

Household Factors, Family Behavior Patterns, and Adherence to Dietary and Physical Activity Guidelines Among Children at Risk for Obesity

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ABSTRACT

Objective: To describe the proportion of children adhering to recommended physical activity and dietary guidelines, and examine demographic and household correlates of guideline adherence.

Design: Cross-sectional (pre-randomization) data from a behavioral intervention trial designed to prevent unhealthy weight gain in children.

Participants: A total of 421 children (aged 5–10 years) at risk for obesity (body mass index percentile, 70–95).

Main Outcomes Measured: Physical activity (accelerometry), screen time (parent survey), and fruit and vegetable and sugar-sweetened beverage intake (24-hour dietary recall).

Analysis: Proportions meeting guidelines were calculated. Logistic regression examined associations between demographic and household factors and whether children met recommended guidelines for (1) physical activity (≥ 60 min/d), (2) screen time (≤ 2 h/d), (3) fruit and vegetable intake (≥ 5 servings/d), and (4) sugar-sweetened beverage avoidance.

Results: Few children met more than 1 guideline. Only 2% met all 4 recommended guidelines and 19% met none. Each guideline had unique sociodemographic and domain-specific household predictors (ie, availability of certain foods and beverages, media, and active play and exercise equipment).

Conclusions and Implications: Families equipped to promote healthy child behavior patterns in 1 activity or dietary domain may not be in others. Results have implications for the development of interventions to affect children's weight-related behaviors and growth trajectories.

Key Words: physical activity, diet, guidelines, child, home environment (*J Nutr Educ Behav.* 2015;47:206–215.)

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INTRODUCTION

Children's activity patterns and dietary intake are associated with important aspects of their health and well-being. Prior studies suggest that physically active children have stronger cognitive/academic functioning, higher self-esteem, and lower adiposity than less active peers.^{1–4} Sedentary behaviors (eg, watching television [TV]) have also been

associated with overweight and obesity⁵ and metabolic syndrome markers.^{6,7} Sugar-sweetened beverage (SSB) intake has been associated with obesity,⁸ and fruit and vegetable consumption has been linked to lower risk of chronic health conditions.^{9,10} Activity and dietary patterns established during childhood often persist into adulthood,¹¹ which underscores the importance of identifying who is at risk for maladaptive

patterns early on and what modifiable factors may mitigate this risk.

Guidelines for physical activity and healthy eating have been established for obesity prevention in children and endorsed by the American Academy of Pediatrics.^{12–15} These guidelines include recommendations for minimum levels of moderate to vigorous physical activity (ie, at least 60 min/d), limiting screen time (to no more than 2 h/d), eating at least 5 servings of fruits and vegetables per day, and avoiding SSBs. Numerous population-based studies have examined demographic correlates of physical activity and dietary intake patterns in children.^{16–20} Some have included rates of adherence to guidelines nationally, with a focus on whether guideline adherence varies as a function of sociodemographic and child characteristics.^{21–23}

Most prior studies examined guideline adherence in isolation (ie, a single

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guideline) or within a single domain (eg, either activity or dietary intake). A recent parent survey study from a nationally representative dataset²¹ found that 70% of children aged 6–11 years met physical activity recommendations and 54% met screen-time viewing guidelines. Older children (aged 9–11 years) and those who were obese were less likely to meet these guidelines. Rates of adherence to dietary guidelines are much lower. Population-based survey studies estimate that between 16% and 26% of elementary school-aged children meet fruit and vegetable intake guidelines, with obese children showing lower adherence rates.²³ Although SSB consumption has decreased over the past decade, a recent study found only 36% of children aged 2–19 years met guidelines for SSB avoidance.²² Demographic factors such as lower levels of parental education and socioeconomic status have been associated with greater consumption of SSBs by children^{24–26}; other studies found that soda intake increases with increasing age.^{27–29}

Fewer studies have examined the impact of modifiable household factors and family behavior patterns on children's adherence to both activity and dietary guidelines. Nonetheless, several studies have examined the role of these factors on children's weight-related behaviors more generally. Such studies have found that media equipment at home, and specifically in the bedroom, is positively associated with children's sedentary behavior.^{30–32} Exercise and play equipment availability have been inversely associated with sedentary behavior (eg, media use) but inconsistently associated with physical activity levels.³³ Parents' engagement in physical activity with the child has been inconsistently linked to children's physical activity and sedentary behavior.¹ The availability of certain food groups (eg, fruits and vegetables, SSBs) in the home has also been associated with children's intake of these foods^{34–37} and family behavior patterns such as higher fast-food frequency and having the television on during meals have been associated with lower child intake of fruits and vegetables and higher intake of unhealthy foods, such as salty snacks and soda.^{38,39} These studies have shown correlations among household factors,

family behavior patterns, and children's dietary and activity levels. However, such studies have not established whether these factors contribute significantly to a meaningful level of engagement in these weight-related behaviors, as reflected by whether children are meeting recommended guidelines, and have not examined guideline adherence across physical activity and dietary domains. Identifying household and family behavior patterns that are associated with children's adherence to both activity and dietary recommendations would support the development of more effective obesity prevention interventions.

This study used data from the Healthy Homes/Healthy Kids trial⁴⁰ to examine the proportion of children meeting dietary and activity guidelines, and associations with demographic and household patterns in a cohort of children aged 5–10 years who are at risk for obesity. In addition to examining adherence to individual dietary and activity guidelines (ie, objectively measured moderate to vigorous physical activity, screen-time viewing, fruit and vegetable intake, and SSB consumption), the proportion adhering to multiple guidelines is also described, to provide a more complete picture of weight-related behaviors within this cohort. To date, there is a paucity of studies that have examined adherence to multiple dietary and activity guidelines in this age group. This is a major gap in the literature given that the combined influence of dietary and activity patterns is believed to contribute to childhood obesity risk and often is targeted concurrently in interventions.^{41,42} It was hypothesized that overweight children (body mass index [BMI] between the 85th and 95th percentiles) would have lower adherence rates to single and multiple guidelines than children at risk for overweight (defined here as the 70th to 84th percentile), and further that key household variables (availability of media, exercise and play equipment, and specific food and beverage items), family behavior patterns that comprise the home food, eating, and activity environment (eating fast food, family meals with the TV on, and shared parent–child physical activities), and demographic characteristics (child's age, child's sex, and

parent education) would be associated with children's adherence to these guidelines.

METHODS

Participants

The researchers used baseline (pre-randomization) data from a behavioral intervention trial (Healthy Homes/Healthy Kids Study) designed to prevent unhealthy weight gain among children who were overweight or at risk for becoming overweight. The study recruited families scheduled for a well-child visit at clinics in the Minneapolis–St Paul area. Eligible children were aged 5–10 years with BMI percentiles between 70th and 95th for age and gender; parents were English-speaking and willing to complete measures and participate in a parent-targeted intervention. Children with a chromosomal abnormality or chronic medical condition, who consistently used of steroid medication, or who were participating in other child health research were excluded. Parent informed consent and child assent were obtained. Study protocol and procedures were approved by the HealthPartners Institute for Education and Research institutional review board. Further details of the trial are described elsewhere.⁴⁰

Dependent Variables

Physical activity guidelines. Children were asked to wear ActiGraph GT1M accelerometers (ActiGraph LLC, Pensacola, FL) for 7 full days during waking hours to measure physical activity. The devices were placed on elastic belts and fitted on the right hip. Children were included in analyses if they recorded at least 4 valid monitoring days, defined as ≥ 10 hours of wear time per day (77%). Non-wear time was defined as a string of ≥ 60 minutes of zero counts, allowing for a 2-minute interruption interval of ≤ 100 counts. To estimate minutes spent in moderate to vigorous activity, data were aggregated into 1-minute epochs. The researchers developed cut points using the equations of Evenson et al⁴³ and dichotomized them to reflect subjects who were meeting guidelines (≥ 60 minutes of moderate to vigorous

activity, coded 1) or not meeting guidelines (< 60 minutes, coded 0).

Screen time guidelines. Parents reported the amount of time in hours that children spent watching TV and playing video or computer games or using a computer for purposes other than schoolwork on an average weekday and weekend day.⁴⁴ Response options (per day) were 0 hours (coded 0), < 1 hour (coded 0.5), 1 hour (coded 1), 2 hours (coded 2), 3 hours (coded 3), 4 hours (coded 4), and ≥ 5 or more hours (coded 5). Total time per day spent watching TV or using a computer was calculated as the sum of the weekday TV and computer or video game time estimates multiplied by 5 and the weekend estimates multiplied by 2, divided by 7. Children were then classified as meeting (≤ 2 hours, coded 1) or exceeding (> 2 hours, coded 0) recommendations for daily screen time.

Dietary guidelines. Child intake was assessed using a single multi-pass, 24-hour recall administered by staff trained and certified to use the Nutrition Data System for Research (NDSR) (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN). Parents reported whether the child ate a typical amount on the day of the recall; recalls in which the parent or child could not recall ≥ 1 meal were flagged as unreliable. Only typical and reliable daily intake recalls were included in the analyses (94%). Recalls were analyzed using NDSR (version 2011, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN). Total energy intake and servings of whole fruit, vegetables, and sugar-sweetened beverages were used in analyses. White potatoes and 100% fruit juice were excluded from the fruit and vegetable count, to be consistent with intervention approaches to prevent unhealthy weight gain.^{45,46} Fruit and vegetable servings were summed and dichotomized into meeting guidelines (≥ 5 servings, coded 1) or not meeting guidelines (coded 0). Sugar-sweetened beverages included sugar-sweetened flavored milk and waters; sweetened soft drinks and fruit drinks (< 100% juice); sweetened sports drinks and supplements (eg, Gatorade, Powerade, Red Bull);

and sweetened tea. Sugar-sweetened beverage consumption was dichotomized into meeting guidelines (no SSB consumption, coded 1) vs any SSB consumption (not meeting guidelines, coded 0).

Predictor Variables

Sociodemographic characteristics. Parents reported their child's and their own sociodemographic characteristics, such as age, sex, ethnicity, race, and educational attainment.

Anthropometry. Child height and weight were measured in the family home by trained staff using a Seca 217 stadiometer and Seca 876 flat scale (Seca Corp, Hanover, MD). Children were measured without shoes and heavy clothing. Height was measured to the nearest 0.1 cm and weight to the nearest 0.1 kg. Measurements were performed twice and were repeated a third time if the first 2 differed by > 1.0 cm for height or > 0.2 kg for weight. Child BMI was calculated as weight in kilograms divided by height in square meters and BMI percentile was derived using the Centers for Disease Control and Prevention 2000 Growth Charts Study.⁴⁷

Household food availability. Food availability was assessed from lists of items within 5 food and beverage categories (fruits, vegetables, salty snacks, sweet snacks, and beverages) developed from the food frequency questionnaire by Raynor et al.⁴⁸ and Block et al.⁴⁹ Parents selected items available in their home within the past week. A count variable was created for each category to indicate the number of different types of items from that category available in the home. Unhealthy snacks (eg, commercial cheese puffs, sweetened or full-fat popcorn, chips) were aggregated and reported together (7 possible items). Fruit (eg, apples, bananas) and vegetable (eg, string and green beans, celery, broccoli) availability were combined and reported together (24 possible items). All sugar-sweetened beverages (eg, soda, sports drinks, fruit drinks, < 100% juice) were also combined (5 possible item types).

Household media and play equipment availability. Parents reported household availability of play and me-

dia equipment for their child using a 47-item inventory.⁵⁰ Play equipment was categorized as active play equipment (a count of 34 possible items: eg, soccer ball, playhouse, gym shoes), active or exercise media (a count of 2 possible items: active video games, exercise-related media), and non-active or exercise media (a count of 11 possible items: eg, computer, digital TV recorder, handheld video game player). A count variable was created for each category to indicate household availability.

Child's fast-food intake. Parents reported the number of times during the past week that their child ate something from a fast-food restaurant (eg, McDonald's, Taco Bell) using a single item based on a modification of Boutelle et al.⁵¹ Based on the distribution of this variable, response options (*never*, *1–2 times*, *3–4 times*, *5–6 times*, and ≥ 7 times) were dichotomized to compare any fast-food intake (*ate out ≥ 1 times during the past week*) with none (*never ate out*).

Media in child's bedroom. Presence of media (ie, TV, computer or laptop, video game console) in the child's bedroom was assessed with 3 questions modified from the survey by Dennison et al.⁵² Parents who endorsed having any 1 of these items in their child's bedroom were categorized as having media in the child's bedroom.

Parent-child shared physical activities. Frequency and type of parent-child shared physical activities were assessed using a 2-item questionnaire developed for this study. Parents reported the number of times they had been physically active with their child over the past week. Response options were *never*, *1 time*, *2 times*, *3 times*, *4 times*, *5–7 times*, *8–10 times*, and ≥ 11 times. Based on the distribution of this variable, responses were dichotomized to compare parents who were more frequently active with their child (≥ 3 times, coded 1) with those who were less active (< 3 times, coded 0). Parents then selected the type of physical activity in which they had participated with their child from a list of 22 possibilities (eg, swimming, walking, biking) and asked to write in any not

included. Open-ended responses were coded into 3 additional activity types (horseplay, chores, and other). The total number of different physical activities (0–25 categories) was used in analyses.

Family meals with TV on. Parents rated the frequency of watching TV during family meals during the past week using 1 item, adapted from McGarvey et al.⁵³ Response options were *never* (0), *1–2 times* (1), *3–4 times* (2), *5–6 times* (3), and *≥ 7 times* (4). Based on the distribution of this variable, response options were dichotomized to compare families who ate meals with the TV on (≥ 1 time in the past week) with those who did not (never in the past week).

Statistical Analysis

Data were analyzed with SPSS Statistics for Windows, version 21.0 (IBM Corp, Armonk, NY, 2012). Descriptive statistics characterize the sample. Logistic regression examined associations between demographic and household factors and whether children met recommended guidelines for physical activity, screen time, fruit and vegetable intake, and SSB consumption. Simple logistic regression models included children with valid accelerometry ($n = 322$) when predicting adherence to physical activity guidelines, valid NDSR ($n = 396$) when examining fruit and vegetable and SSB guideline adherence, and complete screen time survey ($n = 410$) when the dependent variable was screen time guideline adherence. All continuous predictors were mean-centered. Household and family behavior pattern variables that were significant in simple logistic models were included in multivariate models in which key demographic characteristics (child age [years], sex [male vs female], parent education [at least college educated vs less than college], race or ethnicity [non-Hispanic white vs Hispanic and/or not-white]) and child weight (BMI percentile) were included as covariates. In analysis of adherence to dietary guidelines, child energy intake (total kilocalories from NDSR) was included as a covariate. As total kilocalories were significantly associated with sex and age (ie, boys

had higher energy intakes than girls; older children had higher energy intakes than younger children, which was consistent with expectations in the literature), the authors centered kilocalories on the mean for each child's age and sex and then divided it by 100 to ease interpretation in regression analysis. Interactions between sociodemographic and household factors were tested; if significant ($P < .05$), they were included in the multivariate model.

RESULTS

Participant Characteristics

Table 1 lists sociodemographic characteristics, household factors, and behavior patterns of parent-child dyads. The majority of parents were college educated and children were predominantly white or non-Hispanic. There were low rates of media present in children's bedrooms (25%) and nearly half (41%) had no exercise or active media available at home. Whereas more than half (66%) had consumed fast food at least 1–2 times within the past week, few consumed fast food with higher levels of frequency (ie, ≥ 3 times; 4%).

Meeting Physical Activity, Screen Time, and Dietary Intake Guidelines

The researchers calculated proportions of children meeting aggregate diet and physical activity guidelines among the 302 children with valid accelerometry, reliable dietary recalls, and complete screen time survey data (72%). Children with sufficiently complete data to calculate diet and activity guidelines were more likely to be white or non-Hispanic (75% vs 55%; $P < .01$) and their parents more likely to be college educated (75% vs 64%; $P < .05$) than children without complete data. However, these groups did not differ according to age, sex or child BMI percentile.

Figure 1 displays the percentage of children meeting recommended guidelines for physical activity, fruit and vegetable intake, screen time viewing, and avoidance of SSBs for those who provided valid accelerometry, reliable diet recall, and complete screen time surveys. Approximately 36% of this

sample met recommended guidelines for physical activity and fewer than half (48%) met screen time guidelines. Only 17% met guidelines for both physical activity and screen time. Even fewer children met guidelines for 5 servings/d of fruit and vegetables (14%); however, 42% met SSB guidelines. Only 8% met both dietary guidelines. Examination of adherence rates across all 4 guidelines showed that although 81% of children met at least 1 guideline, only 31% met 2 guidelines, 11% met 3 guidelines, and 2% met all 4 guidelines. Nineteen percent of children met none of these guidelines. There were no differences (all $P > .05$) in the proportions of children who were overweight (BMI between the 85th and 95th percentiles, $n = 156$) and at risk for overweight (BMI between the 70th and 84th percentiles, $n = 146$) adhering to physical activity ($\chi^2[1] = 0.19$), screen time ($\chi^2[1] = 0.19$), or dietary guidelines (SSBs, $\chi^2[1] = 0.26$; fruits and vegetables, $\chi^2[1] = 0.27$), nor were there differences in the proportion meeting none, 1, or > 1 guideline ($\chi^2[4] = 2.39$).

Factors Associated With Adherence to Physical Activity and Screen Time Guidelines

Associations between availability of exercise or play equipment, non-exercise media availability, having a TV in the child's bedroom, and parent engagement in physical activity with the child were simultaneously examined as predictors of adherence to physical activity and screen time guidelines (Table 2).

Screen time. In the multivariate model, children who met screen time viewing guidelines were more likely to have greater amounts of exercise or active play equipment available at home (odds ratio [OR], 1.12; 95% confidence interval [CI], 1.07–1.18) and fewer non-exercise media items available (OR, 0.65; 95% CI, 0.57–0.74). Demographic covariates were not significantly related to adherence to screen time guidelines.

Physical activity. As illustrated in Figure 2a and b, respectively, interactions between child age and sex and

Table 1. Participant Sociodemographics, Weight-Related Behaviors, and Household Characteristics

Characteristic	n	
Sociodemographic		
Age at randomization, y (mean [SD]) (range, 5–10 y)	421	6.6 (1.7)
Body mass index percentile (mean [SD])	421	84.9 (6.9)
Parents with at least college education (%)	418	71
Child, Hispanic ethnicity	419	7
Child race	421	
White (%)		71
Black or African American (%)		10
Multiracial (%)		12
Asian (%)		3
American Indian/Alaskan Native (%)		1
Unknown (%)		3
Sex of child (% female)	421	49
Physical activity and dietary intake		
Screen time, h/d (mean [SD])	418	2.4 (1.3)
Moderate to vigorous physical activity, min/d (mean [SD])	322	53.6 (30.9)
Sugar-sweetened beverage consumption, servings/d (mean [SD])	396	0.8 (1.1)
Fruit and vegetable consumption, servings/d (mean [SD])	396	2.8 (2.4)
Household		
Fruit and vegetables available (mean [SD]) (range, 0–24)	420	13.7 (3.9)
Unhealthy snacks available (mean [SD]) (range, 0–4)	420	1.8 (1.8)
Sugar-sweetened beverages available (mean [SD]) (range, 0–4)	420	1.5 (1.2)
Active play equipment available (mean [SD]) (range, 0–34)	420	19.3 (6.0)
Active or exercise media available (mean [SD]) (range, 0–2)	420	0.7 (.59)
Non-active or exercise media available (mean [SD]) (range, 0–11)	420	5.5 (2.2)
Television/computer/video games in child’s bedroom (%)	420	25
Family behavior patterns		
Frequency (%) of family meals with television on, times in past wk	417	
0		48
1–2		21
3–4		14
5–6		10
≥ 7		7
Frequency (%) of parent physical activity with child, times in past wk	416	
0		12
1–2		32
3–4		34
5–7		17
≥ 8		5
Frequency (%) of eating fast food, times in past wk	419	
0		34
1–2		63
3–4		3
5–6		< 1
Number of parent–child physical activities (mean [SD]) (range, 0–25)	420	3.0 (2.6)

between age and BMI percentile were significant. Although males and females were equally likely to meet guidelines in the younger years, females were much less likely to meet guidelines than males at older ages

(aged ≥ 6 years). Children with higher BMI percentiles (≥ 85th) were also much less likely to meet guidelines at older ages. Household variables were not significantly related to adherence to physical activity guidelines.

Factors Associated With Adherence to Dietary Intake Guidelines

Total energy intake, home availability of food or beverage items (fruits or

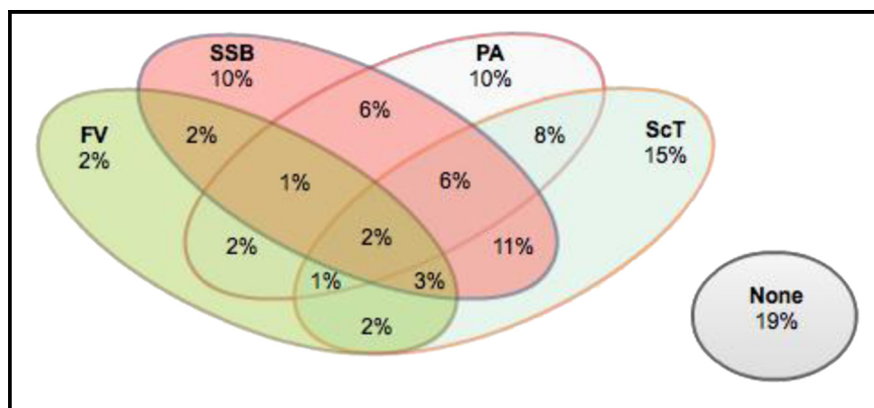


Figure 1. Percentage of children meeting recommended dietary and activity guidelines. FV indicates fruit and vegetable intake; None, meeting none of these activity and dietary guidelines; PA, physical activity; ScT, screen time; SSB, sugar-sweetened beverage intake. The figure includes those who provided valid accelerometry, reliable dietary intake, and screen time surveys ($n = 302$).

vegetables, unhealthy snacks, and SSBs), and family behavior patterns (ie, eating fast food, family meals with the TV on) were examined as predictors of dietary guideline adherence (Table 2).

Fruit and vegetables. Children who met guidelines for fruit and vegetable consumption were more likely to be older (OR, 1.25; 95% CI, 1.05–1.49) and to consume more total calories (NDSR total kilocalories: OR, 1.06; 95% CI, 1.01–1.12). Greater availability of fruits and vegetables in the home was also positively associated with guideline adherence (OR, 1.11; 95% CI, 1.01–1.21) in the multivariable model. Females were less likely to meet fruit and vegetable guidelines (OR, 0.54; 95% CI, 0.29–0.99).

Sugar-sweetened beverages. Children who met guidelines for sugar-sweetened beverage avoidance were more likely to be younger (OR, 0.85; 95% CI, 0.75–0.97), to have parents with at least a college education (OR, 2.46; 95% CI, 1.46–4.13), and to consume fewer overall calories (OR, 0.93; 95% CI, 0.89–0.97). Home availability of SSBs was inversely associated with guideline adherence (OR, 0.74; 95% CI, 0.61–0.90).

DISCUSSION

This study examined rates of adherence to multiple physical activity and dietary intake guidelines in a cohort of children aged 5–10 years who were at risk for obesity but not yet obese.

Subgroups with poor adherence to dietary and activity guidelines were identified and risk factors for poor adherence were described. Only one third of children in this sample met physical activity recommendations and fewer than half met screen time recommendations. These findings are similar to previous studies with regard to screen time viewing, but lower than recent population-based estimates of physical activity guideline adherence.²¹ Differences in adherence rates between this sample and population estimates are likely influenced by variations in measurement methods (ie, accelerometry vs survey) and the BMI range of this cohort. Although 42% of children in this sample met guidelines for SSB avoidance, the proportion adhering to fruit and vegetable guidelines was smaller, which was generally consistent with estimated US population trends (eg, 16% to 26% for fruit and vegetable consumption and 36% for SSB avoidance).^{23,54,55} Contrary to predictions, no differences were observed in guideline adherence between children who were overweight and those at risk for overweight, likely because of the restricted range of BMI within this cohort. Qualitatively, overall rates of guideline adherence in this sample appeared to be more similar to adherence rates among obese and overweight children than the general population of similarly aged children per se, particularly with regard to screen time viewing²¹ and fruit and vegetable consumption.²³

This study of 5- to 10-year-old children at risk for obesity presents adherence rates across multiple dietary and physical activity guidelines, an approach that is necessary to provide a more complete picture of weight-related behaviors that may contribute to a child's obesity risk. Of interest, few children met more than 1 guideline. Only 2% of children met all 4 of these guidelines and a significant portion (19%) met none of them. There was little overlap between screen time and physical activity guideline adherence, with only 17% of children meeting both guidelines. Because others have observed physical activity and sedentary behavior to be independent,⁵⁶ these findings are expected, although there continues to be controversy as to whether screen time displaces physical activity.⁵⁷ There was also little overlap between children who met fruit and vegetable and sugar-sweetened beverage guidelines, with only 8% meeting both guidelines.

Sociodemographic and household correlates of adherence to physical activity and screen time guidelines were specific to each domain. That is, lower levels of non-exercise media at home and higher levels of active play equipment were associated with screen time guideline adherence but not with adherence to physical activity guidelines. Age, gender, and BMI were strongly associated with physical activity but not screen time. Although 5-year-old girls and boys were equally likely to meet guidelines for physical activity, at age 6–7 years, girls were significantly less likely to meet activity guidelines than were boys, a pattern that continued through the upper age range of the cohort. Whereas some studies have shown that physical activity levels tend to drop more sharply for girls compared with boys during adolescence,⁵⁸ these findings are consistent with other studies suggesting that gender differences in physical activity may be observed much earlier,^{59,60} warranting early intervention to promote girls' physical activity, particularly for those at risk for overweight and obesity.

Sociodemographic and household factors associated with fruit and vegetable and sweetened beverage adherence were also guideline-specific, with the exception of child's age.

Table 2. Multivariate Logistic Regression Models for Adherence to Physical Activity and Dietary Intake Guidelines

Guideline	Odds Ratio	95% Confidence Interval	P
Screen time (≤ 2 h/d)			
Child's age	0.99	0.85–1.13	.80
Child's race/ethnicity (1 = non-Hispanic white)	0.86	0.50–1.51	.61
Child's sex (1 = female)	1.22	0.78–1.89	.37
Child's body mass index percentile	1.00	0.97–1.04	.85
Parent education (1 = college)	1.60	0.96–2.68	.07
Media availability at home	0.65	0.57–0.74	< .001
Active play or exercise availability at home	1.12	1.07–1.18	< .001
Frequency of parent physical activity with child	1.35	0.86–2.10	.19
Media in child's bedroom (1 = yes)	0.65	0.37–1.12	.12
Physical activity (≥ 60 min/d)			
Child's race/ethnicity (1 = non-Hispanic white)	0.51	0.27–0.97	.04
Parent education (1 = college)	1.59	0.84–3.01	.16
Age $\times$ sex			< .001
Age, males	0.73	0.34–1.56	
Age, females	0.18	0.08–0.38	
Age $\times$ child's body mass index percentile			.02
Age, 75th percentile	1.00	0.98–1.03	
Age, 85th percentile	0.73	0.71–0.75	
Age, 95th percentile	0.53	0.51–0.54	
Number of parent-child shared physical activities	1.03	0.93–1.15	.53
Fruit/vegetable intake (≥ 5/d)			
Child's age	1.25	1.05–1.49	.01
Child's race/ethnicity (1 = non-Hispanic white)	1.71	0.80–3.63	.17
Child's sex (1 = female)	0.54	0.29–1.00	.05
Child's body mass index percentile	1.01	0.97–1.06	.54
Parent education (1 = college)	1.02	0.50–2.11	.95
Child energy intake: total kilocalories	1.06	1.01–1.12	.03
Fruit and vegetable availability at home	1.11	1.01–1.21	.02
Avoiding sugar-sweetened beverages (0/d)			
Child's age	0.85	0.75–0.97	.02
Child's race/ethnicity (1 = non-Hispanic white)	1.35	0.82–2.20	.24
Child's sex (1 = female)	0.66	0.43–1.02	.06
Child's body mass index percentile	0.99	0.96–1.02	.49
Parent education (1 = college)	2.46	1.46–4.13	.001
Child energy intake: total kilocalories	0.93	0.89–0.97	.002
Sugar-sweetened beverage availability at home	0.74	0.62–0.90	.001

Note: Child energy intake was derived from Nutrition Data Systems for Research. Multivariate logistic regression was used to examine associations among sociodemographic characteristics, household factors, family behavior patterns, and children's adherence to dietary and physical activity guidelines.

Older children were more likely to meet fruit and vegetable guidelines but less likely to avoid sugar-sweetened beverages. Children who are older may have more exposure to SSBs through increasing peer group influences and activities outside the home, which may facilitate consump-

tion,²⁷ and they may be more willing to consume vegetables than are their younger counterparts, as prior studies suggested.⁵⁴ As in other studies, children of parents who had at least a college education were more likely to meet guidelines for SSB consumption.²⁶ However, parental education

was not associated with fruit and vegetable consumption. The low numbers of children meeting guidelines for fruit and vegetable consumption in this cohort (14%) may have reduced the authors' ability to document associations between parental education and fruit and vegetable

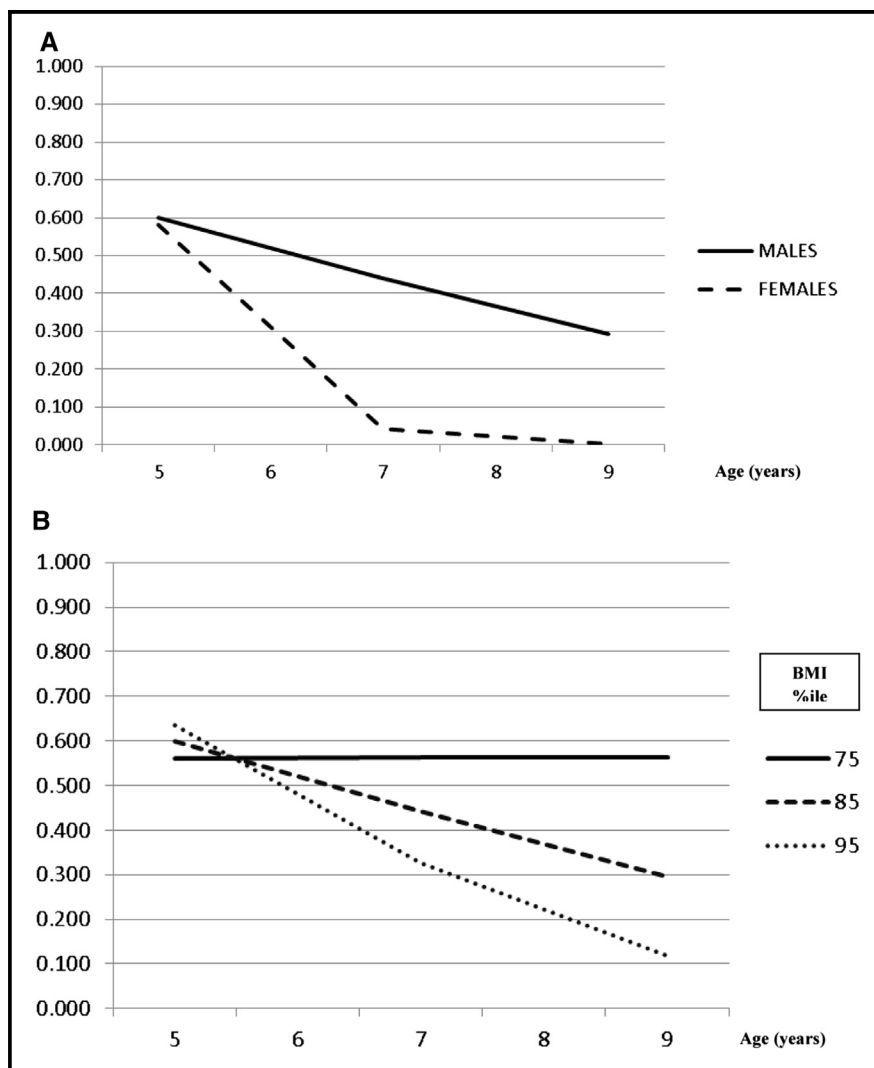


Figure 2. (A) Percentage of children meeting recommended guidelines for physical activity as a function of age and sex. (B) Percentage of children meeting recommended guidelines for physical activity as a function of age and body mass index percentile (BMI %ile).

consumption. Household variables associated with dietary guideline adherence corresponded directly to specific guideline content, with availability of fruits and vegetables and SSBs strongly associated with adherence, which was consistent with prior studies.^{34,35} Although significant at the univariate level, family behavior patterns, including fast-food frequency and the frequency of eating family meals with the TV on, were not associated with adherence to dietary guidelines in multivariate models, likely because of the relatively low frequencies of these behaviors within this cohort. Frequency and number of parent-child shared physical activities were also not associated with guideline adherence.

Study results must be understood within the context of potential limitations. The study sample consisted of children with BMI percentiles between 70 and 95, whose parents agreed to participate in an obesity prevention intervention, and does not represent the general population of children in this age range. Also limiting generalizability is the fact that the sample, although large, was predominantly white and well-educated. Because of time and budgetary constraints, this study used a single 24-hour dietary recall (as opposed to the 3-recall reference standard), which may not represent usual intake. Despite quality assurance efforts for administering and reviewing dietary recalls, parental under- or over-reporting may have

occurred. Because other studies have shown that higher BMI tends to be associated with underreporting,^{61,62} it is possible that the actual daily intakes of fruits and vegetables and SSBs may have been underestimated. The home food availability measure had a restricted range of response options for families. Other factors potentially associated with both home availability and consumption (eg, household income, child food preferences) and the accessibility of foods in the home (eg, ready-to-eat carrots in a plastic bag) were not measured. Finally, given the cross-sectional nature of these data, conclusions about a causal role cannot be made regarding demographic or household factors in children's adherence to dietary and activity guidelines. Nonetheless, these findings extend an understanding of factors that influence adherence to dietary and activity guidelines in children at risk for obesity.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Understanding determinants of health-related behavior, particularly modifiable home environmental factors, can inform the development of interventions to affect children's weight-related behavior and growth trajectories. In particular, the role of modifiable home environmental factors in adherence to dietary and activity guidelines has clear importance for obesity prevention efforts. Little overlap was found in adherence to guidelines for child physical activity, fruit and vegetable intake, screen time viewing, and avoidance of sugar-sweetened beverages in this cohort of children who were overweight or at risk for overweight, which may suggest that families who are equipped to promote healthy child behavior patterns in 1 domain may not be so in others. Furthermore, each guideline had unique domain-specific predictors. Taken together, these findings suggest that interventions designed to promote adherence to dietary and activity guidelines for obesity prevention in children should be tailored to address particular environmental factors relevant to the behavior of interest, and with sufficient flexibility to

ensure that families work on the areas from which they would most benefit.

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CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.