



Variety of fruit and vegetables is related to preschoolers' overall diet quality

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ABSTRACT

Children are encouraged to eat a specific amount of fruits and vegetables to optimize health. The purpose of this study was to assess whether consumption of a variety of fruits and vegetables, respectively, was associated with a greater diet quality among preschool-aged children. Analyses were performed using a cross-sectional, nationally representative sample of US children. Dietary intakes from 24-h dietary recalls of two-five year old children ($n = 2595$) in 2005–2010 NHANES were examined. Diet quality was evaluated using MyPlate equivalents and the Healthy Eating Index 2010 (HEI-2010). Variety categories were determined based on children's fruit, fruit juice, and vegetable consumption on the recalled day. Differences in diet quality were examined using *t*-tests. Variety of fruits and vegetables was linked to higher overall diet quality. Children who consumed whole fruit had better diet quality scores for total fruit, whole fruit, whole grains, dairy, seafood, refined grains, sodium, and empty calories ($P \leq 0.018$). Significantly higher HEI-2010 scores for total fruit, whole fruit, fatty acids, sodium, and empty calories, but a lower dairy HEI-2010 score, were identified in children who drank fruit juice ($P \leq 0.038$). Vegetable consumption was significantly associated with higher total vegetables, greens/beans, and empty calories, but a lower sodium score ($P \leq 0.027$). Children who consumed whole fruit, fruit juice and non-starchy vegetables ($P \leq 0.017$), but not white potatoes, had significantly higher total HEI-2010 scores. Reinforcing fruit and 100% fruit juice consumption may indirectly support healthier diets among children. However, underlying associations between fruit and vegetable intakes and overall diet quality should be examined further.

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1. Introduction

Numerous health promotion efforts reinforce increased consumption of fruits and vegetables because of the many resulting health benefits (Kim et al., 2014; Miller et al., 2011; World Health Organization, 2002). While young children's consumption of fruit is more likely to meet current guidelines, vegetable consumption in the United States continues to be less than recommended (Guenther et al., 2006; Ramsay et al., 2014; US Department of Health and Human Services and United States Department of Agriculture, 2015). Not only do national guidelines encourage the general population to consume a greater quantity of fruits and vegetables, but guidelines also promote the consumption of a variety of fruits and vegetables to optimize health and nutritional status (US Department of Agriculture, 2010). However, the leading sources of fruits in children's diets are in the forms of 100% fruit juice, apples, and oranges that are generally lacking in the variety needed to promote nutritional diversity (Lorson et al., 2009).

Although, achieving adequate overall intakes of fruits and vegetables are important, greater focus on variety is needed to support the health benefits conferred by various vitamins, minerals and phytochemicals (US Department of Agriculture, 2010). While some nutrients are commonly found in many fruits and vegetables, such as vitamins A and C, and potassium, there can be vast differences in overall nutrient content (Drewnowski, 2005). Consumption of a variety of fruits and vegetables can increase the likelihood of a greater nutrient intake in children (US Department of Agriculture, 2010). To date, a paucity of research with children and adolescents has examined fruit and vegetable intakes separately (Ramsay et al., 2014; Krolner et al., 2011) as well as the actual benefit of consuming a variety of fruits and vegetables (Ramsay et al., 2014). While the Dietary Guidelines for Americans (US Department of Agriculture, 2010) has consistently encouraged the consumption of a variety of fruits and vegetables, and previous research suggest a consumption of a variety of fruits and vegetables is linked with overall nutrient intakes in young children (Ramsay et al., 2014), there is a need for further research.

Children's eating behaviors develop in early childhood (Birch and Fisher, 1998) and are related to food preference and intake in adolescence (Skinner et al., 2002). Much of the health promotion efforts for children's consumption of fruits and vegetables have emphasized

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quantity rather than a variety (Evans et al., 2012); however, reinforcing and supporting intakes and liking of a variety of fruit and vegetables in early childhood could have important implications for improving children's overall diet quality and health status later in life.

To fill the gap in evidence for the relationship between variety in children's fruit and vegetable intakes and overall diet quality (Ramsay et al., 2014), the purpose of this study was to assess whether consumption of a variety of fruits and vegetables, respectively, was associated with a greater diet quality among preschool-aged children as measured using the Healthy Eating Index 2010 (HEI-2010) (Guenther et al., 2013; Guenther et al., 2014). Specific objectives of the study were to: 1) Describe children's fruit and vegetable intake in terms of amount and variety of fruit and vegetables; 2) Determine whether differences in overall diet quality exist among children based on the variety of fruit and vegetables consumed; 3) Determine whether differences exist in overall diet quality between children who consume commonly researched fruits and vegetables categories versus those who do not.

2. Methods

One day dietary intakes of children aged 2–5 years ($n = 2595$) from the 2005–2010 National Health and Nutrition Examination Survey were examined to identify the relationship between consuming a variety of fruits and vegetables and overall diet quality. These data represent a cross-sectional national nutrition monitoring survey that assessed the health and nutritional status of the non-institutionalized US population (Centers for Disease Control and Prevention, 2009). Household 24-h recall interviews were conducted to collect sociodemographic and personal characteristics. Physical examinations and dietary intake data were collected in a Mobile Examination Center. Data were collected in two-year cycles as NHANES employs a multi-stage, random sampling approach, with an oversampling of young children, adolescents, Hispanics, African Americans and low-income persons. Informed consent was obtained from all parents who volunteered to participate in the study before they provided information on their children's dietary intake. More information about the procedures utilized to collect the data is described elsewhere (Centers for Disease Control and Prevention, 2009). All protocols were approved by the NHANES ethics review board.

Quantitative dietary intake data were obtained from a 24-h dietary recall interview conducted using a Computer Assisted Dietary Interview process by trained interviewers during a Mobile Examination Center visit. The interview was conducted with an adult proxy that was most familiar with the child's consumption during the time period of assessment using the Automated Multiple Pass Method (Ahuja et al., 2012; Moshfegh et al., 2008). Individual foods and beverages reported for the previous 24 h prior to the interview were collected with the time, eating occasion, food source and amount. The nutrients and MyPlate intake equivalents for fruits and vegetables were estimated using the Food and Nutrition Database for Dietary Surveys (US Department of Agriculture, Agricultural Research Service, 2014) and the Food Patterns Equivalents Database (FPED) as described by Bowman et al. (2013), respectively. Children were included in the final analyses if they had valid and reliable dietary recall data, per NHANES protocol (Ahuja et al., 2012; Moshfegh et al., 2008).

Diet quality was measured by means of the 2010 Healthy Eating Index (HEI-2010) described by Guenther et al. (2013) using the data from the MyPlate food group equivalents from the FPED (Bowman et al., 2013). The total HEI-2010 score (maximum score of 100), a measure of overall diet quality, is comprised of a summative score across 12 subscales, with higher scores indicative of a better diet quality. The subscale scores are computed based on the proportion of children achieving thresholds of food group intakes per 1000 kcals. The HEI-2010 scores were tallied from the number of MyPlate equivalents consumed for the following subscales: total fruit (0–5); whole fruit (0–5); total vegetables (0–5); greens and beans (0–5); whole grains (0–10); dairy (0–

10); total protein foods (0–5); seafood and plant proteins (0–5); fatty acids (0–10); refined grains (0–10); sodium (0–10); and empty calories (0–20).

Fruit and vegetable variety was evaluated using intakes of 1) citrus whole fruit (including cut-up fruit), 2) non-citrus whole fruit (including cut-up fruit), 3) 100% fruit juice, 4) dark green vegetables, 5) red and orange vegetables (comprised of tomato products and other red or orange vegetables), 6) starchy vegetables (comprised of white potatoes i.e. French fries, peas, and corn) and 7) other vegetables. Determination of children's Fruit and Vegetable Variety score was computed as the sum of consumption from the aforementioned fruit and vegetable categories (range: 0–7). Thus, three fruit categories and four vegetable categories were used to determine the 7 point variety score.

Children's intakes for each fruit and vegetable category were dichotomized to "consumers" and "non-consumers" based on the total FPED values for the day of record. Consumers from the above fruit and vegetable categories were defined as those children with any reported fruit intake or vegetable intake (in cup equivalents) on the recorded day. For example, a child with a reported zero cup of fruit juice consumed was identified as a 'non-consumer.' To assess the differences in diet quality across consumption of commonly targeted fruit and vegetable groups from nutrition research, intakes of fruit juice, whole fruit, non-starchy vegetables and white potatoes were dichotomized to identify "consumers" and "non-consumers" on the day of intake for comparison.

2.1. Statistical analysis

Public use data were downloaded from the National Center for Health Statistics (NCHS) and United States Department of Agriculture (USDA) websites and tabulated using the Statistical Package for the Social Sciences (SPSS version 22, 2015, IBM SPSS Inc.). Means and standard errors of the HEI-2010 total scale score and subscale scores were compared using the stratified Fruit and Vegetable Variety scores of children's reported intake. Analysis also was conducted to assess the diet quality across the consumption of specific fruit and vegetable subgroups. Descriptive statistics were computed to identify the proportion of 2–5 year old children that consumed fruit, vegetable, fruit juice, and white potatoes on the day of record.

To account for the complex sampling design and produce nationally-representative estimates with statistically-appropriate standard errors, data were analyzed using the Complex Samples module of SPSS. Data are presented as means and standard errors or un-weighted counts and weighted population percent for categorical data. Potential differences in total and subscale HEI-2010 scores were assessed between "consumers" and "non-consumers" using independent samples *t*-tests. Significance was established a priori at $P < 0.05$.

3. Results

The sample was 52% male ($n = 1349$), 48% female ($n = 1246$), 55% non-Hispanic white ($n = 852$), 14% African-American ($n = 557$), 16% Mexican American ($n = 774$), and 15% Other ($n = 412$.) The overall mean (SE) intakes per day of fruit and vegetables were 1.5 (SE: 0.04, range: 0–11.3) cups and 0.7 cups (SE: 0.02, range: 0–6.0), respectively. Of the 2595, 76% ($n = 1989$) drank fruit juice, 74% ($n = 1840$) ate whole fruit, 50% ($n = 1317$) consumed white potatoes and 85% ($n = 2196$) reported a non-starchy vegetable on the day of the recall. The overall mean HEI-2010 score for all children was 49.9 (SE: 0.45, range: 12.81–89.3) out of a possible 100 points (Table 1).

3.1. Children's variety of fruit and vegetable intake

Only 1% ($n = 25$) of the children did not consume a fruit or vegetable and 2% ($n = 44$) consumed 7 different fruit or vegetable categories. The highest percentage of children consumed 3–5 different fruits and vegetables on the recalled day: 3 year old children ($n = 595$, 22%), 4 year old

Table 1
Demographic table of children 2–5 years of age.

	Category	Sample size	Population size	% of Total
Gender	Male	1349	8,445,196	52.3%
	Female	1246	7,706,267	47.7%
Age (years)	2 years	885	4,434,638	27.5%
	3 years	555	3,745,880	23.2%
	4 years	619	4,269,815	26.4%
	5 years	536	3,701,130	22.9%
	Race/Ethnicity	Mexican American	774	2,591,277
	Other Hispanic	235	1,153,705	7.1%
	Non-Hispanic White	852	8,886,379	55.0%
	Non-Hispanic Black	557	2,263,346	14.0%
	Other or Multiracial	177	1,256,757	7.8%

children ($n = 728$, 29%), and 5 year old children ($n = 578$, 24%). Children commonly consumed whole fruit that was cut up and fruit juice. Consumption of a variety of vegetables was less frequent; with the most commonly consumed vegetable being white potatoes followed by the red and orange vegetable category, of which tomatoes and tomato products were the most frequently consumed (data not shown).

3.2. Differences in HEI-2010 scores among children based on the variety of fruit and vegetables consumed

Higher fruit and vegetable variety was associated with small, incrementally better dietary quality scores for total fruit, total vegetable and empty calories subscales in the sample (Figs. 1 and 2 respectively). The greater the variety of fruit and vegetable consumed, the higher the HEI-2010 scores for total fruit, whole fruit, total vegetables and greens and beans (Fig. 1). Larger incremental differences in fruit and vegetables subscales were seen in children who consumed 5 or more different types of fruits and vegetables over the course of the recall day. A u-shaped trend was evident for empty calories HEI-2010 scores, with the lowest scores for children who consumed 1–2 subgroups of fruits and vegetables. Mean total HEI-2010 scores for children who did not consume any fruits and vegetables subgroups on the day of record were 37.9 (SE: 3.9), while those who consumed all 7 fruit and vegetable subgroups had a mean total HEI-2010 score of 62.1 (SE: 1.7, Fig. 2).

3.3. Differences in HEI-2010 scores across consumption of fruit and vegetable subgroups on the recalled day

The differences in mean HEI-2010 subscales and total scores across consumption of selected fruit and vegetable subgroups are presented

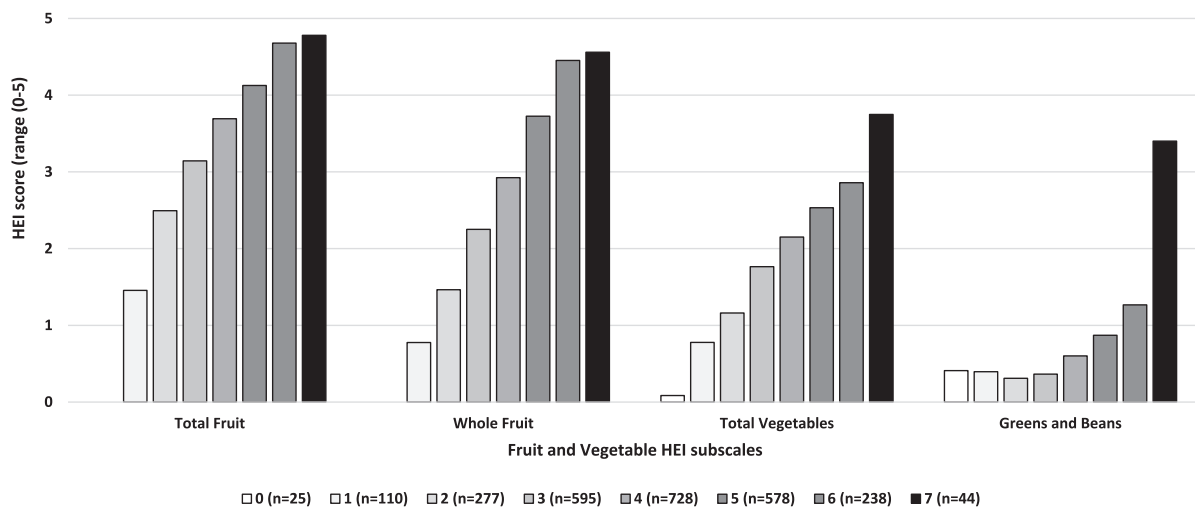


Fig. 1. Mean fruit and vegetable Healthy Eating Index 2010 subscale scores of 2–5 year old children from NHANES 2005–2010 by Fruit and Vegetable Variety score ($n = 2595$). Fruit and Vegetables Variety scores (range 0–7) were based on the number of categories of fruits and vegetables reported as consumed from the following categories: citrus whole fruit; non-citrus whole fruit; fruit juice; dark green vegetables; red and orange vegetables; starchy vegetables; and other vegetables.

in Table 2. Children who consumed fruit juice, whole fruit and non-starchy vegetables on the day of recall had significantly better empty calories ($P \leq 0.003$) and total HEI-2010 scores ($P < 0.02$). Children who consumed fruit juice on the day of record had significantly better HEI-2010 scores for total fruit ($P < 0.001$), whole fruit ($P = 0.038$), fatty acids ($P = 0.007$) and sodium ($P < 0.001$), while having significantly poorer dairy HEI-2010 scores ($P = 0.003$). There were no significant differences in total vegetable or greens and beans HEI-2010 scores for children who consumed whole fruit, but they had significantly better total fruit ($P < 0.001$), whole grains ($P < 0.001$), dairy ($P = 0.017$), and seafood and plant proteins ($P = 0.004$) HEI-2010 scores. Whole fruit ($P = 0.027$), total vegetables ($P < 0.001$), and greens and beans ($P < 0.001$) were significantly greater in children who reported consuming a non-starchy vegetable on the day of record, but significantly poorer sodium HEI-2010 scores ($P < 0.001$). Despite no significant differences in total HEI-2010 score, children who consumed white potatoes had significantly poorer total fruit ($P = 0.007$), whole fruit ($P < 0.001$), whole grains ($P < 0.001$), dairy, and seafood and plant proteins HEI-2010 subscale scores. Those children that did not consume white potatoes had a significantly poorer HEI-2010 score for total vegetables ($P < 0.001$), total protein foods ($P = 0.039$), fatty acids ($P < 0.001$), and refined grains ($P < 0.001$).

4. Discussion

This study demonstrated a relationship between overall diet quality measured by the HEI-2010 and the consumption of a variety of fruits and vegetables in children's diets. Children who consumed greater variety of fruit and vegetable categories were more likely to have higher diet quality; however, these findings were more distinct in fruit intakes versus vegetable intakes. Although, it is important to note that children's low intake of vegetables limits the capacity to fully examine the relationship between vegetable variety and diet quality. A greater consumption and variety of whole fruit was associated with better HEI-2010 scores in young children. Children generally have a preference for fruits over vegetables and consume greater quantities of fruits than vegetables (Ramsay et al., 2014; Zeinstra et al., 2007). This study highlights the potential importance of children's consumption of whole fruit as it related to overall diet quality of young children. Whole fruit intake was associated with greater consumption of whole grains, dairy, seafood, and plant proteins. Consumption of whole fruit provides vitamin A, vitamin C, fiber, and numerous other phytonutrients beneficial to health (US Department of Agriculture, 2010). Children's consumption

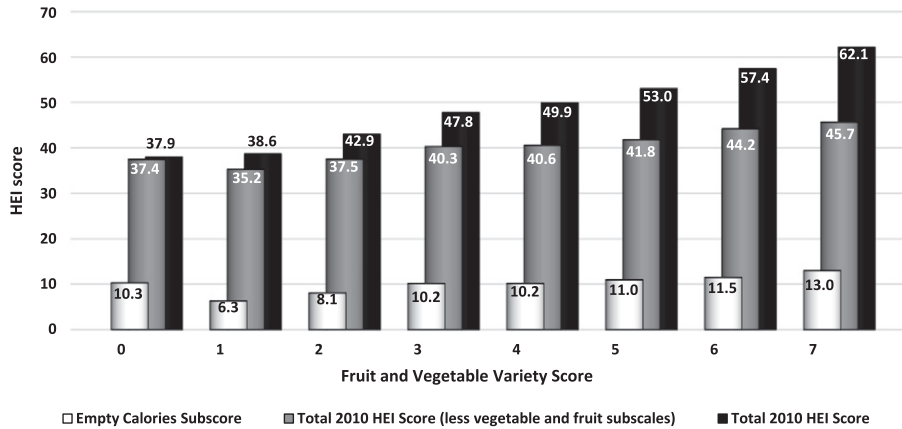


Fig. 2. Mean empty calories, non-vegetable and non-fruit, and total Healthy Eating Index 2010 scores of children aged 2–5 years from NHANES 2005–2010 by Fruit and Vegetable Variety score ($n = 2595$). Fruit and Vegetable Variety scores (range 0–7) were based on the number of categories of fruits and vegetables reported as consumed from the following categories: citrus whole fruit; non-citrus whole fruit; fruit juice; dark green vegetables; red and orange vegetables; starchy vegetables; and other vegetables.

of fruits and vegetables is associated with the availability and accessibility of those foods in the home (Ding et al., 2012); thus, caregivers may be able to support children's variety of fruit and vegetable intake by offering them more frequently.

When 100% fruit juice was included, children's diet quality was better for whole fruit, fatty acids and empty calories and sodium, but the dairy HEI-2010 score was poorer. This finding is consistent with some, but not all research suggesting that juice consumption may displace milk in children's diets (Dodd et al., 2013). However, a recent study by Nicklas et al. (2014) did not identify an impact of 100% fruit juice consumption on dairy intake in young children. In addition, 100% fruit

juice was associated with greater whole fruit consumption in our sample. It may be children develop flavor associations (Anzman-Frasca et al., 2012), and when children consume 100% fruit juice in the recommended amounts, they are exposed to fruit flavors that could foster consumption of whole fruit at a later time.

Children's variety of fruit and vegetable consumption was associated with better HEI-2010 scores for total vegetables, vegetable greens and beans and empty calories (fewer empty calories), but a poorer sodium score. Considering the most consumed vegetable source was potatoes, including French fried potatoes, as previously noted (Ramsay et al., 2014), then this primary food source could impact children's sodium

Table 2
Differences in mean (SE) Healthy Eating Index 2010 scores for 2–5 year olds by consumption of selected fruit and vegetable subgroups.

Healthy Eating Index score ^a	Fruit juice		P	Whole fruit		P
	Did not consume ($n = 606$, 24%)	Consumed ($n = 1989$, 76%)		Did not consume ($n = 755$, 26%)	Consumed ($n = 1840$, 74%)	
Total fruit	2.2 (0.12)	4.0 (0.05)	<0.001	2.0 (0.1)	4.1 (0.05)	<0.001
Whole fruit	2.7 (0.12)	3.0 (0.10)	0.038	–	3.9 (0.07)	–
Total vegetables	2.2 (0.08)	2.1 (0.05)	0.283	2.1 (0.08)	2.1 (0.06)	0.625
Greens and beans	0.8 (0.08)	0.7 (0.07)	0.287	0.6 (0.08)	0.7 (0.06)	0.456
Whole grains	2.6 (0.15)	2.3 (0.10)	0.148	1.5 (0.10)	2.7 (0.09)	<0.001
Dairy	8.5 (0.15)	7.9 (0.10)	0.003	7.7 (0.17)	8.2 (0.10)	0.017
Total protein foods	3.4 (0.10)	3.4 (0.05)	0.849	3.5 (0.10)	3.3 (0.06)	0.241
Seafood and plant proteins	1.2 (0.12)	1.5 (0.08)	0.073	1.2 (0.09)	1.5 (0.08)	0.004
Fatty acids	2.8 (0.18)	3.4 (0.13)	0.007	3.4 (0.21)	3.2 (0.13)	0.413
Refined grains	6.1 (0.17)	6.2 (0.14)	0.504	5.6 (0.21)	6.4 (0.13)	0.001
Sodium	5.0 (0.18)	6.0 (0.12)	<0.001	5.1 (0.20)	6.0 (0.12)	<0.001
Empty calories	9.3 (0.28)	10.5 (0.16)	0.001	8.3 (0.30)	10.9 (0.18)	<0.001
Total HEI score	46.7 (0.58)	50.9 (0.54)	<0.001	41 (0.74)	53 (0.46)	<0.001
	Non-starchy vegetables		P	White potatoes		P
	Did not consume ($n = 399$, 15%)	Consumed ($n = 2196$, 85%)		Did not consume ($n = 1278$, 50%)	Consumed ($n = 1317$, 50%)	
Total fruit	3.3 (0.13)	3.6 (0.06)	0.051	3.7 (0.08)	3.4 (0.07)	0.007
Whole fruit	2.6 (0.18)	2.9 (0.09)	0.027	3.2 (0.11)	2.6 (0.11)	<0.001
Total vegetables	0.9 (0.07)	2.3 (0.05)	<0.001	1.6 (0.07)	2.6 (0.07)	<0.001
Greens and beans	0.2 (0.04)	0.8 (0.06)	<0.001	0.8 (0.08)	0.6 (0.06)	0.068
Whole grains	2.4 (0.21)	2.4 (0.09)	0.807	2.7 (0.10)	2.1 (0.12)	<0.001
Dairy	7.8 (0.20)	8.1 (0.09)	0.135	8.3 (0.12)	7.8 (0.11)	0.002
Total protein foods	3.2 (0.10)	3.4 (0.05)	0.140	3.3 (0.07)	3.5 (0.05)	0.039
Seafood and plant proteins	1.3 (0.15)	1.5 (0.08)	0.187	1.6 (0.10)	1.2 (0.08)	0.004
Fatty acids	3.5 (0.20)	3.2 (0.13)	0.131	2.9 (0.16)	3.6 (0.13)	<0.001
Refined grains	6.4 (0.29)	6.2 (0.13)	0.452	5.5 (0.18)	6.9 (0.12)	<0.001
Sodium	7.0 (0.21)	5.6 (0.12)	<0.001	5.7 (0.13)	6.0 (0.14)	0.090
Empty calories	9.2 (0.32)	10.4 (0.17)	0.003	10.3 (0.24)	10.1 (0.24)	0.644
Total HEI score	47.8 (0.93)	50.3 (0.49)	0.017	49.4 (0.68)	50.3 (0.54)	0.285

^a Higher scores indicate better diet quality.

intake and thus their sodium HEI-2010 score. The majority of vegetables provide a high amount of nutrients with relatively few calories (Drewnowski, 2005) and, thus, an increase in consumption of vegetables has been recommended for weight management purposes largely in adulthood (Perez-Escamilla et al., 2012). Less evidence exists to support the increased consumption of vegetables as being an effective strategy for weight management in childhood (Ledoux et al., 2010). In our sample, children who consumed a non-starchy vegetable had higher overall diet quality scores, which suggest a greater focus on non-starchy vegetables may represent an important target for this population.

Children's overall diet quality measured by HEI-2010 was higher for total fruit and fruit juice consumed, but not total vegetables consumed. As evidence in the present study and in previous research, vegetables are consumed less frequently (Ramsay et al., 2014) and are often less preferred by young children, due to a number of attributes including a more bitter taste (Krolner et al., 2011). Regardless of total fruit and total vegetable consumption, results from the present study indicate a higher HEI score can be achieved when a greater variety of fruits and vegetables are consumed. However, adults should consider individual factors in the aesthetic characteristics of food, such as taste and texture, which influence children's liking and intake (Rozin and Vollmecke, 1986). For example, vegetables may present a choking hazard when not prepared appropriately for young children (Ramsay et al., 2014), this risk could impact whether adults offer and whether children consume them. While adults often report challenges with getting children to consume vegetables (Hingle et al., 2012), repeatedly offering vegetables in a variety of ways and in appropriate forms is best practice to support the development of a preference and intake of a variety of vegetables (Birch and Fisher, 1998; Anzman-Frasca et al., 2012). Further, other strategies such as offering with a dip (Savage et al., 2013) pairing with liked food items (Capaldi-Phillips and Wadhera, 2014) and modifying recipes to include more vegetables (pureed, adding to dishes, adding to soups) (Glanz and Hoelscher, 2004) can help to facilitate exposure and intake.

These data provide an opportunity to assess the intakes from a national sample of children to evaluate dietary intakes and overall diet quality. The data cannot provide a broader picture of total dietary intakes, and nuances of the day of the week selected for the single day recall, and the season upon which data was collected, may limit reporting of food intake, particularly of rarely consumed foods. However, previous research supports the use of a single day with large samples (Ramsay et al., 2014) that offer the variability in intakes to assess the intended patterns. Limitations of the study are evident in that data was collected using 1 day from NHANES and the day may not be typical for the child. The population studied were children 2–5 years of age; however, examination of the variety of fruits and vegetables with a larger age range could impact results, thus further research should examine diet quality and variety in other age ranges. Legumes were excluded from the analysis because the intakes were negligible with the priority to allocate legumes to protein food requirements, and therefore only the residual legume intakes counted towards vegetable intake. Future research should examine the role of legumes in children's vegetable consumption and promote interventions to increase legume intake in young children. The strengths of the study include the evidence of nutritional benefit in children's dietary intake when a variety of fruits and vegetables are consumed from a nationally representative sample. The study reinforces national guidelines to encourage consumption of a variety of fruits and vegetables and provides evidence for the need to increase health promotion efforts on the consumption of a variety of fruits and vegetables than amounts alone.

5. Conclusions and implications

Examination of fruit and vegetable consumption is necessary to identify young children's food consumption patterns related to overall health. Children who consumed a greater variety of fruit and vegetable

categories had better overall diet quality as well as the subscales, such as empty calories. National recommendations emphasize the consumption of specific amounts of fruits and vegetables; however, results from the present study indicated children's consumption of a variety of fruits and vegetables were linked to greater overall diet quality, independent of the amount of fruits and vegetables consumed. Thus, stronger emphasis may need to be placed on children's variety of fruits and vegetables. Further, our study suggests that children's fruit intake is linked to other components of children's overall diet quality. Further research is necessary to identify and understand potential mechanisms of this relationship in young children. Registered dietitians, health professionals, and caregivers of young children should continue to offer a variety of fruits and vegetables, reinforce fruit and 100% fruit juice consumption, and in the meantime utilize strategies to support young children's development of a preference for a variety of vegetables.

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Transparency document

The Transparency document associated with this article can be found, in the online version.

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