	73.1	75.6	78.8	76.8	
Percentage of students in **schools or districts** that receive incentives once total soft drink receipts exceed a specified amount					
8th	25.3	24.8	23.4	21.1	
10th & 12th	31.5	31.3	30.4	30.3	
Median revenue **schools** get from soft drink sales per year ($)					
8th	1000.0	0	200.0	200.0	WB
10th & 12th	6000.0	5000.0	10000.0	7500.0	
Median revenue **schools** get **per student** from soft drink sales per year ($)					
8th	1.54	0.00	0.26	0.26	WB
10th & 12th	6.73	4.81	7.01	6.19	WB
Percentage of students in **schools** that receive revenue from foods and/or beverages sold in:					
Vending machines					
8th	78.8	70.3	72.6	65.8	
10th & 12th	94.7	98.0	96.3	96.9	
School/student store					
8th	24.1	28.0	34.2	18.9	
10th & 12th	31.9	26.5	36.3	46.3	
Snack bars/carts					
8th	18.3	18.3	18.5	17.2	
10th & 12th	22.3	29.1	29.3	29.9	
À la carte sales in cafeteria					
8th	36.1	32.5	28.5	21.3	
10th & 12th	36.7	30.3	21.4	28.0	WH
Percentage of students in **school districts** that receive revenue from foods and/or beverages sold in the following locations:[a]					
Vending machines					
8th	44.7	32.5	32.4	39.5	
10th & 12th	43.2	37.8	46.1	43.3	
School/student store					
8th	3.5	4.3	4.3	4.1	
10th & 12th	8.7	6.8	4.7	6.0	

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Table 3. (*continued*)

	Student race/ethnicity				Sig. racial/ ethnic comparison
	White	**Black**	**Hispanic**	**Other**	
Snack bars/carts					
8th	10.0	7.7	8.5	23.3	
10th & 12th	12.1	18.6	30.1	31.1	WH
À la carte sales in cafeteria					
8th	50.2	63.4	28.3	46.0	WH
10th & 12th	57.1	46.1	42.5	53.1	WH,BH
C. Advertising/promotion in schools					
Percentage of students in **schools** that allow the soft drink bottler to advertise in the school building, school grounds, or school buses					
8th	7.8	6.0	2.7	9.1	WH,BH
10th & 12th	21.5	20.4	24.1	15.7	
Percentage of students in **schools** that advertise or promote meals from fast-food restaurants or soft drinks with:					
Posters or other materials on display in the school					
8th	2.2	2.8	2.1	1.7	
10th & 12th	7.4	8.2	7.1	7.1	
Ads on textbook covers or school food service menus					
8th	3.8	5.5	9.2	7.7	WH
10th & 12th	3.5	3.9	5.8	3.5	
Coupons for free or reduced-price products					
8th	10.5	11.9	17.8	9.2	
10th & 12th	17.8	20.6	10.6	13.1	BH
Sponsorship of school events					
8th	15.6	13.1	15.2	12.3	
10th & 12th	25.0	24.3	17.5	15.8	
D. Availability of beverages					
Percentage of students in **schools** that offer the following beverages in **vending machines at any time in the day:**[b]					
Diet soft drinks[c]					
8th	54.1	45.9	29.9	42.3	WH
10th & 12th	85.9	72.9	76.4	78.7	WB
Bottled water					
8th	86.0	74.6	80.3	75.7	
10th & 12th	97.5	94.4	98.2	97.4	
1% or skim milk					
8th	54.2	55.5	45.7	41.4	
10th & 12th	57.2	52.3	50.7	57.9	
100% fruit or vegetable juice					
8th	62.3	59.6	61.8	53.7	
10th & 12th	82.9	82.9	76.9	85.4	
Regular soft drinks[d]					
8th	69.5	46.9	56.9	60.2	WB
10th & 12th	89.7	82.2	83.7	84.9	
Whole or 2% milk, or flavored milk					
8th	59.5	50.7	59.9	51.7	
10th & 12th	65.2	62.4	55.6	64.8	
Percentage of students in **schools** that offer the following beverages in **vending machines throughout the day:**[b]					
Diet soft drinks[c]					
8th	5.8	3.9	10.5	5.9	
10th & 12th	21.4	15.6	31.9	22.9	
Bottled water					
8th	16.3	17.5	32.2	14.5	
10th & 12th	48.3	39.4	48.3	46.4	
1% or skim milk					
8th	2.8	3.9	2.2	1.3	WH
10th & 12th	14.0	6.8	8.1	10.1	

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Table 3. School food and beverage contracts by student race/ethnicity: 2004–2005 (*continued*)

	Student race/ethnicity				Sig. racial/ ethnic comparison
	White	Black	Hispanic	Other	
100% fruit or vegetable juice					
8th	5.5	4.3	9.7	3.7	
10th & 12th	24.3	24.2	31.2	26.6	
Regular soft drinks[d]					
8th	8.5	6.2	17.6	10.7	BH
10th & 12th	22.9	15.8	32.1	23.6	
Whole or 2% milk, or flavored milk					
8th	4.5	1.4	8.1	2.9	BH
10th & 12th	16.5	12.2	16.2	14.9	
Percentage of students in **schools** that offer the following beverages **à la carte in the cafeteria at lunch:**					
Diet soft drinks[c]					
8th	7.9	14.2	3.3	7.6	WH,BH
10th & 12th	23.2	18.3	26.5	32.0	
1% or skim milk					
8th	71.5	80.1	72.3	68.5	
10th & 12th	80.1	67.4	82.5	85.2	
100% fruit or vegetable juice					
8th	66.4	81.1	76.5	66.3	WB
10th & 12th	78.5	72.2	75.7	84.7	
Regular soft drinks[d]					
8th	49.0	38.1	49.4	49.8	
10th & 12th	59.0	54.1	63.4	64.6	
Whole or 2% milk, or flavored milk					
8th	77.3	80.2	83.3	78.4	
10th & 12th	83.3	86.3	71.3	84.2	
E. Attempts to promote healthier habits					
Mean score on serious/real effort the **school** has made to promote healthy eating and drinking habits among students[e]					
8th	3.0	3.1	3.2	3.1	
10th & 12th	2.9	3.0	2.8	3.1	
Mean score on serious/real effort the **school district** has made to promote healthy eating and drinking habits among students[e]					
8th	3.2	3.2	3.2	3.2	
10th & 12th	2.9	3.0	2.9	3.1	
Percentage of students in **schools or districts** that have significant activities underway to promote healthier eating and drinking practices among students					
Total	45.8	46.6	50.2	53.0	
8th	47.9	44.7	54.2	50.1	
10th & 12th	44.7	47.4	47.7	55.4	

Note: Between-race/ethnicity differences are indicated in the column "Sig. Racial/Ethnic Comparison" where WB=White–Black, WH=White–Hispanic, and BH=Black–Hispanic.
[a]Data are based on 2005 data only because this question differs considerably from the one asked in 2004.
[b]The number of occasions that items can be available per day ranges from none to four times (all day).
[c]Includes Diet Coca-Cola, Diet Pepsi-Cola, or Diet Dr. Pepper (among others).
[d]Includes Coca-Cola, Pepsi-Cola, or Dr. Pepper (among others), sports drinks that are not 100% juice.
[e]1=Not at all, 2=To a little extent, 3=To some extent, 4=To a great extent, 5=To a very great extent.

racial/ethnic groups on the effort that schools or school districts have made to promote healthy eating and drinking habits among students. Nor are there significant differences in the percent of students in schools or districts that "currently have significant activities underway to promote healthier eating and drinking practices among students" (Table 3E).

Overall, the situation is quite similar for the three racial/ethnic groups under study. About equal proportions are in schools that have pouring rights contracts, that receive revenues from those contracts, or that have incentives for achieving certain thresholds in sales. One difference is that the median revenues, and per-student revenues, that middle schools receive from soft drink sales differ significantly: White students attend schools with higher revenues than schools attended by black students. A similar significant difference occurs for per-student revenue in high schools.

Socioeconomic Differences

Soft drink contracts. Differences as a function of SES are detailed in Table 4, where differences across a five-category scale based on parental education are tested for a linear association that is significantly different from zero. No significant linear association is found between student SES and the percent of students in schools or districts that have a contract with a soft drink bottler, although the very top stratum has the lowest rate in both middle and high schools (Table 4A). At the high school level, a significant negative association exists between SES and the proportion of students in schools where both the school and the district are party to the soft drink contract ($p<0.01$).

Overall beverage and food revenues. There was only one significant association in relation to beverage and food revenues: A positive association exists between SES and the percent of students in middle schools that receive revenues from foods and/or beverages sold in à la carte sales in the cafeteria ($p<0.05$) (Table 4B). A similar relationship exists at the high school level that falls just short of significance ($p<0.06$).

Advertising/promotion in schools. The percent of students in schools that allow the soft drink bottler to advertise in the school building, school grounds, or school buses is inversely related to SES, with the largest differences existing in high schools ($p<0.001$), where 29% of students in the lowest stratum are exposed to such advertising versus 13% of students in the highest stratum (Table 4C). The most prevalent forms of advertising and promotion in the schools of soft drinks, or meals from fast-food restaurants, are sponsorship of school events and the distribution of coupons for free or reduced-price products (Table 4C). Sponsorship of school events occurs with greater frequency in schools attended by low-SES students ($p<0.05$); and when data for all schools are combined (tabular data not shown), a significant negative association with SES is observed ($p<0.01$).

Availability of beverages. Among both middle and high school students, higher SES is generally associated with greater access to a number of beverages in vending machines. Student SES is positively associated with being in schools that give greater access to 1% or skim milk (among middle schools, $p=0.08$) and 100% fruit or vegetable juice, but also with whole or 2% milk or flavored milk (Table 4D). Higher SES was inversely associated with access to diet soft drinks among middle but not high school students (Table 4D). On the other hand, having access throughout the day from vending machines to regular soft drinks does not vary systematically as a function of SES. Access to soft drinks throughout the school day is relatively uncommon for students in all SES strata, and not systematically related to SES. In fact, that is generally true for all of the beverage classes covered, with the single exception that skim milk availability correlates positively, although weakly, with SES.

More social class differences are found in the à la carte beverage offerings in the cafeteria at lunch. Taking all grades combined (data not shown), there is a positive association between the SES of the students and the proportion who have access at lunch to regular soft drinks ($p<0.01$), diet soft drinks ($p<0.01$), and 100% fruit and/or vegetable juices ($p<0.05$). In all SES strata, the majority of students have access to each of the beverage classes covered, with the single exception of diet soft drinks; those in higher-SES schools tended to have more access to all beverages, both those relatively high in calories or fat and those low.

Attempts to promote healthier habits. A positive linear association ($p<0.05$) exists between SES and the mean score given by the middle school principals on the extent to which the school district has made a serious/real effort to promote healthy eating and drinking habits among students (Table 4E). This suggests that middle school students in more privileged districts have received somewhat more attention. (No such association exists at the high school level.) The other related question, on whether the school or district has "significant activities underway to promote healthier eating and drinking practices among students," shows a similar linear association that is significant for middle schools ($p<0.01$) (Table 4E). Again, high schools do not show such an association.

To summarize the findings regarding SES, there are a number of relevant dimensions on which there do not seem to be important differences, but there also are a number of systematic differences that may be contributing to differentials in overweight. Lower-SES students are more likely to be exposed to the advertising and promotion of soft drinks and fast-food restaurants, less likely to have skim milk available throughout the school day, and less likely to have diet soft drinks or 100% fruit and vegetable juices available in the cafeteria (although they are also less likely to have regular soft drinks available in the cafeteria). On some variables, it can be seen that the very highest SES group seems to be different from the others: They have the least advertising allowed in the school and it appears that more effort is going into improving meal offerings in schools attended by these more privileged students, at least in the middle schools.

Discussion

The study findings clearly highlight the beverage and food industry's extensive reach into the nation's schools, at least up to the point of the industry's 2006 agreement with the Alliance for a Healthier Generation to improve beverage offerings in the schools. Consistent with findings

Table 4. Food and beverage contracts by student socioeconomic status (SES): 2004–2005

	Student SES						
	1 (Low)	2	3	4	5 (High)	b	Sig. linear association
Approx N total	2,760	8,449	9,840	10,544	5,950		
Approx N 8th	1,005	3,046	3,262	3,813	2,241		
Approx N 10th & 12th	1,755	5,403	6,577	6,732	3,709		
A. Soft drink contracts							
Percentage of students in **schools or districts** that have a contract with a soft drink bottler							
8th	68.6	69.2	69.4	69.1	56.4	−2.60	
10th & 12th	84.2	84.4	83.3	82.7	80.3	−1.05	
Percentage of students by source of contract:							
School only							
8th	23.6	24.5	23.0	22.5	20.5	−0.98	
10th & 12th	28.6	36.7	36.6	35.0	39.8	1.32	
District only							
8th	29.1	25.6	29.3	29.3	24.7	−0.18	
10th & 12th	26.3	23.2	24.6	27.8	24.5	0.56	
Both, school & district							
8th	15.9	19.1	17.1	17.3	11.2	−1.44	
10th & 12th	29.3	24.6	22.1	19.9	15.9	−2.93	**
B. Overall beverages and food revenues							
Percentage of students in **schools or districts** that receive a specified % of the soft drink receipts							
8th	59.0	59.8	60.5	58.3	45.5	−3.12	
10th & 12th	76.1	75.0	74.0	74.4	72.4	−0.69	
Percentage of students in **schools or districts** that receive incentives once total soft drink receipts exceed a specified amount							
8th	22.1	22.2	25.6	27.3	22.3	0.68	
10th & 12th	28.7	32.1	31.1	33.3	28.0	−0.21	
Median revenue **schools** get from soft drink sales per year ($)							
8th	500	1000	1000	600	—	−330.7	
10th & 12th	6500	5750	6000	6500	5000	89.0	
Median revenue **schools** get **per student** from soft drink sales per year ($)							
8th	0.77	1.54	1.18	0.77	—	−0.33	
10th & 12th	5.56	6.67	6.67	6.73	5.25	−0.14	
Percentage of students in **schools** that receive revenue from foods and/or beverages sold in:							
Vending machines							
8th	72.6	76.4	77.7	76.5	71.6	−0.57	
10th & 12th	95.7	95.1	95.2	95.6	95.9	−0.16	
School/student store							
8th	32.1	26.0	26.4	23.5	18.7	−2.61	
10th & 12th	31.5	29.4	32.4	34.3	37.6	2.06	
Snack bars/carts							
8th	15.5	18.3	18.4	20.0	16.0	0.10	
10th & 12th	25.6	22.4	24.2	24.5	27.1	0.83	
À la carte sales in cafeteria							
8th	26.9	25.4	31.8	37.8	39.9	4.44	*
10th & 12th	27.6	31.6	34.1	36.3	35.2	1.84	
Percentage of students in **school districts** that receive revenue from foods and/or beverages sold in the following locations:[a]							
Vending machines							
8th	34.9	43.0	38.9	42.0	44.6	1.32	
10th & 12th	36.1	40.7	42.2	46.8	42.3	1.72	
School/student store							
8th	5.2	5.2	3.6	2.7	3.2	−0.70	
10th & 12th	6.4	8.2	9.1	8.5	5.3	−0.44	

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Table 4. (*continued*)

	Student SES						
	1 (Low)	2	3	4	5 (High)	b	Sig. linear association
Snack bars/carts							
8th	15.7	12.9	10.5	11.8	9.1	−1.18	
10th & 12th	17.7	13.3	16.3	16.4	18.8	1.04	
À la carte sales in cafeteria							
8th	45.8	47.2	47.0	49.0	55.5	2.25	
10th & 12th	47.3	56.2	57.2	54.3	50.5	−0.66	
C. Advertising/promotion in schools							
Percentage of students in **schools** that allow the soft drink bottler to advertise in the school building, school grounds, or school buses							
8th	8.1	9.8	8.4	6.2	4.2	−1.43	*
10th & 12th	28.6	26.6	22.4	17.7	12.8	−4.26	***
Percentage of students in **schools** that advertise or promote meals from fast-food restaurants or soft drinks with:							
Posters or other materials on display in the school							
8th	3.5	2.3	2.7	2.0	0.9	−0.48	
10th & 12th	6.1	7.1	7.2	8.4	7.1	0.32	
Ads on textbook covers or school food service menus							
8th	5.8	4.9	5.0	5.1	4.6	−0.13	
10th & 12th	4.8	4.7	4.4	3.3	1.7	−0.83	*
Coupons for free or reduced-price products							
8th	16.3	12.7	11.8	10.0	7.7	−1.82	
10th & 12th	17.1	19.7	18.4	15.8	13.2	−1.58	
Sponsorship of school events							
8th	22.5	19.0	16.1	11.6	9.8	−3.33	*
10th & 12th	25.9	26.2	23.5	22.1	20.3	−1.70	
D. Availability of beverages							
Percentage of students in **schools** that offer the following beverages **in vending machines at any time in the day:**[b]							
Diet soft drinks[c]							
8th	47.3	56.0	53.1	46.9	39.8	−0.04	*
10th & 12th	75.2	83.2	84.5	85.1	79.0	0.01	
Bottled water							
8th	76.3	81.1	82.9	83.8	87.1	0.02	
10th & 12th	95.1	96.5	97.1	97.8	98.2	0.01	
1% or skim milk							
8th	40.9	48.1	51.7	54.9	56.0	0.03	
10th & 12th	51.5	51.1	54.5	58.3	64.8	0.04	*
100% fruit or vegetable juice							
8th	51.8	57.7	59.6	63.2	66.7	0.03	*
10th & 12th	77.4	80.0	81.5	84.3	87.6	0.03	**
Regular soft drinks[d]							
8th	63.2	67.4	66.7	62.6	63.8	−0.01	
10th & 12th	81.0	87.4	89.1	89.2	87.1	0.01	
Whole or 2% milk, or flavored milk							
8th	48.1	53.4	56.5	59.5	66.4	0.04	*
10th & 12th	58.4	59.8	63.4	66.5	69.4	0.03	**
Percentage of students in **schools** that offer the following beverages in **vending machines throughout the day:**[b]							
Diet soft drinks[c]							
8th	9.9	5.8	6.2	5.8	5.3	−0.60	
10th & 12th	23.7	18.1	20.7	24.4	23.1	1.25	
Bottled water							
8th	21.1	15.9	18.1	18.7	16.2	−0.21	
10th & 12th	45.8	44.6	46.5	48.0	50.8	1.57	

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Table 4. Food and beverage contracts by student socioeconomic status (SES): 2004–2005 (*continued*)

	Student SES						
	1 (Low)	2	3	4	5 (High)	b	Sig. linear association
1% or skim milk							
8th	2.2	1.6	2.7	3.4	3.0	0.43	
10th & 12th	8.9	9.7	11.3	13.6	17.4	2.20	
100% fruit or vegetable juice							
8th	8.0	4.9	5.6	5.6	4.8	−0.31	
10th & 12th	26.5	21.9	24.2	25.3	30.3	1.57	
Regular soft drinks[d]							
8th	14.4	9.4	9.8	9.1	7.7	−0.10	
10th & 12th	24.2	19.0	21.8	25.6	24.9	1.50	
Whole or 2% milk, or flavored milk							
8th	3.9	3.5	4.3	5.4	4.2	0.38	
10th & 12th	14.6	13.4	15.5	16.9	18.5	1.35	
Percentage of students in **schools** that offer the following beverages **à la carte in the cafeteria at lunch:**							
Diet soft drinks[c]							
8th	6.5	7.5	8.4	8.9	7.1	0.22	
10th & 12th	19.4	17.4	22.1	27.2	31.5	3.40	**
1% or skim milk							
8th	69.8	72.7	69.4	71.4	76.3	1.03	
10th & 12th	79.0	77.5	78.5	79.7	82.7	1.19	
100% fruit or vegetable juice							
8th	68.0	65.6	66.3	68.2	76.9	2.43	
10th & 12th	73.3	75.5	78.5	79.2	81.7	1.97	
Regular soft drinks[d]							
8th	46.9	44.6	45.5	48.1	57.4	2.86	
10th & 12th	55.4	54.3	59.0	62.0	64.1	2.86	*
Whole or 2% milk, or flavored milk							
8th	77.8	78.7	76.9	77.1	82.0	0.62	
10th & 12th	79.1	82.4	83.1	83.5	83.1	0.68	
E. Attempts to promote healthier habits							
Mean score on serious/real effort the **school** has made to promote healthy eating and drinking habits among students[e]							
8th	3.1	3.0	3.0	3.1	3.2	0.03	
10th & 12th	2.9	2.9	2.9	2.9	3.0	0.03	
Mean score on serious/real effort the **school district** has made to promote healthy eating and drinking habits among students[e]							
8th	3.1	3.1	3.2	3.2	3.4	0.07	*
10th & 12th	2.9	2.9	2.9	3.0	3.0	0.02	
Percentage of students in **schools or districts** that have significant activities underway to promote healthier eating and drinking practices among students							
8th	42.8	41.6	44.5	50.6	62.7	5.49	**
10th & 12th	49.7	44.5	44.2	46.7	50.1	0.88	

Note: The column labeled "b" refers to the unstandardized regression coefficient obtained from the OLS regression analyses that were utilized to determine if a linear association exists between SES and each of the dependent variables (items in rows). Significance of regression coefficients is indicated with asterisks in the column "Sig. linear association." "–" indicates the estimated coefficient is essentially zero.

[a]Data are based on 2005 data only because this question differs considerably from the one asked in 2004.

[b]The number of occasions that items can be available per day ranges from none to four times (all day).

[c]Includes Diet Coca-Cola, Diet Pepsi-Cola, or Diet Dr. Pepper (among others).

[d]Includes Coca-Cola, Pepsi-Cola, or Dr. Pepper (among others), sports drinks that are not 100% juice.

[e]1=Not at all, 2=To a little extent, 3=To some extent, 4=To a great extent, 5=To a very great extent.

*$p<0.05$; **$p<0.01$; ***$p<0.001$.

from previous studies,[28] a large proportion of all secondary school students in grades 8, 10, and 12 have access to soft drinks at school. In 2004 and 2005, nearly two thirds or more had attended schools that had regular soft drinks available in vending machines (65% of middle schools students and 88% of high schools students); two thirds or more (67% of middle school students and 83% of high school students) were in schools and/or school districts that had pouring rights contracts with soft drink bottlers; the majority (57% and 74%) were in schools and/or

school districts that received a specified percent of the soft drink receipts; and between one quarter and one third (25% and 31%) were in schools or districts that received threshold incentives obviously intended to encourage sales beyond what the fixed percentage cut accomplishes. Half or more (48% and 59%) had access to soft drinks in the cafeteria at lunch. A higher percentage of high school than middle school students were exposed to each of these conditions; clearly the high schools are where the greatest student consumption of soft drinks is occurring, and where student access through vending machines has been the greatest.

The estimated financial benefits to the schools seem modest relative to the health threat that the promotion of soft drinks entails. Overall, the median revenue that soft drinks generate for high schools is $6000 per year, and for middle schools only $500 per year. Median revenues per student per year are $6.48 in high schools versus $0.70 in middle schools. If the sale of soft drinks to young people is viewed as a problem from a health perspective, then it is clear that the problem is most concentrated in the nation's high schools. Not only are these students consuming large quantities of empty calories during their adolescence with the obvious consequences, they also may be establishing unhealthy habits that carry over with them well into adulthood.

The advent of exclusive pouring rights contracts was an unfortunate development, because once one soft drink company started to use this device, all of the others surely felt that they had to follow suit in order to protect market share. Not only is there a fairly substantial sales volume involved in sales through the schools, but young people are very likely developing brand preferences in their soft drink choices at this stage of their lives. While the industry previously had jointly pledged to remove soft drinks from elementary schools and to restrict access in middle schools (very likely in response to rising public concern about this issue as well as fear of possible liability suits in the future[29]), the limits applied to high schools—where the data suggest that the problem is particularly concentrated—have been the least restrictive. Under the newer agreement with the Alliance for a Healthier Generation, the industry has committed to removing soft drinks even from high schools, which will be an important change if it is effected.

Until regular soft drinks are removed from schools, they might consider making the healthier beverages more accessible and perhaps more prominently displayed to students. Currently, only 18% of middle school students and 47% of high school students have unrestricted access to bottled water, for example. This likely would require having a separate vending machine dedicated to bottled water (and possibly other more healthy alternatives), so that when soft drink machines are locked down during parts of the day, the water could remain available. Many students do not have access to other potentially healthier beverages, like 1% or skim milk and 100% fruit juice. These could be offered in all school cafeterias, at a minimum providing some more vigorous competition for the sugar-laden soft drinks.

One central purpose of this paper is to determine to what extent racial/ethnic minorities (specifically, black and Hispanic youth) and lower-SES groups are subject to influences in the school environment that may contribute to their differential rates of overweight and obesity. We did not find larger proportions of black or Hispanic students in schools or districts that have contracts with bottlers, or that receive a specified percent of receipts from soft drink sales, or that have threshold incentives based on sales. These seem to be highly prevalent conditions and fairly evenly distributed by race/ethnicity. The reported per-student median revenue to the school from soft drink sales was highest for Hispanic high school students, but this Hispanic–white difference did not reach statistical significance. (Black students in both high school and middle school, on the other hand, attend schools that have significantly lower per-student soft drink revenues than white students.)

With regard to socioeconomic status, however, students from lower-SES backgrounds were more likely to be in schools that allow soft drink bottlers to advertise in the school, and to sponsor school events in middle school. These differences serve to put those segments of youth already at greater risk for overweight and its accompanying adverse health effects at still greater risk. The schools that serve these at-risk segments of the population are also likely to be those that are the most seriously underfunded, so it would be understandable if these schools and districts prove to be more reluctant to give up the monetary incentives offered by commercial interests. However, those financial rewards would come at a price in terms of their students' health, and according to the findings in this study the rewards are quite modest in any case.

Limitations

Certain limitations should be kept in mind. The data are based on school principals' (or other school staff members') responses to a self-administered questionnaire, raising the possibility of errors in reporting or of social desirability bias. To minimize the latter, the investigators guaranteed the respondents that they would not be identified. To minimize response errors, the investigators attempted to have the questionnaire segments completed by the school personnel most likely to be knowledgeable about the matters covered, such as the food service manager. Also, participants who provided incomplete answers, or whose answers to related questions were inconsistent, were re-contacted by phone by research staff to clarify their answers. Finally, some of the differences examined were not

statistically significant despite what at times appeared to be large and important differences. Even a sample of 345 schools has power limitations, particularly for subgroup comparisons.

Conclusion

Soft drinks were widely available to American students in their schools in the 2004 and 2005 school years—more so in high schools than in middle schools. Pouring rights contracts exist in the majority of schools and/or districts with whatever influences they carry on the promotion of soft drink sales in the schools, but they almost certainly create an incentive for school administrators and school boards not to discourage the sale of soft drinks to students. Threshold incentives, whereby the school receives added incentives for meeting certain sales goals, above and beyond the percentage of soft drink receipts they routinely receive under the pouring rights contract, still exist in schools attended by a quarter of middle school students and nearly one third of high school students.

There are some disparities in the environmental influences that students face with regard to soft drinks—disparities that would tend to encourage those most at risk for overweight and obesity to drink more soft drinks. They include the fact that compared to schools attended by blacks and whites, schools attended by Hispanics provide more exposure to soft drink advertising. Lower-SES students also face some differential influences. The proportion of students whose schools permit the soft drink bottler to advertise in the school and to sponsor school events increases with declining SES.

Principals of the schools attended by about half of the students studied report that their schools or districts have "significant activities" underway to promote healthier eating and drinking practices among their students. This encouraging finding suggests that this is a time of "unfreezing" traditional ways of viewing the food and beverage offerings in schools, and that reform is beginning to occur. Indeed, these recently collected data may well reflect some of that change; but they also make clear that there remains a great deal of room for improving the environmental influences of schools on their students when it comes to developing healthy behaviors in beverage consumption. Perhaps the industry's new agreement with the Alliance for a Healthier Generation will bring about the major changes outlined in the agreement, despite possible resistance from bottling companies and even school districts who may not want to give up the revenues generated under current contracts. Future surveys in this series should speak to the progress being made. Indeed, the questionnaire for the 2007 YES survey of school administrators includes a section that asks respondents if they are aware of the agreement and whether they have implemented, or are planning to implement, in their school the school beverage guidelines adopted under the agreement. It is quite possible, of course, that the financial losses to both the industry and the schools will not be as large as is commonly assumed if students switch to buying beverages such as water, skim milk, and 100% fruit or vegetable juice that could be made increasingly available to them through vending machines. That would be a win-win-win situation for the students, their schools, and the industry.

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Availability of More-Healthy and Less-Healthy Food Choices in American Schools

A National Study of Grade, Racial/Ethnic, and Socioeconomic Differences

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Background: The purposes of this study are to examine the extent to which (1) more-healthy and less-healthy food choices are available to American secondary students in their schools, and (2) there are differences in the availability of such foods as a function of grade, racial/ethnic background, and socioeconomic status (SES).

Methods: United States nationally representative samples of over 37,000 students in 345 secondary schools were surveyed in 2004 and 2005 as part of the Youth, Education, and Society (YES) study and the Monitoring the Future (MTF) study. In the YES study, school administrators and food service managers completed self-administered questionnaires on food policies and food offerings in their schools. In the MTF study, students in the same schools completed self-administered questionnaires. Data were analyzed in 2006.

Results: A greater percent of high school students have access to both more-healthy and less-healthy food choices than middle school students. Compared to white students, fewer black students have access to certain healthy foods (lowfat salty snacks, lowfat cookies and pastries). Hispanic high school students have greater access to regular ice cream and to fruits and vegetables. Otherwise the racial/ethnic group differences are modest. However, there is a positive linear association between SES (as indicated by parental education) and (1) access to most types of healthier snacks from vending machines, school/student stores, or snack bars/carts and (2) the number of healthier foods offered à la carte in the cafeteria. The association between SES and access to less-healthy snacks varies more by item.

Conclusions: Indisputably, less-healthy foods are more available than more-healthy foods in the nation's schools. At a time when food and beverage offerings are under intense policy scrutiny, this study provides a comprehensive assessment of the types of foods made available to students. While it is encouraging to see schools offering healthy food alternatives, such as lowfat snacks and fruits and vegetables, the findings strongly suggest that the availability of more-healthy snacks needs to be increased, particularly for racial/ethnic minorities and youth of lower SES. Simultaneously, schools could considerably decrease the availability of less-healthy snack choices available to students. Future monitoring is needed to evaluate the effectiveness of the food industry's recent agreement to play a role in helping to solve these problems.

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Introduction

To ensure that American students receive meals with adequate nutritional value, the United States Department of Agriculture's (USDA) Food and Nutrition Service (FNS) administers the School Lunch and School Breakfast Programs that provide meals (breakfast, lunch, and in some schools, after-school snacks) that follow nutritional guidelines set forth by the FNS.[1] These government guidelines are intended to limit total and saturated fat and to ensure that meals have a minimum amount of vitamins and nutrients. However, concerns have emerged regarding the nutritional value of foods and beverages that students consume in schools. These concerns stem largely from the increased commercialization of the foods and beverages provided to students in schools that do not fall under the administration of the FNS.[2,3] "Competitive foods" is the label given by the USDA to all foods

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and beverages sold in schools that are not part of the meals provided through the School Lunch and School Breakfast Programs. These competitive foods, which are largely composed of items having high fat, high sodium, and/or added sugars (such as cookies, candies, salty chips, and carbonated beverages), are usually sold in vending machines, à la carte in the cafeteria when meals are offered, and through school stores, canteens, and snack bars/carts.

Although many of these foods and beverages do not meet the government's recommended nutritional value, schools make them available to students because the contracts with the food and beverage industry provide needed revenue that at least partially offset budget woes that schools have experienced in recent years.[4] Despite some restrictions on their sales by federal and state governments,[2] studies have shown that students' access to these competitive foods in one or more of those venues (vending machines, à la carte) has been nearly universal.[5–8]

In response to the increased obesity epidemic[9–13] and the concern about foods available to American students,[5–8] a number of states and schools have begun initiatives to decrease the availability of less-healthy foods and to increase the availability of nutritious food to students.

The present study extends the work done by the Centers for Disease Control and Prevention (CDC) School Health Policies and Programs Study (SHPPS).[6,14] Briefly, the purpose of SHPPS was to obtain information on school health policies and programs at the state, district, school, and classroom levels. SHPPS was conducted in 1994 and 2000, and a third survey was scheduled for 2006. Findings from the present study, the Youth, Education, and Society (YES) School Policies and Programs study, will serve to complement the findings from the SHPPS in four important ways. First, the present study is in the beginning stages of what will be annual monitoring of U.S. school and school district policies that are likely to have an impact on the foods offered to middle and high school students. Second, it will be possible to examine the extent to which types of foods available to all American students, by racial/ethnic backgrounds and socioeconomic levels, vary over time as a function of federal, state, district, and school policy changes. Third, data are presented that reflect the percentage of American students who are exposed to various foods rather than data that simply reflect the percentage of schools that offer certain foods, as was the case with the SHPPS. That takes into account the fact that large schools influence a disproportionately large number of students. Fourth, original national survey data are presented that allow a comparison of the school food environments faced by students of different levels of schooling and different racial/ethnic and socioeconomic status (SES) backgrounds. This information will serve to inform scholars and policymakers about the role that the schools may play in disparities in overweight among these groups in the entire country. This latter activity is made possible by the connection of data from school administrator surveys with data from students in the same schools.

The overrepresentation of overweight and obesity among youth from certain racial/ethnic backgrounds and low socioeconomic groups[9,15–17] highlights the importance of identifying the mechanisms that can serve as targets of interventions in order to prevent and reduce obesity among all children, and in particular among those most at risk. To this end, this article focuses specifically on describing the availability and types of foods offered by schools to students by race/ethnicity and SES, with distinctions made between different grade levels (grade 8 in middle school versus grades 10 and 12 in high school).

Methods

Samples and Survey Methods

The analyses utilized data from two ongoing studies: Monitoring the Future (MTF), funded by the NIDA, and Youth, Education, and Society (YES), funded by the Robert Wood Johnson Foundation (RWJF). Both studies were conducted at the University of Michigan's Institute for Social Research (ISR). MTF involves annual surveys of nationally representative samples of 8th-, 10th-, and 12th-grade students, located in approximately 410 public and private schools; each school participates for 2 consecutive years. In YES, administrators in schools that are in the half-samples cycling out of the MTF survey that year are asked to complete a lengthy questionnaire describing school policies and programs related to various health issues, including food services, physical education, and substance use. These are nationally representative half-sample replicates. Data were analyzed in 2006.

MTF design and methods. The design and methods for the MTF project are summarized briefly here; a detailed description is available elsewhere.[18] At each of three grade levels (8th, 10th, 12th), a multistage sampling design was used to obtain nationally representative samples of students from the 48 contiguous states. The stratified random sampling procedure involved three stages:[19] (1) geographic regions were selected, (2) schools were selected within regions with probability proportional to the estimated number of students in the target grade, and (3) approximately 45,000 students were selected per year within schools, usually by means of randomly selecting whole classrooms. Sample weights were assigned to each student to take into account variations in selection probabilities that occurred at all stages of the sampling procedures. Participating students completed a self-administered questionnaire during a normal class period.

The current study used the student self-reported race/ethnicity and parent education. Students' racial/ethnic background was measured by the item "How do you describe yourself?" For the present study, students were coded as being of white, black, Hispanic, or other background. There were insufficient cases for other racial/ethnic groups to make reliable estimates. Parent education was defined as an average

of father's and mother's educational attainment (with one missing data case permitted). The measure was coded as follows: 1=completed grade school or less, 2=some high school, 3=completed high school, 4=some college, 5=completed college, 6=graduate or professional school after college. Parent education was utilized as a proxy for SES. (Parent education was chosen as a measure of SES because students are generally unable to provide accurate information on family income.) Grade refers to the grade in which the student was enrolled: 8th, 10th, or 12th. For purposes of this study, 10th and 12th graders have been combined, and are referred to as high school students, and 8th graders as middle school students.

Design and methods of YES. The half-samples of nationally representative schools that were cycling out of the MTF study in 2004 and 2005 composed the target sample (N=345, 85% response rate) for the current study. School administrators were asked to complete a self-administered questionnaire that contained, among other things, questions related to school and district policies concerning contracts with soft drink bottlers as well as detailed questions about the types of foods and beverages available to students. Over 85% of the primary respondents were school administrators (e.g., school principals, vice-principals), followed by teachers and other school personnel. For some sections of the questionnaire, it was recommended that a person other than the school administrator (e.g., food service manager) answer if they were more likely to know the information. One section of the questionnaire asked about the types of foods and beverages made available to students in the school's vending machines (including when they are made available), à la carte offerings at lunch, and the standard school lunch menu. This section was answered by the food service manager or other food worker in 71% of schools where 8th graders were surveyed, 78% of schools in which 10th graders were surveyed, and 70% of those in which 12th graders were surveyed. In the remaining schools the principal usually answered these questions.

School and student data were available on the variables of relevance to the present analyses for over 340 schools and the 37,000 student respondents from these schools who provided data on the MTF questionnaires. The school administrator and student data were combined into one data set. Combined across grades, the student sample was 69% white, 11% black, 9% Hispanic, and 11% from other racial/ethnic backgrounds. About 7% were in the lowest socioeconomic group, and 16% in the highest.

The primary data for this study included the answers to the questions on the types of foods available to students. First, school principals were asked to estimate the percentage of students who on a typical day eat the lunch offered at their school, bring their own lunch, or go off campus to buy lunch. Then, questions were asked to determine if students in schools that offer lunch have à la carte and other lunch options. Questions were also asked to determine the type of menu planning system schools utilize (nutrient standard menu planning or NuMenus, assisted nutrient standard menu planning or Assisted NuMenus, enhanced food-based menu planning, traditional food-based menu planning, and any other menu planning) and to identify whether decisions about menus and food service were made at the school level, the district level, by an external contractor, or some other entity.

The availability of brand-name fast-food items (such as Pizza Hut, Taco Bell) was determined using a set of questions that asked about the availability of such foods during a typical week as à la carte lunch items and for school lunch meals. To identify the types of foods available to students, a set of questions was asked concerning the availability of a number of healthier and less-healthy food items (see list below) in vending machines, in school/student stores, and in snack bars/carts. The food items were:

Candy
Salty snacks that are not low in fat, such as regular potato chips
Cookies, crackers, cakes, or other baked goods that are not low in fat
Ice cream or frozen yogurt that is not low in fat
Lowfat salty snacks, such as pretzels, baked chips, or other lowfat chips
Lowfat cookies, crackers, cakes, pastries, other lowfat baked goods
Lowfat or fat-free ice cream, frozen yogurt, sherbert, or lowfat or nonfat yogurt
Fruits or vegetables (not including fruit or vegetable juice)

The first four were considered to be less-healthy snack choices because of their high sugar, fat, and/or salt content, and the last four to be more healthy because they have lower such content. The terms less-healthy and more-healthy were used because they distinguish foods more on their relative position on a scale of healthfulness rather than making assumptions about their absolute status. Lowfat salty snacks, for example, are more healthful than salty snacks.

For each of the foods listed above, school personnel were asked to indicate the times of the day when these were available to students: (1) before classes begin in the morning, (2) during school hours when meals are not being served, (3) during school lunch periods, and (4) after school.

In schools where lunch was offered, respondents were also asked if during a typical week, the same food items as those listed above were offered to students as à la carte selections in the cafeteria at lunch.

Finally, school personnel were also asked about the frequency (never, some days, most or every day) that students were offered any one of the choices listed below as part of the school lunch meals (not à la carte):

Two or more different entrees or main courses
Two or more different vegetables
Two or more different fruits
Two or more types of 100% fruit juice
Milk that is 1% fat or skim (e.g., fat-free)
Whole or 2% milk, or flavored milk
Pizza
Deep-fried French-fried potatoes (including fries that you just reheat)

For the purpose of this report, the first five items were considered more-healthy food choices and the last three items, less-healthy food choices for the reasons cited earlier. Items were coded 0, 1, or 2 for never, some days, or most or every day, respectively. After reverse coding, the responses to all eight variables were added to create an index that mea-

sured the extent that more-healthy food choices are offered as part of school lunch meals (not à la carte).

Data Analysis

A major analytic objective was to determine how different the food environment was for students (1) in middle schools versus high schools, (2) of different racial/ethnic groups, and (3) of different socioeconomic levels as indicated by level of parent education. The distribution (percents and medians) of the food environment variables were compared across grades, racial/ethnic groups, and SES groups. Chi-square and t-test statistics were used to determine whether the percents and means, respectively, varied according to the students' grade level. These variables were also used to determine differences among white, black, and Hispanic youth. While percents and means are presented for students identified in the "other" racial/ethnic category for completeness, this category was not included in assessing statistical significance because the "other" racial/ethnic background is a residual category that includes very different population groups. Disaggregation of this category would result in very small sample sizes that would not permit meaningful analysis. Ordinary least squares regression analysis was used to determine the extent to which there was a linear association between each of the dependent variables and the five-category measure of parents' education.

All analyses included weighted data to adjust for the slightly different probabilities of selection of students that occur during the various stages of the sampling process and took into account design effects resulting from clustered sampling in calculating variance estimates using Stata version 8.0.

In addition to the above analyses, the ratio was calculated of the mean number of less-healthy to the mean number of more-healthy food types available to students in vending machines, school/student stores, or snack bars/carts. Differences in the ratio between student grades, racial/ethnic groups, and SES were assessed using the same statistics described above.

Results

Because of the considerable amount of information reported in the following tables, each table includes three sections. These are: (A) School lunch and breakfast participation, (B) Menu planning, and (C) More- and less-healthy food types. When results are noted, both the table number and the section letter are cited to facilitate look-up.

Results by Grade Level

As shown in Table 1A, across the nation, there is nearly universal access to lunch in school by students (99%) and almost all (87% of middle school students, and 92% of high school students) are in schools where they have access to à la carte lunch items. Somewhat smaller percentages of students attend schools that provide breakfast (77% for middle school, 85% for high school). Only the à la carte lunch items differ significantly between grade levels.

Compared to middle school students, high school students are less likely to eat the lunch offered by the school (70% in middle school vs 60% in high school) or bring their own lunch (25% vs 18%), and they are much more likely to go off-campus to buy lunch (less than 0.5% vs 11%) (Table 1A).

The great majority (87%) of students attend schools that participate in the USDA-reimbursable National School Lunch Program (NSLP), with no real difference between middle and high schools (Table 1A). About 44% of students attend schools that participate in the USDA-sponsored Team Nutrition program, with no significant difference between grade levels (Table 1A). The USDA Team Nutrition program provides schools with resources to support innovative activities aimed at improving the students' nutrition in schools. These findings indicate that most schools in the nation do not, or are not able to, take advantage of this program.

About half (49% of middle and 55% of high school students) of students attend schools that use traditional food-based menu planning. The most common nontraditional system is the nutrient standard menu planning (NuMenus) system, with about 31% of students nationwide being in these schools (Table 1B). There are no significant between-grade differences in the types of menu-planning systems that schools utilize (NuMenus, Assisted NuMenus). The importance of these planning systems will be discussed below.

With respect to the locus of decision making about menus and food service, most students attend schools where these decisions are made at the district level (78% for middle, 69% for high), followed by the school level (36% and 42%) and an external contractor (8% and 17%) (Table 1B). These percents add to more than 100% because in some schools decisions are made at more than one level. The only significant between-grade difference is that for an external contractor.

On average, American students are offered a brand-name fast-food item (e.g., Pizza Hut, Taco Bell, others) once a week through à la carte lunch items, and about every 2 weeks in school lunch meals (Table 1C), with no significant difference by grade level.

The more-healthy food choices are less available to middle school than to high school students in all three venues combined: vending machines, school/student stores, or snack bars/carts. Fifty-six percent of middle school students attend schools where lowfat salty snacks (e.g., pretzels) are available, versus 80% of high school students ($p<0.001$). The corresponding figures for lowfat cookies, crackers, and pastries are 41% versus 54% ($p<0.05$); 32%, versus 39% (not significant) for lowfat or fat-free ice cream, including frozen yogurt, sherbet, and lowfat or nonfat yogurt; and 60% versus 65 % (not significant)for fruit or vegetables. The mean number of these more-healthy food items available to students from vending machines, school/student stores, or snack/bar carts is significantly lower for

Table 1. Food availability in all schools and by grade level: 2004–2005

	8th	10th and 12th	8th versus 10th and 12th comparison
Approx N schools	126	219	
Approx N students	13,367	24,176	
A. SCHOOL LUNCH AND BREAKFAST PARTICIPATION			
Percentage of students in schools that offer:			
Breakfast to students	77.4	85.2	
Lunch to students	99.3	99.2	
À la carte lunch items	87.0	92.1	**
Mean percentage of students who:			
Eat lunch offered by the school	69.7	59.6	***
Bring their own lunch	25.2	18.0	*
Go off-campus to buy lunch	–	11.2	***
Percentage of students in schools that participate in the USDA reimbursable National School Lunch Program	88.0	86.4	
Percentage of students in schools that participate in the USDA-sponsored Team Nutrition program	44.6	44.2	
B. MENU PLANNING			
Percentage of students by the menu planning system that schools utilize:			
Nutrient Standard Menu Planning (NuMenus)	30.7	31.5	
Assisted Nutrient Standard Menu Planning (Assisted NuMenus)	6.3	6.0	
Enhanced Food-Based Menu Planning	15.4	15.7	
Traditional Food-Based Menu Planning	49.3	54.9	
Other menu planning	11.5	10.8	
Percentage of students by organization that makes the decision about menus and food service:			
School	35.9	41.5	
District	77.9	69.3	
External contractor	7.7	17.1	**
C. MORE AND LESS HEALTHY FOOD TYPES			
Mean number of days per week that brand-name fast food (e.g., Pizza Hut, Taco Bell, others . . .) is offered to students through:			
À la carte lunch items	0.8	1.1	
School lunch meals	0.6	0.5	
Percentage of students in schools that offer **more healthy foods** (in vending machines, school/student stores, or snack bars/carts) such as:			
Lowfat salty snacks[a]	55.7	79.9	***
Lowfat cookies, crackers & others[b]	40.9	54.1	*
Lowfat or fat-free ice cream[c]	32.4	39.3	
Fruits or vegetables[d]	60.1	64.8	
Mean number of **more healthy food types**[e] available to students from vending machines, school/student stores, or snack/bar carts	1.9	2.4	***
Percentage of students in schools that offer **less healthy foods** (in vending machines, school/student stores, or snack bars/carts) such as:			
Candy[f]	43.7	74.0	***
Salty snacks not low in fat[g]	60.8	84.8	***
Cookies not low in fat[h]	65.5	84.1	***
Ice cream not low in fat[i]	46.4	54.0	
Mean number of **less healthy food types**[j] available to students from vending machines, school/student stores, or snack bars/carts	2.1	3.0	***
Mean number of **more healthy à la carte food types**[k] available to students in the cafeteria at lunch	2.2	2.6	***
Mean number of **less healthy à la carte food types**[l] available to students in the cafeteria at lunch	1.9	2.4	**
Mean number **of more healthy food types offered during lunch**[m]	9.4	9.5	

Note: Between-grade differences are indicated with asterisks in the column "Sig. 8th v. 10th & 12th Comparison." "—" indicates less than 0.5 percent but greater than zero percent.

[a]Includes lowfat snacks such as pretzels, baked chips, or other lowfat chips, among others.

[b]Includes lowfat cookies, crackers, cakes, pastries, and other lowfat baked goods.

[c]Includes lowfat or fat-free ice cream, frozen yogurt, sherbert, or lowfat or nonfat yogurt.

[d]Does not include fruit or vegetable juice.

[e]The number of items range from 0–4 and are based on the four sets of more healthy items listed in a–d.

[f]Includes any type of candy.

[g]Includes salty snacks that are not low in fat, such as regular potato chips.

[h]Includes cookies, crackers, cakes, or other baked goods that are not low in fat.

[i]Includes ice cream or frozen yogurt that is not low in fat.

[j]The number of items range from 0–4 and are based on the four sets of less healthy items listed in f–i.

[k]Range is 0–4. Items include lowfat salty snacks, cookies, crackers, cakes, pastries, other baked goods, lowfat or fat-free ice cream, frozen yogurt, sherbet, fruits, or vegetables.

[l]Range is 0–4. Items include candy, salty snacks (e.g., regular potato chips), cookies, crackers, cakes, other baked goods, ice cream, or frozen yogurt, that are not low in fat.

[m]Index that measures the extent to which students are offered a choice of more and less healthy items as part of lunch meals (not à la carte). Possible range of responses is 0–16 with higher scores representing greater availability of healthy food choices.

*$p<0.05$; **$p<0.01$; ***$p<0.001$.

Table 2. Food availability by student race/ethnicity: 2004–2005

	Student race/ethnicity				Sig. racial/ ethnic
	White	Black	Hispanic	Other	comparison
Approx N total	25,895	4,113	3,280	4,254	
Approx N 8th	9,002	1,202	1,276	1,887	
Approx N 10th & 12th	16,894	2,911	2,004	2,368	
A. SCHOOL LUNCH AND BREAKFAST PARTICIPATION					
Percentage of students in schools that offer:					
Breakfast to students					
8th	72.4	92.6	92.3	81.5	WB,WH
10th & 12th	82.5	94.1	93.3	86.6	WH
Lunch to students					
8th	99.2	99.8	99.6	99.6	WB,WH
10th & 12th	99.0	99.7	99.9	99.8	WH
À la carte lunch items					
8th	85.5	95.8	91.5	85.2	WB,BH
10th & 12th	92.0	89.7	92.1	95.6	
Mean percentage of students who:					
Eat lunch offered by the school					
8th	70.3	69.0	68.1	68.6	
10th & 12th	60.2	60.3	56.6	57.7	
Bring their own lunch					
8th	25.8	23.8	22.4	25.0	
10th & 12th	18.9	13.4	14.1	19.4	WB,WH
Go off-campus to buy lunch					
8th	—	—	—	—	
10th & 12th	11.6	4.0	15.9	11.9	WB,BH
Percentage of students in schools that participate in the USDA reimbursable National School Lunch Program					
8th	86.8	91.6	94.8	87.1	WH
10th & 12th	84.6	92.9	92.8	86.1	WB,WH
Percentage of students in schools that participate in the USDA-sponsored Team Nutrition program					
8th	40.0	68.4	49.3	48.0	WB,BH
10th & 12th	42.9	53.8	48.1	38.6	
B. MENU PLANNING					
Percentage of students by the menu planning system that schools utilize:					
Nutrient Standard Menu Planning (NuMenus)					
8th	29.1	37.3	42.5	26.5	
10th & 12th	28.2	42.7	42.3	32.4	WH
Assisted Nutrient Standard Menu Planning (Assisted NuMenus)					
8th	5.9	10.4	5.5	5.9	
10th & 12th	5.6	10.6	4.2	5.4	BH
Enhanced Food-Based Menu Planning					
8th	14.9	10.2	13.9	22.2	
10th & 12th	16.0	13.6	16.3	15.8	
Traditional Food-Based Menu Planning					
8th	51.4	49.3	33.6	49.2	
10th & 12th	54.5	67.7	49.7	47.7	
Other menu planning					
8th	11.3	12.4	14.3	10.3	
10th & 12th	10.1	12.4	8.7	16.0	
Percentage of students by organization that makes the decision about menus and food service:					
School					
8th	39.5	29.1	23.8	30.9	WH
10th & 12th	42.2	33.1	49.0	40.1	
District					
8th	75.4	89.3	81.5	79.8	WB
10th & 12th	65.0	84.3	79.1	73.4	WB,WH
External contractor					
8th	6.3	6.3	16.4	9.0	WH,BH
10th & 12th	17.2	13.2	17.9	20.9	
C. MORE AND LESS HEALTHY FOOD TYPES					
Mean number of days per week that brand-name fast food is offered to students through:					
À la carte lunch items					
8th	0.8	0.5	0.7	0.8	
10th & 12th	1.0	0.9	1.9	1.6	WH,BH
School lunch meals					
8th	0.6	0.4	0.8	0.7	
10th & 12th	0.4	0.5	0.8	0.7	WH
Percentage of students in schools that offer more healthy foods (in vending machines, school/student stores, or snack bars/carts) such as:					
Lowfat salty snacks[a]					
8th	54.4	48.8	62.6	61.4	
10th & 12th	82.2	67.6	73.2	83.4	WB

(continued on next page)

Table 2. Food availability by student race/ethnicity: 2004–2005 *(continued)*

	Student race/ethnicity				Sig. racial/ethnic comparison
	White	Black	Hispanic	Other	
Lowfat cookies, crackers, & others[b]					
8th	42.2	30.1	30.9	48.4	
10th & 12th	56.0	49.1	42.4	56.1	
Lowfat or fat-free ice cream[c]					
8th	33.8	25.5	31.4	30.8	
10th & 12th	38.3	44.3	34.9	44.5	
Fruits or vegetables[d]					
8th	62.7	46.5	60.6	55.9	WB
10th & 12th	62.9	63.1	76.3	71.0	WH
Mean number of more healthy food types[e] available to students from vending machines, school/student stores, or snack/bar carts					
8th	1.9	1.5	1.9	2.0	
10th & 12th	2.4	2.2	2.3	2.5	
Percentage of students in schools that offer less healthy foods (in vending machines, school/student stores, or snack bars/carts) such as:					
Candy[f]					
8th	44.6	37.7	52.3	37.1	
10th & 12th	75.0	71.6	70.3	72.8	
Salty snacks not low in fat[g]					
8th	62.7	54.3	60.8	56.0	
10th & 12th	85.6	79.7	83.7	86.0	
Cookies not low in fat[h]					
8th	67.6	60.8	57.1	63.8	
10th & 12th	84.7	81.9	78.9	86.8	
Ice cream not low in fat[i]					
8th	46.6	40.4	53.9	43.7	
10th & 12th	52.4	57.0	66.5	51.6	WH
Mean number of less healthy food types[j] available to students from vending machines, school/student stores, or snack bars/carts					
8th	2.2	1.9	2.2	2.0	
10th & 12th	3.0	2.9	3.0	3.0	
Mean number of more healthy à la carte food types[k] available to students in the cafeteria at lunch					
8th	2.3	1.9	2.2	2.3	
10th & 12th	2.7	2.4	2.4	2.8	
Mean number of less healthy à la carte food types[l] available to students in the cafeteria at lunch					
8th	2.0	1.7	2.0	1.7	
10th & 12th	2.4	2.1	2.4	2.5	
Mean number of more healthy food types offered during lunch meals[m]					
8th	9.3	10.2	9.3	9.6	WB
10th & 12th	9.4	9.3	9.9	10.0	WH,BH

Notes: Between-race/ethnicity differences are indicated in the column "Sig. Racial/Ethnic Comparison" with a minimum significance level of $p<0.05$. WB=White-Black, WH=White-Hispanic, and BH=Black-Hispanic. "—" indicates less than 0.5 percent but greater than zero percent. Percentages represent school-level estimates of the corresponding variable by race/ethnicity. For example, white students attend schools where 11.6% of 10th and 12th graders go off campus to buy lunch. It is not the percentage of white students who go off campus to buy lunch.

[a]Includes lowfat snacks such as pretzels, baked chips, or other lowfat chips, among others.

[b]Includes lowfat cookies, crackers, cakes, pastries, and other lowfat baked goods.

[c]Includes lowfat or fat-free ice cream, frozen yogurt, sherbet, or lowfat or nonfat yogurt.

[d]Does not include fruit or vegetable juice.

[e]The number of items range from 0–4 and are based on the four sets of more healthy items listed in a–d.

[f]Includes any type of candy.

[g]Includes salty snacks that are not low in fat, such as regular potato chips.

[h]Includes cookies, crackers, cakes, or other baked goods that are not low in fat.

[i]Includes ice cream or frozen yogurt that is not low in fat.

[j]The number of items range from 0–4 and are based on the four sets of less healthy items listed in f–i.

[k]Range is 0–4. Items include lowfat salty snacks, cookies, crackers, cakes, pastries, other baked goods, lowfat or fat-free ice cream, frozen yogurt, sherbet, fruits, or vegetables.

[l]Range is 0–4. Items include candy, salty snacks (e.g., regular potato chips), cookies, crackers, cakes, other baked goods, ice cream, or frozen yogurt, that are not low in fat.

[m]Index that measures extent to which students are offered a choice of more and less healthy items as part of lunch meals (not à la carte). Possible range of responses is 0–16 with higher scores representing greater availability of healthy food choices.

*$p<0.05$; **$p<0.01$; ***$p<0.001$.

middle school students (1.9 items) than for high school students (2.4 items) ($p<0.001$) (Table 1C).

The reported rates of availability for all of the less-healthy food classes also are lower for middle school students, with three of the four differences reaching statistical significance: candy (44% in middle school vs 74% in high school, $p<0.001$), salty snacks not low in fat (61% vs 85%, $p<0.001$), cookies and other baked goods not low in fat (66% vs 84%, $p<0.001$), and ice cream (46% vs 54%, not significant). As is the case with

the availability of more-healthy snacks, high school students have a significantly higher mean number of the less-healthy food items (3.0 items) available to them than middle school students (2.1 items) ($p<0.001$) (Table 1C). Put another way, high school students on average have a greater variety of food types from which to choose, both those more and less healthy.

The availability of four healthier (lowfat salty snacks, cookies, and ice cream, and fruits or vegetables) and four less-healthy (salty snacks, cookies, and ice cream that are not low in fat, and candy) food choices was also examined for the à la carte items in the cafeteria at lunch. (Percentages for the individual types are not shown; only the mean number is provided in Table 1.) Middle school students have a lower mean number of both more-healthy and less-healthy food types than high school students ($p<0.01$) (see Table 1C).

An index was created to measure the extent to which students have access to more-healthy food choices in the school lunch meals (not à la carte). As indicated in the Methods section, there are five food choices categorized as more healthy (having two or more choices of entrée, fruits, vegetables, 100% fruit juices, and milk that is ≤1% fat) and three as less healthy (pizza, French fries, and 2% or whole milk). The index takes into account the frequency with which these food alternatives are offered, and possible values range from 0 to 16. A score of 16 would indicate that the school offers all of the five healthy food item alternatives most or every day and never offers the three less-healthy ones. Actual values range from a low of 2 to a high of 15, with a mean of 9.4 (SD=2.6). The mean of 9.4 indicates that on average schools are doing a good job of offering more-healthy food choices to students; however, there is still plenty of room for improvement by decreasing the number, or the frequency with which, less-healthy food choices are made available.

Finally, as an indicator of the balance of less-healthy versus more-healthy foods being available to students in vending machines, school/student stores, or snack bars/carts, a ratio was calculated of the mean number of less-healthy food types (out of four) divided by the mean number of more-healthy food types (out of four). As shown in Table 4, the ratio was significantly higher than 1.0 for both middle school (1.14) and high school (1.25), indicating that less-healthy food types tend to be more available than the healthier food types; the grade-level difference is not significant.

Racial/Ethnic Differences

The data in Table 2 show the distribution of the dependent variables by race/ethnicity. Significant differences between white–black (denoted as WB in the table), white–Hispanic (WH), and black–Hispanic (BH) students are indicated in the last column.

As shown in Table 2A, virtually all schools offer lunch to students, and although the difference among racial/ethnic groups is statistically significant, it is not substantively significant. Attending schools that offer breakfast varies by race/ethnicity, with white students (72% in middle school, 83% in high school) generally less likely to be attending such schools when compared to black (93% and 94%) and Hispanic (92% and 93%) students. Also, black students in middle schools (96%) are more likely than white (86%) and Hispanic (92%) middle school students to have access to à la carte lunch items ($p<0.05$ in both cases).

Among high school students, white students attend schools in which a slightly higher percentage of students (19%) bring their own lunch versus black students (13%) and Hispanic students (14%) ($p<0.05$ for both differences) (Table 2A). Also, among high school students, black students attend schools in which fewer students go off-campus to buy their lunch than white (4% vs 12%, $p<0.05$) or Hispanic students (4% vs 16%, $p<0.05$). All but three middle schools reported that no students go off-campus to buy lunch.

Higher percentages of black and Hispanic students attend schools that participate in the NSLP (see Table 2A). With respect to the percentage of students in schools that participate in the USDA-sponsored Team Nutrition program, among middle schools, a significant difference exists between black students (68%) and white students (40%, $p<0.05$) as well as Hispanic students (49%, $p<0.05$) (see Table 2A).

Section C of Table 2 provides information on the availability of various other more- or less-healthy food choices by race/ethnicity. For the most part, the differences by race/ethnicity are not statistically significant, although there are some exceptions. In terms of the mean number of days per week that brand-name fast-food items are offered to students as à la carte lunch items, Hispanics in high school, but not middle school, attend schools with a significantly higher mean number of days when these items are offered on the à la carte menu (about 2 days per week) in comparison to white and black students (about 1 day per week) ($p<0.05$) (Table 2C). These fast-food items are also offered most often for lunch meals in high schools attended by Hispanics, with a significantly higher mean number of days than for whites (0.8 vs 0.4, $p<0.05$).

In middle schools, black students are less likely than white students to attend schools that provide fruits and vegetables in vending machines, school/student stores, and snack bars/carts. At the high school level, schools attended by Hispanic students are more likely than those attended by white students to offer fruits and vegetables in these venues, although they are also more likely offer ice cream not low in fat.

In middle schools, black students on average attend schools with a significantly higher mean number of more-healthy food types offered during lunch meals

than do whites (10.2 vs 9.3), but in high schools, it is Hispanic students whose schools offer a higher number of more-healthy food types, compared to either white or black students. In general, these data indicate that racial/ethnic differences tend to differ by grade level and by type of food.

As is shown in Table 4, the ratio of the mean number of less-healthy to more-healthy food types available to students from vending machines, school/student stores, or snack bars/carts is statistically significantly different from 1.0 for all racial/ethnic groups in both grade levels, but the ratios do not differ by race/ethnicity.

Socioeconomic Status Differences

To assess SES differences, linear regressions were run for middle school and high school, using the five-category SES measure (based on the average education level of the student's parents) as a single predictor variable; the results are shown in Table 3. In both middle and high schools there is a negative linear association between SES and the percentage of students who are in schools that offer breakfast to students (Table 3A). The great majority of schools attended by students in all SES strata provide lunch and à la carte selections, and the variation by SES is not significant.

In middle school, SES has a significant negative linear association ($p<0.01$) with the percentage of students who eat lunch offered by the school (Table 3A). Among the lowest SES stratum, school personnel estimate that 71% of students eat the school lunch, compared to 63% among the highest SES stratum. On the other hand, there is a significant positive linear association ($p<0.001$) with the percentage of students who bring their own lunch in both middle and high schools (Table 3A).

There is a significant negative association of SES with the percentage of middle and high school students in schools that participate in the NSLP and with the percentage of high school students who participate in the USDA-sponsored Team Nutrition program (Table 3A). There also is an inverse association of student SES with the percentage of high schools who utilize NuMenus and Assisted NuMenus to plan lunch meals (Table 3B). There is also a negative association of SES with the percentage of high school students in schools where the district makes the decisions about menus and food service ($p<0.01$) (Table 3B). These findings may be indicative of greater efforts being made in lower-SES schools to provide students with meals that meet dietary guidelines and to engage in innovative activities aimed at preventing and reducing obesity in their student populations. It is also possible that larger school systems, which may tend to have a larger proportion of lower-SES youth, are more likely to follow these types of procedures.

Section C of Table 3 provides information on the availability of various more- or less-healthy food choices by the students' SES. In general, the differences by SES in middle schools are not statistically significant, with only two exceptions (number of days fast-food items are featured at school lunch and mean number of more-healthy items available à la carte).

Most of the differences by SES in high schools are also not significant, but there is a clear tendency for schools attended by higher-SES students to have a wider array of more-healthy food items available. There are significant positive associations for availability in vending machines, school/student stores, or snack bars/carts of lowfat salty snacks and fruits and vegetables, as well as a higher mean number of more-healthy snacks in these venues. There is also a significant positive association with the mean number of more-healthy foods available à la carte. However, there is also a significant positive association with the mean number of less-healthy foods available à la carte. Figure 1 provides a graphic display of the data for the four types of more-healthy foods.

Table 4 shows that there is significant variation by SES at the high school level in the ratio of number of less-healthy to more-healthy food choices available to students. Students in the highest SES stratum have a ratio of only 1.15 compared to a ratio of 1.29 in the lowest stratum. This suggests that low-SES students have a less-healthy mix of options available to them from vending machines, school/student stores, and snack bars/carts.

Discussion

Practically all schools in this study offered lunch to their students, and most offered breakfast. The great majority of students (87%) attend schools that participate in the NSLP. The goals and objectives of the USDA-reimbursable NSLP are to provide all students, but particularly low-income students, with proper nutrition. Consistent with those goals, a higher percentage of black and Hispanic students and students of low SES were found to attend schools that participate in this program. However, despite the nearly universal availability of lunch in schools, the percentage of students who actually eat lunch offered by the school is only about 70% for middle school students and 60% for high school students. Thus, significant percentages of students are bringing their own lunch, or, in the case of high school students, going off-campus to eat lunch. These students may not be getting the benefit of nutritious meals, but a much more detailed individual-level study would be required to determine that.

In order to facilitate schools' meeting the nutritional standards set forth by NSLP, the USDA's School Meals Initiative for Healthy Children provides for several

Table 3. Food availability by student SES: 2004–2005

	Student SES						
	1 (Low)	2	3	4	5 (High)	b	Sig. Linear Assoc.
Approx N total	2,760	8,449	9,840	10,544	5,950		
Approx N 8th	1,005	3,046	3,262	3,813	2,241		
Approx N 10th & 12th	1,755	5,403	6,577	6,732	3,709		
A. SCHOOL LUNCH AND BREAKFAST PARTICIPATION							
Percentage of students in schools that offer:							
Breakfast to students							
8th	91.5	83.9	79.6	75.3	62.6	−6.43	***
10th & 12th	93.2	87.7	84.7	82.3	83.8	−2.15	*
Lunch to students							
8th	99.6	99.5	99.6	99.3	98.7	−0.20	
10th & 12th	99.8	99.4	99.2	99.2	98.8	−0.19	
A la carte lunch items							
8th	85.9	86.0	85.3	86.9	91.5	1.30	
10th & 12th	92.3	91.6	92.0	92.3	92.4	0.18	
Mean percentage of students who:							
Eat lunch offered by the school							
8th	71.4	73.1	71.6	68.7	63.2	−2.45	**
10th & 12th	60.4	61.9	59.8	59.0	56.8	−1.22	
Bring their own lunch							
8th	21.1	21.6	23.2	26.5	32.2	2.93	***
10th & 12th	12.5	14.9	17.7	19.5	22.5	2.44	***
Go off-campus to buy lunch							
8th	0.0	0.1	0.0	0.0	0.0	−0.01	
10th & 12th	11.4	9.9	10.6	12.0	12.4	0.63	
Percentage of students in schools that participate in the USDA reimbursable National School Lunch Program							
8th	95.0	93.2	91.0	85.9	77.1	−4.54	**
10th & 12th	95.4	93.3	89.5	82.3	74.5	−5.65	***
Percentage of students in schools that participate in the USDA-sponsored Team Nutrition program							
8th	48.5	44.7	47.2	42.6	42.2	−1.39	
10th & 12th	50.2	48.9	46.4	41.3	35.6	−3.95	**
B. MENU PLANNING							
Percentage of students by the menu planning system that schools utilize:							
Nutrient Standard Menu Planning (NuMenus)							
8th	36.2	31.7	32.1	31.3	23.8	−2.24	
10th & 12th	43.8	32.9	32.4	28.6	27.2	−3.11	*
Assisted Nutrient Standard Menu Planning (Assisted NuMenus)							
8th	10.4	7.2	7.0	5.2	4.1	−1.32	
10th & 12th	8.1	7.0	7.2	4.9	3.8	−1.12	*
Enhanced Food-Based Menu Planning							
8th	13.3	15.7	15.9	16.2	14.1	0.03	
10th & 12th	15.8	13.7	16.1	17.0	15.5	0.54	
Traditional Food-Based Menu Planning							
8th	44.8	48.2	46.6	49.5	56.5	2.37	
10th & 12th	53.6	57.2	56.1	53.9	52.2	−1.08	
Other menu planning							
8th	9.3	8.1	10.5	12.1	17.8	2.38	
10th & 12th	9.8	10.0	9.7	11.2	13.7	0.10	
Percentage of students by organization that makes the decision about menus and food service:							
School							
8th	34.7	36.1	36.5	34.5	37.5	0.19	
10th & 12th	40.1	36.0	41.5	45.4	43.0	2.20	
District							
8th	81.2	78.0	77.6	76.6	78.7	−0.44	
10th & 12th	79.5	74.6	70.8	65.1	62.1	−4.46	**
External contractor							
8th	10.4	8.7	8.1	7.3	5.2	−1.13	
10th & 12th	13.3	14.6	16.3	18.3	21.9	2.14	
C. MORE- AND LESS-HEALTHY FOOD TYPES							
Mean number of days per week that brand-name fast food is offered to students through:							
À la carte lunch items							
8th	0.8	0.6	0.8	0.9	0.8	0.07	
10th & 12th	1.4	0.9	1.0	1.1	1.1	0.07	
School lunch meals							
8th	0.5	0.4	0.6	0.8	0.7	0.11	*
10th & 12th	0.6	0.4	0.5	0.5	0.5	−0.01	

(continued on next page)

Table 3. Food availability by student SES: 2004–2005 *(continued)*

	Student SES						
	1 (Low)	2	3	4	5 (High)	b	Sig. Linear Assoc.
Percentage of students in schools that offer more healthy food types (in vending machines, school/student stores, or snack bars/carts) such as:							
Lowfat salty snacks[a]							
8th	55.8	53.0	53.6	56.3	61.3	1.86	
10th & 12th	69.6	76.4	78.8	82.1	87.6	3.89	***
Lowfat cookies, crackers, and others[b]							
8th	36.7	36.6	37.7	43.0	49.9	3.64	
10th & 12th	47.1	52.7	52.9	55.1	59.6	2.43	
Lowfat or fat-free ice cream[c]							
8th	28.2	28.1	31.3	33.9	39.3	3.05	
10th & 12th	33.3	38.8	38.9	39.2	44.0	1.78	
Fruits or vegetables[d]							
8th	53.9	59.0	59.8	60.8	63.6	1.77	
10th & 12th	64.4	58.7	61.5	66.9	75.6	3.93	**
Mean number of more healthy food types[e] available to students from vending machines, school/student stores, or snack/bar carts							
8th	1.7	1.8	1.8	1.9	2.1	0.10	
10th & 12th	2.1	2.3	2.3	2.4	2.7	0.12	***
Percentage of students in schools that offer less healthy foods (in vending machines, school/student stores, or snack bars/carts) such as:							
Candy[f]							
8th	48.6	47.6	46.0	42.7	34.5	−3.51	
10th & 12th	69.5	74.8	73.3	74.1	76.1	0.86	
Salty snacks not low in fat[g]							
8th	57.3	63.4	61.1	58.6	62.4	−0.11	
10th & 12th	78.6	83.4	83.9	85.9	89.2	2.12	*
Cookies not low in fat[h]							
8th	60.5	67.8	64.5	64.6	67.5	0.44	
10th & 12th	74.2	83.1	85.2	84.9	87.0	2.04	
Ice cream not low in fat[i]							
8th	48.8	44.2	43.6	46.3	52.4	1.48	
10th & 12th	54.4	52.8	53.4	54.4	55.9	0.65	
Mean number of less healthy food types[j] available to students from vending machines, school/student stores, or snack bars/ carts							
8th	2.1	2.2	2.1	2.1	2.1	−0.02	
10th & 12th	2.8	2.9	3.0	3.0	3.1	0.05	
Mean number of more healthy à la carte food types[k] available to students in the cafeteria at lunch							
8th	2.1	2.1	2.1	2.3	2.6	0.13	**
10th & 12th	2.4	2.5	2.6	2.7	2.8	0.09	**
Mean number of less healthy à la carte food types[l] available to students in the cafeteria at lunch							
8th	1.8	1.9	1.9	1.9	1.9	0.01	
10th & 12th	2.2	2.3	2.4	2.5	2.5	0.08	*
Mean number of more healthy food types offered during lunch meals[m]							
8th	9.1	9.2	9.2	9.5	9.9	0.19	
10th & 12th	9.5	9.4	9.4	9.5	9.6	0.04	

Notes: The column labeled "b" refers to the unstandardized regression coefficient obtained from the OLS regression analyses that were utilized to determine if a linear association exists between SES and each of the dependent variables (items in rows). Significance of regression coefficients is indicated with asterisks in the column "Sig. Linear Assoc." Percentages represent school-level estimates of the corresponding variable by student SES. For example, students of low SES backgrounds attend schools where 11.4% of 10th and 12th graders go off campus to buy lunch. It is not the percentage of low-SES students who go off campus to buy lunch.

[a]Includes lowfat snacks such as pretzels, baked chips, or other low-fat chips, among others.

[b]Includes lowfat cookies, crackers, cakes, pastries, and other lowfat baked goods.

[c]Includes lowfat or fat-free ice cream, frozen yogurt, sherbet, or lowfat or nonfat yogurt.

[d]Does not include fruit or vegetable juice.

[e]The number of items range from 0–4 and are based on the four sets of more healthy items listed in a–d.

[f]Includes any type of candy.

[g]Includes salty snacks that are not low in fat, such as regular potato chips.

[h]Includes cookies, crackers, cakes, or other baked goods that are not low in fat.

[i]Includes ice cream or frozen yogurt that is not low in fat.

[j]The number of items range from 0–4 and are based on the four sets of less healthy items listed in f–i.

[k]Range is 0–4. Items include lowfat salty snacks, cookies, crackers, cakes, pastries, other lowfat baked goods, lowfat or fat-free ice cream, frozen yogurt, sherbet, fruits, or vegetables.

[l]Range is 0–4. Items include candy, salty snacks (e.g., regular potato chips), cookies, crackers, cakes, other baked goods, ice cream, or frozen yogurt, that are not low in fat.

[m]Index that measures the extent to which students are offered a choice of more and less healthy items as part of lunch meals (not à la carte). Range of responses is 0–16 with higher scores representing greater availability of healthy food choices.

$^{*}p<0.05$;$^{**}p<0.01$;$^{***}p<0.001$.

OLS, ordinary least squares; SES, socioeconomic status.

Table 4. Ratio (and standard error) of the average number of less healthy to more healthy food types available to students from vending machines, school/student stores, or snack bars/carts by grade level, race/ethnicity, and SES: 2004–2005

		Student race/ethnicity				Student SES					Sig. linear assoc.
Grade	All students	White	Black	Hispanic	Sig.	1 (Low)	2	3	4	5 (High)	
8th	1.14(0.08)	1.14(0.08)	1.24(0.13)	1.21(0.16)	—	1.22(0.10)	1.26(0.09)	1.18(0.08)	1.09(0.09)	1.00(0.07)	—
10th & 12th	1.25(0.05)	1.24(0.05)	1.29(0.12)	1.31(0.11)	—	1.29(0.09)	1.30(0.06)	1.27(0.06)	1.23(0.06)	1.15(0.06)	*

Note: All ratios are significantly different from the Null of 1.00 at $p<0.001$ with the exception of ratios for SES=4 and SES=5 among 8th graders, which were not significantly different from 1.00. Standard errors are given in parentheses next to the ratios. Columns labeled "Sig." and "Sig. linear assoc." indicate significant ratio differences between racial/ethnic groups and significant linear association with SES, respectively.
*$p<0.05$.

menu planning options.[20] These are the traditional food-based menu planning and enhanced food-based menu planning systems, and two computer-based systems using USDA-approved software, the NuMenus and Assisted NuMenus systems. Over 50% of students attend schools that use the traditional system, about 31% are in schools that use NuMenus, nearly 16% are in schools that use the enhanced system, and about 6% are in schools that use the Assisted NuMenus. There were no between-grade differences in the use of these menu planning systems, and few differences among racial/ethnic and socioeconomic groups.

With regard to where menu planning takes place, black and Hispanic students, as well as low-SES students, are more likely than white students to attend schools where decisions are made at the district level, particularly among high schools. This may reflect their attending public schools located in larger school districts, such as in urban settings, where centralized decision-making may be more the norm.

The Team Nutrition program is another USDA Food and Nutrition Service–sponsored initiative ". . . to support the Child Nutrition Programs through training and technical assistance for food service, nutrition education for children and their caregivers, and school and community support for healthy eating and physical activity."[21] Less than half of all students (44%) attend schools that participate in Team Nutrition. Generally, a

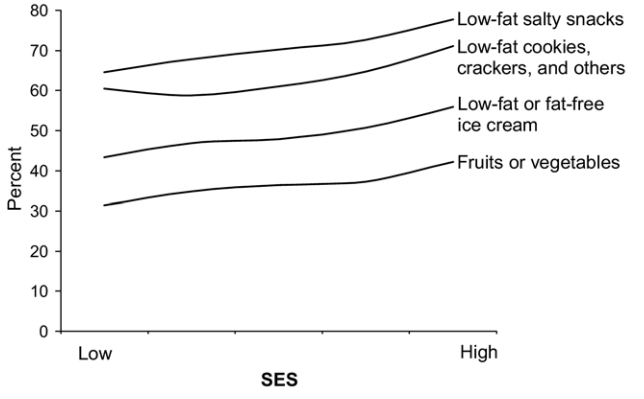

Figure 1. More healthy snacks: percentage of students that attend schools that have them available in vending machines, school or student stores, or snack bars or carts, by SES.

greater percentage of black students and those of low SES attend schools that utilize this service. Greater effort is needed by the USDA to encourage and facilitate more schools participating in this program.

Further examination of school food activities revealed that schools, on average, offer brand-name fast-food items to students through school lunch meals about once a week and through à la carte lunch items about once every 2 weeks, with Hispanic high school students being exposed to these foods more frequently. Reducing the availability of fast-food items served in schools, particularly in schools with high Hispanic enrollment, may serve as a target of interventions that over time might contribute to lowering the percentage of overweight and obese youth.

Some interesting patterns emerged when the availability of the more- and less-healthy food items sold in vending machines, school/student stores, and snack bars/carts was examined. First, a greater percentage of high school students than middle school students have access to both more-healthy and less-healthy food choices. The increased access to a larger variety of snacks may be because high schools, which are larger on average than middle schools, have more vending machines, stores, and snack bars/carts. By way of contrast, there were no differences in the percentage of high school students and middle school students who have access to fruits and vegetables; the majority (63%) of students attend schools that provide this option. However, that leaves more than one in three students without the option of fruits or vegetables from vending machines, school/student stores, or snack bars/carts. Second, there were no consistent differences among racial/ethnic groups in the availability of these products.

Third, there were some differences observed in high schools as a function of SES. High-SES students tend to attend schools with greater access to a variety of the healthier snacks. The fact that lower-SES students have less access to healthier snacks suggests that more needs to be done to increase the availability of healthy snacks to low-SES students. The association of SES with availability of less-healthy snacks was not consistent or as strong, which may suggest that all groups stand to benefit, and if anything higher-SES groups a bit more,

from a diminished availability of such items as cookies and pastries, salty snacks, and ice cream.

Finally, as shown in Table 4, the ratio of less-healthy (four food items) to more-healthy types of snacks (four food items) is significantly higher than 1.0 across all student subgroups, reflecting a relatively high ease of access to less-healthy food types. One would like to see this ratio decline in the coming years, as a result of the healthier types of snacks becoming more available and the less-healthy ones becoming less available. Ideally, the largest increase should occur with fruits and vegetables, by far the healthiest food choices, yet presently, the least available.

Limitations

This study, like most, has limitations that should be kept in mind in interpreting the findings. The school-level data are based on the responses from school administrators (mostly principals) and food service managers through self-administered questionnaires, and there is always the possibility of errors in reporting due to lack of knowledge, misunderstanding, or social desirability bias. However, the types of respondents chosen are responsible people who are quite knowledgeable about the subjects about which they are asked. Moreover, to minimize errors, participants who provided incomplete answers, or whose answers to related questions appeared inconsistent, were recontacted by phone or letter by a research staff member to clarify or complete the answers. Despite the large student sample sizes, it was not possible to analyze data for the various Hispanic subgroups separately nor to disaggregate the residual racial/ethnic category of "Other." Parent education was chosen for the measurement of SES for the reasons discussed in another paper in this supplement[22]; other measures might have been developed, but this measure showed a number of systematic and important differences. Finally, although the number of schools (over 300) is large by most standards, it is still somewhat limited, resulting in limited power. Thus, it is suspected that some observed differences that do not reach statistical significance in fact reflect real differences. As of this writing, a national mailing targeting 600 schools is underway precisely to increase analytic power. These data will permit ongoing monitoring of food and beverage choices in American schools with larger sample sizes.

Conclusion

These findings provide a comprehensive assessment of the types of foods, and their general availability to students, in schools across the nation. While it is encouraging to see that healthy food alternatives such as lowfat snacks and fruits and vegetables are being made available to many students, the study findings are consistent with the recommendations made by the Institute of Medicine (IOM) that calls for schools to limit the availability of competitive foods, but when available, to increase the availability of healthier food choices such as fruits, vegetables, and nonfat or lowfat foods.[23] It is recommended that greater attention be paid particularly to schools with higher concentrations of racial/ethnic minorities and youth of lower SES. In October 2006, the Alliance for a Healthier Generation (a partnership of the American Heart Association and the William J. Clinton Foundation) reached a snack foods agreement with Campbell Soup Company, Dannon, Kraft Foods, Mars, and PepsiCo relating to the nutritional contents of competitive foods sold in the schools, creating the "Nutritional Guidelines for Competitive Foods." It is believed that through ongoing monitoring, as this study offers, it will be possible to measure and understand the extent to which the nascent nutrition-related policies enacted at the federal, state, district, and school levels, including those stemming from partnerships between the food industry and nonfood industry organizations,[24] are being diffused into the nation's schools and contributing to halting and perhaps even reversing the obesity epidemic among children.

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The Availability of Fast-Food and Full-Service Restaurants in the United States

Associations with Neighborhood Characteristics

Lisa M. Powell, PhD, Frank J. Chaloupka, PhD, Yanjun Bao, PhD

Background: Parallel to the rising obesity epidemic, food consumption patterns and household expenditures show a marked upward trend in total energy intake derived from away-from-home sources.

Methods: This study conducted cross-sectional multivariate analyses to examine associations between local-area racial, ethnic, and income characteristics and the availability of full-service and fast-food restaurants. Based on a U.S. national census of 28,050 ZIP codes that cover a population of 280,675,874 people, restaurant outlet data were linked to 2000 Census Bureau data based on ZIP code tabulation areas and analyses were undertaken using negative binomial count models and ordinary least squares regression analyses.

Results: Study results showed that higher- versus lower-income, predominantly black and racially mixed versus predominantly white and Hispanic versus non-Hispanic neighborhoods had fewer available full-service and fast-food restaurants. Near-low- and middle-income neighborhoods had the highest number of available restaurants with 1.24 and 1.22 times number of full-service restaurants and 1.34 and 1.28 times the number of fast-food restaurants compared to high-income neighborhoods. Predominantly black neighborhoods were found to have 58.2% and 59.3% of the number of full-service and fast-food restaurants available in predominantly white neighborhoods. No statistically significant differences were found in the relative availability of fast-food versus full-service restaurants by income, race, or ethnicity in the national sample used. However, across urban areas, near-low-, middle-, and near-high- versus high-income neighborhoods and predominantly black versus white neighborhoods were found to have moderately higher proportions of fast-food among total restaurants.

Conclusions: In urban areas, higher proportions of available fast-food restaurants out of total restaurants in predominantly black versus predominantly white neighborhoods may contribute to racial differences in obesity rates.

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Introduction

Recent estimates from the National Health and Nutrition Examination Survey (NHANES) 2003–2004 reveal that 66.3% of the United States adult population is overweight and close to one third are obese.[1] The prevalence of overweight among children and adolescents (age- and gender-specific body mass index [BMI] ≥95th percentile) has reached 11.5%, 17.7%, and 17.3% among children aged 2–5 years, 6–11 years, and 12–19 years, respectively.[1] The data also show that overweight and obesity do not affect all populations equally, with higher rates generally found for non-Hispanic black persons and Mexican Americans compared to whites.

Parallel to the rising obesity epidemic, data based on nationwide surveys of food consumption patterns and household expenditures show a marked upward trend in total energy intake derived from away-from-home sources, in particular fast-food outlets.[2–4] Several studies have shown that fast-food consumption is associated with higher total energy intake and higher intake of fat, saturated fat, carbohydrates, sugar, and carbonated soft drinks, and lower intake of micronutrients and fruits and vegetables.[5–12] Further, studies have found significant associations between fast-food consumption and increased BMI,[6] increased body weight,[7] and a higher probability of being overweight.[11] However, the relationship between fast-food restaurant availability and weight outcomes is mixed.[13–15]

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An emerging body of literature suggests that the availability of local-area restaurants and fast-food restaurants is associated with the racial and socioeconomic composition of the neighborhood, but there is no consensus in terms of reported findings. Based on a sample drawn across four states, Morland et al.[16] found that full-service restaurants were 2.4 times as prevalent in predominantly white neighborhoods and 3.4 times more prevalent in racially mixed neighborhoods compared to predominantly black neighborhoods. Fast-food restaurants were found to be 1.5 times as prevalent in white neighborhoods and 2.3 times as prevalent in racially mixed neighborhoods compared to predominantly black neighborhoods. Block et al.[17] examined fast-food restaurant density for 156 census tracts within the city limits of New Orleans LA and found that larger numbers of fast-food restaurants were available in census tracts with higher proportions of black residents.

By income, Morland et al.[16] found fast-food restaurants to be more prevalent in neighborhoods that fell into the second- and middle-income quintiles. Lewis et al.[18] found that, in South Los Angeles, less affluent neighborhoods had significantly higher proportions of fast-food restaurants (25.6%) compared to more affluent areas (11.2%). Their results also showed that the availability of healthy options both in terms of preparation methods and by menu choice was significantly higher in more affluent areas compared to their less affluent counterparts. Reidpath et al.[19] found that across four income categories, persons living in Australia in postal districts with the lowest individual median weekly incomes had 2.5 times the exposure to fast-food restaurants compared to those living in districts with the highest incomes. However, in a recent study based on data from Glasgow Scotland, Macintyre et al.[20] found that the likelihood of the presence of an out-of-home eating outlet was lower in deprived neighborhoods.

Systematic differences by race, ethnicity, or income levels in the local-area availability of full-service and fast-food restaurant options may put different groups at different levels of risk for sustaining a healthy diet. Based on a national sample (full census excluding ZIP codes that are P.O. boxes and those with a population of less than 300) of 28,050 ZIP codes in the U.S. that cover a population of 280,675,874 people, this study used multivariate analyses that controlled for population, urbanization, and region to examine associations between local-area racial, ethnic, and income characteristics and the availability of full-service and fast-food restaurants. This study also examined the extent to which the proportion of available fast-food restaurants out of the total number of available restaurants differed by community characteristics.

Methods

Restaurant Outlet Measures

Data on full-service and fast-food restaurant outlets were drawn from a national business list developed by Dun and Bradstreet (D&B).[21] This list was obtained through the use of D&B MarketPlace software. MarketPlace contains information on more than 14 million businesses in the U.S. and uses the following sources to help update its database quarterly: telecenters to update and verify their data; Yellow Page directories that are matched against its database to identify new businesses; news and media sources that are monitored daily to identify businesses that have merged, been acquired, closed, or claimed bankruptcy; government registries to identify business registration information; and, websites, including its own where businesses have the ability to review and update their own information. D&B utilizes "match grade" technology to consolidate multiple business listings into one complete record. This matching technology ensures that there are no duplicate entries of the same business and that data are not matched to the wrong business. D&B also assigns each business a unique numerical identifier to ensure validity of its data over time. This nine-digit number is never recycled and allows D&B to easily track changes and updates for all businesses contained in its database. MarketPlace allows sorting by multiple criteria such as ZIP code and Standard Industry Classification (SIC) codes with SIC code searches for specific types of businesses available at varying levels of specificity. This study drew on the primary SIC code listing in creating the list of outlets used for this analysis.

Restaurant outlet data for the year 2000 available from D&B under the 4-digit classification of "Eating Places" were used. Fast-food restaurants were defined by the full set of 8-digit SIC codes (excluding coffee shops) that fell under "fast-food restaurants and stands" plus the two 8-digit SIC codes for chain and independent pizzerias. Nonfast–food restaurants, referred to as full-service restaurants, were defined as the total number of "Eating Places" minus fast-food restaurants and excluding coffee shops; ice cream, soft drink and soda fountain stands; caterers; and contract food services. A total of 259,182 full-service restaurants and 69,219 fast-food restaurants were retrieved from the D&B database.

Across the 28,050 ZIP codes in the sample, approximately 78% of ZIP codes had at least one restaurant. The sample of 21,976 ZIP codes with at least one restaurant was used in the analyses that examined fast-food restaurant availability as a proportion of total restaurants. Table 1 shows that ZIP codes had, on average, 12.9 restaurants of which 2.5 (or 19.1%) were fast-food restaurants and 10.4 were full-service restaurants.

Census Bureau Population, Socioeconomic Status (SES), and Control Measures

Census Bureau neighborhood population and socioeconomic data along with measures of urbanization and region were matched to the outlet density data for each of the 28,050 ZIP codes based on census ZIP code tabulation areas.[22,23] The ZIP code sample represented in this study was the full census of ZIP codes excluding postal office box addresses and ZIP codes that had a population of fewer than 300 people (the sample of 28,050 ZIP codes accounted for 99.8% of the U.S.

Table 1. Summary statistics: outcome variables

	Mean number of outlets		
	Total restaurants	**Full-service restaurants**	**Fast-food restaurants**
Full sample (N=28,050)	12.9046 (21.0710)	10.4369 (17.4011)	2.4677 (4.2141)

	Proportion of fast-food restaurants out of total restaurants	
	All ZIP codes (N=21,976)	**Urban areas ZIP codes (N=4,272)**
Sample of ZIP codes that have at least one restaurant	0.1550 (0.1827)	0.1931 (0.1187)

Notes: Standard deviations are shown in parentheses.

population). The following variables were drawn from the 2000 Census.

Race/ethnicity. Racial composition of the ZIP code was defined by three categories: predominantly white (population of 70% or greater white), predominantly black (population of 70% or greater black), or racially mixed (population less than 70% white and less than 70% black). Ethnicity was defined by a dichotomous variable of predominantly Hispanic if the ZIP code had a Hispanic population of ≥70%. In the ZIP codes used in this study, the majority (75%) of the U.S. population base was white, while African Americans made up about 12% of the population. On average, 12.5% of the population was Hispanic. Table 2 shows that approximately 69% of ZIP codes had a predominantly white population, 4% had a predominantly black population and 28% were racially mixed. Among all ZIP codes, 3% were predominantly Hispanic.

Income. The income variable was defined by median household income. Dichotomous indicators were created for each income quintile category. Table 2 shows that median household income averaged about $45,000 across ZIP codes. Across the 28,050 ZIP codes, the income quintiles had the following income cut-offs: low income (less that $29,066), near-low income (≥$29,066 and <$34,291), middle income (≥$34,291 and <$40,049), near-high income (≥$40,049 and <$49,905), and high income (≥$49,905). Note that the income quintile cut-off values differed for the subsample of ZIP codes with a positive number of restaurants.

Control variables. For each ZIP code, total population size was included. ZIP codes were populated, on average, by about 10,000 people. In addition, for each ZIP code, a variable was added to describe its degree of urbanization. In the Census 2000, urban areas were defined by two types—urbanized areas and urban clusters. Urbanized areas were defined by an urban nucleus of 50,000 or more people with a population density of 1000 persons per square mile. Urban clusters consisted of densely settled areas with a population of at least 2500 but less than 50,000 persons. The remaining non-urban areas were defined as rural nonfarm and rural farm per the census farm definition. In this paper, these definitions were used to create four urbanization categories: urban (urbanized area), suburban (urban cluster), rural (rural nonfarm), and farm (rural farm). These variables were defined by the percentage of the ZIP code's population that fell into each category based on aggregations of block groups and census blocks. Finally, region (South, West, Midwest, and Northeast) was also controlled.

Analysis

Multivariate analyses were used to examine the availability of full-service and fast-food restaurants and associations with neighborhood characteristics on race, ethnicity, and income, with additional controls for population size, urbanization, and region. Given the count nature of the outlet density

Table 2. Summary statistics of census variables

		Sample of ZIP codes that have at least one restaurant	
Variables	**Full sample**	**All ZIP codes**	**Urban area ZIP codes**
Median household income[a] (in $1,000)	44.83 (17.12)	44.99 (17.14)	45.52 (18.42)
Race[a] %			
Predominantly white	69.0	68.7	50.8
Predominantly black	3.5	3.6	7.5
Racially mixed	27.5	27.7	41.8
Ethnicity[a] (predominantly Hispanic) %	2.8	2.9	4.5
Population	10,006.27 (13,423.91)	12,391.94 (14,231.46)	25,046.53 (17,205.68)
Urbanization %			
Urban	29.9	36.8	—
Suburban	9.7	11.6	—
Rural	56.1	48.3	—
Farm	4.3	3.3	—
Region %			
Northeast	18.3	19.5	29.9
Midwest	30.7	29.8	20.9
South	35.2	34.0	29.0
West	15.9	16.6	20.2
Number of ZIP codes (N)	28,050	21,976	4,272

Notes: Standard deviations are shown in parentheses.
[a]Variables are population weighted.

dependent variables, negative binomial count models were estimated to examine the association between the number of available restaurant outlets and the racial, ethnic, and SES composition of the ZIP code, including the additional control variables. All variables were included in the regression models simultaneously. Poisson models were also estimated, but due to the overdispersion of the data, the negative binomial models were more appropriate. Next, a multivariate ordinary least squares (OLS) regression model was estimated to examine similar associations with the proportion of fast-food restaurants out of total restaurants in the ZIP code. These latter OLS models were estimated for the full sample and the urban subsample. To further assess the findings, simulations of the relative availability of fast-food restaurants based on the significant OLS regression results were performed for communities with different racial compositions and income levels.

Results

The results from the multivariate analyses on the availability of full-service and fast-food restaurants are presented in Table 3. The results show that compared to high-income neighborhoods, ZIP codes falling into lower-income quintiles had more restaurants, in particular for near-low- and middle-income neighborhoods. Compared to high-income neighborhoods, full-service restaurants were 1.24 and 1.22 times more readily available in near-low- and middle-income neighborhoods, respectively. Similar patterns were found for fast-food restaurants. The number of available fast-food restaurants was 1.19, 1.28, 1.34, and 1.24 times greater in near-high-, middle-, near-low- and low-income neighborhoods compared to their high-income counterparts. These results are consistent with findings from earlier studies for limited geographic areas.[16,18,19]

Controlling for all other variables, there were significant differences in restaurant availability by the racial composition of the neighborhood. The availability of full-service and fast-food restaurants in predominantly black neighborhoods was 58.2% and 59.3%, respectively, of that in predominantly white neighborhoods. Racially mixed neighborhoods also had significantly fewer restaurants of both types, but to a lesser degree than predominantly black neighborhoods. These results are similar to the findings by Morland et al.[16] who found fewer available full-service and fast-food restaurants in predominantly black versus predominantly white neighborhoods. However, the results in the present study differ from the findings by Block et al.[17] who found greater availability of fast-food restaurants in census tracts with higher proportions of black residents. However, the mean percentage of black residents in the census tracts examined in the Block et al.[17] study was 60.6%, almost five times the national average and while their geographic sample was restricted to reflect an urban and residential area, their regression model did not explicitly account for population size.

By ethnicity, there were significantly fewer restaurants available in predominantly Hispanic neighborhoods, which had 60.9% the number of available

Table 3. Availability of full-service and fast-food restaurants

	Negative binomial regression: incidence-rate ratios (95% CI)		OLS regression: proportion of fast-food restaurants out of total restaurants (SE)	
	Full-service restaurants	**Fast-food restaurants**	**All ZIP codes**	**Urban area ZIP codes**
Income				
Low	1.1203** (1.076, 1.167)	1.235** (1.175, 1.297)	0.006 (0.004)	0.010 (0.006)
Near low	1.236** (1.189, 1.284)	1.336** (1.275, 1.399)	0.004 (0.004)	0.023** (0.006)
Middle	1.223** (1.178, 1.269)	1.278** (1.224, 1.335)	0.002 (0.004)	0.020** (0.006)
Near high	1.145** (1.105, 1.186)	1.194** (1.147, 1.243)	0.005 (0.004)	0.012* (0.006)
Race				
Predominantly black	0.582** (0.535, 0.632)	0.593** (0.541, 0.650)	0.010 (0.009)	0.028** (0.008)
Mixed races	0.899** (0.870, 0.929)	0.891** (0.859, 0.925)	0.005 (0.004)	−0.004 (0.004)
Ethnicity (predominantly Hispanic)	0.609** (0.553, 0.671)	0.558** (0.501, 0.622)	−0.015 (0.010)	0.001 (0.011)
Population (in 1000s)	1.049** (1.047, 1.050)	1.047** (1.046, 1.048)	0.001** (0.0001)	0.0001 (0.0001)
Urbanization				
Suburban	1.344** (1.282, 1.409)	1.768** (1.679, 1.862)	0.040** (0.005)	—
Rural	0.215** (0.207, 0.224)	0.142** (0.135, 0.150)	−0.074** (0.004)	—
Farm	0.004** (0.003, 0.005)	0.0003** (0.0002, 0.0006)	−0.318** (0.025)	—
Region				
Midwest	0.979 (0.945, 1.014)	1.284** (1.230, 1.341)	0.036** (0.004)	0.066** (0.005)
South	0.986 (0.955, 1.019)	1.434** (1.378, 1.492)	0.042** (0.004)	0.060** (0.005)
West	1.052 (1.013, 1.093)	1.069** (1.021, 1.119)	0.007 (0.004)	0.020** (0.005)
Constant	—	—	0.155** (0.004)	0.143** (0.005)
Number of observations	28,050	28,050	21,976	4,272

Note: For the negative binomial regressions, this table reports estimated coefficients (β_i) transformed to incidence-rate ratios (e^{β_i}).
*statistical significance at the 5% level; **statistical significance at the 1% level.
CI, confidence interval; OLS, ordinary least squares; SE, significant error.

full-service restaurants and 55.8% the number of fast-food restaurants compared to non-Hispanic neighborhoods. Suburban neighborhoods had 1.34 times the number of full-service-restaurants and 1.77 times the number of fast-food restaurants compared to urban areas. As expected, rural and farm areas had substantially fewer available restaurants compared to urban areas.

Turning to the relative availability of fast-food restaurants, the results from the OLS regressions on the proportion of fast-food restaurants among total restaurants for the full sample and for the subsample of ZIP codes in urban areas are presented in the last two columns of Table 3. Focusing first on the full sample, the regression estimates revealed no significant differences in the relative availability of full-service and fast-food restaurants by income, race, or ethnicity. However, turning to the results for ZIP codes in urban areas only, the regression estimates showed significant differences in the relative availability of fast-food restaurants by the racial and SES composition of the neighborhood. The results showed that near-low-, middle-, and near-high-income neighborhoods had a statistically significantly higher proportion of fast-food restaurants compared to their high-income counterparts. By race, while predominantly black neighborhoods were found to have significantly fewer restaurants of all types in urban areas (not shown in the tables for the urban sample), such predominantly black urban neighborhoods had a statistically significantly higher proportion of fast-food restaurants among all available restaurants compared to predominantly white urban neighborhoods. The relative availability of fast-food restaurants, however, was not found to differ statistically significantly across racially mixed versus white neighborhoods or predominantly Hispanic versus nonpredominantly Hispanic neighborhoods.

On the basis of the significant regression coefficient estimates in the urban sample, a series of simulations were undertaken in which differences in the proportion of fast-food restaurants among total restaurants were examined according to different neighborhood income and racial characteristics. Evaluated at the mean, the model predicted the relative availability of fast-food restaurants among total restaurants to be 19.31%. Examining differences across income, the relative availability of fast-food restaurants among total restaurants increased moderately by 12.6% when moving from a high-income neighborhood (18.00%) to a near-low-income (20.27%) community. The proportion of fast-food restaurants out of total restaurants increased by 14.3% when moving from a predominantly white neighborhood (19.27%) to a predominantly black neighborhood (22.03%). Simulations of moving from a high-income and predominantly white neighborhood to a near-low-income and predominantly black neighborhood showed that the proportion of fast-food restaurants increased by 28.0% (from 17.96 to 22.99%).

Discussion

Based on the national analysis of restaurant availability in all ZIP codes with a population greater than 300, this study found that high-income neighborhoods had fewer numbers of available full-service and fast-food restaurants compared to all other lower income categories. Near-low- and middle-income neighborhoods were found to have the highest number of available restaurants with 1.24 and 1.22 times the number of full-service restaurants and 1.34 and 1.28 times the number of fast-food restaurants compared to high-income neighborhoods. By race and ethnicity, predominantly black neighborhoods and racially mixed versus white and Hispanic versus non-Hispanic neighborhoods were found to have significantly fewer restaurants of all restaurant types. In particular, predominantly black neighborhoods were found to have only 58.2% and 59.3%, respectively, of the number of available full-service and fast-food restaurants in predominantly white neighborhoods. Predominantly Hispanic neighborhoods had 60.9% and 55.8% the number of available full-service and fast-food restaurants compared to non-Hispanic neighborhoods. No statistically significant differences were found in the relative availability of fast-food versus full-service restaurants by income, race, or ethnicity in the national sample.

However, moderate differences were found to exist in the relative availability of fast-food versus full-service restaurants in the subsample of urban ZIP codes; near-low, middle-, and near-high- versus high-income neighborhoods and predominantly black versus white neighborhoods were found to have higher proportions of fast-food restaurants among total restaurants. The latter findings based on the urban subsample that predominantly black neighborhoods have a higher proportion of fast-food restaurants may compound barriers shown to exist in accessing healthful foods due to the differential availability of food stores by race. Several studies have found that neighborhoods with higher proportions of black residents had fewer available supermarkets,[16,24–26] which, compared to smaller grocery stores and convenience stores, have been shown to offer more healthful foods.[27,28]

The study is subject to several limitations: First, it is cross-sectional, and the reported associations do not account for potential selection effects. Second, the reported associations do not account for potential differences in zoning across ZIP codes. Third, the study is subject to measurement error due to potential inaccuracies in the commercial outlet density data. And fourth, ZIP code area outlet density data were matched with census-derived ZIP code tabula-

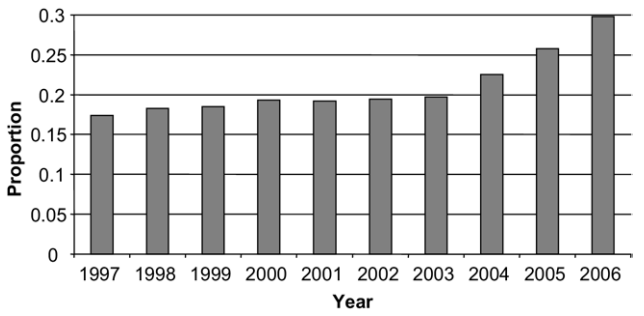

Figure 1. Proportion of fast-food restaurants out of total restaurants, 1997–2006. Data Source: D&B Marketplace 1997–2006. Authors' calculations based on restaurant definitions used in this study.

tion area data which may result in potential spatio-temporal mismatches.[29]

Based on the restaurant definitions used in the study, the number of fast-food restaurants in the U.S. doubled over the last decade while the number of full-service restaurants remained relatively constant. Figure 1 shows the related increase in the proportion of fast-food restaurants among total restaurants based on D&B outlet density data from 1997 to 2006. Nationally, in 2006, fast-food restaurants made up roughly 30% of all restaurants, up from 17% in 1997, an increase of 71%. Most of this increase has occurred in the last 3 years. This dramatic increase in the absolute and relative availability of fast-food restaurants may be associated with increased fast-food consumption and lower-quality diets for the population as a whole. The extent to which recent increases in the availability of fast-food restaurants differ by income and race warrants continued investigation. Further, the question of causality in the association between access to fast-food restaurants and diet and weight outcomes remains an important area for future research.

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Missed Opportunities

Local Health Departments as Providers of Obesity Prevention Programs for Adolescents

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Background: This study examined the availability of local health department programs related to youth healthy eating, obesity control, and physical activity.

Methods: Data were obtained in the spring and summer of 2003. Selection of communities was based on a nationally representative sample of 8th-, 10th-, and 12th-grade students. Health departments with jurisdiction over these communities were contacted. Information was collected on departmental activities around healthy eating, weight loss, and physical activity.

Results: Results reveal that on average less than half the health departments surveyed provide, support, or advocate for programs targeting these activities. While the majority of informants indicated that these programs are of high priority, there is still an opportunity for health departments to expand these types of services.

Conclusions: By increasing and expanding these programs and advocacy efforts, health agencies could be an important resource in helping to curb the current obesity epidemic.
(Am J Prev Med 2007;33(4S):S246–S250)

Introduction

The United States has been experiencing a growing trend in overweight and obesity among both adults and youth over the past 20 years.[1–3] The problem has grown to such proportions that obesity is second only to tobacco as the leading cause of preventable disease and death. Given recent trends, poor diet, physical inactivity, and resulting obesity may soon overtake tobacco as the leading cause of death.[4,5] Although there has been some recent controversy on the magnitude of the health impact that obesity has on excess mortality, there is still strong evidence that obesity is associated with increased rates of mortality.[6] Thorpe et al.[7] found that during 1987–2001, 27% of the growth in healthcare spending was attributable to the increase in obesity prevalence and increased spending on the obese.

Chronic diseases are responsible for seven of every ten deaths in the U.S.[8] and being overweight or obese increases the risk of many chronic diseases, such as hypertension, type 2 diabetes, coronary heart disease, stroke, and some cancers.[9] Results of a survey, administered in January 2003 to local health departments with jurisdiction over 37 million people (13% of the U.S. population), show that on average only 1.85% of the health department's overall budgets was spent on chronic disease–related programs.[10] The survey also revealed that only half of responding health departments had received any federal funding for chronic disease programs; this represented only minimal amounts of funding ($0.24 per capita).[10]

The risk of obesity varies by race, ethnicity, and socioeconomic status (SES). Using cross-sectional data collected annually from 1993 through 2003 for 8th and 10th graders, and from 1986 through 2003 for 12th graders, researchers[11] found significant differences in the percent of racial and ethnic minorities and youth with lower SES who were overweight and, particularly among males, had less healthy lifestyle habits, which included eating and exercise behaviors, as well as time spent viewing television. Powell et al.[12] found that low-income and minority populations most at risk for physical inactivity and obesity were likely to have access to fewer outdoor physical activity–related settings. These results are of particular concern because physical activity and eating behaviors that youth develop in their adolescence will most likely follow them into adulthood; maintaining regular physical activity and healthy eating behaviors can reduce the risk of overweight and obesity.

Although constantly evolving as new threats to the nation's health emerge, the responsibilities of public health agencies fall primarily into three overarching categories: (1) health promotion, (2) disease preven-

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tion, and (3) health protection.[13] The public health system is vast, with agencies at not only the federal and state level, but also at the regional/district and local level. In a survey of state health officers (N=47), 43% of the respondents reported that their state had a regional or district structure in place and over 80% responded that local public health agencies served all areas of the state.[14] With the increasing threat that obesity poses to future quality of life and preventable disease and death, public health agencies at both the state and local level could serve as resources for obesity prevention programs. Results of a study conducted by the National Association of County and City Health Officials show that 55% of local public health agencies include obesity as part of their programmatic responsibilities.[13] In 2000, the Centers for Disease Control and Prevention (CDC) launched a state-based obesity prevention program that provides funding to 28 state health departments to develop and implement population-based nutrition and physical activity interventions.[9] The purpose of this study was to examine the availability of local public health department programs related to adolescent healthy eating, obesity control, and physical activity. The results will provide evidence on what, if anything, health departments are doing to address these issues, as well as help policymakers and public health officials improve and/or better target these programs.

Methods

Sample

In 2003, ImpacTeen, a component of the Bridging the Gap: Research Informing Healthy Youth Behavior Initiative (www.impacteen.org, funded by The Robert Wood Johnson Foundation), developed a brief survey, targeted to local health departments, that focused on the availability of programs related to adolescent healthy eating, obesity control, and physical activity. Data-collection activities were conducted at 219 sites surrounding a national sample of 8th-, 10th-, and 12th-grade schools participating in their second year of the Monitoring the Future study (MTF), supported by the National Institute on Drug Abuse. MTF uses a multi-stage sampling design to obtain nationally representative samples of students.[15] Site boundaries were defined as the area from which each school drew the majority (at least 80%) of its student population (school enrollment zone). School enrollment zones vary in size depending on the type of school, thus some sites comprise multiple communities.

A total of 162 health departments were identified through a combination of Internet searches and directories of local health departments as having jurisdiction over the sites. There were fewer health departments than sites because in most cases a county or regional health department had jurisdiction over a site and some sites were located in the same counties. However, interviews were conducted with multiple agencies for 26 sites. This happened when sites encompassed multiple communities with multiple health departments having jurisdiction over these communities or when the health department contracted out some of its obesity-related services. In order to account for this in the analyses, respondents' answers were first weighted based on the proportion of the population each community represented within the site and then aggregated to the site level. Next, to account for the complex MTF multi-stage sampling design, sampling weights were applied to adjust for differential selection probabilities.

Interviews were completed with 156 health department informants who had jurisdiction over 215 of the total 219 sites for a 96% response rate. Initial telephone contact was made with the health department director to confirm jurisdiction. Once jurisdiction was confirmed, the health department director was then asked a screener question about the presence or support of programs related to adolescent healthy eating, obesity control, or physical activity. A total of 105 respondents covering 151 (70%) of the sites indicated they had some type of program related to at least one of these areas. Respondents included health administrators, such as directors of health promotion; health educators; and obesity prevention directors; as well as registered nurses, nutritionists, and youth program coordinators.

Variables

Informants were asked about service provision (Table 1) and whether their agency was involved in any advocacy activities related to these programs. Advocacy was defined as engaging in lobbying, raising awareness, working with schools, and other interest groups, and by enacting new health regulations. Those who did provide support or advocate for these types of programs also were asked about three separate categories—healthy eating, obesity control, and physical activity—that used a 5-point scale (ranging from much less important to much more important) about how important these activities were in comparison to other agency activities. To determine how the availability of these programs related to the level of importance the agency placed on them relative to other programs, scales of the individual questions were created by summing the dichotomous variables for the four topic areas: (1) health department provides or supports healthy eating programs, (2) health department provides or supports obesity control programs, (3) health department provides or supports physical activity–related programs, and (4) health department advocates for healthy eating and/or physical activity–related community/school programs. Due to the skewed distribution of responses (presence of programs versus no programs offered), a dichotomous indicator variable of availability was created. Availability for Category One was 87 of 145; Category Two was 76 of 144; Category Three was 74 of 148; and, Category Four was 79 of 147 sites.

Statistical Analysis

Descriptive analyses and cross-tabulations were performed using SAS version 9.1. For all analyses, weights were included to account for the MTF-stratified sampling procedures. Z-scores were calculated to the test for significant differences in the proportion of communities having any presence of healthy eating, obesity control, and physical activity programs.

Table 1. Healthy eating, obesity control, and physical activity programs for youth

Specific program/activity	Provide/ support (%)	*n*
Healthy eating programs for youth		
Individual nutrition counseling	25	209
Group nutritional counseling	17	215
Health fairs or seminars on healthy eating	41	215
Other healthy eating programs	25	215
Presence of any healthy eating programs	39	210
Obesity control programs for youth		
Group or peer weight loss programs	6	215
Parent education programs to reduce obesity	32	215
Programs to manage type 2 diabetes	23	215
Summer camps for overweight youth	3	215
Presence of any obesity control programs	33	215
Physical activity programs for youth		
Walking or bike clubs	18	215
Sports leagues, sports camps or programs	18	215
Organized physical activity events	20	215
Training for teachers to provide better PE	15	215
After-school physical activity programs at schools	13	215
After-school physical activity programs at public parks or recreation centers	15	214
After-school physical activity programs at community agencies or religious institutions	17	215
Training for physical activity leaders	18	215
Walk to school programs	18	215
Other physical activity programs	10	213
Presence of any physical activity programs	34	215

Percentages are based on respondents saying yes to presence of programs.

Results

Two thirds of the informants interviewed indicated that their health departments were doing something related to healthy eating, obesity and physical activity. Table 1 presents results on the presence of these programs and shows that fewer than half of the respondents indicated availability/support for these types of programs. Table 2 presents the results and shows that in all but one instance, fewer than a third of the respondents indicated involvement in advocacy activities. The proportion of communities having any type of healthy eating versus obesity versus physical activity programs were examined in an effort to determine if there were significant differences in the availability of the three target areas (results not shown). No significant differences were found. Informants were also asked how important healthy eating, obesity control, and physical activity programs were in relation to other health department activities. The majority of informants indicated that all were either somewhat more or much more important in relationship to other health department activities (74%, 75%, and 75%, respectively). In contrast, only 11%, 14%, and 10% of respondents indicated that these programs were somewhat less or much less important, with the remaining informants stating these programs were of equal importance to other public health activities.

Cross-tabulations were run for four categories—healthy eating, obesity control, physical activity and advocacy activities for these programs—to determine if the availability of programs offered was an indicator of the level of importance placed on it by the agency (see Table 3 for full results). Of the ten cross-tabulations run, only four show statistically significant relationships (bolded in Table 3).

Limitations and Conclusions

These data illustrate that although respondents indicated that obesity control activities were important in relationship to other activities, the lack of programs does not support this. This is not surprising given that the allocation of resources has not kept pace with the increased and competing demands on health departments.[13] With the continually growing evidence showing that both healthy eating and physical activity are effective at reducing overweight and obesity, which in turn should reduce the burden chronic disease causes in the U.S., it is important to consider many outlets, including health departments, where this existing research can be turned into practice.[16,17] Although health departments are an important setting for disseminating research findings related to obesity prevention, they may lack the adequate infrastructure, including trained staff, facilities, and funding to effectively offer these pro-

Table 2. Health department obesity prevention advocacy activities

Specific program/activity	*n*	Advocates for (%)
Healthy school meals	215	41
After-school physical activity programs at schools	214	22
After-school physical activity programs at public parks or recreation centers	214	26
Training for physical activity leaders	213	28
Walking or bike paths	214	21
Increased PE requirements	214	20
Improved training of PE teachers	214	29
Better quantity and quality of play	212	20
Walk to school programs	211	18
Safe street and sidewalk designs for children to walk and bike	213	28

Percentages are based on respondents saying yes to advocating for programs.

Table 3. Cross-tabulations between level of importance of programs and presence of programs

Importance of	Healthy eating programs (HE) N=87 (%)	Obesity control programs (OC) N=76 (%)	Physical activity programs (PA) N=81 (%)	Healthy eating, obesity control, and physical activity advocacy activities (HE/OC/PA) N=85 (%)
Healthy eating	—	—	—	—
Much more important	**30 (34)**	36 (47)	N/A	**36 (42)**
Somewhat more important	**25 (28)**	21 (28)	N/A	**24 (28)**
Of equal importance	**19 (22)**	12 (15)	N/A	**14 (17)**
Somewhat less important	**11 (13)**	7 (10)	N/A	**9 (11)**
Much less important	**2 (3)**	0 (0)	N/A	**2 (2)**
Obesity control	—	—	—	—
Much more important	**25 (29)**	34 (44)	33 (40)	34 (40)
Somewhat more important	**31 (36)**	24 (31)	25 (30)	29 (34)
Of equal importance	**13 (15)**	7 (10)	8 (11)	9 (11)
Somewhat less important	**15 (17)**	11 (15)	13 (17)	11 (13)
Much less important	**3 (3)**	0 (0)	2 (2)	2 (2)
Physical activity	—	—	—	—
Much more important	N/A	**31 (41)**	34 (42)	35 (40)
Somewhat more important	N/A	**27 (36)**	26 (31)	30 (36)
Of equal importance	N/A	**8 (11)**	14 (17)	11 (13)
Somewhat less important	N/A	**10 (12)**	5 (6)	6 (7)
Much less important	N/A	**0 (0)**	3 (4)	3 (4)

Bolded entries show statistical significance.
HE by healthy eating-chi-square 21.45 (***p*≤0.001**) N=145; OC by healthy eating-chi-square 4.26 (p≤0.37) N=144; HE/OC/PA by healthy eating-chi-square 8.28 (***p*≤0.10**) N=147; HE by obesity control-chi-square 18.77 (***p*≤0.001**) N=145; OC by obesity control-chi-square 4.98 (p≤0.29) N=144; PA by obesity control-chi-square 6.27 (p=0.18) N=148; HE/OC/PA by obesity control-chi-square 4.02 (p=0.40) N=147; PA by obesity control -chi-square 10.83 (***p*≤0.05**) N=144; PA by physical activity-chi-square 4.43 (p=0.35) N=148; HE/OC/PA by physical activity-chi-square 4.08 (p=0.39) N=147.

grams[16,18]; the development of this infrastructure is essential if health departments are to be successful in conducting obesity prevention programs.[17]

The results of this study are limited in a number of ways. First, there is only one year of data, therefore trends in the availability of healthy eating, obesity, and physical activity programs cannot be examined over time. Second, although respondents were asked about numerous types of programs, information was collected only on the availability or support of these programs; there was no detailed information about the programs themselves or the level of resources allocated to these programs. Finally, no specific information was collected on local policy efforts related to obesity prevention. Respondents were asked about their advocacy activities related to healthy eating, obesity, and physical activity, which included local policy efforts. It was not possible to disentangle efforts to enact new local policies from other advocacy efforts.

Local public health departments are typically available in all areas of a state,[14] making them a good, accessible, and affordable resource for most of the population. This is important given the significant differences in the risk of obesity by race, ethnicity, and SES.[11] Although the findings of this study show fewer than half of the local health departments surveyed had some type of healthy eating, obesity control, or physical activity program, more recent research[13] indicates that as of 2005 approximately 55% of local health departments undertook some type of obesity prevention activity. This growth could be attributed to the increased attention and funding[9] given to this growing problem in recent years.

There is still much that can be learned about what health departments are doing to address the issue of obesity. Future research could examine what causes health departments to offer these types of programs, how resources are allocated to these programs, what is the organizational capacity/infrastructure of these agencies in relation to obesity prevention, and, who uses the programs or what is the program's reach in the community. This survey helped shed some light on the types of healthy eating, obesity control, and physical activity related programs offered by local health departments, and provides a starting point on examining the role that local health departments can play in obesity prevention.

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Adolescent Exposure to Food Advertising on Television

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Background: Television viewing is hypothesized to contribute to obesity among children and adolescents through several mechanisms that include the displacement of physical activity, snacking while watching TV, and the influence of food advertising.

Methods: This study drew on television ratings to examine the distribution of food advertising exposure among adolescents aged 12 through 17 based on 170 top-rated shows across network, cable and syndicated TV stations over the 9-month period from September 2003 to May 2004. A total of 238,353 30-second equivalent advertisements on the top-rated shows were assessed. Each advertisement was weighted by its rating to measure actual exposure to advertisements.

Results: The results showed that among total nonprogram content time, food-related products accounted for roughly one fifth of advertising exposure. Excluding TV promotions and public service announcements, as a proportion of all product advertising, total food-related advertising made up 26% of advertised products viewed by adolescents. By race, the proportion of advertising exposure to food products was 14% greater for African-American versus white adolescents and total exposure to food advertising would be even larger for African-American teens given that, on average, they watched more TV. Fast food was the most frequently viewed food product category comprising 23% of all food-related advertisements among adolescents.

Conclusions: Food ads made up just over one quarter of TV ads viewed by adolescents with the most commonly viewed products of fast food, sweets, and beverage products well within the reach of their own purchasing power.

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Introduction

American adolescents are often overweight, fail to meet dietary recommendations, and watch several hours of television (TV) per day. Obesity rates (age- and gender-specific body mass index [BMI]≥95th percentile) among American adolescents aged 12 through 19 reached 17.4 % in 2003–2004. By race, obesity rates were 21.8% among non-Hispanic African-American youths, 16.3% among Mexican Americans, and 17.3% among non-Hispanic white adolescents.[1] Further, a number of studies suggested that American youths consume too much dietary fat and sugar and that fruit and vegetable consumption and micronutrient intake is low compared with the United States Department of Agriculture (USDA) dietary recommendations.[2–5]

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Adolescents were estimated to watch on average just over 3 hours of television per day in 2004–2005.[6,7] The amount of TV viewing among adolescents was found to differ by race. Among a sample of children and teenagers aged 8–18 years, African-American youths were found to spend 48% more time watching TV daily compared to their white counterparts.[6] African-American teens aged 12–17 watched on average approximately 40% more TV during prime-time hours and approximately 95% more TV during the daytime (Monday–Friday, 10 AM–4:30 PM) compared to nonblack youths.[8] In addition, programming choices in African-American households also were distinct to those among non-African-American audiences.[8]

Poor dietary practices and related overweight among adolescents begs the question as to whether exposure to TV food advertising may be a contributing factor to these outcomes. This was the key focus of the recent Institute of Medicine[9] report that provided a comprehensive examination of food advertising to children and youth. The report concluded that there is strong evidence for children aged 2–11 that television advertising influenced short-term food consumption patterns and moderate evidence that it influenced usual

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dietary intake, but there was insufficient corresponding evidence for teens aged 12–18. With respect to health, the report concluded that there was strong evidence for both children aged 2–11 and adolescents aged 12–18 that exposure to television advertising was significantly associated with adiposity.[9] However, assessing a causal relationship between exposure to food advertising and obesity is difficult. Television viewing is hypothesized to contribute to obesity among children and adolescents through several mechanisms that include the displacement of physical activity, snacking while watching TV, and the influence of food advertising. Thus it is difficult to quantify the effect of advertising on obesity because of its interrelatedness with sedentary activity and snacking while watching. TV viewing itself also may be endogenous to youth overweight and cross-sectional studies are unable to determine causality.[10] Several studies have linked television viewing with obesity among adolescents,[11–14] but have not disentangled the causal pathways.

No study to date has examined the content of advertising exposure specifically among adolescents, but several have done so for children. Assessing the extent of food advertising and the types of food products advertised on children's programming, a number of content analyses of advertisements have focused primarily on Saturday morning programming[15–17] with other analyses incorporating afternoon and primetime viewing hours[18–20] and one study to date has used ratings data for children aged 2–11.[21] These studies found that the proportion of food advertising ranged from 27% to 58% of total nonprogram content time and 36% to 71% of product advertising time.[15–17,19,21] The proportion of food advertising for cereal ranged from 28% to 49% and the proportion for candy and snacks ranged from 21% to 34%.[15–19,21] Estimates of the distribution of food advertising among children aged 6–11 years found 15% of ads to be for cereal and bread with estimates for candy/sweets and soft drinks at 44%.[20] A recent study focused its content analyses on differences in food advertisements aired on predominantly African-American versus general audience television stations during after-school programming and found statistically significantly more food and beverage commercials aired on Black Entertainment Television (BET) compared to Warner Brothers (WB) and the Disney Channel.[22] Other studies have also found a higher proportion of food advertising on African-American versus general audience primetime programming.[23,24]

This study drew on television ratings to examine the distribution of food advertising exposure among adolescents aged 12 through 17 based on 170 top-rated shows across network, cable and syndicated TV stations over the 9-month period from September 2003 to May 2004. A total of 238,353 30-second equivalent advertisements on the top-rated shows were assessed. To examine differences in exposure to food advertising by race, we similarly assessed a total of 267,189 advertisements on the top-rated shows among white adolescents and a total of 253,885 advertisements on the top-rated shows among African-American teens aged 12–17. Using ratings data for each commercial, the distribution of exposure to nonprogram content time was classified across six mutually exclusive categories that include: (1) food products, (2) restaurants, (3) fast food, (4) other (non-food) products, (5) public service announcements (PSAs), and (6) TV promotions. The distribution of exposure to total food-related advertising was then examined across seven broad food categories and at a more disaggregated level highlighting the distribution rates for the top 25 food product categories.

Methods

Television show ratings from Nielsen Media Research (NMR) for adolescents aged 12 through 17 years were used to select the following top-rated youth programming: (1) the 60 top-rated broadcast network series shows; (2) the 60 top-rated cable network series shows; (3) the 30 top-rated syndicated series shows; (4) the 10 top-rated broadcast network specials; and, (5) the 10 top-rated cable network specials. Based on this programming selection, we acquired monthly ratings from NMR on every advertisement that appeared during the 9-month period from September 2003 through May 2004. Standardized to a 30-second ad, these data amounted to a total of 238,353 advertisements aggregated over the 9-month period. The sample used in this study reflects the vast majority of the programming viewed by American adolescents. Cable and broadcast shows that fell below the 60-show cut-off used in this study consisted of shows viewed, on average, by less than 2.3% and 1%, respectively, of adolescents aged 12–17.

Thirty-eight percent of the sample of top-rated network series for adolescents aged 12–17 were from broadcast networks and 62% were from cable networks. Cable TV exposure was made up predominantly from MTV (40%), Nickelodeon (29%), Cartoon Network (TOON) (20%), and ABC Family (FAM) (7%), with Spike TV (SPK), Nick at Night (NAN), TBS Superstation (TBSC), TBS, and Country Music Television (CMT) making up the last 4%. The distribution of top-rated TV viewing across broadcast networks was composed as follows: FOX (34%), CBS (15%), WB (15%), ABC (14%), NBC (13%), and UPN (8%).

Samples by race, based on the same sampling procedure as for the full sample, contained 267,189 30-second equivalent advertisements on the top-rated shows among white adolescents aged 12–17 and a total 253,885 30-second equivalent advertisements on the top-rated shows among African-American adolescents aged 12–17. Among African-American adolescents, the distribution of cable network viewing was composed of BET (38%), TOON (37%), Nickelodeon (20%), MTV (3%), and SPK and TBS totaling 2%, while the distribution across broadcast network TV was composed of UPN (33%), WB (29%), FOX (22%), ABC (11%), NBC (3%), and CBS (2%). For white adolescents the distribution of viewing across cable TV was composed of MTV (37%), Nickelodeon (25%), FAM (17%), and TOON (13%), with SPK, NAN,

TBSC, TBS, and CMT making up the last 8%. The distribution of TV viewing for white adolescents across broadcast networks was comprised as follows: FOX (33%), ABC (18%), CBS (16%), WB (15%), NBC (14%), and UPN (4%).

Nielsen Media Research assigned each product advertisement a product classification code (PCC) that identified it with a product category. Each of the product categories had a corresponding aggregated major group PCC and industry group PCC along with a PCC description. The structure of product classification codes used by NMR is based on that used by the Publisher's Information Bureau.[25] In this sample, the food advertisements fell into a total of 103 product categories made up from a total of 616 distinct food product brands. The non–fast-food restaurant and fast-food restaurant product categories were single categories at both the product and group level. Several distinct product categories have common product groups. For example, the single product categories of candy, candy bar, and chewing gum all had a corresponding product group category of "candy and gum." The PCC codes, descriptions, and major group categories provided a clear characterization of items that were cereal, sweets, snacks, or beverages. The remaining products were classified as other.

Using the ratings data associated with each commercial, actual advertisement exposure was distinguished, rather than giving all advertisements equal weight based simply on the airing of the commercial. Ratings provided an estimate of the percentage of households with televisions watching a program or advertisement over a specified time interval. To assess the ratings of an advertisement among the U.S. adolescent audience, this study used targeted ratings points (TRPs), which estimate the reach and frequency of advertising to adolescents aged 12–17 years. For example, a commercial with 80 TRPs per month was estimated to have been seen an average of one time by 80% of adolescents aged 12–17 years over the 1-month period. The TRPs in these analyses weighted each advertisement by its rating to provide a measure of overall exposure. The monthly ratings on advertisements were aggregated over the 9-month period.

The distribution of exposure to nonprogram content time was classified across six mutually exclusive categories including: (1) food products, (2) non–fast-food restaurants, (3) fast-food restaurants, (4) other (nonfood) products, (5) PSAs, and (6) TV promotions. We then examined the distribution of exposure to total food advertising (food products, non–fast-food restaurants and fast-food restaurants) by separate food product categories that included cereal, snacks, beverages, candy, fast-food restaurants, non–fast-food restaurants, and other food products. Finally, we examined advertising of food product categories at a more disaggregated level, highlighting the distribution rates for the top 25 food product categories. In our analyses by race, we tested whether the observed differences were statistically significant.

Results

The distribution of nonprogram content time exposure among the mutually exclusive categories of food products, non–fast-food restaurants and fast-food restaurants, other product advertising, PSAs, and TV promotions for adolescents aged 12–17 along with separate exposure estimates for African-American and white adolescents are shown in Table 1. These data revealed that approximately one fifth (19.6%) of all national nonprogram content time exposure for adolescents aged 12–17 (20.4% for African-American and 18.7% for white adolescents) was food-related. Just over one fifth (21.9%) of total exposure among adolescents was to TV promotions; TV promotions made up roughly one quarter of nonprogram content time seen by African-American teens whereas they comprised just over one fifth of ads seen by white teens.

Excluding TV promotional advertising and PSAs, Table 1 shows that as a proportion of all product advertising, total food (food, restaurant, and fast-food) advertising made up 25.7% of product advertising (27.9% for African-American youths and 24.5% of product advertising among white adolescents). While the proportion of advertising exposure to food products was 3.4 percentage points (or 14%) greater for African-American versus white adolescents, total exposure to food advertising would have been even larger for

Table 1. Distribution of exposure to television nonprogram content time and advertising among adolescents aged 12–17 (%)

	All adolescents		African-American adolescents		White adolescents	
	Total nonprogram content time	Product ads	Total nonprogram content time	Product ads	Total nonprogram content time	Product ads
Food products	14.0	18.3	14.8*	20.2*	13.2	17.2
Non-fast-food restaurant	1.1	1.5	1.1	1.6**	1.2	1.5
Fast-food restaurant	4.6	6.0	4.4	5.9*	4.4	5.8
Food subtotal	19.6	25.7	20.4*	27.9*	18.7	24.5
Other products	56.9	74.3	52.8*	72.1*	57.9	75.5
Product subtotal	76.5	100	73.2	100	76.6	100
PSAs	1.6	Excluded	1.4	Excluded	1.7	Excluded
TV promos	21.9	Excluded	25.3*	Excluded	21.7	Excluded
Total	100	NA	100	NA	100	NA

* and ** indicate that the distribution of exposure to the given item for the African-American is significantly different at $p<0.01$ and $p<0.05$, respectively, from the distribution for the corresponding item in the respective column for white adolescents.
Subtotals may not add up due to rounding.
PSA, public service announcements.

African-American teens, given that, on average, they watched more TV.

Categorizing food advertising into seven broad food groups that included candy, cereal, beverages, snacks, fast-food restaurants, non–fast-food restaurants, and other foods, Figure 1 shows that fast-food was the most frequently viewed food product category, composing 23% of all food-related advertisements among adolescents. After fast food, advertisements for sweets and beverages made up 22% and 17%, respectively, of food ads. Next, cereal, snacks, and non–fast-food restaurant ads each made up 11%, 9%, and 6% of total food ads, respectively.

Table 2 reports exposure for the top 25 food product categories among total food advertising for adolescents aged 12–17 with separate estimates by race for African-American and white teens. As shown in Figure 1, fast-food restaurants ranked the highest, comprising 23.1% of total ads. This held for both racial groups, with fast-food ads comprising 21.5% and 23.6% of total food advertising exposure for African-American and white adolescents, respectively. At a disaggregated level, cereal was the next most frequently viewed single food product category, making up 11.5% of food ads (14.6% of food ad exposure among African-American teens and 10.2% among white teens).

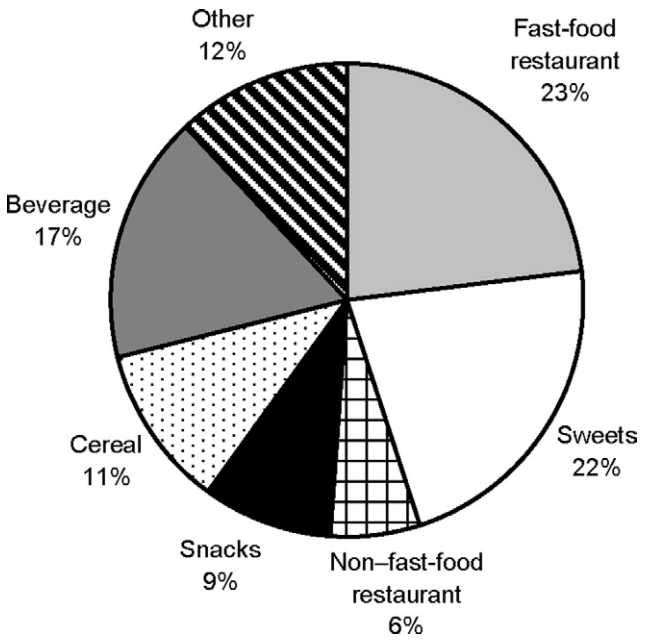

Figure 1. Distribution of advertising exposure by food. *Notes:* Candy includes: breath mints, candy, candy bar, chewing gum, cookie dough, cookies, cupcakes, frozen novelties, gelatin (mix and prepared), ice cream, ice cream novelties, pastry, pudding (mix and prepared) and snack cakes. Cereal includes: cereal and oatmeal. Beverages include: bottled water, cocoa mix, coffee, regular and diet soft drinks, dink mix, isotonic drinks, noncarbonated drinks, fruit drinks, fruit juices, iced coffee and tea, iced tea mix, milk, milk shake, and vegetable juice. Snacks include: crackers, nuts, popping corn, potato chips, rice cakes, snack bar, snacks, tortilla chips. Other includes: artificial sweetener, baby foods, bacon, baking chocolate, baking mix, baking soda, beans, beef, bread, buns, butter, cheese, cooking oil, cream cheese, dairy pdts, dips, dough, eggs, entrees (frozen and prepared), food products, French fries, French toast-frozen, gravy, hot dogs, infant formula, luncheon meat, margarine, marinade, mayonnaise, mustard, non-dairy creamer, non-stick spray, pasta dinners, pasta sauce, peanut butter, pickles, pizza-frozen, pork, preserves, rice mix, salad dressings (bottled and mix), sauce (salsa, barbecue, hot, steak, Worcestershire), sausage, seafood, seasoning, soup-condensed, soup (ready to serve), sour cream, syrup, vegetables-canned, waffles-frozen, whipped topping, and yogurt.

Table 2. Distribution of exposure to top 25 food product categories among total food product advertising for adolescents aged 12–17, all teens and by race (%)

Food product category	All teens	African-American teens	White teens
Fast-food restaurants	23.1	21.5	23.6
Cereals	11.5	14.6	10.2
Candy	7.2	8.2	7.0
Regular soft drinks	6.0	5.0	6.2
Candy bars	5.9	6.3	5.5
Non–fast-food restaurants	5.8	5.6	6.2
Chewing gums	4.8	4.3	5.0
Fruit drinks	3.3	3.1	3.7
Snacks	3.3	4.2	2.9
Drinks—isotonic	3.0	1.9	3.0
Yogurt	2.4	2.8	2.3
Potato chips	1.7	1.4	1.8
Milk	1.7	1.2	1.8
Cookies	1.7	2.1	1.5
Waffles—frozen	1.4	2.0	1.2
Tortilla chips	1.3	0.8	1.4
Entrees—frozen	1.3	1.2	1.4
Snack bar	1.2	1.4	1.2
Crackers	0.9	1.1	0.8
Entrees—prepared	0.9	1.0	0.8
Fruit juices	0.8	0.3	1.1
Pastry	0.8	1.0	0.7
Soup—condensed	0.7	0.9	0.6
Drink mix	0.5	1.0	0.5
Pasta dinners	0.5	0.6	0.4

Note: The differences in the distribution of exposure for African-American and white adolescents for each of the 25 top food product categories are statistically significant at $p<0.01$.

Examining candy and sweets at the disaggregated level, candy made up 7.2% of food ads, followed by candy bars (5.9%), chewing gum (4.8%), cookies (1.7%), and pastry (0.8%). Each of these candy and sweets categories (with the exception of chewing gum) made up a greater proportion of food ads among African-American versus white teens. In terms of beverages, regular soft drinks comprised 6.0% of food ads (5.0% and 6.2% of ads seen by black and white adolescents, respectively), while milk accounted for only 1.7% (1.2% for African-American and 1.8% for white teens) of all food ads seen by adolescents.

Given that fast food restaurant ads were the most frequently viewed food-related product category, the

Table 3. Distribution of fast-food restaurant advertising by company name seen by adolescents aged 12–17, all teens and by race (%)

Parent company	All teens	African-American teens	White teens
Burger King	22.3	24.0	20.8
McDonald's	22.0	28.5	20.3
Taco Bell	11.0	4.1	10.7
Subway	10.8	6.9	12.0
Wendy's	8.7	8.2	8.8
KFC	8.0	11.0	8.5
Pizza Hut	5.9	8.5	6.7
Dominos	3.5	3.7	4.1
Sonic	3.0	1.5	2.8
Papa John's	1.4	1.4	1.8
Arbys	1.1	0.6	0.9
Quizno's	1.0	1.3	1.3
Dairy Queen	1.0	0.4	1.0
Long John Silver's	0.2	0.0	0.2
Total	100.0	100.0	100.0

Note: The differences in the distribution of exposure for African-American and white adolescents for each of the fast food companies (with the exception of Quizno's) were statistically significant at $p<0.01$. Ads for Boston Market also occurred in our sample but they made up less than 0.01% of fast food advertising in the full sample and by race and hence were not included in the table.

study examined the distribution of products within this category. Table 3 lists the distribution of fast-food restaurant advertising by restaurant parent company name seen by adolescents aged 12–17. The table shows that in national advertising, Burger King and McDonald's advertisements each accounted for roughly 22% of all fast-food ads seen by U.S. adolescents. Next, Taco Bell and Subway each accounted for another 11% of fast-food ads. Wendy's, KFC, and Pizza Hut made up 9%, 8%, and 6% of total fast-food ads, respectively, while the remaining fast-food restaurants each accounted for less than 4%. By race, for African-American teens, ads from the most frequently viewed fast-food restaurants (McDonald's and Burger King) combined made up 52.5% of all fast-food ads, compared to 41.1% of such ads seen by white teens. Among white teens, Subway made up 12.0% of all fast-food ads seen, whereas these ads comprised only 6.9% of ads viewed by African-American teens. KFC ads were more prevalent among African-American viewers, making up 11.0% of fast-food ads.

Discussion

This study presented the first content analyses of television advertising viewed by American adolescents. Based on television ratings for adolescents aged 12 through 17, the results showed that among total non-program content time, food-related products accounted for roughly one fifth of advertising exposure, while TV promotions made up just over another one fifth of all ads. Excluding TV promotions and PSAs, as a proportion of all product advertising, total food-related advertising made up 25.7% of advertised products viewed by adolescents. Fourteen percent more food-related advertising was viewed by African-American teens (27.9%) than by white teens (24.5%).

Fast-food restaurant advertisements were found to make up 23.1% of all food ads seen by adolescents (21.5% and 23.6% for African-American and white teens, respectively), and McDonald's and Burger King advertisements made up approximately 44% of fast-food ads seen by teens. Sweets and beverage ads accounted for 22% and 17% of all food ads, respectively, while cereal ads made up 11%. The finding of the top category of fast-food ads in the distribution of food products viewed by teens differed from findings in earlier studies for younger children's programming which consistently reported cereal as the top food product advertised to children.[15–19,21]

A key limitation to the results presented in this study was that the data did not include spot (non-national local-area) advertising. If the distribution of products in spot advertising was substantially different from the distribution of national advertising then this sample selection would bias our results. However, the majority of spot advertising is for products not relevant to the teen market (e.g., automotive, telecommunications, furniture stores, insurance and real estate, financial).[26] Despite this limitation, this was the first study to examine the content of TV advertising based on a programming sample that was representative of the shows viewed by adolescents aged 12–17 and, in addition, reported weighted findings based on television ratings.

Children and adolescents represent an important market for advertisers.[27,28] Food advertising has been associated with increased product-specific purchase requests among young children,[29–32] and such children are estimated to directly influence $330 billion of parental spending.[33] Among older children, it is estimated that approximately three quarters of youths aged 8–17 influence family food purchases.[9] In addition, adolescents represent an important consumer market as they are much more likely than younger children to be direct consumers, given that they spend a significant amount of their own money. U.S. adolescents aged 12–19 were estimated to have spent $159 billion in 2005.[34] Indeed, fast food, sweets, and beverage products shown in this paper to make up the majority of food advertising seen by adolescents are items that are well within the reach of their own purchasing power. In order to provide policymakers with sufficient evidence to assess the extent to which food advertising impacts adolescents' dietary patterns and weight outcomes, further research is needed to examine differences in exposure to television advertising content by holding TV viewing time constant and controlling for sociodemographic and other contextual factors.

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Public Health Obesity-Related TV Advertising
Lessons Learned from Tobacco

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Background: Over the past 25 years, the percent of overweight and obese adults and children in the United States has increased dramatically. The magnitude and scope of the public health threat from obesity have resulted in calls for a national comprehensive obesity prevention strategy, akin to tobacco use prevention strategies undertaken over the past two decades. The purpose of this paper is to describe and compare population exposure to paid media campaigns for tobacco and obesity prevention, draw lessons from tobacco advertising, and compare tobacco and obesity behaviors/influences to identify priorities and pitfalls for further research on obesity adverting.

Methods: This is a descriptive study. Ratings data for the years 1999–2003, for the top 75 designated market areas in the U.S. were used to quantify exposure levels to anti-obesity and anti-smoking advertising in the U.S.

Results: Anti-tobacco campaigns preceded anti-obesity campaigns by several years, and in each year exposure levels—both total and average—for anti-tobacco media campaigns far outweighed those of anti-obesity campaigns.

Conclusions: It is important to compare both similarities and differences between smoking- and obesity-related behaviors, which might affect the potential impact of anti-obesity media campaigns. Given the scope of the public health risks attributable to obesity, and the amount of federal, state, and other resources devoted to anti-obesity media campaigns, there is a clear need to evaluate the potential impact of such campaigns efforts. Nonetheless, the challenges are significant in both motivating and monitoring such complex behavior change, and in attributing changes to a given media campaign.
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Introduction

Over the past 25 years, the percent of overweight and obese adults and children in the United States has increased dramatically.[1–5] This trend is alarming because of the increased morbidity and mortality, reduced quality of life, social stigmatization, and increased medical costs associated with obesity.[4,6–8] The magnitude and scope of the public health threat from obesity have resulted in calls for a national comprehensive obesity prevention strategy, akin to tobacco use prevention strategies undertaken over the past 2 decades.[9]

State tobacco control programs vary substantially in scope and intensity, but three central components are common to nearly all: (1) increases in cigarette excise taxes, (2) clean indoor air laws, and (3) paid media campaigns.[10] In the context of obesity prevention, taxation and regulation related to obesity-related behavior remain highly controversial.[11] Television advertising, however, is among the most effective media for health communication,[10,12] and therefore represents a potentially important and viable component of any public health obesity prevention strategy.

For decades, the public health community has relied on paid and unpaid advertising to communicate health-related messages, ranging from cancer prevention, seat-belt promotion, and oral health to drunk-driving prevention and anti-drug and anti-tobacco campaigns. Generally, research has shown that such campaigns have small-to-moderate effects on attitudes, beliefs, and behaviors related to the primary message.[13–15] Research from tobacco control has shown that paid anti-tobacco advertising is associated with increased anti-tobacco attitudes and beliefs and reduced tobacco use.[16–27] To the extent that obesity reflects modifiable behaviors that have similarities with smoking-related behaviors, public health anti-obesity media campaigns promise to contribute to reductions in population obesity.

The purpose of this paper is to describe and compare population exposure to paid media campaigns for tobacco-use and obesity prevention. Lessons are drawn from anti-tobacco advertising that might apply to anti-obesity advertising, tobacco and obesity behaviors and

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influences are compared, and next steps for further research on anti-obesity advertising are identified.

Methods

Data Sources

Two types of data were used for this study. First, advertising ratings data for the largest 75 designated market areas (DMAs) in the U.S. for the years 1999–2003 were purchased from Nielsen Media Research (NMR). A DMA consists of a group of counties that comprise a major metropolitan area and that receive the largest proportion of programming from TV stations within the metropolitan area. The ratings data include information on commercial occurrences, ad sponsor, ad length (in seconds), gross and targeted ratings, and programming information, such as program type and title of all tobacco-related and anti-obesity television advertisements appearing on network, cable, and syndicated television. In addition, digital copies of all televised anti-smoking and anti-obesity advertisements produced by states or other non-profit organizations were obtained from two sources: for the tobacco control ads, from the Centers for Disease Control and Prevention (CDC)'s Media Campaign Research Center (MCRC); for the anti-obesity ads, from NMR.

Identification and Classification of Advertisements

Ratings data were used to identify and classify the sponsors of all tobacco-related and anti-obesity advertisements[28] and to categorize them as either anti-tobacco or anti-obesity ads. This study included all ads sponsored by state tobacco control agencies, the American Legacy Foundation, state health departments, and the CDC. In the majority of cases, classification as either anti-smoking or anti-obesity was straightforward; tobacco control organizations sponsor only anti-tobacco ads. For ads sponsored by state health departments or the CDC, classification was slightly more complex. In most cases, however, the ad descriptor included information that made it relatively easy to ascertain whether an ad was anti-smoking or anti-obesity. For example, a typical descriptor offered a few words, such as "woman smoking" or "fruits dancing." When there was ambiguity in the descriptor, the digital copy of the ad was viewed by a research assistant, allowing for definitive classification as anti-tobacco or anti-obesity, or elimination from further consideration if an ad was neither.

Using content analysis of the digital videos of the relevant ads, code descriptors for the content of the ads were developed. Anti-obesity ads were coded for primary message, which included healthy eating, encouraging physical activity, or a combination of the two messages. Because the number and variety of anti-obesity ads were limited, further coding within the healthy eating or physical activity categories was not pursued, but common messages were noted. In contrast, due to the number of different anti-smoking ads and the variety of primary messages, not all of the anti-smoking ads for message content were coded. Rather, a sample of ads was viewed from the four largest state anti-tobacco media campaigns, California, Massachusetts, Florida, and Arizona,[29] their primary message described, and the ads compared across four common anti-tobacco message themes: (1) health effects of smoking, (2) environmental tobacco smoke, (3) tobacco industry advertising practices and manipulation, and (4) smoking cessation.[30,31] In addition, both the anti-tobacco and anti-obesity ads were coded for target audience which included youth (aged 12–18 years) or general audience, based on the age of the main character(s) in the ad. If the age of the main character(s) was not obvious, the coding rules instructed to code the ad as general audience. Two coders independently coded approximately half the ads; because the message and target audience characteristics were very simple, there was 100% agreement between the coders. For the remaining half of the ads, one coder was used to classify the message and target audience.

Measuring Exposure to Advertising

Television ratings estimate the mean audience exposure to all television programming, and the advertisements that appear during programs, across media markets in the U.S. It is customary for the advertising industry to sum rating points for a program over a specified time interval, usually weekly or monthly.[28] These summed rating points are called Gross Ratings Points (GRPs) for all households and provide estimates of audience size. For the analyses, ratings data for national broadcast, national cable, national syndication, and local broadcast were used; together, these categories represent the majority of television shows viewed on network and cable television.

Ratings were aggregated by sponsor to derive total GRPs for each campaign type by month and media market for the period from January 1999 to December 2003. To create national-level measures of total annual GRPs, monthly GRPs were summed across media markets by campaign category and by year. All figures were rounded to the nearest integer. Annual average exposure levels were created for each campaign type, by dividing the total annual GRPs in each category by the number of media markets that ran each type of ad. For example, average exposure levels for the national anti-tobacco and anti-obesity campaigns were calculated as the total ratings for a given year, divided by the 75 media markets for which data were available; the average exposure levels for state-sponsored campaigns were calculated as the total ratings for a given year, divided by the number of media markets across the states that ran campaigns.

Results

Campaign Emergence

Table 1 lists anti-tobacco and anti-obesity media campaigns, by sponsor for each year, 1999–2003. California was the first state to launch a large-scale and ongoing anti-tobacco media campaign in 1990. Massachusetts initiated a statewide anti-smoking media campaign in 1994, followed by Arizona in 1997, and Florida and Oregon in 1998. The $206 billion payments to participating states that resulted from the 1998 Master Settlement Agreement (MSA) between 46 states and the tobacco industry enabled 30 more states and the American Legacy Foundation to sponsor additional anti-smoking media campaigns.

In 2000, the first anti-obesity television ads were sponsored by the California Department of Health and

Table 1. Year of initiation of state and national anti-tobacco and anti-obesity media campaigns

Year	Anti-tobacco	Anti-obesity
1990	California	
1994	Massachusetts	
1995	Michigan	
1996	Arizona	
1998	Florida, Maine, Oregon	
1999	Indiana, Mississippi, New Mexico, New York, Oklahoma, Utah, Washington, Wisconsin	
2000	Idaho, Kansas, Minnesota, American Legacy Foundation (National)	California
2001	Alabama, Connecticut, Georgia, Iowa, Illinois, Nebraska, New Jersey	
2002	Colorado, Maryland, New Hampshire, Ohio, Pennsylvania, Rhode Island, Texas, Virginia, West Virginia	Hawaii, VERB (National), New Hampshire
2003	Wyoming, Louisiana	Louisiana, Missouri, Ohio, Virginia, Washington

were aired in a single media market (San Diego). In 2001, California remained the only state with an anti-obesity campaign, running its ads in all five of California's major media markets. In 2002, the CDC's VERB campaign,[32] which promotes physical activity, was launched across more than 75 media markets nationally and two additional state-level campaigns, from Hawaii and New Hampshire, aired across three new media markets. In 2003, the VERB campaign continued to run and five more states launched campaigns—bringing the total of anti-obesity campaigns to nine.

Campaign Audience Target and Exposure Levels

Table 2 describes total U.S. exposure levels across the top 75 media markets in the U.S. for state-sponsored anti-tobacco ads, the national Legacy anti-tobacco ads, state-sponsored anti-obesity ads, and the national CDC anti-obesity VERB campaign, disaggregated by whether they targeted youth or general audiences. The table shows that most state-sponsored tobacco control and anti-obesity ads targeted a general audience; in contrast, the national Legacy and VERB campaigns exclusively targeted youth.

The table also shows that in 1999, only state-sponsored tobacco control ads were aired, and only in the media markets of the eight states that had campaigns at that time. In 2000, when Legacy launched its media campaign, Legacy ads dominated the ratings, with over 380,000 total GRPs, compared to fewer than 100,000 for state-sponsored anti-tobacco ads, and only 1504 for state-sponsored anti-obesity ads. In 2001, state tobacco control ads achieved higher total GRPS than Legacy, with 273,498 and 165,117 total GRPs, respectively; both far outweighed state-sponsored anti-obesity advertising, with less than 3500 GRPs. In 2002, state and national anti-tobacco ads continued to dominate total ratings, with totals of over 320,000 total GRPs each, but there were significant increases in anti-obesity advertising. GRPs for state-sponsored anti-obesity ads were nearly five times higher in 2002, compared to 2001; the total 131,566 GRPs for the first year of CDC's VERB campaign reflect only 6 months of exposure, since the campaign launched in July. By 2003, state-sponsored anti-obesity ads still significantly lagged in GRPs compared to the state-sponsored anti-smoking ads, but the CDC's national anti-obesity advertising overtook Legacy's national anti-tobacco ads, and also exceeded exposure levels to state-sponsored anti-tobacco ads.

Table 3 shows the annual mean ratings for each type of media campaign, based on the number of markets in which each campaign ran each year. Similar to the total numbers, the averages show that even after controlling for the number of markets in which each type of campaign ran, annual average exposure levels to anti-tobacco media campaigns exceeded the average exposure levels for anti-obesity campaigns.

Reflecting the fact that TV ad space is usually sold in 30-second intervals, an analysis of the length of the anti-tobacco and anti-obesity ads shows that nearly all of the anti-tobacco ads were 30 seconds or longer. While most (over 83%) of the anti-obesity ads were also 30-second spots, it is notable that over 15% were 15-second spots; the shorter spots were all among state-sponsored anti-obesity ads. The reported ratings are not adjusted to

Table 2. Total annual ratings for anti-tobacco and anti-obesity advertisements, by sponsor and target audience, 1999–2003

	State anti-tobacco			National anti-tobacco (Legacy)			State anti-obesity			National anti-obesity (CDC VERB)		
Year	General	Youth	Total	General	Youth	Total	General	Youth	Total	General	Youth	Total
1999	66,096	47,140	113,236	0	0	0	0	0	0	0	0	0
2000	66,872	33,025	99,897	0	381,779	381,779	1,120	384	1,504	0	0	0
2001	218,682	54,816	273,498	0	165,127	165,127	3,428	0	3,428	0	0	0
2002	262,281	61,085	323,366	0	329,882	329,882	15,470	338	15,808	0	131,566	131,566
2003	239,232	45,833	285,065	0	255,010	255,010	12,361	4,844	17,205	0	294,443	294,443

Table 3. Mean annual ratings for anti-tobacco and anti-obesity advertisements, by sponsor and target audience, 1999–2003

	State anti-tobacco			Legacy (National) anti-tobacco			State anti-obesity			National anti-obesity (CDC VERB)		
Year	General	Youth	Total	General	Youth	Total	General	Youth	Total	General	Youth	Total
1999	1102	655	1757	0	0	0	0		0	0	0	0
2000	1555	508	2063	0	5090	5090	1120	384	1504	0	0	0
2001	3837	1119	4956	0	2202	2202	686	0	686	0	0	0
2002	4857	1388	6245	0	4398	4398	2210	68	2278	0	1754	1754
2003	3680	1273	4953	0	3400	3400	883	404	1287	0	3926	3926

reflect the different ad lengths; comparable ratings levels reflect comparable audience sizes, regardless of ad length.

Campaign Messages

The messages and target audiences of the state-sponsored and Legacy tobacco control advertisements vary across states and over time. The California media campaign targeted a general audience and focused on changing social norms about smoking to reduce smoking prevalence, with messages about environmental tobacco smoke and encouraging cessation. The Massachusetts media campaign promoted a wide range of anti-smoking messages, including youth-oriented smoking prevention and general audience-targeted messages about the health effects of smoking, encouraging smokers to quit and explaining the dangers of "light" cigarettes. The Arizona campaign included both adult- and youth-targeted messages, focusing on the health effects of smoking and encouraging quitting. Florida's "truth" campaign used an exclusively youth-targeted message, which aimed to prevent youth smoking and expose the tobacco industry as a manipulator of youth behavior. The Legacy campaign is exclusively youth-targeted, and like the Florida "truth" campaign, emphasizes tobacco industry manipulation.

Table 4 describes national average exposure levels for state-sponsored and national anti-obesity ads by primary message: healthy eating, physical activity, or both. The table shows a dichotomy in ad messages between the state-sponsored and CDC anti-obesity ads, with states accounting for the vast majority of ads promoting healthy eating and the CDC's VERB campaign accounting for nearly all the ads promoting physical activity. While the early California ads included messages that addressed both healthy eating and physical activity, very few other states ran ads with a comprehensive message. Most of the state-sponsored ads that promoted healthy eating included the five-a-day message, encouraging the consumption of at least five servings of fruits and vegetable per day. Prior to the launch of CDC's VERB campaign in 2002, there were no ads on TV that contained a primary message promoting physical activity. In the same year that VERB was introduced, several state-sponsored ads also began to promote physical activity. The CDC's VERB campaign includes various ads, all of which encourage youth to choose a verb with which they identify, such as run, bounce, skate, or peddle, and engage in that active behavior; most of the dialogue occurs between youth, but adult voiceovers are also featured.

Discussion

The analyses showed that in 1999 and 2000, there was virtually no anti-obesity advertising on television. In 1999, state-sponsored anti-tobacco ads appeared in 72 of the 75 largest media markets, and by 2000, Legacy ads were broadcast in each of the 75 major media markets in the U.S. State ads tended to target a general audience, and featured a variety of messages, whereas the Legacy ads focused exclusively on youth, and the message was primarily about tobacco industry manipulation and advertising practices. Throughout the observation period, exposure levels to anti-smoking ads remained relatively high, peaking in 2002. Beginning in 2001, state anti-obesity advertising increased, as early adopter states initiated anti-obesity media campaigns. For the most part, these state-sponsored anti-obesity ads promoted healthy eating, and were targeted toward a

Table 4. Total annual ratings for anti-obesity advertisements, by primary message, 2000–2003

	State			CDC VERB		
Year	Active	Healthy eating	Both	Active	Healthy eating	Both
2000	0	1,045	459	0	0	0
2001	0	3,338	90	0	0	0
2002	4,129	5,366	6,313	131,566	0	0
2003	2,428	4,272	10,504	294,443	0	0

general audience. The launch of CDC's VERB campaign represented the first large-scale anti-obesity campaign, promoting physical activity, and targeting youth. In the final year of observation, exposure levels to the VERB campaign came close to those of the anti-smoking campaigns.

Several studies have concluded that both national and state-sponsored anti-tobacco advertising are associated with significantly reduced smoking and increased anti-tobacco attitudes and beliefs.[16–26,33,34] Importantly, however, recent research has suggested that the positive effect of state-sponsored anti-tobacco ads was manifest only at a threshold level of at least one unit of exposure over a 4-month period.[27] The implication of this threshold effect is that minimal levels of anti-tobacco advertising do not have a significant association with smoking-related outcomes. If the relationship between exposure to anti-obesity ads and obesity-related behavior is similar to that between the anti-smoking ads and smoking behavior, the relatively modest levels of exposure to state-sponsored anti-obesity ads may not result in measurable changes in obesity-related behavior.

Although the evidence from tobacco control suggests that anti-obesity media campaigns could be expected to contribute to reductions in the nationwide obesity epidemic, it is important to compare both similarities and differences between smoking- and obesity-related behaviors, which might affect the potential impact of anti-obesity media campaigns. First, tobacco use is a relatively easily measured behavior, which is not essential to daily living. Clearly, there are many complex intermediate outcomes related to tobacco use, such as changes in smoking-related attitudes and beliefs and exposure to environmental tobacco smoke, but the ultimate outcome is whether and how much an individual smokes. In comparison, like smoking, it is possible to refer to a single measure, such as body mass index (BMI), as the ultimate outcome of anti-obesity campaigns. However, obesity reflects a chronic positive energy balance that results from a combination of multiple behaviors involving total caloric consumption, the types of food and drink consumed, and amount and type of physical activity, all of which are necessary to modify in some combination in order to affect obesity.[7] Thus, it is arguable, that motivating behavior change related to obesity is a much more complex—and therefore potentially much more difficult—endeavor.[35–37]

The comparison of anti-tobacco and anti-obesity media campaigns also reveals important similarities and differences between the broader contexts in which the ads appear. Few evaluations of anti-tobacco advertising have been able to control for other tobacco control policy variables, or other tobacco-related advertising.[27] Nonetheless, it is feasible to control for several of the important tobacco control policies, as well as the volume and variety of tobacco-related messages. While reliable data do not exist at a national level on many tobacco control policies, national data on cigarette taxes and clean indoor air laws, two of the most important tobacco control policies, are widely available and used. In contrast, there are currently a limited number of regulations related to obesity, which could be included in evaluation models. For example, most states have school-related policies on physical education requirements, and some have begun to pass laws related to vending machines in school. As state and/or local legislators develop further obesity-related policies, it will be crucial to develop corresponding databases for use as controls in evaluation models of anti-obesity advertising.

Another key difference between anti-tobacco and anti-obesity advertising relates to commercial advertising on TV. Researchers have been able to control for other tobacco-related advertisements in their analyses of tobacco control ads,[27,38] but controlling for other obesity-related messages may prove much more challenging. Anti-tobacco ads face no direct message competition because tobacco companies have not been allowed to advertise cigarettes on TV since 1971, and the 1998 Master Settlement Agreement (MSA) virtually eliminated event sponsorships and other opportunities to promote cigarette brands on TV. The only other tobacco-related messages on TV come from ads produced either by pharmaceutical companies, promoting cessation products, or by the tobacco industry, putatively offering an anti-smoking message or promoting the corporate image.[27,38,39] In contrast, food advertising constitutes the single largest advertising category on children's TV, and ads for sugary childrens' cereals comprise a substantial proportion of these food ads.[40–45] The overwhelming majority of food products advertised to children are of poor nutritional content, high in sugar or fat.[46] Moreover, food ads in childrens' programs increasingly link the product to toy and movie products, in effect multiplying the impact of the ads.[47,48] For adolescents, fast-food ads are the most commonly viewed food-related ad category.[45] Empirical evidence shows that commercial food advertising is significantly associated with younger children's food purchase requests, short-term food consumption patterns, and usual dietary intake, though there is insufficient corresponding evidence for teens aged 12–18.[49] Including food and beverage advertising, the volume and variety of advertisements that could be related to obesity is staggering: fast-food restaurants, cereals and snacks, soda and sugary-beverages, recreation opportunities, sports programming, and health club promotions, to name a few. Controlling for the many and diverse competing and complementary messages presents a critical challenge for the evaluation of anti-obesity ads. Finally, it is important to note that anti-tobacco advertising began to appear on television at the same time that tobacco control programs were achiev-

ing widespread and significant policy gains. Smokefree air laws were proliferating across state and local jurisdictions, and substantial increases in cigarette excise taxes were achieved across nearly all states and many local jurisdictions. In addition, during the late 1990s, the tobacco industry was under siege from litigation, which was widely publicized, and which raised public awareness and negative sentiment toward the industry.[50] Therefore, it is arguable that many populations were "primed" by the policy environment for the anti-tobacco messages that appeared on television, similar to how traditional advertising can prime an audience to change behavior.[51–53] Thus, tobacco control policies, such as smokefree air laws, likely made the message of the anti-tobacco ads more salient than it would otherwise have been, resulting in a stronger effect from the ads than could have been achieved absent the policy-priming.

In contrast, anti-obesity ads appear in the context of a near vacuum of anti-obesity policy. While some local jurisdictions or school districts have implemented initiatives, there is minimal upstream policy activity.[54] Indeed, a large proportion of the U.S. population lives in communities where the built environment makes physical activity challenging to perform[37]; healthy food is either inaccessible, relatively more expensive than food of poor nutritional content, or both[55]; advertisements for unhealthy foods permeate the airwaves[44–46]; and product tie-ins seduce youth to demand often unhealthy foods that are advertised by their favorite cartoon character.[46] In this context, it seems unlikely that anti-obesity ads promoting personal responsibility and individual behavior change could be expected to achieve the positive associations observed between exposure to anti-smoking ads and reductions in smoking over time and across communities.

This research is subject to limitations. The most important limitation is that the NMR data are measures of aggregate exposure to smoking-related advertising at the DMA level. They do not reflect actual individual exposures to the various types of smoking-related ads. Additionally, the data were only available through 2003. Therefore, the analyses do not reflect that many tobacco control media campaigns have been severely cut or completely eliminated since 2003; conversely, it is likely that many more states have initiated anti-obesity media campaigns since 2003, which are not captured in our data. In addition, this research focused on general population exposure to public health advertising; it did not examine relative exposure levels across race/ethnic groups. Research has shown that exposure to advertisements for unhealthy foods is even greater among African-American audiences than in the general population,[56,57] but there has been no investigation to date of exposure levels to anti-obesity advertising across racial/ethnic groups. Despite these limitations, the ratings data provide an important description of the relative volume of the different types of public health television advertisements in the U.S., and can ultimately be used to inform models that relate exposure to such ads to the relevant health outcomes.

This research has shown that it is important to compare both similarities and differences between smoking- and obesity-related behaviors, which might affect the potential impact of anti-obesity media campaigns. The lack of evidence on exposure levels to anti-obesity advertising across race/ethnic groups presents a clear direction for future research. Beyond the individual behaviors, it is also critical to understand the local and national policies that affect both eating patterns and physical activity. Finally, analyzing the potential impact of anti-obesity media campaigns necessitates an understanding of the very complex array of media messages promoting obesogenic behaviors. Given the scope of the public health risks attributable to obesity, and the amount of federal, state, and other resources devoted to anti-obesity media campaigns, there is a clear need to evaluate the potential impact of such campaigns efforts. Nonetheless, the challenges in both motivating and monitoring such complex behavior change, and in attributing changes to a given media campaign are significant.

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Development of a Physical Education–Related State Policy Classification System (PERSPCS)

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Background: As policy-based approaches are increasingly proposed to address childhood obesity, this paper seeks to: (1) present the development of a system to systematically and reliably assess the nature and extent of state physical education (PE) and recess-related policies; (2) determine the inter-rater agreement in using the system; and (3) report on the variability in state policies using a December 31, 2003 baseline.

Methods: The PE and Recess State Policy Classification System (PERSPCS) was developed from a conceptual framework and was informed by reviewing the scientific and gray literatures and through consultations with an expert panel and key experts. Statutes and regulations enacted as of December 31, 2003 were retrieved from Westlaw (data retrieved and analyzed in 2004–2005).

Results: PERSPCS addresses five areas: PE time requirements, staffing requirements for PE, curriculum standards for PE, assessment of health-related fitness, and recess time (elementary schools only). The inter-rater agreement ranged from 0.876 (PE staffing requirements) to perfect agreement (recess time). Staffing requirements had more restrictive policies, followed in decreasing order by time requirements, curriculum standards, assessment, and recess time. Overall, state policies met minimal requirements across areas and grade levels as of December 2003.

Conclusions: Extending PERSPCS to address other aspects of childhood obesity is a critical first step in understanding the range of state policy approaches in this area and their impact. PERSPCS should be examined in conjunction with school district–level policies to determine the overall effects of policies on school environmental and behavioral outcomes. PERSPCS is not designed to set policy guidelines.

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Introduction

In many industrialized nations, the prevalence of childhood obesity is increasing at an alarming rate.[1–3] Currently, there is a strong consensus that policy-based approaches targeting the school environment may have the greatest population-level impact on childhood obesity. This is due primarily to the fact that such approaches can reach most children and because children consume one third of their daily caloric intake and spend 50% of their energy expenditure in schools.[2,4,5] As many public health accomplishments (e.g., reduction of motor vehicle and firearm injury; lowering of dental caries through water supply fluoridation; tobacco control) have been attributed to policy change,[6,7] a broad spectrum of school-based policies already have been proposed to address childhood obesity (e.g., eliminating vending machines in schools, increasing time spent in physical education [PE]). Both nutrition and physical activity policies have been proposed, as it is recognized that obesity, for the majority of children, results from an imbalance in calorie consumption and/or lack of physical activity.[2] Currently, there is a need to develop a system to systematically and reliably classify the breadth and depth of these policies across states to facilitate environmental and systems-level evaluations that relate to childhood obesity.

Increasing physical activity opportunities during school hours is one area that has been targeted by policy-based approaches. Such strategies may target the PE program and/or recess time (for children in elementary school only). Results from a recent systematic review suggest that having adequate instruction time

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and modifying the curriculum to increase the amount of time children are active in PE results in a significant increase in fitness among school-aged children.[8] While the systematic review had mixed results for body mass index (BMI), more recent studies have found that increased time spent in PE was associated with a decrease in BMI.[9,10] In addition, the literature suggests that both the qualifications of the PE teachers and increasing time spent being physically active during PE are key factors for increasing physical activity behavior.[11–13] Establishing content standards (e.g., increasing knowledge, attitudes, skills, behaviors, self-efficacy) for the PE curriculum is expected to be important for increasing time spent active during PE and considered to be a prerequisite for increasing physical activity in school. Regular assessment can serve to monitor and reinforce student learning in PE and can include the assessment of knowledge, skills, and health-related fitness. Although regular assessment of PE has not been linked to behavior change, the need for regular evaluation of PE programs appears to be well supported for improving their quality.[14–17] Finally, outside of the PE program, recess can provide spontaneous opportunities for elementary school children to be active. At this time, it remains unclear what the impact of increasing recess time alone will have on behavior, but it appears that combining an increase in recess time with access to physical activity games or equipment may hold promise in increasing physical activity among that age group.[13,18]

Evidence to formulate model policies for specific physical activity options in school, including PE and recess, is still emerging. A number of recommendations have, however, been put forward by various organizations (Action for Healthy Kids, American Academy of Pediatrics, the Centers for Disease Control and Prevention [CDC], National Association for Sport and Physical Education [NASPE], National Association of State Boards of Education [NASBE], U.S. Department of Health and Human Services [DHHS], as well as others).[8,14–17,19–21] These recommendations address all or some aspects of what NASPE and CDC define as a quality PE program: (1) adequate instruction time, (2) qualified staff, (3) meaningful content standards, and (4) regular assessment.[14,15] In addition, providing adequate recess time for elementary school children is recommended by NASPE and CDC.[14,15] Recognizing the need to understand the impact of PE and recess time policies on physical activity behavior during school, the purpose of this paper is to: (1) describe the development of a system for systematically and reliably classifying the breadth and depth of state statutory and regulatory policies addressing PE and recess time—the PE and Recess State Policy Classification System (PERSPCS); (2) determine the inter-rater agreement of the system to code state statutory and regulatory policies enacted as of December 31, 2003; and (3) provide a baseline assessment of the variability in state policies related to PE and recess time.

Methods

Data Source

Statutes and regulations for each of the 50 states and the District of Columbia (hereafter referred to as "states") were obtained via primary legal research based on electronic searches of the Westlaw legal database.[22] Only state statutes and regulations that were enacted or adopted as of December 31, 2003 were included, regardless of their effective dates. Data were retrieved and analyzed in 2004 and 2005, respectively. Statutes reflect the codified compilations of laws enacted by a state over time (including amendments and repeals). For this project, regulations included all rules and regulations promulgated by the states (including amendments and repeals to existing provisions) that were codified in the state administrative code as of December 31, 2003—the study reference date. Searches of both statutes and regulations were necessary since PE and recess time policies may be formulated through both the legislative and executive branches of government. Hereafter, statutes and regulations will collectively be referred to as "policies." Keyword searches were developed to identify policies in Westlaw addressing the following areas: (1) PE time requirements, (2) staffing requirements for PE, (3) curriculum standards for PE, (4) assessment of health-related fitness, and (5) recess-related policies. The CDC's Nutrition and Physical Activity Legislative Database[23] and the National Conference of State Legislature's (NCSL) Health Promotion Program State Legislation and Statute Database[24] were used as secondary data sources to supplement the primary searches. To further cross-reference the searches, reports from the School Health Policies and Programs Study (SHPPS)[25] and the NASPE[26,27] were reviewed as tertiary sources of information.

Conceptual Framework and Development of PERSPCS

PERSPCS is based on the methodology developed by the National Cancer Institute (NCI) to examine changes in state tobacco control policy.[28,29] A conceptual framework, based on the socio-ecologic model,[30] is provided in Figure 1 to illustrate the underlying assumption of PERSPCS. PE-related policies at the state level are expected to have an impact on the school environment and social norms that may in turn affect children's behavior. Not all policies assessed in PERSPCS are expected to have an impact on behavior. For example, a policy to increase assessment of health-related fitness is expected to change school-level behavior by requiring schools to collect this information, but it may not have an impact on children's behavior. The current conceptual framework focuses on policies that can affect children's behavior during school hours. Other areas of interest, not currently incorporated, include after-school activities and walking to school.

Development of PERSPCS included a review of the literature, consultation with an expert panel followed by in-depth consultation with key experts, and pilot testing of the coding system. In addition, it was informed by reviewing: (1) various public health objectives and recommendations that relate to physical activity and PE (e.g., American College of Sports Medicine [ACSM],[31] Dietary Guidelines for Americans,[32]

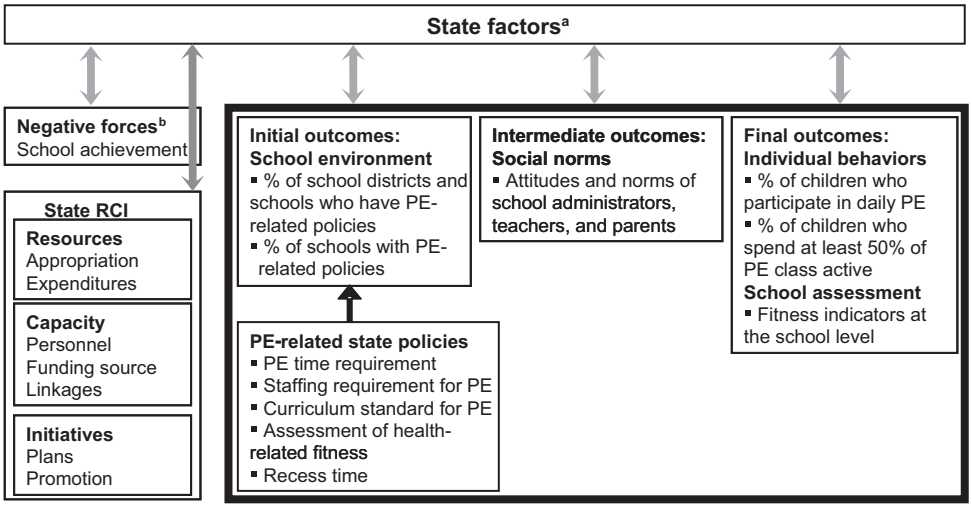

Figure 1. Physical education (PE) and recess time conceptual framework. [a]Age, education, population size, poverty status, race/ethnicity, urban/rural, baseline policies, sociopolitical factors. [b]This may be a force that can detract from allocating resources to PE.
RCI, resources, capacity, and infrastructure.

Healthy People 2010 objectives,[33] National Academy of Sciences,[34] Surgeon General's Report on Physical Activity and Health,[4] and others[35]); (2) position statements from agencies that recommend national standards or model policies for PE and recess,[15–17,36] and (3) by reviewing the criteria that have been used to develop the CDC School Health Index.[37] A panel (n=12) with expertise in physical activity, public health policy, and environmental health was convened in 2004. The expert panel focused on a broader group of topics that included urban planning, active transportation, community-based physical activity, and PE. PERSPCS represented a small component of this meeting, but it served to provide guidance on priority areas within each of the topics discussed at the meeting. Given the current attention to policy approaches in the school environment, starting with PE and recess time seemed timely. Based on the information from the scientific and gray literatures and input from the experts, an initial system was developed. As there were no agreed-upon standards to develop the policy classifications, select members from the expert panel provided feedback on several iterations of PERSPCS. Given the likelihood of policy variance in all areas except recess time, separate scores were created for policies addressing elementary, middle, and high schools.

A seven-state pilot test was conducted to investigate the reliability of PERSPCS both within and across topic areas, to make further revisions, and to refine the decision rules. California, Maine, New York, and Texas were selected for the pilot as they had the largest number of PE-related policies. Minnesota was chosen because a 2003 law repealed a number of PE-related policies. Missouri and West Virginia were selected to represent states with more rural areas. Two raters, with legislative expertise and knowledge of the project, independently coded 67 policies in these seven states. Agreement for the pilot was high (89%). Reviewing the discrepancies uncovered issues that served to fine-tune PERSPCS, including: (1) standardizing measurement of credit hours, (2) dealing with differences in grade configurations in school districts across and within states, and (3) dealing with the level of in-field teachers in PE. Table 1 summarizes the five policy areas addressed by PERSPCS, the maximum score within each policy area, and dichotomous enhancement or inhibiting factors that may affect policy implementation and/or impact. A complete description of the scoring system is included in Appendix A with decision rules available upon request.

As shown in Table 1, PERSPCS spans five areas, four of which are scored by grade levels (elementary, middle, and high schools). The scoring system ranged from a minimum score of 0 points to a maximum score of 5 points for PE time requirements or a maximum score of 4 points for the other policy areas. A score of 0 was assigned to a state when no policy existed for that policy area. The maximum score, on the other hand, reflected the most restrictive policy option for that policy area based on input from the experts. A score of 1 had somewhat consistent interpretation across policy areas, indicating that a policy was recommended but not mandated. The recommended level was included to facilitate future assessments of the relationship among varying levels of state policy restrictions and changes in the school environment, social norms, and student behaviors. Scores between 1 and 2 reflected gradually more restrictive policies for that policy area, and scores of 2 and above reflected that a policy in a given area was mandated (see Appendix A).

In addition to the policy-specific scores, a series of dichotomous subcodes was created to account for factors that might potentially enhance or inhibit the implementation of these policies. For PE time requirements, states were given credit for providing a policy that required daily PE participation in accordance with the recommendations of the expert panel. Conversely, a state's policy was considered to include a possible inhibiting factor if it allowed for PE substitutions based on a course or activity or if PE was not required for the entire school year. State policies were considered to potentially inhibit the impact of the PE teacher qualifications statewide if the staffing requirements for PE applied to some but not all school districts in the state. Such an allowance was considered as inhibiting, since there is literature suggesting that PE classes taught by certified instructors achieved better

Table 1. Policy areas for physical education (PE) and recess time

Policy areas	Description	Maximum score	Description of maximum score	Enhancement (E)/ inhibiting (I) factors
PE time requirements	Policies that address the amount of PE instruction required time for students.	5 points	State requires students in public schools to participate in PE for a minimum of 150 minutes per week (elementary school) and 225 minutes per week or the equivalent (middle and high schools).	E: State requires daily PE. I: State permits substitutions for PE OR PE is not required for the full school year.
Staffing requirements for PE	Policies that address certification requirements for newly hired teachers and education requirements for obtaining certification.	4 points	State offers certification/licensure/ endorsement to teach PE and requires newly hired PE teachers to be certified/licensed/endorsed and have a college major or its equivalent in PE.	E: None I: Teacher qualifications apply to most but not all school districts.
Curriculum standard for PE	Elements of the PE curriculum that are taught to students in elementary and secondary grades.	4 points	State standards address knowledge of physical activity, behavioral, and motor skills *and* health-related fitness OR the state requires that minimum national standards including such components be met.	E: None I: None
Assessment of health-related fitness	Policies that require the evaluation of student fitness in the following five areas: cardiovascular endurance, muscle strength, muscle endurance, flexibility, and body composition.	4 points	State requires students to participate in at least an annual fitness test that addresses each of the five assessment areas of interest.	E: State requires report on the assessment results. I: Fitness test is only required for a portion of the students.
Recess time (elementary schools only)	Policies for physical activity outside of the PE realm.	4 points	State requires public elementary schools to provide a minimum of 30 minutes of daily recess that does not substitute for PE.	E: None I: None

outcomes than those taught by noncertified personnel.[38] Finally for the assessment area, state policies were considered to include a potential enhancement if they required the health-related fitness assessment for a given education level to be reported to a specific state agency, whereas policies were considered potentially inhibiting if the assessment only was required for some, but not all, students.

Inter-Rater Agreement

Inter-rater agreement was established by having two raters (legal assistant and attorney) independently code each state's policies. Intraclass correlation coefficients (ICC)[39] were computed to assess the inter-rater agreement, one for each content area.

Policy Scores

Descriptive statistics were calculated to present the coding results. Two levels of aggregation were computed: one by grade level and one by policy areas. Data were aggregated across grade levels within the PE time requirements, staffing requirements for PE, curriculum standard for PE, and assessment of health-related fitness areas to determine the lowest policy that would be in effect for all grades in a given state. For example, a state with an aggregate score of 1 for PE time requirements indicates that across all grades the state received at least a score of 1. A state that received a score of 1 for high school but higher scores for both elementary and middle schools would receive an aggregate across-grade score of 1, reflecting the lowest policy restriction that would apply to all grade levels in that state.

A weighted summary score was computed by summing the across-grade-level scores for PE time requirements, staffing requirements for PE, curriculum standards for PE, and assessment of health-related fitness areas. The aggregated score did not include recess as it measures a non-PE-related dimension. The summary score was weighted to count the time requirements and staffing requirements scores at their full value (1.0) and to count the curriculum standards and assessment scores at half of their full value (0.5) (i.e., time requirements+staffing requirements+0.5*[curriculum standard+health assessment]). Our rationale for weighting the time and staffing areas higher than the standards and assessment areas was: (1) these areas may have a more direct impact on behaviors than the other areas, and (2) there is some evidence in the literature suggesting that increasing PE time and the qualification of the PE teachers can result in an increase in energy expendi-

ture and aerobic capacity in children.[2,8] All analyses were conducted in SPPS 14.01.

Results

Inter-Rater Agreement

Results indicated that the ICCs between the two raters ranged from a low of 0.876 (staffing requirements for PE) to a perfect agreement of 1.00 (recess time). The ICC across all five topic areas was high (0.947), indicative of the reliability of PERSPCS. All discrepancies were triangulated (two raters and a reconciler resolved the discrepancies by discussing and coming to an agreement) and the triangulated score was used for the remaining analyses.

Recess time was the least-difficult policy area to code because there were few provisions addressing recess in elementary schools, and the targets for this area were relatively straightforward—the existence of a policy requiring or recommending recess. In addition, only three states had recess provisions as of December 31, 2003. Staffing requirements for PE was the most difficult policy area to code, mainly because of unclear policy distinctions between the requirements for elementary and middle school PE teachers and the requirements for all-grade PE teachers. In other instances, such as in Delaware, the coding for staffing requirements was challenging because the state's regulation addressing teacher certification requirements (DEL. CODE REGS. § 14 1553 [2003]) included a number of options (i.e., several credit amounts, major in PE, or completion of a teacher preparation program), all of which could be coded differently.

Policy Areas and Grade-Level Scores

Table 2 presents grade-level scores and aggregated scores across grades with the state data aggregated across grades presented in Appendix B. State policy actions were more prevalent with regard to the time requirements, staffing requirements, and curriculum standards areas. However, the scores for the staffing requirements area were higher than all other policy areas. Within grade levels, policies were more restrictive at the high school level for the time and staffing requirements areas but were comparable across grade levels for the curriculum standards and assessment areas.

Physical Education Time Requirements

Approximately 20% of the states did not specifically have a policy addressing requirements for a minimal amount of time to be spent in PE for elementary or middle school students (score of 0). Conversely, this was quite different at the high school level, where only two states did not specifically address PE time requirements. The majority of the state policies received a score of at least 2 within each grade level, specifying at least some type of time requirement for PE. The policies went beyond simply recommending that PE occur or that it be an option, requiring less than 60 minutes per week of PE for elementary school children and less than 90 minutes per week of PE for middle and high school children. This finding was further illustrated by the results of the across-grade aggregation, which revealed that nearly 67% of the state policies received a score of at least 2. Only two states exceeded this score across grade levels by specifying at least a range of time equivalent to a score of 3 (requiring 60 to 90 minutes per week of PE for elementary school children and 90 to 150 minutes per week of PE for middle and high school children). No state policies achieved the PE time requirement maximum score for any of the grade levels. Few states required that PE be conducted on a daily basis at any grade level. Substitutions for PE or less than full-year requirements were less common at the elementary and middle school levels than at the high school level (27.5% of the states allowed this at the high school level).

Staffing Requirements for PE

States took a much more restrictive policy stance with regards to staffing requirements for a teacher to teach PE at the elementary, middle, or high school levels. At least 43% of the states (22 states) achieved a score of at least 2 for each grade level. In other words, in these states, certification/licensure/endorsement to teach PE was offered and the policies required newly hired PE teachers across grade levels to obtain this certification/licensure/endorsement as well as some other type of preparation that is less rigorous than a college minor in PE (e.g., less than 15 credit hours). The staffing requirements were somewhat more stringent at the middle and high school levels as compared to the elementary level, with the median scores at the middle and high school levels equating to a score of 3, which required state authorization and a college minor in PE. Only one state specified that the staffing requirements did not apply to all districts in the state.

Curriculum Standards for PE

State policy requirements for curriculum standards varied greatly within grade levels, although the across-grade-level scores were fairly consistent. Within each of the three grade levels, there appeared to be a tri-modal distribution: states either did not specify minimal curriculum standards (score of 0, 41.2% of states across grade levels); curriculum standards were required, but only by reference to a curriculum framework (score of 2, 25.5% of states across grade levels); or extensive state curriculum standards were required (score of 4, 19.6% across grade levels).

Table 2. Descriptive statistics of physical education (PE) and recess time policies by grade levels and aggregated across grade levels, as of December 31, 2003

		Elementary school		Middle school		High school		Aggregate–all grades		
Policy areas	**Score**	***n***	**%**	***n***	**%**	***n***	**%**	**Score**	***n***	**%**
PE time requirements	0	10	19.6	11	21.6	2	3.9	Some 0	11	1.6
	1	4	7.8	2	3.9	1	2.0	At least 1	4	7.8
	2	31	60.8	35	68.6	45	88.2	At least 2	34	66.7
	3	2	3.9	2	3.9	3	5.9	At least 3	2	3.9
	4	4	7.8	1	2.0	0	0.0	At least 4	0	0.0
	5	0	0.0	0	0.0	0	0.0	All 5	0	0.0
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum	5		5		5				
	Mean (SD)	1.73 (1.08)		1.61 (.94)		1.96 (.49)				
	Median	2		2		2				
	Observed Low-High	0–4		0–4		0–3				
	Enhancement factor	2	3.9	1	2.0	1	2.0			
	Inhibiting factor	3	5.9	2	3.9	14	27.5			
Staffing requirements for PE	0	5	9.8	1	2.0	0	0.0	Some 0	5	9.8
	1	1	2.0	1	2.0	1	2.0	At least 1	1	2.0
	2	22	43.1	23	45.1	21	41.2	At least 2	22	43.1
	3	10	19.6	12	23.5	14	27.5	At least 3	10	19.6
	4	13	25.5	14	27.5	15	29.4	All 4	13	25.5
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum	4		4		4				
	Mean (Std. Dev.)	2.49 (1.19)		2.73 (.96)		2.84 (.88)				
	Median	2		3		3				
	Observed Low-High	0–4		0–4		1–4				
	Inhibiting factor	1	2.0	1	2.0	1	2.0			
Curriculum standard for PE	0	19	37.3	20	39.2	19	37.3	Some 0	21	41.2
	1	3	5.9	3	5.9	2	3.9	At least 1	3	5.9
	2	13	25.5	12	23.5	15	29.4	At least 2	13	25.5
	3	4	7.8	4	7.8	5	9.8	At least 3	4	7.8
	4	12	23.5	12	23.5	10	19.6	All 4	10	19.6
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum	4		4		4				
	Mean (Std. Dev.)	1.75 (1.60)		1.71 (1.62)		1.71 (1.54)				
	Median	2		2		2				
	Observed low-high	0–4		0–4		0–4				
Assessment of health-related fitness	0	39	76.5	39	76.5	39	76.5	Some 0	39	76.5
	1	0	0.0	0	0.0	0	0.0	At least 1	0	0.0
	2	11	21.6	11	21.6	12	23.5	At least 2	12	23.5
	3	0	0.0	0	0.0	0	0.0	At least 3	0	0.0
	4	1	2.0	1	2.0	0	0.0	All 4	0	0.0
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum	4		4		4				
	Mean (SD)	0.51 (0.97)		0.51 (0.97)		0.51 (0.97)				
	Median	0.0		0.0		0.0				
	Observed low-high	0–4		0–4		0–2				
	Enhancement factors	4	7.8	4	7.8	4	7.8			
	Inhibiting factors	0	0.0	0	0.0	0	0.0			
Recess time	0	48	94.1					Some 0	48	94.1
	1	1	2.0					At least 1	1	2.0
	2	2	3.9					At least 2	2	3.9
	3	0	0.0					At least 3	0	0.0
	4	0	0.0					All 4	0	0.0
	Total	51	100.0					Total	51	100.0
	Maximum	4								
	Mean (SD)	0.10 (0.41)								
	Median	0								
	Observed low-high	0–2								

Assessment of Health-Related Fitness

State policies either did not address the assessment of health-related fitness (39 states across all grade levels, 76.5% of states) or they required students within each grade level to participate in the assessment of health-related fitness at least one time within the grade level (e.g., elementary, middle, or high schools; 12 states across all grade levels [23.5% of states]). Four states required that a report be provided at the state level at all grade levels, and no state specified that such assessment was required only within a specified grade level.

Recess Time

The vast majority of state policies did not incorporate recess time at the elementary school level (48 states, 94.1%). One state recommended recess without specifying a minimal amount of time, and two states required recess for less than 20 minutes per day or the policy required recess without specifying a minimal amount of time or frequency (score of 2).

Summary Scores

Table 3 presents descriptive statistics for the aggregated score (i.e., combined score across grade levels) for PE time requirements, staffing requirements for PE, curriculum standards for PE, and the assessment of health-related fitness as well as for the weighted summary score across the four PE-related areas (excluding recess). Consistent with the all-grade data presented above, the state policies were rather limited, particularly in the time requirements, curriculum standards, and assessment areas. Across the three grade levels, state policies hovered around the policy recommendation level (i.e., 1 point) for the time requirements area, a minimal restriction (i.e., the 2-point level) for the curriculum standards area, and at the policy recommendation (i.e., 1 point) or below level for the assessment area. Staffing provisions were somewhat more restrictive, with the state policies exceeding at least the minimal requirements (i.e., 2-point level), on average, across the three grade levels. Analysis of the weighted summary score revealed that, overall, the state policies were around the minimal requirements across policy areas and grade levels (i.e., score of 2). In other words, on average, the policies were more restrictive than a simple policy recommendation but not by much.

Discussion

Development of the PERSPCS is particularly timely given the increased interest in using policy-based approaches as one of multiple strategies to target childhood obesity. The purpose of this paper is to present the methodology developed to classify state policies for five key areas related to physical activity in the school environment, including PE and recess time requirements, staffing requirements for PE, curriculum standards for PE, and the assessment of health-related fitness. The methodology developed herein provides a reliable system for systematically and reliably classifying the nature and extent of state PE and recess time policies. PERSPCS can be a valuable tool to help states monitor change over time as it relates to these policy areas, as well as for providing longitudinal data for use in policy evaluation and impact studies.

These results provide a first look at the variability in state policies related to PE and recess time as of a December 31, 2003 baseline. Of the five policy areas examined, staffing requirements were most restrictive. Policies were increasingly less restrictive for each of the following areas: PE time requirements, curriculum standards for PE, the assessment of health-related fitness, and recess time. Staffing requirements for PE teachers likely had more restrictive policies mainly because teacher qualification has a longstanding history of being addressed at the state level as this is often included in the teacher credentialing section of the state regulations, although this is not necessarily specific to PE teacher qualifications.[40] Also, it was not surprising that the PE time requirement was the area that had the most restrictive policies. Most states have PE requirements for high school graduation, which can explain its ranking with respect to the other policy areas.[41] In addition, increasing PE time may have a more direct impact on behavior than the other areas.

Table 3. Summary scores for the physical education (PE) policies and weighted summary score for the PE-related policies, as of December 31, 2003

	PE time requirements	Staffing requirements for PE	Curriculum standard for PE	Assessment of health-related fitness	Weighted summary score[a]
Maximum	15	12	12	12	39
Mean (SD)	5.29 (2.24)	8.06 (2.79)	5.16 (4.60)	1.49 (2.77)	16.68 (5.33)
Median	6.00	7.00	6.00	0.00	16.00
Observed low-high score	0–11	3–12	0–12	0–10	6–31

[a]The summary score was weighted to count the time requirements and staffing requirements scores at their full value (1.0) and to count the curriculum standards and assessment scores at half of their full value (0.5).
SD, standard deviation.

As there is some evidence in the literature suggesting that increasing PE time alone may not be sufficient or the only approach necessary to increase physical activity during school hours, it is important to increase the policy action with respect to the other policy areas.[2,8,13,18,42] Although few states have mandated requirements for the assessment of health-related fitness, those that have a higher score in this policy area were more likely to have more restrictive policies governing PE time requirements ($r=0.348$, $p<0.05$) and curriculum standards for PE ($r=0.355$, $p<0.05$), potentially representing the more progressive PE-related states. Plans are underway to update the PERSPCS and to make the data available on the NCI website.

The 2003 scores provide a useful baseline against which future annual assessments can be compared to monitor changes in state policies related to PE and recess time. As PERSPCS is designed to capture the range of variability in state policies that go beyond the presence or absence of policy, it provides more descriptive information. Most importantly, such a system can be useful to incorporate into socio-ecologic studies aimed at examining the impact of state policies on the school environment, social norms, and behavioral outcomes at the macro- and micro-levels. To address the existing childhood obesity epidemic, there is a need to expand the current system to measure other areas related to physical activity (e.g., extracurricular activities, safe route to schools) and to combine it with nutrition-related policy classification information.[43]

The data are presented within the context of several limitations. First, it is important to consider that policies affecting the school environment with respect to PE and recess time also are enacted by lower levels of government, particularly at county, municipal, and/or school-district levels. For some areas, such as recess, where state requirements are minimal or virtually nonexistent, policy actions may be occurring at lower levels. Understanding such jurisdictional nuances is particularly important for assessing the interrelationship of public policies and their collective relationship with school practices and individual behaviors. By assessing only state policies or assessing only local policies, it may be difficult to ascertain the true policy environment and its relationship to system- and individual-level outcomes. Therefore, PERSPCS should be examined in conjunction with policies developed by local and school-district governments to determine overall effects of policies on system- and individual-level outcomes. PERSPCS provides a solid foundation for developing local-level policy indicators; however, the generalizability of the system to classify local-level policies needs to be established in future studies. In addition, it is expected that identifying and collecting local policies will require a different data-collection methodology, as lower-level policies are not readily available via a central electronic database.

Assessment of the reliability of PERSPCS utilized two coders, with one of them having legal expertise, and it is unclear if the same level of reliability would be obtained if the coders had different experience and background than was used in this study. Another limitation is that the reported data solely reflect a baseline assessment of PE and recess time laws developed by state legislatures and regulations promulgated by state agencies as of December 31, 2003. The analysis did not include Executive Orders nor did it account for state Attorney General opinions or any case law that may have existed to examine the legality of a given law. Likewise, it is important to recognize that many other policy areas beyond those presented in this system (such as those prescribed in model school wellness polices) relate to school- and individual-level outcomes. While including these additional policy areas was beyond the scope of this study, future efforts will be well-served by incorporating them to assess the nature and extent of those policies. Finally, the system also does not capture information on the implementation of policies by responsible state agencies or by school districts. Future research to understand the true "meaning" or impact of these policy actions is needed as enacting a policy is an important first step but it does not necessarily mean that it will be enforced. PERSPCS does not track enforcement but it can serve to conduct such evaluation. In several cases, it is still necessary to examine whether varying levels of policy requirements or restrictions have differential impacts on the school environment, social norms, and student-level behavior change. Yet a meaningful assessment of the potential policy impact of varying levels of restrictions would not be possible without ongoing classification of the nature and extent of these policies. This paper provides information on baseline policy status; additional years of data will be needed to conduct actual policy impact studies.

It should be noted that PERSPCS was developed to assess policy variability across and within states for a specific area but is not meant to provide policy guidelines. Currently, the evidence supporting a given policy change is not firmly established for PE and recess time. Until the predictive validity of these scores is established, it is not feasible to make policy recommendations. Therefore, it is important that the scoring system not be inappropriately used until more empirical data become available to guide policymakers. For example, it is unclear what will be the impact of having extensive state policies governing the assessment of health-related fitness. This may depend on how the data will be used. If the health-related fitness assessment data are aggregated at the school-district level and are reported only as such, it is unlikely to be as controversial as reporting individual data in the student report card, where the latter may have a negative impact on behavior as well as having unintended emotional conse-

quences. This illustrates that it is yet unknown if more restrictive policies are needed to have the desired behavioral outcome.

To summarize, this study developed a system for classifying the nature and extent of state PE and recess time policies. Given the inter-rater agreement in using this system to classify state policies, it suggests a high reliability in measuring the variability in the state policies. Therefore, the methodology developed as part of this paper provides a reasonable framework to begin to evaluate the impact of policies on environmental and behavioral outcomes.

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Appendix A: Physical education (PE) and recess time policy measurement system for elementary (ES), middle (MS), and high (HS) schools

Score	Description
PE time requirements	
5	ES: State requires students in public ES to participate in PE for a minimum of 150 minutes per week. MS/HS: State requires students in public MS/HS to participate in PE for a minimum of 225 minutes per week (or the equivalent in credit(s) based on the Carnegie unit).[a]
4	ES: State requires students in public ES to participate in PE for a minimum of 90 minutes per week but less than 150 minutes per week. MS/HS: State requires students in public MS/HS to participate in PE for a minimum 150 minutes per week but less than 225 minutes per week (or the equivalent in credit(s) based on the Carnegie unit).
3	ES: State requires students in public ES to participate in PE for a minimum 60 minutes per week but less than 90 minutes per week. MS/HS: State requires students in public MS/HS to participate in PE for a minimum of 90 minutes per week but less than 150 minutes per week (or the equivalent in credit(s) based on the Carnegie unit).
2	ES: State requires PE for less than 60 minutes per week; or state requires PE (daily/weekly/annually) without a specified time requirement. MS/HS: State requires PE in MS/HS for less than 90 minutes per week; or state requires PE (daily/weekly/annually) without a specified time requirement.
1	ES/MS/HS: State recommends a PE time requirement; or state requirement for physical activity includes an option for PE.
0	ES/MS/HS: No PE requirement. **Potential enhancement factor:** Applies if state specifies daily participation in PE. **Potential inhibiting factor:** Applies if state permits substitution for PE based on a course or activity; or if state specifies that PE instruction is not required for the full school year.
Staffing requirements for PE	
4	ES/MS/HS: State offers certification/licensure/endorsement to teach PE and requires newly-hired PE teachers to have certification/licensure/endorsement and a college major (or a minimum of 30 credit hours) in PE (to fulfill certification/licensure/endorsement requirement or otherwise.
3	ES/MS/HS: State offers certification/licensure/endorsement to teach PE and requires newly-hired PE teachers to have certification/licensure/endorsement and a college minor (or a minimum of 15 credit hours) in PE (to fulfill certification/licensure/endorsement requirement or otherwise).
2	ES/MS/HS: State offers certification/licensure/endorsement to teach PE and requires newly-hired PE teachers to have certification/licensure/endorsement and preparation that is less rigorous than a college minor (e.g., less than 15 credit hours) in PE (to fulfill certification/licensure/endorsement requirement or otherwise).
1	ES/MS/HS: State recommends certification/licensure/endorsement) and an academic degree in PE to teach PE.
0	ES/MS/HS: No requirement or no PE. **Potential inhibiting factor:** Applies if teacher qualifications apply to most but not all districts (e.g., not applicable to districts that regularly employ fewer than 20 teachers).
Curriculum standard for PE	
4	ES/MS/HS: State standards are required for PE that address student knowledge of physical activity, behavioral and motor skills, and health-related fitness; or state requires ES to meet national standards that include such component.
3	ES/MS/HS: State standards are required for PE that address student knowledge of physical activity, behavioral and motor skills, or health-related fitness, but not all such components.
2	ES/MS/HS: State standards are required, but by reference to a curriculum framework (or the equivalent) only.
1	ES/MS/HS: State recommends standards/guidelines for PE.
0	ES/MS/HS: No requirement or no PE.
Assessment of health-related fitness	
4	ES: State requires students in appropriate grade(s) (e.g., grade x and above) to participate in an annual (or more frequent) fitness test that addresses cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition (or a standard fitness test that includes such components). MS/HS: State requires students to participate in an annual (or more frequent) fitness test that addresses cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition.
3	ES: State requires students in appropriate grade(s) (e.g., grade x and above) to participate in a biannual fitness test that addresses cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition (or a standard fitness test that includes such components). MS/HS: State requires students to participate in a biannual fitness test that addresses cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition.

Score	Description
2	ES: State requires students in appropriate grades(s) (e.g., grade x and above) to participate in a health-related fitness test at least once in ES, with or without specified fitness test components. MS/HS: State requires students to participate in a health-related fitness test at least once in MS/HS, with or without specified test components.
1	ES: State recommends health-related fitness testing in appropriate grade(s). MS/HS: State recommends health-related fitness testing.
0	ES/MS/HS: No requirement or no PE. **Potential enhancement factor:** applies if state (e.g., state education agency) requires a report on results of such testing. **Potential inhibiting factor:** applies if fitness test is required for only a portion of students in appropriate grades.
Recess time—elementary school	
4	State requires public ES to provide a minimum of 30 minutes of daily recess that does not substitute for PE.
3	State requires public ES to provide a minimum of 20 minutes but less than 30 minutes of daily recess that does not substitute for PE.
2	State requires public ES to provide recess for less than 20 minutes per day; or requires recess without a time and/or frequency requirement.
1	State recommends recess.
0	No requirement.

[a]Credit are not specified, 1.0 credit unit is equivalent to 120 hour/year of PE instruction.

Appendix B: Weighted summary scores and raw scores for physical education (PE) by state and topic, as of December 31, 2003

State	PE time requirements	Staffing requirements for PE	Curriculum standard for PE	Health-related fitness assessment	Recess time	Weighted summary score
AK	2	6	0	0	0	8
AL	6	6	6	0	0	15
AR	7	9	10	0	0	21
AZ	6	3	0	6	0	12
CA	11	6	5	6	1	22.5
CO	0	6	0	0	0	6
CT	6	12	0	0	0	18
DC	2	12	0	0	0	14
DE	6	9	6	0	0	18
FL	6	12	6	0	0	21
GA	5	12	12	0	0	23
HI	2	6	2	0	0	9
IA	6	9	9	0	0	19.5
ID	6	6	0	0	0	12
IL	6	3	0	0	0	9
IN	4	8	8	0	0	16
KS	6	6	0	0	0	12
KY	2	6	0	0	0	8
LA	2	10	0	0	0	12
MA	6	6	3	0	0	13.5
MD	6	12	12	0	0	24
ME	6	12	12	6	0	27
MI	6	9	0	0	0	15
MN	6	6	0	0	0	12
MO	6	12	9	0	0	22.5
MS	4	7	6	0	0	14
MT	2	9	9	0	0	15.5
NC	6	6	0	0	0	12
ND	8	6	0	0	0	14
NE	6	9	9	0	0	19.5
NH	6	6	12	0	0	18
NJ	6	9	6	6	0	21
NM	6	12	12	6	0	27
NV	7	6	12	0	0	19
NY	10	12	12	6	0	31
OH	6	6	6	6	0	18
OK	1	6	12	0	0	13

State	PE time requirements	Staffing requirements for PE	Curriculum standard for PE	Health-related fitness assessment	Recess time	Weighted summary score
OR	6	6	6	0	0	15
PA	6	6	12	6	0	21
RI	6	6	2	0	0	13
SC	2	12	2	0	0	15
SD	0	9	0	0	0	9
TN	6	6	6	0	0	15
TX	5	9	3	0	2	15.5
UT	6	4	6	6	0	16
VA	6	12	0	0	2	18
VT	6	12	6	6	0	24
WA	9	9	0	0	0	18
WI	5	12	6	0	0	20
WV	6	4	12	10	0	21
WY	6	6	6	6	0	18

Development of a School Nutrition–Environment State Policy Classification System (SNESPCS)

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Background: As policy strategies are rapidly being developed to address childhood overweight, a system was developed to systematically and reliably classify state policies related to the school nutrition environment. This study describes the development process, the inter-rater reliability to code state policies enacted as of December 2003, and the variability in state policies related to the school nutrition environment.

Methods: The development of the School Nutrition Environment State Policy Classification System (SNESPCS) included a comprehensive review of published literature, reports from government and nongovernmental sources, input from an expert panel, and select experts. Baseline statutes and regulations for each of the 50 states and the District of Columbia were retrieved from Westlaw (data retrieved in 2005–2006 and analyzed in 2006) and pilot testing of the system was conducted.

Results: SNESPCS included 11 policy areas that relate to a range of environmental and surveillance domains. At baseline, states had no (advertising/promotion and preferential pricing) or modest (school meal environment, reimbursable school meals, coordinating or advisory councils, body mass index screening) activities in many of the policy areas. As of 2003, 60% of the states had policies related to the sale of foods in school that compete with the school meal program.

Conclusions: Evaluation of policies that affect the school-nutrition environment is in its earliest stage. SNESPCS provides a mechanism for assessing variation in state policies that can be incorporated in an evaluation framework aimed at elucidating the impact of state policies on the school environment, social norms, and children's dietary behaviors in schools.
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Data on the prevalence of overweight among children have triggered an interest in environmental and policy changes in the school setting. The rationale for developing and implementing school policies is emerging.[1] However, in recent years, much policy activity affecting the school nutrition environment has occurred at the federal, state, and local levels. As legislators have had success in developing public health policies in other areas (automobile, safety, and tobacco),[2] such strategies are increasingly being considered as an incentive to structure the school environment to support healthy behaviors. As children consume a significant proportion of their daily food intake in schools, the school environment is a prime target for nutrition-related policy initiatives.[1] To date, recommendations for policy changes in schools have been made based on "best-available" evidence and their effectiveness as it relates to school practices is just beginning to be evaluated.

The use of policy strategies to regulate the school nutrition environment is not new. For example, the nutritional content of meals sold as part of the National School Lunch Program (NSLP) and School Breakfast Program (SBP) is regulated at the federal level to conform to the United States Dietary Guidelines.[3] However, federal regulations are limited for foods and beverages sold outside the NSLP and SBP (termed competitive foods).[4,5] Only a portion of the competitive foods, those defined as Foods of Minimal Nutritional Value (FMNV) cannot be sold in school cafeterias or other food service areas during meal times.[6,7] However, it is well documented that students have easy access to

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competitive foods high in fat, sugar, and calories.[5,8] Currently, federal regulations allow states and local school authorities to further regulate the sale of competitive foods.

The Child Nutrition and Nutrition Program for Women, Infants, and Children (WIC) Reauthorization Act of 2004 is an example of a policy approach employed to change the school environment.[9] The Act required school districts that participate in the NSLP and SBP to implement "wellness" policies that include nutrition by school year 2006–2007. Recently, a number of soft drink companies have issued a joint statement with the Alliance for a Healthier Generation, the American Heart Association, and the Clinton Foundation to voluntarily adopt a new school beverage policy that will restrict the sale of soft drink in schools (e.g., increasing sales of bottled water, low-fat and nonfat milk, 100% fruit juice, and decreasing portion size).[10] Policy recommendations have been put forward by many, including the Institute of Medicine (IOM) which provides suggestions for competitive foods, school meals, nutrition education, advertising in schools, and assessment and reporting of body mass index (BMI) in schools.[1] If some or all of these policy recommendations are adopted and implemented, it is not yet clear what their impact will be on the school environment and children's behavior.

To assess the impact of policies, it is not sufficient to simply assess whether a policy exists given that the components and/or restrictions within a policy may vary greatly by state. From a policy-impact perspective, it is most useful to compare the variation in restrictions contained within a policy provision and to assess how the policy is being implemented in practice. Therefore, this paper describes the development of the School Nutrition Environment State Policy Classification System (SNESPCS), which was designed to classify and prospectively monitor changes in state statutes and regulations.

Methods

Data Source

Statutory (legislation) and administrative (regulatory) laws (collectively referred to as "policies" hereafter) for each of the 50 states and the District of Columbia (hereafter referred to as "states") were obtained via primary legal research[11] using the Westlaw legal database. State statutes reflect the official compilation of laws as enacted by state legislatures; administrative laws reflect the compilation of rules and regulations promulgated by state Executive Branch agencies.[12] Typically, state legislation in the school nutrition area provides an enabling framework or foundation for more detailed policy proscriptions that are specified in administrative laws (i.e., rules and regulations) developed by state agencies.[13] For this study, administrative laws were particularly relevant because most state education-related policies are formulated through the regulatory process. Information on case law, Attorney General opinions, Executive Orders, school district policies, and school-level policies was beyond the scope of this research.

Baseline data on state policies enacted or adopted as of December 31, 2003 were compiled to test the system. The baseline reference date was chosen to: (1) ensure consistency with the study reference date for a similar system created to assess state physical education (PE) policies (reported elsewhere)[14]; (2) serve as a baseline to prospectively assess change; and (3) establish a baseline before most changes occur in this area. The policy data were retrieved and analyzed in 2005–2006. A series of broadly defined Boolean search strategies were developed to identify potentially relevant policies contained in Westlaw. Secondary data source were used to cross-reference the existence of policies in a given topic area including: the School Nutrition Association's State Policy Index[15]; the Centers for Disease Control and Prevention (CDC)'s Nutrition and Physical Activity Legislative Database[16]; the National Conference of State Legislature's (NCSL) Health Promotion Program State Legislation and Statute Database[17,18]; the Health Policy Tracking Service[19]; and the National Association of State Boards of Education's (NASBE) State-Level School Health Policies Database.[20]

Conceptual Framework and Development of SNESPCS

A draft of SNESPCS was developed by the study team through a review of the published literature, web reports, policy recommendations from various health agencies, government recommendations and guidelines, model policies in this area, and key documents.[1,21–33] Development of SNESPCS was modeled after previous tobacco-related policy evaluation system that is used to classify policies against established public health benchmarks.[34,35] In contrast, empirical data is still emerging for the school nutrition environment; therefore, the policy areas and classifications within SNESPCS were based on "best possible" evidence as well as input from an expert panel (n=9) and key experts (n=4). The inclusion of a policy area in SNESPCS is not intended to imply that there is enough scientific evidence supporting such policy. SNESPCS topics focus on the competitive foods, the school meal environment, food service director qualifications, coordinating or advisory councils, nutrition education, marketing, and screening of body mass index (BMI) in schools.

As depicted in Figure 1, the topics included in SNESPCS can be viewed through the lens of the Social–Ecological Model[36,37] and more recently refined models presented by Brownson et al.[38] and Glanz et al.[39] The policy areas in SNESPCS can be classified according to whether they may affect the environment (physical, structural, communication, and economic environments) or the surveillance of BMI in schools with the rationale and scientific justification provided below.

Competitive foods. The term "competitive foods" in SNESPCS follows the U.S. Department of Agriculture (USDA) and Government Accounting Office (GAO) definition, which includes all foods and beverages sold outside of the reimbursable federal school meal programs.[4,5] In SNESPCS, coding is assigned in three categories: (1) à la carte in cafeterias, which include items sold or served in cafeterias, (2) vending machine items sold schoolwide, and (3) other

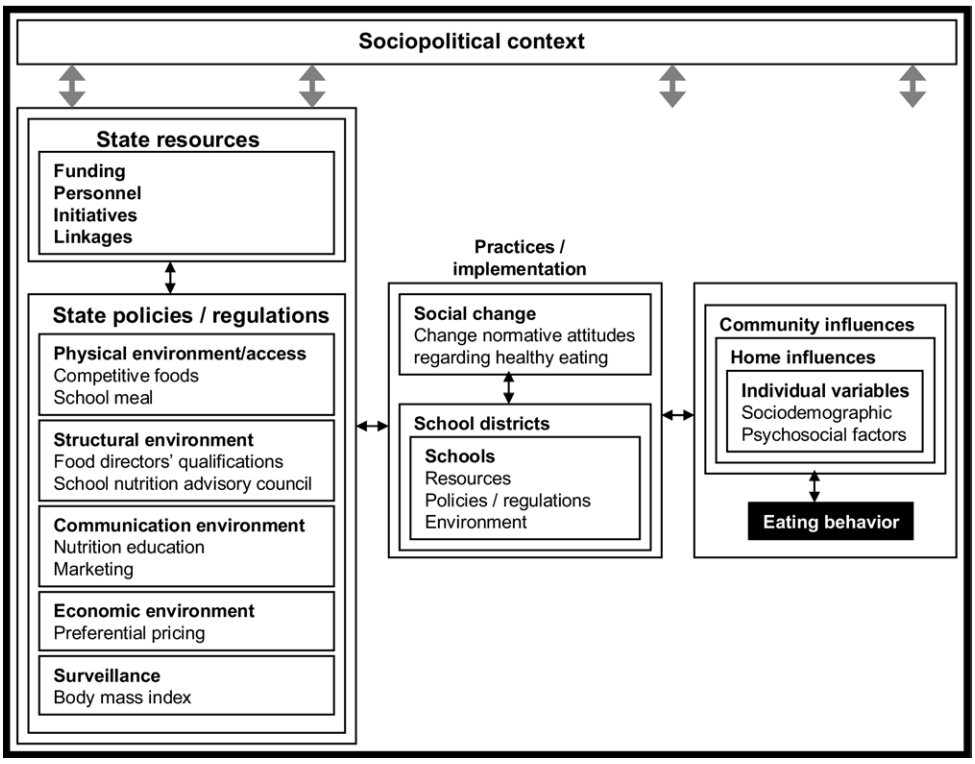

Figure 1. Conceptual framework for understanding the potential impact of policies related to the school nutrition environment.

venues that may include items sold or served in school stores, canteens, and classrooms. The limited number of studies that have examined the impact of competitive foods on children's dietary intake suggest that the availability of these foods is associated with higher intake of fat and saturated fat.[40–42] Federal regulations prohibit schools from selling foods of minimal nutritional value, but only in food service areas during meal times and applicable only to soda, water ices without fruit juice, several hard and soft candy types, and chewing gum.[6,7] SNESPCS includes provisions that go beyond meeting the federal regulation, in part because the definition of foods of minimal nutritional value is limited and does not capture many foods high in fat, sugar, and calories devoid of minerals and vitamins.[5–7] In addition, mid-range to higher codes differentiate among policies that meet or exceed the 2005 federal dietary guidelines.[43] It should be noted that SNESPCS includes less specificity for minimal requirements (e.g., maximum sugar allowance) than advocated by certain groups[44,45] and those identified by USDA as part of its HealthierUS School Challenge,[46] although additional specificity can be incorporated as further recommendations arise in this area.

School meals. Currently, schools participating in the SBP or NSLP are required to offer lunches between 10:00 AM and 2:00 PM, provide sufficient time to eat, and meet current USDA guidelines.[3,6,7] Some studies have indicated that the length of the lunch period is positively associated with improved nutrient intake.[47–49] In addition, those who consume the NSLP have been found to eat more fruits and vegetables[42] and have better nutrient intake.[50] For the SNESPCS, two categories were established, namely, the school environment, which refers to the time and duration of the meal period; and reimbursable school meals, which refers to enhancing the school meal preparation to exceed the 2005 federal dietary guidelines[43] (e.g., less fat than the federal guidelines).

Food service director qualifications. USDA and NASBE recommend setting educational standards for the nutrition personnel.[20,22] One large-scale survey found that credentialed food service managers prepared healthier food options than noncredentialed staff.[27] SNESPCS examines state policies with respect to the qualifications for newly hired food services directors.

Coordinating or advisory councils. Coordinating or advisory councils are created at the state level to build coordination and planning for school health needs[20] and may be linked to school wellness policies. Detailed suggestions for how a coordinating or advisory council relate to a statewide plan have been provided[51,52]; however, it was decided that SNESPCS would initially capture the extent to which states have developed such a framework. This category can be expanded to include more aspects as these state councils evolve.

Nutrition education. Nutrition education has been suggested to be an important component of a comprehensive health program[53] as it has the potential to increase students' knowledge about food choices and their attitudes and skills to eat a healthy diet.[54–56] It has been suggested that providing age-appropriate nutrition education in a school environment where healthy nutrition behavior is promoted can reinforce healthier food behaviors.[1]

Marketing. The American College of Preventive Medicine recommends prohibiting visual advertising, promotion, dis-

tribution, and sampling of "junk foods" on school property.[57] A recent IOM report concludes that there is enough empirical evidence suggesting that marketing practices have a significant impact on children's dietary behavior.[21] In addition, there is initial data indicating that lowering the price of healthier food options increase consumption of these items by children.[58–60] Consequently, SNESPCS includes two categories for marketing: (1) marketing–advertising, which refers to the promotion of food and beverages to student during school hours; and (2) marketing–preferential pricing, which refers to pricing strategies for selling healthier food and beverages options in the school.

Screening for BMI. The IOM has called for annual screening of every student's weight, height, and percentiled BMI as well as recommending that states develop reporting protocols.[1] Controversy about screening for BMI in schools and the reporting of BMI information is ongoing.[61–63] Although BMI screening is a controversial topic, the inclusion was deemed important as empirical evidence is likely to emerge after some states have enacted such policies. The decision to include BMI screening, or any other policy areas, in SNESPCS does not reflect the authors' or experts' endorsement of such policies but that such policies have been considered and enacted by some states.

Pilot testing and finalizing SNESPCS. The initial SNESPCS was reviewed by the expert panel (N=9; expertise in nutrition, education, policy, public health policies, obesity prevention, and nutrition guidelines). The expert panelists agreed on all policy topic areas, except for BMI school-based screening as mentioned above. Additionally, key experts provided focused advice on several iterations of SNESPCS and the associated topic areas. To finalize SNESPCS, a pilot study was conducted to determine the reliability of the system and to clarify decision rules. Eight states with the largest number of nutrition policies were selected for the pilot (DC, CA, DE, FL, LA, NE, OH, and WV). All policies were double coded independently (project manager and legislative analyst) and resulted in high inter-rater agreement (84.5%). The pilot resulted in minor changes and yielded a measurement system that reflected the 11 policy areas described above (see Appendix A). Where appropriate, policies were coded by grade level (elementary, middle, and high school). Grade level is not consistently defined by states; however, the states' operationalizations were employed for the classification. In total, 21 individual codes were developed (5 by grade level and 6 non–grade level = 5 * 3 grade levels + 6 = 21 codes).

Scoring. The SNESPCS is an ordinal scoring system, designed to reflect the relative degree of the policy mandate within each of the 11 policy areas, with scores within a given policy area ranging from "0" to a maximum of "3" or "6" points depending on the area. The "0" score across all topics reflects that a state has no policy and a score of "1" is assigned when a state made a policy recommendation (rather than a policy requirement). Inclusion of level "1" (recommended policy) scoring category was debated; however, an analysis of recommended policies may have research value as compared to mandated policies. Scores of "0" and "1" have consistent interpretation across all policy areas and scores in between reflect an increment in policy requirements and specificity. If a policy area was determined to be less varied in nature, the maximum score was set to a lower value ("3" versus "6") to reflect the limited range at this time (see Appendix A). A series of dichotomous subcodes were created to track policies areas that are not well developed in the literature but have the potential to enhance or inhibit the policy.

Analysis

Inter-rater agreement. Two raters with expertise in state legislative analysis independently rated each state's policies to assess the reliability of the codes. After the raters were trained in coding the policy areas, the reliability of SNESPCS was assessed by evaluating the percentage of agreement and the intraclass correlation coefficient (ICC).[64]

Policy area scores. Aggregate summary scores were computed for each of the 11 policy areas. For the five policy areas with grade-level scores (i.e., à la carte in cafeterias, vending machines, other venues, reimbursable school meals, and nutrition education) a category-specific score was computed by summing the elementary, middle, and high schools scores. In addition, across grade-level scores were computed to determine the lowest policy restriction that would apply across grade levels in the state. For example, states would receive a score of "at least 1" for à la carte in cafeterias if they received a score of "at least 1" across the three grade levels, as would a state that received a score of "4" at the high school level but only a score of "1" for another grade, indicative of the least extensive policy restriction that would apply for all grade levels. Composite scores were not developed as it was felt premature to assign weights both within the scoring categories as well as across policy areas since the empirical evidence is still emerging. All analyses were computed using SPSS version 14.0.1.

Results

Inter-rater Agreement

The percentage of agreement and ICC computations indicate adequate levels of inter-rater agreement. Inter-rater agreement ranged from a low of 74.5% (for nutrition education scores) to perfect agreement (for the marketing–preferential pricing policy area), with an average inter-rater agreement of 88.8%. Disagreement for the nutrition education area centered on the subtle difference between a policy mandating nutrition education standards without specific requirements and one that specified requirements for knowledge, skills, and behavior. ICCs were not computed for seven of the items as not enough policies existed in these areas. The ICCs were fairly high—ranging from a low of 0.835 (nutrition education for elementary schools) to a high of 0.962 (competitive foods in other venues for elementary schools). The average ICC was fairly high, 0.902, indicative of the reliability of SNESPCS.

Policy Area Scores

Summary statistics are presented in Table 1 with grade-level scores presented in Table 2. State-level data (summed across grades by policy areas) are presented

Table 1. Policy-area descriptive statistics, without grade distinctions (as of December 31, 2003)

				Without grade distinctions				
Policy area	**Brief description**	**Grade-level scores**	**Maximum attainable score per grade**	**Maximum attainable score across grades**	**# of states with scores >0 N (%)[a]**	**Low–high scores achieved**	**Mean**	**SD**
Competitive foods à la carte in cafeterias	Individual food items sold or served outside the federal school meal program	Yes	5	15	14 (27.5)	0–15	2.37	4.43
Competitive foods—vending machine	Individual food items sold or served through vending machines in schools	Yes	6	18	17 (33.3)	0–12	2.33	3.73
Competitive foods: other venues	Individual food items sold or served outside the cafeteria or vending machines	Yes	6	18	17 (33.3)	0–12	2.29	3.66
Reimbursable school meal	Exceeding federal requirements for the reimbursable school meal	Yes	3	9	3 (5.9)	0–9	0.41	1.80
School meal environment	Exceeding federal requirements for meal time and meal period	No	3	3	3 (5.9)	0–3	0.10	0.46
Food service director qualifications	Qualification for newly hired food service directors	No	4	4	8 (15.7)	0–4	0.49	1.19
Coordinating or advisory councils	Creation of council or plan	No	3	3	8 (15.7)	0–2	0.24	0.59
Nutrition education	Requirements for the nutrition education curriculum	Yes	4	12	30 (59.8)	0–12	4.49	4.29
Marketing: advertising	Promotion of food and beverages during school hours	No	5	5	0 (0.0)	0–0	0.00	0.00
Marketing: preferential pricing	Preferential pricing for selling healthier food in school	No	4	4	0 (0.0)	0–0	0.00	0.00
BMI screening	BMI screening and reporting	No	3	3	3 (5.9)	0–3	0.18	0.71

[a]The column, "# of states with scores >0" reflect the aggregate scores without grade-level distinctions.
SD, standard deviation; BMI, body mass index.

in Appendix B with more detailed data available on request. Overall, 38 states (74.5%) received a score greater than "0". Policy activity as of December 31, 2003 was limited to a few areas—competitive foods (à la carte in cafeterias, vending machines, and other venues; nutrition education; and, to a lesser extent, coordinating or advisory councils and food service directors. With the exception of nutrition education, where 30 states had taken some type of action, the summary scores and statistics across the policy areas were quite low.

Competitive foods (à la carte in cafeterias, vending machines, and other venues). The scores for à la carte in cafeterias were somewhat higher than the vending machines and other venues scores and between 14 (27.5%) to 17 (33.3%) states received a score in these policy areas (see Table 1). Fewer states received a score of at least "1" for each of the three grade levels; 12 (13.5%) states for the à la carte sales; ten (19.6%) states for vending machines; and 11 (21.6%) for other venues (see Table 2). The maximum score was attained only for the à la carte sales and only three were given "full credit" for meeting the maximum score "5", which prohibited à la carte sales or service in cafeterias outside the reimbursable school meal program with some exceptions (e.g., sale of water, low-fat/nonfat milk, beverages with at least 100% fruit/vegetable juice, and nonfat fruits and vegetables).Overall higher scores were more prevalent for elementary schools followed by middle and high schools (see Table 2). Only one state

Table 2. Descriptive statistics for policy areas with grade-level distinctions (as of December 31, 2003)

		Elementary school		Middle school		High school		Aggregate all grade		
Policy area	**Score**	**N**	**%**	**n**	**%**	**n**	**%**	**Score**	**n**	**%**
Competitive foods—à la carte in cafeterias	0	37	72.5	39	76.5	39	76.5	Some 0	39	76.5
	1	0	0.0	0	0.0	0	0.0	At least all 1	0	0.0
	2	5	9.8	6	11.8	6	11.8	At least all 2	6	11.8
	3	3	5.9	2	3.9	2	3.9	At least all 3	2	3.9
	4	2	3.9	1	2.0	1	2.0	At least all 4	1	2.0
	5	4	7.8	3	5.9	3	5.9	All 5	3	5.9
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum		5		5		5			
	Mean (SD)		0.92 (1.65)		0.73 (1.46)		0.73 (1.46)			
	Tracking variable: portion size[a]	0	0.0	0	0.0	0	0.0			
	Tracking: penalty[a]	1	2.0	1	2.0	1	2.0			
Competitive foods: vending machines	0	35	68.6	38	74.5	40	78.4	Some 0	41	80.4
	1	0	0.0	0	0.0	1	2.0	At least all 1	0	0.0
	2	3	5.9	4	7.8	4	7.8	At least all 2	4	7.8
	3	8	15.7	7	13.7	6	11.8	At least all 3	6	11.8
	4	2	3.9	2	3.9	0	0.0	At least all 4	0	0.0
	5	1	2.0	0	0.0	0	0.0	At least all 5	0	0.0
	6	2	3.9	0	0.0	0	0.0	All 6	0	0.0
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum		6		6		6			
	Mean (Std. Dev.)		1.08 (1.75)		0.73 (1.30)		0.53 (1.07)			
	Tracking variable: portion size[a]	0	0.0	0	0.0	0	0.0			
	Tracking penalty[a]	1	2.0	1	2.0	1	2.0			
Competitive foods: other venues	0	35	68.6	38	74.5	39	76.5	Some 0	40	78.4
	1	0	0.0	0	0.0	1	2.0	At least all 1	0	0.0
	2	4	7.8	4	7.8	4	7.8	At least all 2	4	7.8
	3	8	15.7	7	13.7	7	13.7	At least all 3	7	13.7
	4	3	5.9	2	3.9	0	0.0	At least all 4	0	0.0
	5	0	0.0	0	0.0	0	0.0	At least 5	0	0.0
	6	1	2.0	0	0.0	0	0.0	All 6	0	0.0
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum		6		6		6			
	Mean (SD)		0.98 (1.57)		0.73 (1.30)		0.53 (1.12)			
	Tracking variable: portion size[a]	0	0.0	0	0.0	0	0.0			
	Tracking penalty[a]	1	2.0	1	2.0	1	2.0			
Reimbursable school meals	0	48	94.1	48	94.1	48	94.1	Some 0	48	94.1
	1	1	2.0	1	2.0	1	2.0	At least all 1	1	2.0
	2	0	0.0	0	0.0	0	0.0	At least all 2	0	.0
	3	2	3.9	2	3.9	2	3.9	All 3	2	3.9
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum		3		3		3			
	Mean (SD)		0.14 (0.60)		0.14 (0.60)		0.14 (0.60)			
Nutrition education	0	22	43.1	22	43.1	21	41.2	Some 0	22	43.1
	1	2	3.9	2	3.9	1	2.0	At least all 1	2	3.9
	2	13	25.5	14	27.5	15	29.4	At least all 2	14	27.5
	3	8	15.7	8	15.7	8	15.7	At least all 3	8	15.7
	4	6	11.8	5	9.8	6	11.8	All 4	5	9.8
	Total	51	100.0	51	100.0	51	100.0	Total	51	100.0
	Maximum		4		4					
	Mean (SD)		1.49 (1.48)		1.45 (1.43)		1.55 (1.46)			
	Tracking variable: curriculum integration[a]	7	13.7	7	13.7	6	11.8			
	Tracking variable: instruction[a]	0	0.0	0	0.0	0	0.0			

[a]Tracking variables are not part of the scoring system but are monitored as these variables may have the potential to influence the measurement system.
SD, standard deviation.

received credit (see tracking variables in Table 2) at each grade level for establishing penalties for violations of the state law and this was consistent across the à la carte, vending machines, and other venues sale of competitive foods. In addition, no state addressed portion sizes of food sold à la carte, in vending machines, and other venues.

Reimbursable school meals. Only three states (5.9%) had policies governing reimbursable school meals (Table 1). As Table 2 reveals, two states (3.9%) were given the maximum score of "3" for each grade levels as they specified requirements for exceeding compliance with the 2005 federal regulations.[6,7] One state recommended (score of "1") nutrition standards to exceed compliance with the federal regulations for school meals.

School meal environment. As with the reimbursable school meal area, only three states (5.9%) had a relevant policy for the school meal environment that exceeded compliance with the 2005 federal regulations in this area.[43] Notably, two of the three state policies were limited to a recommendation (score of "1") and the remaining state received a score of "3" for mandating at least two standards beyond the federal requirements.

Food service director qualifications. Eight states (15.7%) included at least a minimal qualification requirement (score of "2") for newly hired food service directors (Table 1). Two states included a minimal requirement of a high school degree/GED (score of "2"), three states required a minor (score of "3"), and three states received the maximum score "4" for requiring a bachelor's degree in nutrition, dietetics, food service management or a related field. Six states' policies (11.8%) included a provision for professional development of food service directors, regardless of whether it was related to the certification.

Coordinating or advisory councils. Eight states (15.7%) recommended the establishment of at least voluntary school health coordinating or advisory councils for districts or schools (Table 1). Four states included this minimal recommendation, while the other four had a minimal requirement ("2") for the creation of such councils or programs. Five states (9.8%) included a provision requiring the state to create an advisory board to provide recommendations related to nutrition and youth overweight policies.

Nutrition education. As Tables 1 and 2 indicate, state policies were more likely to address the nutrition education area than any other category included in SNESPCS. Across grade levels, most states (30 states, 59.8%) had at least a minimal policy provision and 29 states (56.9%) included at least a recommendation (score of "1"). Five states (9.8%) received the maximum score "4" across grade levels for requiring a curriculum to incorporate sequential nutrition education content into the standard health education curriculum with reference to specific nutrition standards. Seven states policies (13.7%) included requirements for integrating the nutrition instruction in the school with the food service program or with other subjects at the elementary and middle school levels; six states (11.8%) included such provision for high schools. No state policy specified a set or minimal amount of hours for nutrition education or hours of professional development for nutrition educators.

Advertising/marketing. Although included in SNESPCS, no state policies addressed either the advertising/promotion or the preferential pricing areas (see Table 1).

Screening for BMI. Three states' policies (5.9%) were given credit for addressing BMI screening (Table 1). In each case, the states were given maximum credit ("3") for mandating that schools perform annual BMI screening of all students (as long as they were not exempted by parents). One state included a provision that the state and/or school district addressed procedures for parental notification and referral.

Discussion

Understanding the relationship between school nutrition policies with the school nutrition environment, social norms, and student dietary behavior is a topic of great interest. For evaluation purposes, a monitoring system that facilitates classification of school nutrition policies both within and across states is an important preliminary step. This paper described the methodology to monitor and classify state policies that have the potential to affect the school nutrition environment and to provide an initial baseline for ongoing policy evaluation. The SNESCPS will help states monitor change over time and will provide a reliable system which can be incorporated in evaluation research focused at elucidating the impact of these policies.

Baseline data reported herein demonstrate that SNESPCS can be used to reliably classify state policies addressing the school nutrition environment, a key criterion of any measurement system.[65] As of December 31, 2003, policies in most states focused on the following areas from our conceptual framework: the physical environment (i.e., competitive foods and school meal policies), communication environment (particularly nutrition education) and, to a lesser extent, on the structural environment (i.e., food service director qualifications and school nutrition advisory councils). Few states policies addressed the economic environment or surveillance issues. It was not surprising that nutrition education received the most attention thus far, since it is integrated into the health education curriculum, a component that is commonly taught in schools. Con-

versely, the other components assessed by the system are not part of the school curriculum and may have received less attention given the increased focused on student achievement.[66] Furthermore, the relatively small number of state policies targeting the school nutrition environment may reflect that: (1) the policy focus in this area is emerging; (2) states deferred to local authorities on school-related policies; and (3) state policymakers are wary of restrictions on competitive foods sales and other restrictions that might create financial challenges for schools since competitive foods revenues are used to subsidize food service operations, field trips, and athletic equipment and facilities.[5] Plans are underway to update the data and to make it available on the National Cancer Institute (NCI) website.

A major strength of SNESPCS is that it was designed to capture the variation in state-level policies governing the school nutrition environment that extend beyond simply assessing the presence or absence of policies in a given area. It is meant to serve as a starting point for surveillance and to be incorporated in a comprehensive evaluation framework (see Figure 1). As such it addresses an important need for evaluation research in this area, which IOM has identified as an important focus for obesity prevention.[67] A rigorous process was used to develop SNESPCS; however, much is still needed to be done to establish its validity and develop composite scores. As the empirical evidence continues to emerge across policy areas, SNESPCS should not be viewed as a report card on school nutrition environment policies of individual states.

Recognizing that the system is in its infancy, it is important to review this paper and the system within the context of the following limitations. First, only statutes and regulations were assessed. Thus, a range of obesity-related programs and interventions as well as industry agreements were not reflected in this study. Second, local school district policies addressing nutrition may be more extensive than what is required by state law and although local school district policies were analyzed as part of the development process, the applicability of SNESPCS for assessing local-level policies has not been fully assessed. Third, the passage of a policy is an important first step; however, it does not necessarily mean that the policy was enforced. SNEPCS does not track enforcement as it does not provide an evaluation of the implementation of these policies, although the resulting data can be linked to both programs and practices. Fourth, as more empirical data or recommendations (such as the IOM report on nutrition standards for foods in school[68]) emerge, the categories and the scoring structure within SNESPCS may need to be refined to ensure that the system accurately reflects new evidence and captures the policy variance both within and across categories. Finally, psychometric analyses are warranted to assess the performance of the system in relation to the hypothesized understanding of the policy components.[65]

With these limitations in mind, the development of SNESPCS is particularly timely given the interest in policies enacted to respond to the childhood overweight epidemic. Combining SNESPCS with the PE policy system[14] provides data, beginning with a 2003 baseline, on the variability of a range of policies which have an impact in structuring school environments to support healthy behaviors. Linking the policy data with other data has significant potential for understanding how these policies affect the school environment, and potentially social norms and behavioral outcomes among children as similar efforts have been successful in helping understand the impact of tobacco consumption and related behaviors.[69–71] Furthermore, combining the knowledge of school policy influences with measures of home, neighborhood, media, and other influences can provide a more comprehensive understanding of children's dietary behaviors.

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Appendix A: School nutrition environment state policy classification system for elementary (ES), middle (MS), and high (HS) schools

Terminology	Definition
Competitive foods	USDA and GAO defined to include all foods and beverages sold outside of the reimbursable federal school meal program.[4,5]
Federal dietary guidelines	2005 federal dietary guidelines that recommend total fat intake of less than 35% of calories (saturated fat at less than 10% of calories) for ages 4 to 18; little added sugars or caloric sweeteners, and consumption of fiber rich fruit, vegetables and whole grains and nonfat dairy foods.[43]
Food of minimal nutritional value (FMNV)	Includes carbonated beverages, water ices, chewing gum, hard candy, jellies and gums, marshmallow candies, fondant, licorice, spun candy, and candy-coated popcorn (7 CFR 210 Appendix B).[6,7]
Food and beverages of low nutritive value	Food and beverages providing most of its calories from fat and/or sugar and few vitamins and minerals.

Score	Description
Competitive Foods: à la carte in cafeterias	
5	ES/MS/HS: State prohibits the sale or service of à la cart food and beverages outside the reimbursable school meal programs, with exceptions only for the sale or service of water, lowfat/nonfat milk, beverages with at least 100% fruit/vegetable juice with no added caloric sweeteners, and nonfried fruit and vegetables.
4	ES/MS/HS: State mandates nutrition standards that meet or exceed federal dietary guidelines,[43] with specified limits on fats and added sugar and requirement(s) for nutrient-dense options, applicable to all à la carte food and beverage items sold or served in cafeterias outside the school meal program.
3	ES/MS/HS: State restricts sale/service of à la carte food and beverages of low nutritive value beyond federal requirements for FMNV, but without establishing nutrition standards that meet or exceed federal dietary guidelines.[43]
2	ES/MS/HS: State requirement for à la carte food and beverages sold or served in cafeterias outside the school meal program is undefined (e.g., "healthy" foods and beverages must be available); or state requires a state agency to develop and adopt nutrition standards applicable to à la carte sales/service.
1	ES/MS/HS: State recommends nutrition standards for à la carte items.
0	ES/MS/HS: No provision.
Tracking variable	**Potential enhancement factor:** Applies if state specifies portion sizes. **Potential enhancement factor:** Applies if penalties are established for violations.
Competitive foods: vending machines	
6	ES/MS/HS: State prohibits the sale or service of nonreimbursable food and beverages in vending machines (or student access to vending machines selling such items), with exceptions only for the sale or service of water, lowfat/nonfat milk, beverages with at least 100% fruit/vegetable juice with no added caloric sweeteners, and nonfried fruit and vegetables.
5	ES/MS/HS: State mandates nutrition standards that meet or exceed federal dietary guidelines,[43] with specific limits on fats and added sugar and specific requirement(s) for nutrient-dense options, applicable to all food and beverage items sold or served outside the school meal program in vending machines (or access to such vended items).
4	ES/MS/HS: State prohibits, at any time during school hours (beyond meal service times in the cafeteria), vending (or access to vending) of FMNV, including, but not limited to, carbonated beverages (e.g., no vending-machine soda during school hours).
3	ES/MS/HS: State mandates a restriction on vending-machine food/beverages of low nutritive value beyond federal requirements for FMNV, but for fewer than all school hours.
2	ES/MS/HS: State requirement for food and beverages sold/served in vending machines outside the school meal program is undefined (e.g., "healthy" foods and beverages must be available); or state requires the development of nutrition standards applicable to vending machines sales/service.
1	ES/MS/HS: State recommends nutrition standards for vended items.
0	ES/MS/HS: No provision.
Tracking variables	**Potential enhancement factor:** Applies if State specifies portion sizes for vended items. **Potential enhancement factor:** Applies if penalties are established for violations.
Competitive foods: Other venues	
6	ES/MS/HS: State prohibits the sale or service of nonvending-machine food and beverages sold or served outside of (reimbursable) school meal programs, with exceptions only for the sale or service of water, lowfat/nonfat milk, beverages with at least 100% fruit/vegetable juice with no added caloric sweeteners, and nonfried fruit and vegetables.
5	ES/MS/HS: State mandates nutrition standards that meet or exceed federal dietary guidelines,[43] with specific limits on fats and added sugar and specific requirement(s) for nutrient-dense options, applicable to all food and beverage items sold or served outside the school meal program in any nonvending-machine setting (i.e., school stores/canteens/snack bars, fundraisers, and classrooms).

Score	Description
4	ES/MS/HS: State prohibits, at any time during school hours (beyond meal service times in the cafeteria), nonvending-machine sales or service food or beverages of FMNVs, including, but not limited to, carbonated beverages.
3	ES/MS/HS: State mandates a restriction on sales or service of food/beverages of low nutritive value in settings that include, but are not limited to, stores/canteens/snack bars, applicable beyond federal requirements for FMNV, but for fewer than all school hours.
2	ES/MS/HS: State requirement for nonvending-machine food and beverages sold/served outside the school meal program is undefined (e.g., "healthy" foods and beverages must be available); or state requires a state agency to develop and adopt nutrition standards applicable to nonvended settings.
1	ES/MS/HS: State recommends or offers voluntary guidelines for nonvended food/beverages sold outside the school meal program.
0	ES/MS/HS: No provision.
Tracking variables	**Potential enhancement factor:** Applies if state specifies portion sizes. **Potential enhancement factor:** Applies if penalties are established for violations.
Reimbursable school meals	
3	ES/MS/HS: State addresses nutrition in (reimbursable) school meal programs with specific requirements or standards that exceed compliance with federal regulations for school meals (7 CFR 210 for the National School Lunch Program and 7 CFR 220 for the School Breakfast Program) (e.g., state prohibits deep-fried foods in school meals and requires school menus to include nutritional information).
2	ES/MS/HS: State addresses nutrition in (reimbursable) school meal programs with a general mandate to develop and adopt requirements or standards that exceed compliance with federal regulations (e.g., State Board of Education is required to establish nutrition standards for all food and beverages sold or served in schools, including school nutrition programs).
1	ES/MS/HS: State recommends nutrition standards for school meals that exceed compliance with federal regulations.
0	ES/MS/HS: No provision.
School meal environment	
3	State mandates two standards (beyond the school meal federal requirements)[6,7] for designated meal periods, in categories such as: (1) specific meal scheduling time requirements (e.g., lunch must be served between 11 AM and 1 PM and/or lunch must follow recess), and (2) specific eating time requirements (e.g., school must provide 20 minutes for students to eat after students are seated).
2	State mandates one standard (beyond the school meal federal requirements)[6,7] for designated meal period, in categories such as: (1) specific meal scheduling time requirements (e.g., lunch must be served between 11 AM and 1 PM), and/or (2) specific eating time requirements (e.g., school must provide 20 minutes for students to eat after students are seated).
1	State recommends requirements for designated meal periods that exceed compliance with federal regulations for the school meal.
0	No provision.
Food service director qualifications	
4	State requires newly hired district food service directors to have a minimum of a bachelor's degree in nutrition, dietetics, food service management (or related field) or certification/credentialing from either a state or national program (e.g., American School Food Service Association or American Dietetic Association) at a level that specifies a post-secondary degree and a minimum requirement for specialized training in a nutrition-related field.
3	State requires newly hired food service directors to have a minor in a nutrition, dietetics, food service management (or related field) or certification/credentialing that specifies a post-secondary degree (e.g., associate's degree) and a minimum requirement for specialized training in a nutrition-related field.
2	State requires newly hired district food service directors to have a high school degree/GED and, in addition, a minimum requirement for specialized training in a nutrition-related field; or state requires certification/credentialing that specifies a HS/GED degree with a minimum requirement for specialized training in a nutrition-related field.
1	State recommends credentials for food service directors (or State certification is voluntary).
0	No provision.
Tracking variable	**Potential enhancement factor:** Applies if state addresses professional development for food service directors, whether related to certification or otherwise.
Coordinating or advisory councils	
3	State mandates that districts or schools form school health coordinating or advisory councils that include a nutrition component (e.g., Coordinated School Health Program [CSHP]), whether linked to local wellness policies required by the federal Child Nutrition and WIC Reauthorization Act of 2004 (P.L. 108-265 section 204) or otherwise establishes a statewide infrastructure to support such programs.

Score	Description
2	State mandates that districts or schools form school health coordinating or advisory councils (e.g., Coordinated School Health Program [CSHP]), whether linked to local wellness policies required by the federal "Child Nutrition and WIC Reauthorization Act of 2004" or otherwise.
1	State recommends voluntary coordinating or advisory councils for districts or schools.
0	No provision.
Tracking variable	**Potential enhancement factor:** Applies if state creates a board/commission/committee to provide advice and recommendations related to nutrition and youth overweight policies.
Nutrition education	
4	ES/MS/HS: State requires a curriculum to incorporate/integrate sequential nutrition education content into standards-based health education curriculum with reference to specific nutrition standards.
3	ES/MS/HS: State requires a curriculum to incorporate/integrate sequential nutrition education content into standards-based health education curriculum without reference to specific nutrition standards.
2	ES/MS/HS: State requires a curriculum to incorporate nutrition education content into health curriculum without reference to any additional requirements.
1	ES/MS/HS: State recommends nutrition education content.
0	ES/MS/HS: No provision.
Tracking variables	**Potential enhancement factor:** Applies if state specifies that schools must integrate/coordinate nutrition instruction in the school with the food service program and/or instruction in other subjects. **Potential enhancement factor:** Applies if state specifies hours of student instruction per year (e.g., 50 hours per year) and/or hours of nutrition education professional development (e.g., 10 hours per year).
Marketing: advertising	
5	State mandates the promotion of noncommercial healthy school nutrition information/activities and prohibits commercial advertising/promotion of food and beverages that do not conform to specified nutrition standards that meet or exceed federal dietary guidelines.[43]
4	State prohibits commercial advertising/promotion of all food and beverages that do not conform to specified nutrition standards that meet or exceed federal dietary guidelines.[43]
3	State limits commercial advertising/promotion for low-nutrient food and beverages in certain locations and/or at certain times (e.g., direct advertising, such as a requirement to switch vending machine signage for soda to signage for water; or indirect advertising, such as a ban on providing FMNVs[43] and all forms of candy as a free promotion).
2	State requirement for advertising/marketing is undefined (e.g., schools must promote "healthy" food choices and prohibit advertising/marketing of "less healthy" food and beverages); or state requires districts or schools to develop and adopt a standard for commercial advertising/promotion of food or beverages. State prohibits all advertising associated with instruction.
1	State recommends a standard for nutrition-based marketing of food and beverages to students during the school day.
0	No provision.
Tracking variables	**Potential enhancement factor:** Applies if a state addresses the use of commercial food products (through coupon, incentives or other means) as a reward for school achievement. **Potential inhibiting factor:** Applies if a state explicitly permits commercial advertising/promotion for food and beverages that may not conform to the federal dietary guidelines[43] (e.g. State permits commercial advertisement on protective book covers).
Marketing: preferential pricing	
4	State mandates preferential pricing, applicable to multiple settings, to promote nutrient-dense food or beverages choices (e.g., preferential pricing of fruits and vegetables wherever sold or served in school).
3	State mandates preferential pricing, applicable to a single setting or food group to promote nutrient-dense food or beverages choices (e.g., vending prices may not favor carbonated beverages over water or 100% fruit juice).
2	State mandates a general requirement for preferential pricing (e.g., districts or schools shall promote healthy foods through preferential pricing); or State requires districts or schools to develop and adopt a policy related to preferential pricing for nutrient-dense food and beverages,
1	State recommends preferential pricing to promote nutrient-dense food or beverage choices.
0	No provision.
Tracking variable	**Potential enhancement factor:** Applies if State addresses placement of food or beverages to promote nutrient-dense food and beverage choices* (e.g., fruits and vegetables should be offered at all points of service).
Body mass index (BMI) screening	
3	State mandates that schools perform annual BMI screening of all students (if not exempted by parents).
2	State mandates that schools perform BMI screening of students in fewer than all grade levels (if not exempted by parents).

Score	Description
1	State recommends or explicitly permits student screening for BMI.
0	No provision.
Tracking variables	**Potential enhancement factor:** Applies if state addresses required procedures for BMI screening (e.g., State requires schools to develop rules for screening, including use of CDC's EPI-info computer program). **Potential enhancement factor:** Applies if State addresses required procedures for notification to parents and referral (e.g., State requires schools to develop rules to ensure confidentiality/privacy and referrals to healthcare system). **Potential enhancement factor:** Applies if statewide agency is authorized to establish a surveillance system to track childhood overweight data.

Appendix B: State-level data aggregated across grade levels as of December 31 2003*

	Competitive foods			Reimbursable school meals					
State	À la carte in cafeterias	Vending machines	Other venue	Reimbursable school meals	School meal environment	Food service director qualifications	Coordinating/ advisory council	Nutrition education	BMI screening
AK	0	0	0	0	0	0	0	0	0
AL	0	0	0	0	0	4	0	0	0
AR	6	10	6	0	0	0	2	6	3
AZ	0	0	0	0	0	0	0	0	0
CA	4	9	8	3	0	0	0	6	0
CO	0	6	9	0	0	0	0	0	0
CT	9	9	9	9	0	0	0	4	0
DC	0	0	0	0	0	0	0	6	0
DE	6	6	6	0	0	0	0	6	0
FL	9	12	12	0	0	0	0	0	0
GA	0	3	3	0	0	3	0	4	0
HI	0	0	0	0	0	0	0	0	0
IA	0	0	0	0	0	0	0	4	0
ID	0	0	0	0	0	0	0	8	0
IL	3	3	3	0	0	0	0	4	0
IN	0	0	0	0	0	0	0	4	0
KS	0	0	0	0	0	0	0	0	0
KY	15	9	9	0	0	0	0	0	0
LA	15	9	9	0	1	4	0	4	0
MA	0	0	0	0	0	0	0	0	3
MD	0	0	0	0	0	0	2	8	0
ME	15	6	6	0	0	0	0	6	0
MI	0	0	0	0	0	0	0	4	0
MN	0	0	0	0	0	0	0	0	0
MO	0	0	0	0	0	0	0	0	0
MS	6	9	9	0	0	4	1	2	0
MT	0	0	0	0	0	0	0	6	0
NC	6	4	4	0	0	0	0	0	0
ND	0	0	0	0	0	2	0	0	0
NE	0	0	0	0	0	0	0	4	0
NH	0	0	0	0	0	0	0	4	0
NJ	0	0	0	0	0	0	0	0	0
NM	0	0	0	0	0	0	0	2	0
NV	0	0	0	0	0	0	0	8	0
NY	0	9	9	0	0	0	0	4	0
OH	6	6	6	0	0	0	0	4	0
OK	0	0	0	0	0	0	0	6	0
OR	0	0	0	0	0	0	0	0	0
PA	0	0	0	0	0	0	1	4	3
RI	0	0	0	0	0	2	0	6	0
SC	0	0	0	0	0	0	0	6	0
SD	0	0	0	0	0	0	0	0	0
TN	0	0	0	0	0	3	1	0	0
TX	0	0	0	0	0	0	2	8	0
UT	0	0	0	0	0	0	0	0	0
VA	9	1	1	0	1	0	2	4	0
VT	0	0	0	0	0	0	1	0	0

State	Competitive foods			Reimbursable school meals		Food service director qualifications	Coordinating/ advisory council	Nutrition education	BMI screening
	À la carte in cafeterias	Vending machines	Other venue	Reimbursable school meals	School meal environment				
WA	0	0	0	0	0	0	0	0	0
WI	0	0	0	0	0	0	0	0	0
WV	12	8	8	9	3	3	0	8	0
WY	0	0	0	0	0	0	0	0	0

*Data for marketing—advertising and—preferential pricing not shown as there are no policies in this area.

The Availability of Local-Area Commercial Physical Activity–Related Facilities and Physical Activity Among Adolescents

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Background: A significant number of American youth do not participate in sufficient levels of physical activity.

Methods: This article reports the association between the availability of commercial physical activity–related facilities and self-reported physical activity behavior among United States adolescents. Geographic identifiers at the ZIP-code level were used to combine repeated cross-sections of individual-level data on 8th-, 10th-, and 12th-grade adolescents from the Monitoring the Future (MTF) Survey with external commercial physical activity–related facility outlet density measures obtained from business lists from Dun and Bradstreet for the years 1997 through 2003. The estimation samples based on questions from different survey forms included a total of 195,702 observations on which information on physical activity (sports, athletics, or exercise) was available and 58,876 observations on which information on vigorous exercise behavior was available.

Results: The results showed a statistically significant but very small association between local-area per capita availability of commercial physical activity–related facilities and physical activity behavior among U.S. adolescents. An additional local-area facility per 10,000 capita was associated with only a 0.22 percentage point increase in frequent vigorous exercise among the full sample of adolescents. By gender and grade level, the study found significant associations among female and older students: increasing availability from a low (1 facility) to a high (8 facilities) number of local-area facilities was associated with a 6.6% and 9.0% increase in frequent physical activity and frequent vigorous exercise among 12th-grade girls, respectively, and a 6.4% increase in frequent vigorous exercise among 12th-grade boys.

Conclusions: Improving the availability of commercial physical activity–related opportunities among underserved populations may help to increase activity levels among older adolescents and girls.

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Introduction

The positive health benefits associated with regular physical activity include reduced risk of obesity, coronary heart disease, diabetes, colon cancer, hip fractures, and high blood pressure.[1,2] Despite this evidence, a significant proportion of American youths do not participate in sufficient levels of physical activity. Data from the 2005 Youth Risk Behavior Survey[3] showed that 31.3% of high school students had not participated in sufficient vigorous physical activity (at least 20 minutes on 3 or more of the past 7 days) and/or had not participated in sufficient moderate physical activity (at least 30 minutes on 5 or more of the past 7 days). These data also showed that 9.6% of students participated in no vigorous or moderate exercise during the past 7 days. Further, the data revealed significant differences in the prevalence of having participated in an insufficient amount of physical activity by gender, race, and ethnicity and by grade level: higher among female (38.5%) versus male (24.2%) students; higher among black (38.0%) than Hispanic (30.6%) and white (29.8%) students; and higher among 11th- (32.6%) and 12th- (38.2%) grade than 9th- (26.5%) and 10th- (29.5%) grade students.[3] The Centers for Disease Control and Prevention (CDC) found that in 2002, based on the Youth Media Cam-

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paign Longitudinal Survey (YMCLS), among children aged 9–13, 38.5% participated in organized sports, and 77.4% participated in freetime physical activity where substantial differences by race and parental income and education levels were found in the participation rates of organized sports.[4]

Examining trends in physical activity among 8th, 10th, and 12th graders, Johnston and O'Malley[5] found that over time there has been a steady decrease in both exercise levels (for 10th and 12th graders) and participation in sports/athletics among all three age groups, with the exception of 8th-grade girls who showed no decline. Results also showed that, in general, boys reported higher rates of exercise than girls. Lower than the rates for the 10th graders, the nearly every day or more vigorous exercise rates for 12th-grade boys and girls were reported to be 42% and 26%, respectively, in 2002, down from 50% and 33%, respectively, in 1979.[5]

Therefore, it is not surprising that physical activity and fitness are key areas of the *Healthy People 2010* initiative.[6] In addressing the importance of contextual influences in their support of physical activity and healthy food choices, the Surgeon General's 2001 Report called for research to "determine the root causes, behaviors, and social and ecological factors leading to obesity and how such forces vary by race and ethnicity, gender, and socioeconomic status."[6] Promoting regular physical activity and creating an environment that supports this behavior is essential to reducing the obesity epidemic and establishing healthy behaviors that youth can carry into adulthood.

An increasing body of behavioral physical activity research has examined associations between local area environmental factors and physical activity among children and adolescents.[7] Outdoor play/sports areas and parks[8–12] have been associated with higher levels of children's and adolescents' physical activity. Participation in community sports[13] and use of a community recreation center[14] have been found to be significant predictors of higher levels of moderate and vigorous physical activity among children and suggest that local-area facility access was important. Several recent studies have found that greater access to commercial physical activity–related facilities was positively associated with higher levels of physical activity among youths.[11,15–17] A limited number of these studies[8,15,17] have included objective rather than perceived measures of local-area recreational infrastructure.

Data also suggest that barriers to physical activity vary significantly by race and socioeconomic status (SES). Based on the YMCLS, parents of non-Hispanic black children and parents with lower income and education levels perceived significantly higher barriers that included transportation problems, lack of opportunities to participate in physical activity, expense, and concerns about neighborhood safety.[4] Studies based on objective measures of available local-area physical activity–related commercial and public outdoor settings have found less availability in minority and low-SES communities.[17–20]

The research presented in this article examined the association between the availability of commercial physical activity–related facilities and self-reported physical activity behaviors among United States adolescents in 8th, 10th, and 12th grades. The study used geographic identifiers at the ZIP-code level to combine repeated cross-sections of individual-level data on adolescents from the Monitoring the Future (MTF) Survey with external commercial physical activity–related facility outlet density measures obtained from business lists from Dun and Bradstreet (D&B)for the years 1997 through 2003. Multivariate regression analyses that controlled for individual, family, and neighborhood covariates were undertaken to examine the associations among the availability of commercial physical activity–related facilities and (1) frequent physical activity and (2) frequent vigorous exercise.

Methods

Conceptual Framework

This study draws on economic and ecologic theories to examine the importance of external factors associated with youth physical activity. Economic models are based on the assumption that individuals make behavioral decisions that maximize their utility (happiness) based on a set of personal preferences and subject to constraints.[21] Individual behaviors (i.e., physical activity behaviors) are affected by tastes and are constrained by income and the total cost of goods. The total cost refers to both the monetary cost (price) and other costs such as those related to access. For example, close proximal access will reduce transportation costs associated with a given behavior. Ecologic models also highlight access and availability as important environmental factors that underlie physical activity behaviors.[22,23] The importance of policy interventions based on ecologic models to promote physical activity has been clearly articulated in several studies.[22,23] Sallis et al.[23] discussed the importance of physical environmental factors as essential elements of an ecologic model of physical activity. Underlying this is the premise that physical activities take place in specific physical environments (behavior settings) that are likely to influence the amount and type of activity. Behavior settings were defined as the physical and social contexts in which behaviors occur (e.g., sports fields, gyms, health clubs, and bicycle trails). While the range of external factors associated with physical activity is extensive, this study focuses on the importance of commercial physical activity–related facilities.

Data

Repeated cross-sections of individual-level national data for 8th-, 10th-, and 12th-grade students from the MTF surveys were combined with external data on commercial physical activity–related facility outlets obtained from business lists developed by D&B. The physical activity–related outlet den-

sity measures were matched to the individual-level data at the school ZIP-code level for the years 1997 through 2003.

MTF Survey Data

The MTF study, conducted by the University of Michigan's Institute for Social Research (ISR) and funded by the National Institute on Drug Abuse, began in 1975; using national samples of high school seniors in the coterminous U.S., it is the nation's longest running survey of youth substance use and abuse. Since 1991 the MTF surveys also have included 45,000 to 50,000 8th- and 10th-grade students annually. Located in approximately 420 schools, these students/schools were selected annually for the MTF survey based on a three-stage sampling procedure.[24] Stage 1 involved geographic area selection. Stage 2 involved the selection of one or more schools in each area based on establishing the probability for inclusion proportionate to the size of the respective grade to be sampled. Stage 3 focused on the selection of students within each selected grade. Within each school, up to 350 students per grade were selected for the study. For those schools with a smaller student body for the respective grade, all students were selected. If a school had more than 350 students, a random sample of classrooms or other random method was used to choose the final sample.

Questionnaires were administered by an ISR representative in classrooms during normal class periods whenever possible. Students were informed of the importance of accurate responses and assured that their confidentiality would be protected. Neither parents nor the school was informed of individual student responses, but schools were provided with the overall survey results for their respective schools. In the MTF study 8th and 10th graders were administered four different forms and 12th graders six different forms of the questionnaire. This occurred in an ordered sequence, to ensure virtually identical subsamples for each form. Approximately one third of the questions on each form were

Table 1. Summary statistics: Outcomes, commercial physical activity–related facilities and control variables

	Frequent physical activity sample	Frequent vigorous exercise sample
Frequent physical activity (%)	73.48	—
Frequent vigorous exercise (%)	—	64.94
Total physical activity-related facilities (per 10,000 capita)	3.7574 (2.8775)	3.8289 (2.9419)
Per capita income (in 10,000s)	2.1929 (0.9663)	2.2173 (0.9808)
Male (%)	48.25	47.32
Age	14.9896 (1.4804)	15.1810 (1.5548)
Grade (%)		
8th grade	44.46	39.71
10th grade	42.73	42.14
12th grade	12.81	18.15
Race (%)		
White	67.96	70.40
Black	11.51	10.30
Hispanic	10.54	9.58
Other race	9.99	9.72
Father's education (%)		
Father less than high school	13.73	13.24
Father completed high school	29.94	29.27
Father college or more	56.33	57.49
Mother's education (%)		
Mother less than high school	11.51	10.88
Mother completed high school	28.71	28.32
Mother college or more	59.78	60.80
Live with both parents (%)	78.50	79.09
Live in rural area (%)	22.74	23.24
Student's weekly real income (in 100s)	0.2570 (0.2857)	0.2716 (0.2886)
Weekly hours worked by student	5.0521 (8.2874)	5.6822 (8.6717)
Mother's work status (%)		
Mother did not work	17.30	17.07
Mother worked part-time	18.72	18.98
Mother worked full-time	63.98	63.95
Year indicators (%)		
Year 1997	15.27	14.84
Year 1998	15.26	15.07
Year 1999	13.80	13.99
Year 2000	13.80	13.56
Year 2001	13.85	13.78
Year 2002	13.37	13.63
Year 2003	14.65	15.13
Number of observations	195,702	58,876

Notes: Standard deviations are shown in parentheses for nondummy variables. Statistics are weighted using the sampling selection weights.

common to all 10 forms; these included the demographic variables and questions about substance use. Questions related to physical activity behavior were all form-specific and were included on only a subset of forms.

For the 7 years of data from 1997 through 2003 for 8th-, 10th-, and 12th-grade students, 195,702 observations with information on physical activity (sports, athletics, or exercise) and 58,876 observations with information on vigorous exercise behavior and nonmissing information on all of our control variables were available. As noted above, the reason for the differing sample sizes was that in order to collect as much varied information as possible on adolescent attitudes, beliefs, and behaviors, MTF consisted of multiple forms that included both core and form-specific questions. Many of the questions on physical activity were form-specific and often were not on the same form.

Physical activity outcome measures. Two self-reported measures available in the MTF surveys were used to study physical activity. The first measure was based on the following question: How often do you do actively participate in sports, athletics, or exercise? Responses were based on a 5-point scale that included: never, a few times a year, once or twice a month, at least once a week, and almost every day. Based on these answers, a dichotomous indicator was created for frequent participation in physical activity equal to unity if the student answered at least weekly or almost every day and equal to zero otherwise. The second measure was based on the question: How often do you exercise vigorously (jogging, swimming, calisthenics, or any other active sports)? Students' responses included the following possible categories: never, seldom, sometimes, most days, nearly every day, and every day. Based on these answers, a dichotomous indicator was created for frequent vigorous exercise equal to unity if the student answered most days, nearly every day, or every day and equal to zero otherwise. Table 1 shows that 73.5% of students participated in physical activity (sports, athletics, or exercise) at least weekly and that 64.9% frequently participated in vigorous exercise.

Control measures. Basic demographic measures available in the MTF student surveys were controlled, including: gender; grade; race/ethnicity; highest level of schooling completed by father; highest level of schooling completed by mother; rural/urban area neighborhood designation; total student income (earned and unearned, such as allowance) in real (consumer price index base $82–$84) dollars; weekly hours of work by the student; and mother's work status (did not work, worked

Table 2. Marginal effects of availability of physical activity–related facilities on frequent physical activity (N=195,702)

	Model 1	Model 2	Model 3
Total physical activity-related facilities (per 10,000 capita)	0.0010 (0.0007)	0.0023*** (0.0007)	—
Per capita income	0.0175*** (0.0023)	—	—
Male	0.0925*** (0.0034)	0.0926*** (0.0034)	0.0926*** (0.0034)
Grade (Referent category: 8th grade)			
10th grade	−0.0445*** (0.0042)	−0.0439*** (0.0044)	−0.0440*** (0.0044)
12th grade	−0.0711*** (0.0056)	−0.0705*** (0.0057)	−0.0699 (0.0057)
Race (Referent category: White)			
Black	−0.0301*** (0.0047)	−0.0360*** (0.0049)	−0.0394*** (0.0048)
Hispanic	−0.0433*** (0.0061)	−0.0480*** (0.0063)	−0.0510*** (0.0064)
Other race	−0.0576*** (0.0051)	−0.0570*** (0.0051)	−0.0581*** (0.0051)
Father's education (Referent category: Father completed high school)			
Father less than high school	−0.0492*** (0.0044)	−0.0498*** (0.0044)	−0.0503*** (0.0045)
Father college or more	0.0498*** (0.0029)	0.0542*** (0.0029)	0.0547*** (0.0029)
Mother's education (Referent category: Mother completed high school)			
Mother less than high school	−0.0508*** (0.0048)	−0.0523*** (0.0049)	−0.0531*** (0.0049)
Mother college or more	0.0476*** (0.0030)	0.0505*** (0.0030)	0.0509*** (0.0030)
Live with both parents	0.0436*** (0.0030)	0.0447*** (0.0030)	0.0448*** (0.0030)
Live in rural areas	−0.0100*** (0.0038)	−0.0169*** (0.0039)	−0.0177*** (0.0038)
Student's weekly real income	0.0423*** (0.0059)	0.0432*** (0.0060)	0.0431*** (0.0060)
Weekly hours worked by student	−0.0026*** (0.0002)	−0.0026*** (0.0022)	−0.0026*** (0.0002)
Mother's work status (Referent category: Mother did not work)			
Mother worked part-time	0.0240*** (0.0038)	0.0235*** (0.0038)	0.0238*** (0.0038)
Mother worked full-time	0.0294*** (0.0033)	0.0276*** (0.0034)	0.0276*** (0.0034)
Year indicators (Referent category: Year 1997)			
Year 1998	−0.0179*** (0.0055)	−0.0190*** (0.0055)	−0.0189*** (0.0055)
Year 1999	−0.0069 (0.0062)	−0.0074 (0.0063)	−0.0072 (0.0063)
Year 2000	−0.0069 (0.0063)	−0.0073 (0.0064)	−0.0068 (0.0064)
Year 2001	−0.0135** (0.0061)	−0.0154** (0.0063)	−0.0138** (0.0062)
Year 2002	−0.0164*** (0.0063)	−0.0179*** (0.0063)	−0.0155** (0.0063)
Year 2003	−0.0146** (0.0059)	−0.0155*** (0.0060)	−0.0139** (0.0060)

Notes: Standard errors are robust and clustered at the school zip code level and are shown in parentheses. Models 1 and 2 provide estimates with and without controlling for neighborhood per capita income, respectively. Model 3 provides estimates with only the demographic covariates. The symbols *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

part-time, or worked full-time). Neighborhood wealth effects were controlled for by including a measure of mean per capita income at the ZIP-code level from the Census 2000.[25,26] Table 1 presents the summary statistics for all of the control variables.

Physical Activity–Related Outlet Density Measure

Data on physical activity–related outlets were obtained from a business list developed by D&B.[27] The data were obtained through D&B MarketPlace software, which allowed a sorting of the data by ZIP code and Standard Industry Classification (SIC) codes. The database allowed for SIC code searches at varying levels of outlet detail/specificity. A measure of physical activity–related facilities was developed based on a list of facilities drawn from 100 different 8-digit SIC codes. These business SIC codes included facilities such as physical fitness facilities, membership sports and recreation clubs, public golf courses, ice rinks, swimming pools, dance studios, sports and athletic instruction (i.e. gymnastics), tennis courts, and the YMCA. All businesses in the D&B database had a primary SIC code but may have had multiple nonprimary SIC codes assigned to it depending on the combination of services/products offered. The search was not limited to "primary" SIC codes because certain facilities such as a YMCA may offer physical activity facilities but may, for example, have primary SIC codes related to social services. All duplications were eliminated prior to consolidating the list of total physical activity–related facilities. The total number of facility outlets were summed across ZIP codes and divided by ZIP-code population times 10,000 to develop a measure of commercial physical activity–related facility availability per 10,000 capita. Table 1 shows that ZIP codes had, on average, 3.8 physical activity–related facilities per 10,000 capita.

Estimation Framework

Following the conceptual framework and variable definitions as outlined above, empirical models examined the importance of commercial physical activity–related facility availability for two measures of adolescent physical activity behavior. Separate models were used to examine the associations between the availability of physical activity–related facilities and frequent physical activity (sports, athletics, or exercise) and frequent vigorous exercise outcomes. Separate models were estimated by grade and gender.

Specifically, the following specification was estimated:

$$PA_{ist} = \beta_0 + \beta_1 PAD_{st} + \beta_2 I_{st} + \beta_3 X_{ist} + \varepsilon_{ist} \quad (1)$$

Table 3. Marginal effects of availability of physical activity–related facilities on frequent vigorous exercise (N=58,876)

	Model 1	Model 2	Model 3
Total physical activity-related facilities (per 10,000 capita)	0.0022** (0.0010)	0.0026** (0.0010)	—
Per capita income	0.0064** (0.0028)	—	—
Male	0.1166*** (0.0049)	0.1166*** (0.0049)	0.1166*** (0.0049)
Grade (Referent category: 8th grade)			
10th grade	−0.0828*** (0.0065)	−0.0827*** (0.0065)	−0.0828*** (0.0065)
12th grade	−0.2005*** (0.0089)	−0.2005*** (0.0089)	−0.1998*** (0.0089)
Race (Referent category: White)			
Black	−0.0507*** (0.0091)	−0.0528*** (0.0092)	−0.0564*** (0.0091)
Hispanic	−0.0087 (0.0094)	−0.0103 (0.0094)	−0.0137 (0.0094)
Other race	−0.0332*** (0.0084)	−0.0327*** (0.0084)	−0.0338*** (0.0084)
Father's education (Referent category: Father completed high school)			
Father less than high school	−0.0480*** (0.0084)	−0.0482*** (0.0084)	−0.0490*** (0.0084)
Father college or more	0.0610*** (0.0057)	0.0627*** (0.0056)	0.0632*** (0.0057)
Mother's education (Referent category: Mother completed high school)			
Mother less than high school	−0.0371*** (0.0087)	−0.0377*** (0.0087)	−0.0384*** (0.0087)
Mother college or more	0.0274*** (0.0055)	0.0286*** (0.0055)	0.0289*** (0.0055)
Live with both parents	0.0544*** (0.0059)	0.0549*** (0.0059)	0.0551*** (0.0059)
Live in rural areas	0.0098 (0.0061)	0.0071 (0.0061)	0.0062 (0.0060)
Student's weekly real income	0.0578*** (0.0111)	0.0584*** (0.0111)	0.0581*** (0.0111)
Weekly hours worked by student	−0.0033*** (0.0004)	−0.0033*** (0.0004)	−0.0033*** (0.0004)
Mother's work status (Referent category: Mother did not work)			
Mother worked part-time	0.0123 (0.0078)	0.0120 (0.0078)	0.0125 (0.0078)
Mother worked full-time	0.0115* (0.0066)	0.0106 (0.0067)	0.0108 (0.0067)
Year indicators (Referent category: Year 1997)			
Year 1998	0.0020 (0.0093)	0.0016 (0.0093)	0.0017 (0.0093)
Year 1999	−0.0026 (0.0095)	−0.0028 (0.0095)	−0.0026 (0.0096)
Year 2000	−0.0171* (0.0099)	−0.0171* (0.0099)	−0.0167* (0.0099)
Year 2001	−0.0110 (0.0099)	−0.0116 (0.0099)	−0.0099 (0.0099)
Year 2002	−0.0128 (0.0097)	−0.0134 (0.0097)	−0.0106 (0.0097)
Year 2003	−0.0101 (0.0095)	−0.0105 (0.0095)	−0.0088 (0.0095)

Notes: Standard errors are robust and clustered at the school zip code level and are shown in parentheses. The symbols *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Models 1 and 2 provide estimates with and without controlling for neighborhood per capita income, respectively. Model 3 provides estimates with only the demographic variates.

where PA_{ist} defined our dichotomous frequent physical activity behavior outcome variable for individual i, living in area s at time t. PAD_{is} defined the per 10,000 capita density of commercial physical activity–related facility outlets available in geographic area s and time t, I_{st} was per capita income in area s and time t, and, X_{ist} was a vector of individual characteristics and time dummy variables and ε_{ist} was a disturbance term. Marginal effects were reported from maximum likelihood probit models for our physical activity binary outcome measures. All models were estimated using Stata version 9.2. Weights were used to adjust for differential probabilities of student selection, and standard errors were adjusted using a Huber–White covariance matrix estimate that was robust to clustering at the ZIP-code level and heteroskedasticity of unknown form.[28]

Results

Tables 2 and 3 present the marginal effects of the probit estimation results on the association between the availability of commercial physical activity–related facilities per 10,000 capita and self-reported frequent participation in physical activity and vigorous exercise among adolescents. Models 1 and 2 provide estimates with and without controlling for neighborhood per capita income, respectively. Model 3 provides estimates with only the demographic covariates. Examining first the results presented in Table 2 for frequent physical activity (sports, athletics, or exercise) participation, the results show that the availability of commercial physical activity–related facilities, had a statistically significant positive but small association with the likelihood of frequent physical activity (Model 2). However, as shown in Model 1 this effect fell substantially in magnitude (from 0.0023 to 0.0010) and lost statistical significance once neighborhood per capita income was controlled for in Model 1.

The results from Model 1 show that the estimated effect of the availability of commercial physical activity–related facilities was significantly associated with frequent vigorous exercise among adolescents (Table 3). Comparing the results from Model 2 to Model 1, the magnitude of the effect dropped slightly (from 0.0026 to 0.0022) once neighborhood per capita income levels were accounted for, and it remained statistically significant. The presence of one additional physical activity–related facility per 10,000 capita was statistically significantly associated with just over one fifth of a percentage point increase in frequent vigorous exercise. The present study found smaller associations between facility availability and adolescent physical activity than those reported in a similar previous study.[17]

Tables 4 and 5 present the estimated association of the availability of commercial physical activity–related facilities and adolescent physical activity measures by gender for the full sample and by gender for each grade. These tables also provide predicted probabilities of frequent physical activity simulated for increasing

Table 4. Effects of physical activity-related facilities on frequent physical activity: by gender and by grade

	Female				Male			
	All grades (N=101,693)	**8th grade (N=44,807)**	**10th grade (N=44,028)**	**12th grade (N=12,858)**	**All grades (N=94,009)**	**8th grade (N=41,795)**	**10th grade (N=40,291)**	**12th grade (N=11,923)**
Mean rate of frequent physical activity (%)	68.73	72.32	67.18	61.47	78.57	80.91	76.92	75.94
Marginal effects of total physical activity-related facilities on frequent physical activity	0.0020** (0.0009)	0.0006 (0.0016)	0.0016 (0.0013)	0.0057*** (0.0017)	−0.0002 (0.0008)	−0.0001 (0.0013)	−0.0006 (0.0011)	0.0012 (0.0013)
Number of physical activity–related facilities	Predicted probabilities of frequent physical activity with increasing numbers of facilities (%)							
1	69.12	73.16	67.55	60.23	79.19	81.54	77.63	76.06
4	69.71	73.35	68.04	61.94	79.13	81.52	77.43	76.42
8	70.48	73.61	68.69	64.19	79.05	81.49	77.18	76.89

Note: Marginal effects and predicted probabilities are based on regression estimates that include all control covariates shown in Model 1 of Table 2. The symbols *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are robust and clustered at the school ZIP-code level and are shown in parentheses.

Table 5. Effects of physical activity-related facilities on frequent vigorous exercise: by gender and by grade

	Female				Male			
	All grades (N=31,315)	**8th grade (N=12,260)**	**10th grade (N=13,503)**	**12th grade (N=5,552)**	**All grades (N=27,561)**	**8th grade (N=10,891)**	**10th grade (N=11,714)**	**12th grade (N=4,956)**
Mean rate of frequent vigorous exercise (%)	59.27	68.13	57.42	44.10	71.25	76.92	71.54	58.90
Marginal effects of total physical activity-related facilities on frequent vigorous exercise	0.0029** (0.0013)	0.0017 (0.0024)	0.0024 (0.0019)	0.0055** (0.0025)	0.0014 (0.0012)	0.0018 (0.0018)	−0.0008 (0.0021)	0.0052** (0.0022)
Number of physical activity-related facilities	Predicted probabilities of frequent vigorous exercise with increasing numbers of facilities (%)							
1	58.87	68.24	56.97	42.21	71.37	76.81	71.76	57.34
4	59.75	68.75	57.69	43.84	71.79	77.34	71.52	58.92
8	60.92	69.41	58.65	46.03	72.34	78.05	71.20	61.01

Note: Marginal effects and predicted probabilities are based on regression estimates that include all control covariates shown in Model 1 of Table 3. The symbols *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

numbers of available facilities. For the full-sample of all grade levels, the tables show that greater numbers of local-area commercial physical activity–related facilities were statistically significantly associated with both physical activity outcome measures for girls but not for boys. The presence of an additional local-area commercial physical activity–related facility was associated with a 0.20 and 0.29 percentage point increase, respectively, in frequent physical activity and frequent vigorous exercise among female adolescents. A previous study that examined separate models by gender also found significant associations between commercial recreation facilities and physical activity levels for adolescent girls but not boys.[15]

Examining the associations by gender across grades, the results showed no significant associations for either gender among 8th- and 10th-grade students. Statistically significant effects were found for both activity measures among 12th-grade girls and for the frequent vigorous exercise among 12th-grade boys. The simulation results showed that increasing availability from a low (1 facility) to a high (8 facilities) number of local-area facilities was associated with a 6.6% and 9.0% increase in frequent physical activity and frequent vigorous exercise among 12th-grade girls, respectively, and a 6.4% increase in frequent vigorous exercise among 12th-grade boys.

Turning to the neighborhood SES control covariate, the results from Model 1, presented in Tables 2 and 3, show that living in a neighborhood with higher per capita income was associated with a greater probability of both frequent physical activity and vigorous exercise. Accounting for the availability of total physical activity–related facilities and all other control variables, a $10,000 increase in per capita income was associated with a 1.75 percentage point increase in frequent physical activity and a 0.64 percentage point increase in frequent vigorous exercise.

In terms of individual- and household-level covariates, regression results from Model 1 in Tables 2 and 3 showed that male students were statistically significantly more likely to frequently engage in both types of physical activity. Students of minority races were statistically significantly less likely to frequently participate in sports, although Hispanic teens did not differ significantly from their white counterparts in their likelihood of frequent vigorous exercise. Compared to middle school students, adolescents in 10th and 12th grade were substantially less likely to exercise vigorously (by 20 percentage points among 12th-grade students), though students in higher grades did not differ as much in terms of their general physical activity participation. Students with parents who had less than a high school education were less likely to participate frequently in both physical activity behaviors, whereas students with college-educated parents had significantly higher participation rates, with a large percentage

point spread in participation across these parental characteristics. Further, living in a household with both parents present increased the likelihood of frequent participation in physical activity by about 4–5 percentage points. Higher student income was associated with an increased probability of both types of physical activity, but holding income constant, greater hours of work were associated with a slightly lower probability of both types of activity. Students with mothers who worked part- or full-time versus not working were more likely to participate in physical activity more frequently but mothers' work status was only weakly statistically significantly associated with the probability of frequent vigorous exercise. Living in a rural area reduced physical activity rates slightly, but was not associated with vigorous exercise behavior. After controlling for all of the covariates, the time dummies showed that a statistically significant downward time trend still remained for frequent physical activity but not for frequent vigorous exercise among the adolescent sample.

Discussion

The results from the present study showed a statistically significant but small association between local-area per capita availability of commercial physical activity–related facilities and frequent vigorous exercise among U.S. adolescents. An additional local-area facility per 10,000 capita was associated with only a 0.22 percentage point increase in frequent vigorous exercise among the full sample of adolescents.

Results by gender, however, showed that the availability of physical activity–related facilities had a statistically significant positive association with both frequent physical activity and frequent vigorous exercise among girls, but was not significantly associated with either of the two physical activity behavior outcomes among boys. By gender and grade levels, increasing the number of available commercial physical activity–related facilities from 1 to 8 was associated with an increased likelihood of frequent physical activity by 6.6% and an increased likelihood of frequent vigorous exercise by 9.0% among 12th-grade girls and a 6.4% increase in the likelihood of frequent vigorous exercise among 12th-grade boys.

In all models, the estimated associations between the availability of commercial physical activity–related facilities and physical activity behaviors were substantially reduced once local-area per capita income was controlled for. These results implied that much of the correlation between the availability of commercial physical activity facilities and adolescent physical activity behaviors is attributable to lower density of these outlets in low-income neighborhoods. Higher neighborhood per capita income was associated with a greater frequency of physical activity and vigorous exercise.

This study was subject to several limitations. First, the physical activity–related outlet facility data were linked to the individual-level data by the student's school ZIP code. While this may be a good proxy for the student's home ZIP code at lower grade levels (in this case grade 8), high schools were likely to draw their student population from beyond its own ZIP code. The extent to which neighboring ZIP codes are similar will help to mitigate this potential source of error. Second, the study was subject to measurement error due to potential inaccuracies in the commercial outlet density data. Third, the physical activity behavior measures were self-reported. However, the validity of the MTF physical activity data is enhanced by preliminary analyses that suggest that a reasonable level of agreement exists between the school principals' responses about the rates of sports participation by students and how students in the same schools respond about their own level of participation in school athletics.[29] Fourth, while parental education was controlled, no information on household income was available. In addition, existing literature suggested that other family/household factors such as parental physical activity behavior (role modeling) were important determinants of children's physical activity behavior.[30–32] Fifth, the study did not control for school-level physical education (PE) and intramural sports opportunities. Cawley et al.[33] found that increased PE time increased both the weekly number of days of 20 minutes of moderate to vigorous exercise and strength building, but with a very small positive effect. However, they also found that more PE time resulted in a substitution away from light physical activity. Sixth, the availability of parks and other outdoor public facilities, which as noted earlier has been shown to be correlated with children's physical activity, were not accounted for. Finally, facility user cost was not addressed. Access barriers relate to both availability and cost. Future studies that could link local-area price data for physical activity opportunities would contribute immensely to this debate.

Despite these limitations, the results from this study revealed statistically significant, albeit very small, associations between the availability of commercial physical activity–related facilities and physical activity levels among a national sample of U.S. adolescents. The results suggested that improved availability was likely to be more important for female and older students whose rates of physical activity tend to be lower than their respective male and younger counterparts.

However, given the small magnitude of incremental effects of commercial facility outlet density on physical activity behavior, any efforts to promote additional neighborhood facilities should be concentrated in areas with disparate availability to substantially improve the extent of availability. Also, increased availability of proximal commercial facilities within the neighborhood is likely to be particularly important for low-SES

populations given that they are less likely to have private means of transportation[34] to reach facilities outside of their immediate community. Improving availability among underserved minority and low-SES populations may help to increase activity levels and reduce health disparities.

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Associations Between Access to Food Stores and Adolescent Body Mass Index

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Background: Environmental factors such as the availability of local-area food stores may be important contributors to the increasing rate of obesity among U.S. adolescents.

Methods: Repeated cross-sections of individual-level data on adolescents drawn from the Monitoring the Future surveys linked by geocode identifiers to data on food store availability were used to examine associations between adolescent weight and the availability of four types of grocery food stores that include chain supermarkets, nonchain supermarkets, convenience stores, and other grocery stores, holding constant a variety of other individual- and neighborhood-level influences.

Results: Increased availability of chain supermarkets was statistically significantly associated with lower adolescent Body Mass Index (BMI) and overweight and that greater availability of convenience stores was statistically significantly associated with higher BMI and overweight. The association between supermarket availability and weight was larger for African-American students compared to white or Hispanic students and larger for students in households in which the mother worked full time.

Conclusions: Economic and urban planning land use policies which increase the availability of chain supermarkets may have beneficial effects on youths' weight outcomes.
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Introduction

Numerous studies have documented increasingly poor dietary behaviors among adolescents, including an excess intake of fat, sugar, snacks, soda, and fast food[1–3] and a low intake of fruit and vegetables.[4–7] Unhealthy food consumption patterns put youths at higher risk for overweight.[8–13] With an obesity epidemic among American society as a whole and a tripling of the prevalence of overweight among American adolescents aged 12–19 over the last few decades to a current level of 17.4%,[14] researchers are examining a broad range of environmental factors as potential contributors to these critical outcomes. Barriers to accessing healthful foods due to a lack of local-area supermarkets are one such factor that may affect weight outcomes.

Several studies have suggested indirectly that increased supermarket availability may affect weight by showing that availability is associated with increased fruit and vegetable consumption among adults[15] and with higher quality diets.[16] There is also evidence that the effect of access to food stores varies with the types of store. For example, larger food stores and chain supermarkets were more likely to stock healthful foods than smaller stores and nonchain supermarkets.[17–19] Larger stores and chain stores also offered foods at lower prices.[20,21] Cheadle et al.[22] found significant correlations between diet and the availability of healthful food in stores. While several studies have found significant associations among weight status, food prices,[23–25] and restaurant availability,[25] no existing studies have directly examined associations between food store availability and weight outcomes. Evidence is provided in this paper to relate availability of food stores of various types to weight outcomes controlling for food prices and restaurant outlet density.

Whether a lack of local-area food stores such as chain supermarkets are likely to be associated with adolescents' body mass index (BMI) and overweight status was examined. Specifically, the associations between BMI and overweight and the availability of four types of grocery food stores, including chain supermarkets, nonchain supermarkets, convenience stores, and other grocery stores, holding constant a variety of other individual- and neighborhood-level influences were ex-

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amined. Repeated cross-sections of individual-level data on adolescents drawn from the Monitoring the Future (MTF) surveys linked at the ZIP-code level to data on food store availability were used. It was found that increased availability of chain supermarkets was statistically significantly associated with lower adolescent BMI and overweight and that greater availability of convenience stores was associated with statistically significantly higher BMI and overweight.

Methods

This study drew on individual-level national data for 8th- and 10th-grade students from the MTF study, combined with external data on four types of food store outlets and two types of restaurant outlets obtained from business lists developed by Dun and Bradstreet (D&B) and fast food and fruit and vegetable price data obtained from the American Chamber of Commerce Researchers Association (ACCRA). The external outlet density and food price measures were matched to the individual-level data at the school ZIP-code level for each year 1997 through 2003. Data on per capita income were drawn from the Census 2000.

Monitoring the Future Survey Data

Since 1975, the MTF study conducted at the University of Michigan's Institute for Social Research annually surveyed nationally representative samples of high school seniors in the coterminous United States. Since 1991, the MTF surveys also included over 30,000 8th- and 10th-grade students annually. These 8th- and 10th-grade students were located in approximately 280 schools that were selected annually for the MTF survey based on a three-stage sampling procedure (see Johnston et al.[26] for details on the sampling procedure). In order to cover the range of topic areas in the study, 8th- and 10th-grade students were administered four different questionnaire forms. This occurred in an ordered sequence, ensuring virtually identical subsamples for each form. Approximately one-third of the questions on each form were common to all forms, including the demographic variables used in this study. Questions on height and weight were form-specific. For the 7 years of data from 1997 through 2003 for 8th and 10th- students, the sample had a total of 73,079 observations for which information was available on height and weight and nonmissing information on the covariates. Sensitivity analyses were undertaken to assess the robustness of the results to the high number (13.1%) of missing observations on parent education. Analyses were rerun including dummy indicators for missing on these variables and found that the results for all of the key contextual variables were robust to their exclusion.

Outcome Measures

BMI was calculated based on the self-reported anthropometric information (height and weight) available in the MTF survey. BMI was calculated as equal to weight (kilogram)/height (meter)-squared. Adolescents were classified as overweight when BMI≥age-gender-specific 95th percentile based on the Centers for Disease Control and Prevention (CDC) growth chart.[27] Note that for children the CDC recommends using the term "overweight" rather than "obese". Table 1 shows that the average BMI for the full sample of students was 21.8 and that 10% of the students were overweight.

Table 1. Summary statistics: Outcomes, store access, and control variables

	Mean or percentage	SD for continuous variables
N	73,079	—
Body mass index	21.8059	4.2947
Overweight	10.28%	—
Number of grocery stores[a]	3.2835	3.0097
Number of convenience stores[a]	2.1535	2.2501
Number of chain supermarkets[a]	0.3037	0.5805
Number of non-chain supermarkets[a]	0.2609	0.5906
Number of fast food restaurants[a]	2.6009	2.2078
Number of non-fast food restaurants[a]	11.4236	9.2185
Price of fast food	2.7127	0.1740
Price of fruit and vegetables	0.7205	0.1046
Per capita income (in 10,000s)	2.2107	0.9665
Male	47.54%	—
Age	14.6542	1.1640
8th grade[b]	48.69%	—
10th grade	51.31%	—
White[b]	69.66%	—
Black	10.59%	—
Hispanic	9.67%	—
Other race	10.08%	—
Father less than high school	13.06%	—
Father complete high school[b]	29.43%	—
Father college or more	57.51%	—
Mother less than high school	11.11%	—
Mother complete high school[b]	28.00%	—
Mother college or more	60.89%	—
Live with both parents	80.02%	—
Live in rural area	24.10%	—
Students' weekly real income (in 100s)	0.2281	0.2666
Hours worked by student	3.8560	7.1366
Mother does not work[b]	17.60%	—
Mother works part-time	18.28%	—
Mother works full-time	64.12%	—
Year 1997[b]	14.73%	—
Year 1998	14.78%	—
Year 1999	13.98%	—
Year 2000	13.85%	—
Year 2001	13.93%	—
Year 2002	13.73%	—
Year 2003	15.00%	—

[a]Per 10,000 capita.
[b]Denotes omitted categories in regression models.
SD, standard deviation.

Individual-Level Control Measures

Controlled demographic measures available in the student surveys included: gender; grade; age; race/ethnicity; highest schooling completed by father; highest level of schooling completed by mother; rural/urban area neighborhood designation; total student income (earned and unearned, such as

allowance) in real dollars (CPI base $82–$84); weekly hours of work by the student; and whether the mother works part-time or full-time. The summary statistics in Table 1 show that just under half of the sample was male and that approximately 70% of the students were white, 11% were African-American, 10% were Hispanic, and 10% were of other (or mixed) racial/ethnic backgrounds. The average age of the sample was 14.7 and just under half of the sample was in 8th grade. The majority of students' parents had at least some college education (58% of fathers and 61% of mothers). Most (80%) students lived with both of their parents and just under one quarter lived in a rural area. Students worked on average 3.9 hours per week. Students' average weekly real income was about $23. Approximately 64% of students' mothers worked full-time and 18% worked part-time. The sample was evenly distributed across years with about 14% in each of the 7 years from 1997–2003.

Local-Area Socioeconomic Status

Local-area per capita income was controlled for at the ZIP-code level; shown in Table 1 to be, on average, $22,107. These data were obtained from the Census 2000.[28]

Local-Area Food Prices

Food price data were obtained from the ACCRA Cost of Living Index reports. These reports contained quarterly information on prices from more than 300 U.S. cities. The ACCRA collects 62 different prices for a range of products. These price data were matched to the MTF sample based on the closest city match available in the ACCRA data using school ZIP-code geocode data. Price data were drawn from quarters one and two as these reflected the time frame of the MTF surveys. From the items provided in the ACCRA data, two prices indices were created: a fruit and vegetable price index and fast food price index. All prices were deflated by the Bureau of Labor Statistics (BLS) Consumer Price Index (CPI) (1982–1984=1). The fruit and vegetable price index was based on the food prices available for this food category: potatoes, bananas, lettuce, sweet peas, tomatoes, peaches, and frozen corn. The fast-food price was based on the following three items included in the ACCRA data: a McDonald's Quarter Pounder with cheese, a thin crust regular cheese pizza at Pizza Hut and/or Pizza Inn, and fried chicken (thigh and drumstick) at Kentucky Fried Chicken and/or Church's Fried Chicken. Each price index was weighted based on expenditure shares provided by ACCRA derived from the BLS Consumer Expenditure Survey.

Outlet Density Measures

Data on food store and restaurant outlets were obtained from a business list developed by D&B.[1] This list was obtained through use of D&B MarketPlace software. MarketPlace contains information on more than 14 million businesses in the U.S. and D&B employs a staff of more than 1,300 individuals to compile and update quarterly these records through interviews, public documents, and directories. In addition to these sources, D&B has telecenters that conduct approximately 100 million phone calls annually to update and verify business list information.

D&B has a number of quality assurance protocols in place to ensure accuracy of the data. For instance, D&B utilized "match grade" technology to consolidate multiple business listings into one complete record to ensure that there are no duplicate entries of the same business and that data are not matched to the wrong business. D&B also assigns each business a unique numerical identifier to ensure validity of its data over time. This nine-digit number is never recycled and allows D&B to easily track changes and updates for all businesses contained in its database.

MarketPlace allows sorting by multiple criteria such as location (ZIP code, county, state) and Standard Industry Classification (SIC) codes. SIC codes allow for searching for, and selection of, specific types of businesses. The database allows for SIC code searches at varying levels of detail/specificity. Facilities may appear on the Marketplace list by both "primary" and "secondary" SIC codes. Primary SIC code listings were used to create the list of outlets used for this analysis.

Information on food store outlets available in the D&B data set was pulled by ZIP code for the years 1997 through 2003. The outlet density data were linked to the individual-level data by the students' school ZIP code. Information on the total number of grocery food stores was available at the 4-digit SIC code level. The 6- and 8-digit SIC classifications allowed us to examine the grocery food stores separately by type. These data were pulled and classified into four subcategories that included: (1) chain supermarkets, (2) nonchain supermarkets, (3) convenience stores, and (4) grocery stores. Supermarkets were substantially larger food stores compared to grocery stores and were more likely to have on-site food preparation such as a butcher, baker, and deli. For example, in the D&B sample of food stores, supermarkets averaged seven times the number of employees as grocery stores and 46 times the sales volume of grocery stores. Grocery stores averaged twice the number of employees as convenience stores. In terms of the presence of at least one food store by type, 45.4%, 34.3%, 92.9% and 88.5% of students in the sample had at least one available chain supermarket, nonchain supermarket, other grocery store, and convenience store present in their ZIP code area. Table 1 shows that the mean per 10,000 capita[28] number of chain supermarkets outlets was 0.30. The per 10,000 capita number of nonchain supermarkets was 0.26, the per 10,000 capita number of convenience stores was 2.2, and the per 10,000 capita number of grocery stores was 3.3.

Restaurant outlet data were available from D&B under the 4-digit classification of "Eating Places." Fast-food restaurants were defined by the full set of 8-digit SIC codes that fell under "Fast-food restaurants and stands," excluding coffee shops and including the two 8-digit SIC codes for chain and independent pizzerias. Nonfast-food restaurants, referred to as full-service restaurants, were defined as the number of total number of "Eating Places" minus fast food restaurants and excluding coffee shops; ice cream, soft drink, and soda fountain stands; caterers; and contract food services. Table 1 shows that on average in each ZIP code there were 2.6 fast-food and 11.4 full-service restaurants per 10,000 people.

[1]Information on D&B's methods was obtained from several sources that include: (1) www.zapdata.com; (2) "The DUNSright Quality Process: The Power behind Quality Information" (2005) Dun and Bradstreet; and, (3) Personal communication with Todd Mertz, Relationship Leader, U.S. DUNSright Customer Solutions, D&B, February 2, 2004.

Empirical Model

The goal of the empirical work was to estimate the associations between access to various types of food stores and adolescent weight, holding constant a variety of socioeconomic characteristics which may be correlated with both weight outcomes and neighborhood characteristics. Per capita availabilities of alternative types of food stores proxy the opportunity cost of the time spent acquiring healthful food. The extent to which alternative food stores are available within local communities is likely to affect eating patterns and weight outcomes. As discussed earlier, previous studies have found that larger versus smaller and chain versus nonchain food stores were more likely to stock healthful foods. Hence, increased availability of chain supermarkets was expected to be associated with lower weight outcomes, while greater availability of smaller stores such as convenience stores were likely to be associated with greater risk of overweight. Further, increased availability of chain supermarkets was expected to have a stronger protective association with weight outcomes compared to the availability of nonchain supermarkets or grocery stores. Differences in the availability of alternative choice sets for food shopping across different communities may result in systematic differences in eating patterns and weight status.

Reduced form models of individual BMI of the form

$$BMI_{ist} = \beta_0 + \beta_1 FT_{ist} + \beta_2 OC_{ist} + \beta_3 X_{it} + \beta_4 D_{it} + \varepsilon_{ist} \quad (1)$$

were estimated by ordinary least squares (OLS), where FT_{ist} was a vector measuring food store outlet density available to individual i in geographic area s at time t, OC_{ist} measured other local-area contextual factors including per capita income, food prices, and restaurant availability in area s, D_{it} was a vector of year dummy variables, X_{it} was a vector of individual and household characteristics, β were conformable vectors of parameters to be estimated, and ϵ_{ist} was a disturbance term. The characteristics in the vector X_{it} included race/ethnicity, grade, highest schooling completed by father, highest level of schooling completed by mother, a rural/urban indicator, total student income, weekly hours of work by the student, and whether the mother worked part-time or full-time. In X_{it} complete sets of gender-specific age dummy variables also were included to remove gender-specific differences in BMI growth. These dummies implicitly included both a constant and a gender dummy. The coefficients on other covariates may then be interpreted as reflecting variation around arbitrary gender-specific growth curves.

The inclusion of the year dummy variables in the model was equivalent to nonparametrically detrending each variable in the analysis such that the estimates do not reflect common trends. Neighborhood per capita income was included in the model to account for local-area wealth effects distinct from food store availability that may affect health outcomes and variation in food store density related to local incomes. Several studies have shown that local-area supermarket availability varies with neighborhood-level socioeconomic status.[15,21,29,30] Not including a measure of neighborhood income confounds food store availability with other wealth effects. To control for other factors that may be related to weight outcomes through food access channels, full-service and fast-food restaurant outlet density measures were included in the model as well as fast-food and fruit and vegetable prices.[23–25]

Table 2. Effects of access to food stores on adolescent BMI and overweight (N=73,079)

	Overweight model 1	BMI model 1	BMI model 2	BMI model 3	BMI model 4
Number of chain supermarkets[a]	−0.0059** (0.0026)	−0.1093*** (0.0288)	−0.1116*** (0.0281)	−0.1100*** (0.0278)	−0.1169*** (0.0297)
Number of non-chain supermarkets[a]	0.0008 (0.0027)	0.0170 (0.0375)	0.0161 (0.0374)	0.0184 (0.0382)	0.0189 (0.0397)
Number of grocery stores[a]	0.0009* (0.0005)	0.0122 (0.0088)	0.0116 (0.0083)	0.0129 (0.0084)	0.0174 (0.0088)
Number of convenience stores[a]	0.0015** (0.0007)	0.0295** (0.0125)	0.0292** (0.0122)	0.0298** (0.0122)	0.0433*** (0.0129)
Restaurant and fast food restaurant, included in model[a]	Yes	Yes	No	No	No
Fast food and fruit and vegetable prices included in model	Yes	Yes	Yes	No	No
Neighborhood per capita income included in model	Yes	Yes	Yes	Yes	No

Note: Standard errors are shown in parentheses and are adjusted using a Huber-white covariance matrix estimate which is robust to both clustering at the zip code level and heteroskedasticity of unknown form. All of the models include but do not report on the following control variables: gender and age interaction terms, grade, race, fathers' education, mothers' education, living with both parents, living in rural areas, students' weekly real income, hours worked by students, mother works part-time, mother works full-time, and year effects.

[a]Per 10,000 capita.

*, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

A Huber–White covariance matrix estimate which is robust to clustering at the ZIP-code level and heteroskedasticity of unknown form was used.[31] Finally, the full model was also estimated with overweight as the outcome using maximum likelihood probit regression, for which the marginal effects were reported.

Results

Table 3 reports the results from the BMI and overweight regressions. Also, the table provides results for three additional BMI model specifications: (1) no restaurant outlet density control variables; (2) no restaurant outlet density or food price control variables; and (3) no restaurant, food price, or local-area SES control variables.

Focusing first on the results from the full model specification for both BMI and overweight with all variables (Model 1), it was found that availability of chain supermarkets had a statistically significant negative relationship with adolescent BMI and overweight status. Each additional chain supermarket outlet per 10,000 capita was estimated to reduce BMI by 0.11 units and to reduce the prevalence of overweight by 0.6 percentage points. BMI and overweight were statistically significantly higher in areas where there were more convenience stores; an additional convenience store per 10,000 capita was associated with a 0.03 unit increase in BMI and a 0.15 percentage point increase in overweight. The availability of nonchain supermarkets and general grocery stores was not statistically significantly associated with adolescent BMI, although increased availability of grocery stores had a very small positive and statistically weak association with overweight.

Comparing the results across models for BMI in Table 2, it can be seen that the parameter estimate for chain supermarkets was robust (falling slightly from −0.1169 in Model 4 to −0.1093 in Model 1) to the exclusion of local-area per capita income, restaurant availability and fast-food and fruit and vegetable prices. Previous research has shown lower availability of supermarkets in low-income neighborhoods.[15,21,29,30] The parameter estimate for convenience stores fell substantially in the BMI models once local-area income was controlled. These results implied that part of the positive correlation between adolescent BMI and convenience and grocery stores was attributable to greater density of these outlets in low-income neighborhoods. Similarly, the neighborhood income effect fell once food store contextual effects were included (not shown in the table) which, in a parallel argument, suggested that some of the correlation between income and adolescent body weight was attributable to differential access to food stores in low-income neighborhoods.

In Table 3 the sample is broken down by race/ethnicity and mother's work status to explore differ-

Table 3. Effects of access to food stores on adolescent BMI by sub-population

	Full sample	White	Black	Hispanic	Mother works full-time	Mother works part-time	Mother does not work
Number of chain supermarkets, per 10,000 capita	−0.1093*** (0.0288)	−0.0959*** (0.0349)	−0.3187*** (0.0987)	−0.0898* (0.0478)	−0.1261*** (0.0348)	−0.1066 (0.0851)	−0.0268 (0.0728)
Number of non-chain super-markets, per 10,000 capita	0.0170 (0.0375)	0.0494 (0.0324)	−0.0721 (0.1608)	−0.0578 (0.1613)	0.0265 (0.0433)	0.0821 (0.0576)	−0.0684 (0.0813)
Number of grocery stores, per 10,000 capita	0.0122 (0.0088)	0.0105 (0.0083)	0.0026 (0.0238)	0.0401 (0.0354)	0.0061 (0.0132)	0.0258 (0.0222)	0.0213 (0.0243)
Number of convenience stores, per 10,000 capita	0.0295** (0.0125)	0.0162 (0.0121)	0.0476 (0.0341)	0.0988** (0.0515)	0.0293* (0.0152)	−0.0026 (0.0256)	0.0635** (0.0258)
N	73,079	50,459	7,821	7,064	46,745	13,590	12,744

Note: Standard errors are shown in parentheses and are adjusted using a Huber-white covariance matrix estimate which is robust to both clustering at the zip code level and heteroskedasticity of unknown form. All of the models include but do not report on the following control variables: gender* age interaction terms, grade, race, fathers' education, mothers' education, living with both parents, living in rural areas, students' weekly real income, hours worked by students, mother works part-time, mother works full-time, year effects, per capita restaurant and fast food restaurant outlet density, fast food and fruit and vegetable prices, and neighborhood per capita income.
*, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

ences in the associations between weight and food store access across these subpopulations. Increased availability of chain supermarkets had a substantially stronger association with BMI among African-American students compared to their white and Hispanic counterparts. For example, one additional local-area chain supermarket per 10,000 capita was associated with lower BMI among African-American students by 0.32 units whereas the associated BMI of white and Hispanic students was lower by 0.10 and 0.09 units, respectively.

By mothers' work status, the food store access variables had a stronger impact on students whose mothers worked full-time; for example, the effect of a chain supermarket was slightly higher in the subsample of students whose mothers worked full-time compared to those with mothers who worked part-time and roughly four times as great compared to students whose mothers did not work. These results suggest that the effect of access to healthful food outlets was stronger in families with a working mother. The opportunity cost of time spent acquiring food is high in such families, so lack of access to supermarkets is more likely to result in substitution of less healthful fast foods or other convenience foods in these families.

The results presented above were not without their limitations. First, the outlet density data were linked to the individual-level data by the student's school's ZIP code. There might have been measurement error in the density data to the extent that students lived in different areas than their schools, which might have been a particular problem for the high school subsample. This error was mitigated by the fact that access near the school was also an important factor and because neighborhood characteristics might have been spatially correlated. A second limitation to bear in mind was that the estimated coefficients on food stores might only be interpreted as causal if, holding everything else in the model constant, variation in food store density came from the supply side (for example, variation in local zoning laws) or if supply was perfectly inelastic. However, if, all else equal, some of the variation in food store density was because of variation in demand across ZIP codes, the estimated associations cannot be interpreted as recovering the causal effect of changes in density on adolescent weight, given that supply was not perfectly inelastic.

Discussion

The results showed statistically significant associations between food store availability and adolescent BMI. Controlling for individual- and family-level characteristics and holding neighborhood per capita income, restaurant availability and food prices constant, an additional chain supermarket per 10,000 capita was associated with 0.11 units lower BMI and a 0.6 percentage point reduction in the prevalence of overweight, whereas an additional convenience store per 10,000 capita was associated with 0.03 units higher BMI and a 0.2 percentage point increase in overweight. The availability of nonchain supermarkets and other grocery stores was not found to be statistically significantly associated with adolescent weight outcomes. Although it was found that differential access to alternative types of food stores revealed significant associations with BMI, these contextual factors explained relatively little of the observed increase in mean BMI over the 1997 through 2003 sampling period. As shown in the summary statistics in Table 1, the sample mean number of chain supermarkets was only 0.3 per 10,000 capita. Model 1 suggests that increasing the availability of chain supermarkets from 0.3 per 10,000 to 1 per 10,000 people (a 230% increase) would decrease mean adolescent BMI by only 0.35%.

However, running the same model with overweight status as the dependent variable, it was found that similarly increasing supermarket availability would reduce overweight prevalence by 4.0%, substantially more than the impact on BMI. These results suggest that adolescents in and around the upper tail of the BMI distribution were more strongly affected by supermarket availability. Put differently, the large sample allows us to precisely estimate the associations between mean BMI and food store availability; the associations are small but were not zero. There was some evidence that overweight adolescents may respond more than the average adolescent, suggesting further research ought to investigate the distribution of BMI rather than its conditional mean.

Different groups of adolescents also responded differently to changes in food store availability. The results showed that the association between chain supermarket availability and BMI was three times higher among African-American students compared to their white and Hispanic counterparts, and for students with mothers who worked full-time the association was slightly greater compared to students with mothers who worked part-time and substantially greater compared to those with mothers who did not work. A similar pattern of differences in effect sizes was found across the subpopulations in models of overweight. At the same time, as noted earlier, existing research has shown that neighborhoods with higher proportions of minority populations are likely to have fewer supermarkets. Taken together, these results suggest that food store availability may be most important for African-American adolescents and those with mothers who work full-time, particularly if the youth is at risk of overweight.

The associations found in this study between food store availability and BMI and overweight were consistent with earlier findings that link healthful food consumption patterns with food store availability.[15,16] The study findings suggest that economic and urban planning land-use policies that encourage commercial de-

velopment to improve the local food store environment in underserved areas may have beneficial effects on youth weight outcomes.

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