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Dietary Intakes and Physical Activity among Preschool Aged Children living in Rural American Indian Communities Prior to a Family-based Healthy Lifestyle Intervention

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Abstract

Objective—To report dietary intake and physical activity among preschool-aged children living in rural American Indian (AI) communities prior to a family-based healthy lifestyle intervention and to compare data to current age-specific recommendations.

Subjects/Design—One hundred thirty-five preschool-aged children, living in rural AI communities, provided diet and physical activity data, prior to a two-year randomized healthy lifestyle intervention. Three 24-hour dietary recalls assessed nutrient and food and added sugar intake, which were compared to the National Academy of Science's Daily Reference Intakes, the United States Department of Agriculture's (USDA) MyPyramid, and the American Heart Association recommendations. Time watching television and moderate plus vigorous activity (MVA) was compared to the MyPyramid and the American Academy of Pediatrics recommendations.

Statistical analysis—Nutrient, food group, added sugar intake and time watching television and in MVA were compared to recommendations by computing the percent of recommendations met.

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Nonparametric tests identified differences in diet and physical activity among age groups and normal and overweight children (body mass index < 85th and ≥ 85th percentile).

Results—Average nutrient intakes met recommendations whereas food group intakes did not. Mean fruit and vegetable intakes for two to three year-olds were 0.36 cups/day fruit and 0.45 cups/day vegetables and, for four to five year-olds, 0.33 cups/day fruit and 0.48 cups/day vegetables. Both age groups reported consuming more than 50 grams of added sugar, exceeding the recommendation of 16 grams. Overweight versus normal weight children reported significantly more sweetened beverage intake (8.0 ± 0.10 vs. 5.28 ± 0.08 ounces/day, $p < 0.01$) On average, all children reported watching television 2.0 hours/day and significant differences were observed for total television viewing and non-viewing time between overweight and normal weight children (8.52 ± 0.6 vs. 6.54 ± 0.6 hours/day, $p < 0.01$). All children engaged in less than 20 minutes/day of MVA.

Conclusions—Overall, children in this sample did not meet MyPyramid recommendations for fruits or vegetables and exceed added sugar intake recommendations. Viewing and non-viewing television time was highly prevalent along with low levels of MVA. The HCSF intervention has the potential for improving nutrition and physical activity among preschool children living in rural AI communities.

Keywords

dietary intake; physical activity; preschool-aged American Indian children; USDA's MyPyramid

Introduction

Childhood obesity rates in the US are increasing (1), with American Indian (AI) children having the highest rates of overweight and obesity (2-3). Nearly 37% of AI children, aged two to five years, are overweight or obese compared to 30% in all ethnic groups combined (1).

In early childhood, adequate dietary intake is important for growth and development and to prevent nutrient-related deficiencies and toxicities, but excess dietary intake is linked to obesity (4). Developing healthy diet and physical activity patterns early in life is essential so that these practices follow into adulthood, which may prevent obesity, type 2 diabetes, and other chronic diseases. In general, US children are not meeting national dietary and physical activity recommendations (5-8). Few studies have examined food intake and physical activity among young AI children. In one study among preschool aged AI children living in rural Oklahoma, reported major food sources of nutrients included milk, cheese, white breads, salty snacks, nondiet soft drinks, hot dogs, candy, and sweetened fruit drinks, but physical activity was not reported (9).

Previous studies with rural Wisconsin AI populations have observed that several diet and physical activity behaviors may be related to overweight in children including low fruit and vegetable intake, high sweetened beverage consumption, low levels of physical activity, and watching television more than two hours per day (10). As a result of these previous findings, a healthy lifestyle intervention, Healthy Children Strong Families (HCSF), was developed for preschool aged children and their families that focused on four nutrition and physical activity behavior goals: increasing fruit and vegetable intake, decreasing sweetened beverage and sugar intake, increasing physical activity, and decreasing television watching.

The purpose of this paper is to report the baseline dietary intake and physical activity in preschool aged children living in rural AI communities prior to the implementation of the HCSF intervention. Baseline dietary intake and physical activity were compared to the Dietary Reference Intakes, and current recommendations from the USDA MyPyramid, a food-based guidance system to assist in implementing the 2005 *Dietary Guidelines for Americans* (11),

and the American Academy of Pediatrics. In this study, special attention was given to the four HCSF targeted nutrition and physical activity behaviors.

Methods

Study Population

The Great Lakes Inter-Tribal Council, four Wisconsin AI tribes, and researchers at the University of Wisconsin–Madison have formed an ongoing academic and community partnership that is in its ninth year of research (12). One goal of this partnership was to design and implement an obesity prevention intervention, which became Healthy Children Strong Families (HCSF), with additional collaboration from the National Heart, Lung, and Blood Institute. HCSF is a two-year randomized controlled trial for AI children aged two to five years and their primary caregivers. The goal of the intervention is to evaluate the effectiveness of a series of targeted home visits and group sessions on overweight/obesity reduction and healthy lifestyle behaviors for caregivers and their children. Families from each community that enroll in HCSF are randomly assigned according to the child's body mass index (BMI), defined by age- and sex- specific percentiles (13) (i.e., ≥ 85th percentile and <85th percentile), into either an intervention or a control group. A blocked randomization strategy was used to ensure that the number of families in the two groups were equal within each community. Over the course of 12 months, intervention families receive 12 lessons on nutrition and physical activity delivered by a home-visiting mentor, and control families receive the same 12 lessons by mail (14). Mentors are experienced older parents, grandparents, and respected community members, and are capable of delivering the intervention according to study protocol. Mentors were trained extensively before beginning home visits by the University of Wisconsin Extension staff, Tribal Wellness Staff (including nurses, diabetes educators, and dietitians), knowledgeable tribal elders, and HCSF research staff. More on the intervention delivery by home-visiting mentors is described elsewhere (14). In addition, the intervention families receive three group-activity lessons designed to help intervention families support one another in making and sustaining healthy lifestyle choices. Group activity lesson topics reinforce the curriculum topics from the lessons. Year Two of the intervention consists of monthly newsletters for the intervention and control groups and monthly group-activity lessons for the intervention families.

One hundred and fifty families were recruited between April 2006 and March 2009 and provided baseline data before the intervention trial. Recruitment targeted children aged two to five years who attended Head Start programs in all tribal communities. Each family that enrolled in HCSF included at least one child, aged two to five years, and one primary caregiver. Prior to randomization into the intervention phase, children and adults participated in one baseline study visit that included gathering demographic, dietary, physical activity, and anthropometric data. Additional adult information was collected via questionnaires on nutrition and physical activity beliefs and attitudes, and overall general health. Blood and urine samples were also collected from adults to assess cholesterol, C-reactive protein, blood glucose, microalbumin and creatinine levels.

Written consent was obtained by families prior to enrollment into the study. Caregivers were asked to consent for both themselves and for their children. An attempt was made to help the children understand the nature of the study. The University of Wisconsin-Madison Institutional Review Board and the separate tribal councils approved this study.

Dietary Assessment

Dietary intake of children was assessed by three separate 24-hour dietary recall interviews conducted by trained staff between April 2006 and March 2009. Recalls included at least one

weekend day and one week day and were conducted with the child's primary caregiver acting as the proxy. The first recall was an in-person interview and the second and third was conducted over the phone and/or in person within two weeks of the first recalls. The majority of the children in this sample (78.5%) attend Head Start, where breakfast, lunch, and snack are provided. Forty-nine percent of the children's 24-hour dietary recalls were conducted on days when Head Start was in session. When parents could not recall type and food amount because of their children's time at Head Start, dietary intake was either recorded through direct observation or a pre-arranged recall interview with the child's teacher. This information was then added to the child's remaining daily intake that was provided by the primary caregiver.

Dietary intake data was entered and assessed using Nutrition Data System for Research (NDSR) software (version 2008, Nutrition Coordinating Center, University of Minnesota, Minneapolis). The NDSR software utilizes the multiple-pass system of the interview methodology. Interview prompts guide and standardize data entry. NDSR generated nutrients and servings of food consumed by the children for each food group. NDSR software version 2008 bases food group servings on the 1992 US Department of Agriculture Food Guide Pyramid (15); therefore, food group servings were translated into cups and ounces for comparisons with MyPyramid recommendations (16). Children that did not have at least two complete daily recalls (n = 15) were excluded from the analysis.

Physical Activity Assessment

Physical activity for young children this age was quantified using Actical (triaxial) accelerometers (MiniMitter, Respironics Co., Bend, OR). Accelerometry has been shown to be a valid objective method for monitoring physical activity in children this age (17-18) and in adults (19-20). Each child was outfitted with an accelerometer monitor attached to an adjustable belt worn on the hip. Children were instructed to wear the monitor during waking hours for at least five days. The actual number of monitoring days varied among children from one to eight days (mean ± SD: 4.0 ± 1.9 days). The number of monitoring hours each day ranged from 10.5 to 19.8 hours (mean ± SD: 14.2 ± 4.3 hours). Only children who wore the accelerometer greater than 10 hours for more than three days were included in the analysis (n = 108). The accelerometers provided activity counts for each 15-second interval. Data was reduced to quantify activity counts in one-minute intervals and further to quantify the number of intervals for sedentary, light, and combined moderate plus vigorous activity (MVA) per hour. Age-specific count cutoffs were used to correspond to physical activity levels (21-23). These count cutoffs were classified using the metabolic equivalents (METs) prediction equation developed by Sirard et al (24): sedentary ≤ 1.5 METs, light 1.5 to 3.0 METs, moderate, 3.0 to 6.0 METs, and vigorous > 6.0 METs.

To further determine time spent in sedentary activity, television and media (computer and video game use) was assessed by asking parents, on three separate occasions following the dietary recalls, ‘how many minutes/hours was the television on in your home yesterday’ and ‘how many minutes/hours did your child watch television/use the computer/play video games yesterday’. Few children reported any time using computers and video games and therefore, these data were not used in the analysis. Responses were used to determine the mean hours/day that children watched television and mean hours/day the television was on in the home (viewing plus non-viewing time).

Data Analysis

One hundred thirty-five children made up the final sample for this analysis. Group characteristics were described and summarized. Means and standard errors were computed for nutrients, food groups and physical activity measures separately for children aged two to three and four to five years. Four macronutrients and ten micronutrients were chosen to reflect

complete nutrient profiles of children, including major micronutrients that tend to be inadequate in children of this age (such as vitamin E, calcium, folate, and zinc)(25). Food groups and physical activity variables chosen to be analyzed included those similar to the MyPyramid food groups and the HCSF nutrition and physical activity intervention outcomes (fruit and vegetables, sweetened beverages, physical activity, and television watching). Nutrients were compared to the National Academy of Science's Dietary Reference Intakes (DRI) (26) and food groups were compared to the MyPyramid servings (16). No specific recommendations are established for sweetened beverages, therefore added sugar intake was used as a proxy. Because MyPyramid (16) now combines added sugars, fats, and alcohol into a "discretionary calorie allowance" component, added sugar intake was compared to the recent American Heart Association recommendation of no more than 16 grams of added sugars for daily caloric levels of 1,200 and 1,400 (27). Moderate plus vigorous physical activity (MVA) (minutes/day) and television viewing (hours/day) were compared to recommendations from the MyPyramid (16) and the American Academy of Pediatric, respectively (28).

Nonparametric tests (Wilcoxin-Mann-Whitney) were used to test mean differences of nutrients, food groups, and physical activity measures between age groups. Because the HCSF is an intervention focused on improving diet and physical activity in children to prevent obesity, additional analyses were conducted to test whether diet and physical activity components were associated with overweight/obesity in this sample of children. Similar nonparametric tests, described above, were used to test differences between normal weight children (BMI $< 85^{th}$ percentile) and overweight/obese children (BMI $\geq 85^{th}$ percentile) within each age group. A significance level of $p < 0.05$ was used for all analyses. Analyses were conducted using Statistical Analysis Software (version 9.2, Statistical Analysis Systems, Cary, NC).

Results

American Indian children made up 94% of the study sample (Table 1). At the HCSF intervention baseline, 48.1% of children were overweight, defined by age- and sex- specific BMI $\geq 85^{th}$ percentile (12).

Dietary data for children with some meals reported at Head Start did not differ significantly from those with all meals reported at home; therefore, these data were not reported separately. Table 2 presents nutrient intakes in children aged two to three and four to five years. Overall, children met the DRI for most nutrients, although dietary fiber was below the recommended 19 grams/day and 25 grams/day for children aged two to three and aged four to five years, respectively. Mean intakes of calcium and vitamin D met the Adequate Intake (AI) for these nutrients. However, 17% and 49% of children aged two to three and four to five years, respectively, did not meet the AI for calcium and 42% and 49% of children aged two to three and four to five years, respectively, did not meet the AI for vitamin D. Mean intakes for vitamin E met the Estimated Average Requirement (EAR) among all children; however, almost two-thirds of children aged two to three and four to five years fell below the EAR. Few differences were observed between age groups.

Food group intakes are reported in Table 3 and compared with the USDA's MyPyramid recommendations in children aged two to three and four to five years. Among the main food groups, children aged two to three years met 30% to 93.3% of the MyPyramid recommendations and children ages four to five years met 22% to 88% of the MyPyramid recommendations. Children in both age groups consumed substantially less of the recommended amounts of fruits and vegetables compared to the other food groups. For fruit, children aged two to three years reported 0.36 ± 0.05 cups/day (36% of the MyPyramid recommendation) and children aged four to five years reported 0.33 ± 0.05 cups/day (22% of the MyPyramid recommendation). Children aged two to three years reported 0.45 ± 0.04 cups/

day of vegetables (30% of the MyPyramid recommendations) and children aged four to five years reported 0.48 ± 0.04 cups/day of vegetables (32% of the MyPyramid recommendations). Children aged two to three years met 78.5% of the MyPyramid recommendations for grain and their overall intake was significantly less than older children (3.14 ± 0.2 oz/day vs. 4.38 ± 0.2 oz/day, $p < 0.0001$), who met 87.6% of the recommendation. Furthermore, it was observed that a large proportion of grain intake was not from whole grain sources. Approximately one-third of children among all ages met MyPyramid recommendations for all or some whole grains (35% in children aged two to three years and 36% in children aged four to five years). In this sample of children, 70% and 64% of meat intake among children aged two to three and four to five years, respectively, consisted of meat that was predominately high fat/fried and regular varieties. Added sugar was substantially higher than the recommendation of 16g of dietary added sugars. On average, 223 kcals of total caloric intake in children aged two to three years and 237 kcals of total caloric intake in children aged four to five years was attributable to added sugars.

The mean hours of television viewing and non-viewing time in the home and the amount of time spent in sedentary, light, and MVA are reported in Table 4. Reported hours the television was on in the home (viewing and non-viewing time) was 7.13 (SE 0.6) for children aged two to three and 7.83 (SE 0.6) for children aged four to five. Mean hours per day of watching television reached the recommended upper limit of two hours per day; however, the range of television watched was widely variable in children aged two to three years (range = 0 to 5.7 hours) and in children aged four to five years (range = 0 to 6.3 hours). Physical activity levels, measured by accelerometry, showed that children were mainly sedentary or engaged in light activity during waking hours. All children fell short of the recommend 60 minutes of MVA. Children aged two to three years engaged in MVA for an average of 14.5 ± 1.6 minutes/day and those aged four to five years engaged in 19.2 ± 2.0 minutes/day.

Diet and physical activity measures were also compared between all normal weight children (BMI < 85^{th} percentile) and all overweight children (BMI ≥ 85^{th} percentile). No differences in nutrient intake were observed among these BMI groups and subsequently, are not reported. Table 5 summarizes food group intake and physical activity between normal weight and overweight children. Average energy intake among overweight children was almost 100 kcal/day more than normal weight children, but did not reach statistical significance. Sweetened beverage intake was significantly higher among overweight versus normal weight children (8.0 ± 0.10 oz/day vs. 5.28 ± 0.08 oz/day, $p < 0.01$). Overweight children reported watching more television than normal weight children (2.17 ± 0.18 vs.1.83 ± 0.14, $p < 0.23$), and statistically significant differences were observed in the amount of time the television was on in the home for overweight versus normal weight children (8.52 ± 0.6 vs. 6.54 ± 0.6, $p < 0.01$). Physical activity levels, measured by accelerometry, did not differ significantly among normal weight and overweight children.

Discussion

Most American preschoolers are not meeting dietary recommendations (5-7,29-30) even though diet quality has increased slightly in preschoolers over the past few decades (31). Diet quality has also been shown to be better among children that do meet current recommendations (7,29,32). The data presented in the current study among children living in rural AI communities showed that most children are meeting requirements of macro- and micro-nutrients, but are not consuming recommended amounts of fruits, vegetables, whole grains and are consuming excessive amounts of added sugar, partially due to sweetened beverage intake. It is important to consider food sources that may explain the discrepancy between adequate micronutrient intakes and inadequate food groups intakes. White bread and ready-to-eat cereal, food sources that are often fortified with vitamins and minerals, were among the most

frequently reported foods in this sample of children. Similar food sources and dietary patterns were reported from another sample of AI children, ages 10 years and younger (9). That study showed that rural AI and white children living in northeastern Oklahoma were consuming a diet low in fruits and vegetables and high in sugar-sweetened beverages, high-fat foods, and refined grains.

Although average micronutrient intakes met recommendations, there were many children that fell short of specific key nutrient requirements, including fiber, vitamin E, calcium, and vitamin D. Not meeting these nutrient requirements may be due to inadequate intake of recommended foods, such as whole grains, milk, and dark green vegetables.

Dietary intake among this sample of preschool aged children also revealed diets were high in added sugar and sweetened beverage consumption. This may be one reason to explain why children are not meeting MyPyramid recommendations. In a recent large cross-sectional study among children aged two to five years, children's dietary intake of nutrients and food groups decreased as added sugar intake increased (33). Changes in beverage pattern consumption may also change nutrient and food intake. Increased sweetened beverage consumption is related to decreased milk consumption among children (34-37). In the current study, milk consumption decreased from 1.83 cups/day in children aged two to three to 1.76 cups/day in children four to five. Similar trends were seen for 100% juice intake between the two age groups. As milk and 100% fruit juice decreased, sweetened beverage intake increased a small amount from 6.24 oz/day to 6.88 oz/day among children aged two to three and four to five, respectively. Changes in beverage patterns may also contribute to obesity (38). Some studies have shown that sweetened beverage consumption is associated with obesity in children (39-41), while others have not (42-44). Baseline sweetened beverage consumption among children in this study was higher among overweight children versus normal weight children (8.0 oz/day vs. 5.28 oz/day, $p < 0.01$), supporting the possible association between sweetened beverage intake and obesity.

Children not meeting the USDA's MyPyramid recommendations have also been reported in other samples of preschoolers. In a recent study, preschool children attending full-time child care centers in North Carolina, consumed less than the recommended amounts of for fruits, vegetables, and whole grains; however, dietary intake was only reported during child care time (30). In the current study, daily intake for children, including both at-home and child care times were reported. Although the majority of children in the current study attended Head Start programs, only half of the children's dietary recalls were completed during weeks when Head Start was session. No differences were found between children's dietary intake during Head Start session versus those that were completed only at home (data not shown). Head Start nutrition programs must meet specific nutrition standards (45), such as providing at least one-half to two-thirds of children's daily needs for energy and nutrients for children in full-time care (greater than eight hours) and providing at least one-third of daily needs for children in part-time care (four to seven hours). Dietary intake from children participating in this study suggests that they are not meeting nutrition recommendations both in child care and at home. This is consistent with another study that showed child's dietary intake at home does not make up for poor vegetable and grain intake during child-care (29). Findings from this study as well as others may suggest the importance of overall food environments and parental/caregiver role modeling (46) for establishing healthy nutrition habits early in life.

Television watching and media use has been shown to be positively associated with BMI in children (47-50) and the American Academy of Pediatrics recommends that children over two years should not watch more than two hours of television per day (28). The data presented in this study show that preschoolers, on average, reached the upper limit of this recommendation. Overweight children reported watching an average of 20 more minutes of television per day compared to normal weight children ($p < 0.23$). However, the average television time on in

the home (viewing and non-viewing time) was greater than six hours among all children. Furthermore, television time on in the home was significantly different between overweight and normal weight children (8.52 vs. 6.54 hours/day, $p < 0.01$).

This study also found that children were not meeting the minimum recommendation of 60 minutes of MVA. Children engaged between 14 to 19 minutes/day of MVA. These results were not consistent with those reported by an earlier study (51). In that study, mean minutes of MVA, measured by accelerometry, varied from 4.4 to 10.2 minutes/hour among 281 children at nine preschools; however, authors noted that activity time varied significantly among preschools.

This research provides a valuable baseline for studying the effects of interventions on diet and physical activity of preschool-aged children in rural AI communities. Strengths of this study include assessing diet using multiple 24-hour dietary recalls among preschool children. Dietary recalls are based on actual intake (52) and by averaging three recalls, this better predicts usual intake by minimizing day-to-day variability in individuals. Additionally, 24-hour recalls may be more appropriate than a food frequency questionnaire because they have the ability to capture food most commonly eaten by this specific regional AI sample of children, including traditional AI foods. Lastly, this is the first study to report sedentary activity by quantifying time spent watching television and overall physical activity using accelerometry in a sample of young children living in AI rural communities.

The current study is not without limitations. Dietary assessment in young children relies on caregiver, or proxy recall. Parents may not have complete knowledge of what their child ate on a given day and caregivers and teachers may misreport foods eaten and portion sizes because more than one child is under their supervision during meal time. Reported foods and portion sizes when children were in a child care setting were through direct observation by trained personnel to minimize misreporting. Additionally, the use of accelerometry may have limited the ability to measure accurate activity time in a free-living sample of preschool aged children. Instructions were given to caregivers and teachers, when children were in Head Start, on how to place the accelerometer on the child and the length of time it should be worn. However, it is possible that there was variable placement of the accelerometer on the children, which could lead to low precision of activity measurement (53), or other tampering with the device that may have decreased the accuracy of activity counts in the children. Interpreting physical activity levels by use of accelerometery among children is still evolving. The guidelines used in this study followed a few validation studies (21-22,54), but more work is need to categorize activity levels among young children.

Conclusions

Preschool children living in rural AI communities are not meeting MyPyramid recommendations, including fruits and vegetables, and are exceeding the recommended amounts of added sugar, mostly from sweetened beverage consumption. On average, children were reaching the upper limits of recommended time for watching television and were not meeting recommendations for physical activity. Additionally, baseline data from this sample of children showed that overweight children consumed more sweetened beverages and were exposed to more television time (viewing and non-viewing time) than normal weight children.

The HCSF is a family-based intervention among preschool aged children living in rural AI communities. Based on results of children's dietary and physical activity prior to the intervention, HCSF has the potential to decrease the prevalence of overweight and obesity by significantly increasing overall diet quality and physical activity through its objectives of increasing fruit and vegetable intake, decreasing sweetened beverage intake, increasing physical activity, and decreasing screen time.

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Table 1

Baseline characteristics of preschool children living in rural tribal communities: Healthy Children Strong Families Study (n= 135)

Characteristic	n	%
Sex		
Girls	64	47.4
Boys	71	52.6
Age (year)		
2	20	14.8
3	46	34.1
4	50	37.0
5	19	14.1
Ethnicity		
American Indian	127	94.0
Other	8	6.0
BMI Percentile		
$< 85^{th}$	70	51.9
$85\text{-}95^{th}$	23	17.0
$\geq 95^{th}$	42	31.1
Breastfed, Yes (any amount of time)	76	56.3
Enrolled in Head Start, Yes	106	78.5
Enrolled in WIC[a], Yes	102	75.6

[a]WIC= Women, Infants, Children

Table 2

Baseline mean nutrient intakes among preschool children in the Healthy Children Strong Families Study compared to dietary reference intakes

Nutrient	Children 2-3 years (n = 66)			Children 4-5 years (n = 69)		
	Mean ± SE [a]	DRI (EAR/AI) [b]	n (%) < DRI (EAR/AI)	Mean ± SE [a]	DRI (EAR/AI) [b]	n (%) < DRI (EAR/AI)
Total fat (% kcal/day)	33.1 ± 0.7	30-40 [c]		33.9 ± 0.6	25-35 [c]	
Saturated fat (% kcal/day)	12.8 ± 0.3			12.6 ± 0.3		
Carbohydrates (% kcal/day)	54.0 ± 0.9	45-65 [c]		53.0 ± 0.7	45-65 [c]	
Protein (% kcal/day)	14.2 ± 0.3	5-20 [c]		14.3 ± 0.3	10-30 [c]	
Fiber (g/day)	9.4 ± 0.4	19 (AI)		10.0 ± 0.5	25 (AI)	
Calcium (mg/day)	827.5 ± 37.7	500 (AI)	11 (16.7)	806.0 ± 35.9	800 (AI)	34 (49.3)
Vitamin A (mcg/day)	568.7 ± 37.9	210	3 (4.5)	543.1 ± 24.9	275	8 (11.6)
Vitamin E (mg/day)	5.3 ± 0.4 [d] *	5	42 (63.6)	6.0 ± 0.5 [d] *	6	44 (63.8)
Vitamin D (mcg/day)	5.8 ± 0.4	5 (AI)	28 (42.4)	5.4 ± 0.3	5 (AI)	34 (49.3)
Vitamin C (mg/day)	84.0 ± 7.6	13	3 (4.5)	70.4 ± 5.7	22	7 (10.1)
Iron (mg/day)	11.3 ± 0.7	3.0	1 (1.5)	11.9 ± 0.5	4.1	0
Folate (mcg/day)	304.7 ± 20.7	120	3 (4.5)	315.4 ± 14.8	160	4 (5.8)
Vitamin B-12 (mcg/day)	4.4 ± 0.2	0.7	1 (1.5)	4.4 ± 0.2	1.0	0
Zinc (mg/day)	8.2 ± 0.4	2.5	0	8.6 ± 0.4	4.0	3 (4.3)

[a] SE = Standard error.

[b] DRI = dietary reference intakes for children aged 1-3 years and 4-8 years, include two sets of values that serve as goals for nutrient intake: estimated average requirement (EAR) and adequate intake (AI). Blank spaces indicate that no dietary reference value is established.

[c] Acceptable macronutrient distribution range.

[d] Indicates statistically significant difference in means between children aged 2-3 and 4-5 years.

* $P < 0.05$.

Table 3

Comparison of mean baseline dietary data from the Healthy Children Strong Families Study with the MyPyramid[a,b] recommendations

	Children 2-3 years (n = 66)			Children 4- 5 years (n = 69)		
Component	**Mean ± SE [c]**	**Daily MyPyramid [a] recommendation**	**% of recommendation**	**Mean ± SE [c]**	**Daily MyPyramid [b] recommendation**	**% of recommendation**
Energy, kcal/day	1388 ± 45	1200	115.6	1522 ± 52.1	1400	108.7
Grains, oz/day (total)	3.14 ± 0.2 [e]***	4	78.5	4.38 ± 0.2 [e]***	5	87.6
All or some whole grain, oz/day	0.70 ± 0.1	2	35.0	0.90 ± 0.1	2.5	36.0
Vegetables, cups/day (total)	0.45 ± 0.04	1.5	30.0	0.48 ± 0.04	1.5	32.0
Dark green, cups/week	0.12 ± 0.05	1.5	8.0	0.08 ± 0.04	1.5	5.3
Orange, cups/week	0.39 ± 0.1	1	39.0	0.17 ± 0.05	1	17.0
Legumes, cups/week	0.17 ± 0.04	1	17.0	0.20 ±0.05	1	20.0
Starchy, cups/week	1.08 ± 0.2	2.5	43.2	1.33 ±0.2	2.5	53.2
Other, cups/week	1.59 ± 0.2	4.5	35.3	1.79 ± 0.2	4.5	39.8
Fruit, cups/day (not 100% juice)	0.36 ± 0.05	1	36.0	0.33 ± 0.05	1.5	22.0
100% fruit juice, oz/day	4.92 ± 0.2	≤ 6	88.7	3.44 ± 0.1	≤ 6	57.3
Milk, cups/day (total)	1.83 ± 0.1	2	91.5	1.76 ± 0.1	2	88.0
Whole, cups/day	0.23 ± 0.1 [f] *			0.11 ± 0.05		
Reduced fat, cups/day	0.83 ± 0.1 [f] *			0.72 ± 0.1		
1% or nonfat, cups/day	0.46 ± 0.1			0.52 ± 0.07		
Meat, oz/day (total)	2.8 ± 0.2	3	93.3	3.24 ± 0.2	4	80.3
High-fat/fried, oz/day	0.81 ± 0.1			0.83 ± 0.1		
Regular, oz/day	1.15 ± 0.1			1.23 ± 0.1		
Lean, oz/day	0.35 ± 0.8			0.50 ± 0.1		
Alternatives, oz/day	0.51 ± 0.07			0.66 ± 0.1		
Sweetened drinks, oz/day	6.24 ± 0.1			6.88 ± 0.1 [f] **		
Added sugar, g/day	54.8 ± 3.2	16 [d]	343%	59.1 ± 3.5	16 [d]	369%

[a] Based on a 1,200 kcal diet as recommended by MyPyramid for a 3-year-old girl, active 30-60 minutes per day (reference 16).

[b] Based on a 1,400 kcal diet as recommended by MyPyramid for a 4-5-year-old girl and boy, active 30-60 minutes per day (reference 16).

[c] SE = Standard error.

[d] American Heart Association recommendation (reference 27).

[e] Indicates statistically significant difference in means between children aged 2-3 and 4-5 years.

[f] Indicates statistically significant difference in means between children with BMI < 85th percentile and ≥ 85th percentile.

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

Table 4

Comparisons of mean baseline physical activity data from the Healthy Children Strong Families Study with the American Academy for Pediatrics and MyPyramid recommendations

	Children 2-3 years (n = 66)			Children 4- 5 years (n = 69)		
Component	**Mean ± SE** [a]	**Recommendation** [b,c]	**% of recommendation**	**Mean ± SE** [a]	**Recommendation** [b,c]	**% of recommendation**
TV on, hours/day	7.13 ± 0.6 [e] **			7.83 ± 0.7		
TV watched, hours/day	2.0 ± 0.2	< 2 [b]	100.0	2.0 ± 0.2	< 2 [b]	100.0
Physical activity [d]						
Sedentary, hours/day	7.9 ± 0.24			9.4 ± 0.61		
Light, hours/day	5.0 ± 0.16			5.0 ± 0.22		
Moderate plus vigorous, minutes/day	14.5 ± 1.6	60 [c]	24.2	19.2 ± 2.0	60 [c]	32.0

[a] SE = Standard error.

[b] American Academy for Pediatrics recommendation (reference 28).

[c] MyPyramid recommendation (reference 16).

[d] n = 52 for 2-3 year-old children; n = 56 for 4-5 year-old children.

[e] Indicates statistically significant difference in mean comparing children BMI < 85th percentile and ≥ 85th percentile.

** $P < 0.01$.

Table 5

Comparison of mean dietary and physical activity data from the Healthy Children Strong Families Study by body mass index percentile

	BMI Percentile		
Component	**< 85th (n = 70)**	**≥ 85th (n = 65)**	***P* value**
	***Mean* ± *SE*[a]**		
Energy, kcal/day	1405 ± 41.9	1513 ± 56.3	0.27
Grains, oz/day	3.63 ± 0.19	3.93 ± 0.23	0.21
Vegetables, cups/day	0.43 ± 0.04	0.51 ± 0.04	0.16
Fruit, cups/day (not 100% juice)	0.37 ± 0.05	0.32 ± 0.04	0.86
100% fruit juice, oz/day	4.44± 0.16	3.92 ± 0.11	0.88
Milk, cup/day	1.75 ± 0.11	1.84 ± 0.12	0.76
Meat, oz/day	2.83 ± 0.21	3.25 ± 0.22	0.10
Sweetened drinks, oz/day	5.28 ± 0.08	8.00 ± 0.10	0.008**
TV on, hours/day	6.54 ± 0.6	8.52 ± 0.6	0.004**
TV watched, hours/day	1.83 ± 0.14	2.17 ± 0.18	0.23
Physical activity [b]			
Sedentary, hours/day	8.5 ± 0.40	9.4 ± 0.61	0.44
Light, hours/day	5.0 ± 0.16	5.0 ± 0.22	0.94
Moderate plus vigorous, min/day	15.9 ± 1.41	18.1 ± 2.3	0.95

[a] SE = Standard error.

[b] n = 59 for children with BMI < 85th percentile; n = 49 for children with BMI ≥ 85th percentile.

** P < 0.01