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Fruit Consumption by Youth in the United States

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Abstract

Objectives—To describe the contribution of whole fruit, including discrete types of fruit, to total fruit consumption and to investigate differences in consumption by socio-demographic characteristics.

Methods—We analyzed data from 3129 youth aged 2–19 years, from the National Health and Nutrition Examination Survey, 2011–2012. Using the Food Patterns Equivalents Database (FPED) and the What We Eat in America 150 food groups (WWEIA 150), we calculated the contribution of whole fruit, 100% fruit juices, mixed fruit dishes, and 12 discrete fruit and fruit juices to total fruit consumption. We examined differences by age, sex, race and Hispanic origin, and poverty status.

Results—Nearly 90% of total fruit intake came from whole fruits (53%) and 100% fruit juices (34%) among youth aged 2–19 y. Apples, apple juice, citrus juice and bananas were responsible for almost half of total fruit consumption. Apples accounted for 18.9% of fruit intake. Differences

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Contributors' Statements:

Kirsten Herrick: Dr. Herrick conceptualized and designed the study, drafted the initial manuscript, performed analyses and approved the final manuscript as submitted.

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by age were predominantly between youth aged 2–5 y and 6–11 y. For example, apples contributed a larger percentage of total fruit intake among youth 6–11 y (22.4%) than among youth 2–5 y (14.6%), but apple juice contributed a smaller percentage (8.8% v 16.8%), $p < 0.05$. There were race/Hispanic origin differences in intake of citrus fruits, berries, melons, dried fruit, and citrus juices and other fruit juices.

Conclusion—These findings provide insight into what fruits U.S. youth are consuming and demographic factors that may influence consumption.

Keywords

nutrition; survey; diet; youth

INTRODUCTION

Fruits and vegetables are important sources of nutrients that promote health and protect against chronic disease.¹ A diet rich in fruits and vegetables is associated with a decreased risk of diabetes,² stroke, overall cancer, and all-cause mortality.^{3,4} Increased fruit and vegetable intake may also support healthy weight⁵ and weight loss in the context of a reduced calorie diet.⁶ The Dietary Guidelines for Americans 2010¹ recommend that individuals “increase vegetable and fruit intake”¹ in part because fruits and vegetables are good sources of potassium and dietary fiber while low in sodium, cholesterol, and saturated and trans fat.

The DGA 2010 recommends that children 1–18 years of age consume approximately 1–2 cups of fruit per day, depending upon age, sex and physical activity level,¹ with preference given to whole fruits rather than juice or fruits as part of mixed dishes.¹ Furthermore, the American Academy of Pediatrics and the American Heart Association emphasize the importance of consuming a variety of fruits and vegetables, while limiting intake of juice and avoiding sugar-sweetened beverages.^{7,8} Whole forms of fruit contain valuable nutrients such as fiber, and do not contain added sugar, sodium or fat, nutrients that can often be present in juice or mixed dishes.¹

Despite many existing recommendations and guidelines, national estimates from 2007–2010 showed that only 40% of children aged 1–18 y met the recommendation⁹ for fruit.¹⁰ Younger children are more likely than adolescents to consume fruits, with 92%, 82%, and 66% of youth aged 2–5, 6–11, and 12–18 y, respectively reporting any consumption of fruit.¹¹

Missing from this picture of fruit consumption among youth is detail about specific types of fruit. Therefore, the objective of the current study was to describe, using national data from 2011–2012, the discrete fruit (e.g. apples, bananas, melons, etc.) youth are consuming by demographic characteristics and the contribution of these whole fruits to total fruit consumption. Additionally, for the first time, we present national estimates of the contribution of discrete fruits to total fruit intake among non-Hispanic Asian youth.

METHODS

Study Design

We used data from 3129 participants in the National Health and Nutrition Examination Survey (NHANES), a complex, stratified, multistage probability sample of the US noninstitutionalized population. NHANES is conducted by the National Center of Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), which collects and releases data on roughly 10,000 individuals every two years. Participants receive a detailed in-home interview, followed by a physical examination and dietary interview, at a mobile exam center (MEC). The NHANES protocol was approved by the NCHS Research Ethics Review Board. For children, written parental consent was obtained, and for children 7–17 y, assent was obtained. Data from NHANES 2011–2012 were used for the current analysis. Non-Hispanic Asians, non-Hispanic blacks, Hispanics, non-Hispanic white and other persons at or below 130% of the federal poverty threshold, and non-Hispanic white and other persons aged 80 years and older were oversampled. The unweighted examination response rate for youth 2–19 years of age in the 2011–2012 survey cycle was 77%.¹²

Dietary Intake

Trained interviewers, using a computer-assisted dietary interview system that included a multiple-pass format with standardized probes,¹³ collected type and quantity of all food and beverages consumed in the 24 hours previous to the physical examination at the MEC (specifically from midnight to midnight). Two 24 hour dietary interviews were obtained from each participant, one at the MEC and another 3–10 days later by telephone. One 24 hour recall has been shown to be representative of mean population intake because day-to-day variation and random errors cancel out if the data are collected evenly across days of the week and seasons of the year.¹⁴ As the objective of this analysis was to describe population-level patterns of fruit intake, data from one 24 hour recall were used here and thus results refer to intake ‘on a given day’.

Proxy interviews, generally provided by a parent, captured dietary information for children 2–5 y. Children 6–11 y were assisted by proxies and study participants 12 years and older self-reported their dietary interview. Dietary interviews were assessed for quality; a detailed description of these criteria and methods are described elsewhere.¹⁵ Only records deemed reliable were used in the current analysis. Of the 3408 youth aged 2–19 examined in the NHANES survey from 2011–2012, 227 did not provide a dietary recall, 52 supplied a recall that was deemed unreliable, and 224 were missing information on poverty (the individuals missing poverty information were included in analyses that did not involve poverty). The final analytic sample, after non-mutual exclusions, was 3129.

Total fruit consumption was determined using the Food Patterns Equivalents Database (FPED).¹⁶ The FPED is a database that provides the nutrient values for foods and beverages reported in the 24 hour recalls collected as part of the NHANES survey. The FPED disaggregates foods consumed into their respective ingredients. For example, the FPED disaggregates the ingredients of apple pie or blueberry smoothies into their component parts and allows for the apples and blueberries to count toward total fruit intake. Tomatoes are

included in the red and orange vegetable component of the FPED and do not contribute to total fruit intake in the current analysis.¹⁷

Types of fruit were determined using the USDA food classification scheme that characterizes food items as they are commonly consumed. This scheme includes 150 food items, with nine codes corresponding to whole fruits and four codes to fruit juices and fruit drinks (hereafter referred to as WWEIA 150).¹⁸ The WWEIA 150 schema classifies apple pie under the heading of ‘Sweet Bakery Product: Cakes and Pies’ and the apples would therefore not be counted toward whole fruit intake. Similarly, a smoothie with blueberries would fall under the heading of “Sweetened Beverages: Fruit Drinks” and the berries would not be counted in estimates of whole fruit intake using just the WWEIA 150.

Using both the WWEIA 150 and the FPED allows for total fruit intake to be examined according to form (e.g., whole, juice, or mixed dish and even discrete fruits e.g. apples, bananas, etc.) by capitalizing on the different ways that mixed fruit dishes are treated by the WWEIA 150 and the FPED.

Demographic variables

Age was categorized in three groups, 2–5 y, 6–11 y, and 12–19 y. Sex (male, female), race and Hispanic origin (non-Hispanic white, non-Hispanic black, non-Hispanic Asian, and Hispanic) were also used to describe the data. Individuals with race and Hispanic origin classified as ‘other’ include those reporting multiple races and are included in the overall estimates but not shown separately in the results. We also included a measure of poverty: poverty income ratio (PIR) (< 130 %, and >130% of the U.S. Department of Health and Human Services’ (HHS) poverty threshold according to income and household size). PIR is an index representing the ratio of family income to a threshold for poverty. The HHS poverty guidelines were used as the poverty measure to calculate this index. The recommended cut point for eligibility for the Supplemental Nutrition Assistance Program (SNAP)¹⁹ and the free school lunch program is 130%.²⁰

Analysis

We estimated the percentage of fruit eaten as: whole fruit, 100% fruit juice, and mixed fruit dishes. Fruit drinks were included in the mixed fruit dish category. Furthermore, we disaggregated the whole fruit and fruit juices categorized in the WWEIA 150. These 12 discrete fruits/juices were: apples, bananas, grapes, peaches/nectarines, berries, citrus, melons, dried fruit, and other fruits/fruit salads, and three juices: apple juice, citrus juice, and other fruit juices.

Statistical analyses were performed using Stata SE 13.1.²¹ Survey design variables and day one dietary sample weights, which account for differential probabilities of selection, nonresponse, noncoverage, and sample design, were used to obtain estimates representative of the noninstitutionalized US population. The publicly available dietary sample weights include a poststratification step to balance recalls across days of the week. Standard errors (SEs) were estimated by using Taylor series linearization.

Overall mean intake (in cup equivalents) by fruit form was calculated by summing the amount of whole fruit, 100% juice, and fruit in mixed dishes consumed by each participant on a given day and then calculating the mean intake by fruit form. To calculate the percent contribution of fruit form (i.e., whole, 100% juice, mixed) and discrete fruits (12 WWEIA food groups) to total fruit intake, population-weighted intakes were calculated by multiplying the amount of total fruit consumed (cup equivalents) by the individual's first day dietary weight.²² Differences by age group, race/Hispanic origin, PIR, and sex were assessed by including these variables as individual covariates in separate logistic regression models (i.e. models were not mutually adjusted for all covariates); differences were determined to be significant if p-values from adjusted Wald tests were less than 0.05. The hypothesis of no linear trend across ordinal variables was tested by using orthogonal contrast matrices ($p < 0.05$).

RESULTS

On average, US youth consume 1.25 cup equivalents of total fruit (95% CI: 1.14–1.37) per day. Of this total fruit consumption, nearly 90% of total fruit intake can be attributed to two sources: whole fruits (52.9%) and one hundred percent fruit juices (33.5%) with the remainder coming from mixed dishes, which includes fruit drinks (13.5%) (Table 1). By mean cup equivalents, these percentages correspond to 0.60 cups of whole fruits (95% CI: 0.53–0.67), 0.38 cups of one hundred percent fruit juices (95% CI: 0.32–0.44), and 0.15 cups of mixed fruits (95% CI: 0.13–0.18). Youth aged 2–5 y consumed significantly less fruit as whole fruit compared to youth aged 6–11 y (48.8% vs. 57.2% ($p < 0.05$)). The pattern was opposite for 100% fruit juice, with youth aged 2–5 y consuming 40.9% of their total fruit as juice compared to 28.2% of total fruit intake as juice among youth aged 6–11 y ($p < 0.05$). Among older youth, a larger percentage of their fruit intake came from mixed fruit dishes ($p < 0.05$ for linear trend by age). Non-Hispanic black youth consumed a significantly smaller percentage of their total fruit intake as whole fruit (42.8%) than did non-Hispanic white (54.6%), non-Hispanic Asian (60.0%) or Hispanic youth (54.6%) ($p < 0.05$). In a complementary pattern, non-Hispanic black youth (42.5%) consumed a significantly larger percentage of their total fruit intake as 100% fruit juice compared to non-Hispanic white (30.7%), non-Hispanic Asian (29.5%) and Hispanic (34.8%) youth. There were no differences in form of fruit intake between boys and girls or by poverty status (Table 1).

Figure 1 shows greater detail in the contribution of discrete fruits and juices to total fruit intake among all youth aged 2–19 y. Apples accounted for roughly one-fifth (18.9%) of fruit intake. Citrus juice accounted for 14.3%, apple juice for 10.3% and other fruit juices for 9.0% of fruit intake, followed by bananas (6.8%), melons (6.0%), and other fruits/fruit salads (5.5%).

The majority of differences in the percent contribution of the 12 discrete fruit and 100% juice to total fruit intake by age were between youth aged 2–5 y and 6–11 y (Table 2). Apples contributed a larger percentage of total fruit intake among youth 6–11 y (22.4%) compared to 2–5 y (14.6%) ($p < 0.05$). Bananas contributed significantly more to total fruit intake among 2–5 y compared to 6–11 y: 9.0% v. 5.4% ($p < 0.05$). Berries contributed 5.2% to fruit intake among youth aged 2–5 y and 3.9% among youth aged 6–11 y ($p < 0.05$). The

contribution of dried fruit to total fruit intake was also highest among youth aged 2–5 y (1.4%) compared to youth aged 6–11 y (0.3%) ($p<0.05$) and youth aged 12–19 y (0.2%) ($p<0.05$). There were no differences by age in the percent contribution of melons, other fruits/fruit salads, citrus fruits, grapes and peaches/nectarines.

The contribution of apple juice to total fruit consumption decreased with age ($p<0.05$), 16.8% among youth aged 2–5 y, 8.8% among youth 6–11 y and 6.8% among teens 12–19 y ($p<0.05$). There was an opposite trend by age in the contribution that citrus juice made to total fruit intake, with 10.0% of total fruit consumption was attributable to citrus juice for youth aged 2–5 y, compared with 14.0% among youth aged 6–11 y, and 17.6% among youth aged 12–19 y ($p<0.05$).

There were significant race/Hispanic origin differences in the contribution of berries, citrus fruits, citrus juice, melons and peaches/nectarines to total fruit intake (Table 3). Berries contributed 5.9% of total fruit intake among non-Hispanic white youth, significantly higher than among non-Hispanic black youth (1.6% to total fruit intake) ($p<0.05$). Citrus fruits contributed 10.2% to total fruit intake among non-Hispanic Asians in contrast to 3.4% of total fruit intake among non-Hispanic white youth ($p<0.05$). Citrus juice contributed 11.6% to total fruit intake among non-Hispanic white youth; significantly less than Hispanic (18.3%) youth ($p<0.05$). Melons contributed significantly less to total fruit intake among Non-Hispanic black youth (1.8%) compared to non-Hispanic white (7.6%) and non-Hispanic Asian (7.1%) youth ($p<0.05$). Hispanic youth consumed a greater percentage of fruit from peaches and nectarines (3.7%) compared to non-Hispanic black youth (1.5%, $p<0.05$). Hispanic youth also consumed a smaller percentage of fruit in the form of dried fruit (0.2%) compared to both non-Hispanic white (0.8%) and non-Hispanic Asian youth (1.1%; $p<0.05$). Additionally, non-Hispanic Asian youth consumed a greater percentage of total fruit as dried fruit as compared to non-Hispanic black youth (0.4%; $p<0.05$).

There were no differences observed in the types of fruits consumed by U.S. youth by sex, and only one difference emerged by PIR. Children from families earning $>130\%$ of the poverty threshold consumed a greater percentage of their fruit as berries (5.4%) as compared to children in families reporting income below 130% of the poverty threshold (2.5%; $p<0.05$) (data not shown).

DISCUSSION

Twelve discrete fruits and 100% fruit juices were responsible for 86% of total fruit intake in the diet of American youth. The contribution of discrete fruits to total fruit consumption varied by age, with apple juice and dried fruit representing a smaller share of fruit intake, and citrus juice accounting for a larger share as age increased. Additionally, youth aged 6–11 y consumed more of their total fruit as apples, and less in the form of bananas and other fruit juice compared with youth aged 2–5 y. Factors like taste preference, repeated exposures to fruits, social experiences, and availability may drive these differences.²³

This paper adds previously undescribed information about the contribution of discrete fruits to total fruit consumption in a nationally representative sample which includes non-Hispanic

Asian youth. Distinct consumption patterns were observed across racial/ethnic subpopulations; for example, non-Hispanic Asians obtained a greater percentage of fruit from citrus fruits compared to non-Hispanic white youth. Variations in the types of fruits consumed by race and Hispanic origin may be related to acculturation,^{24,25} accessibility, and social experiences.²³

We found that over half of all fruit consumed by youth aged 2–19 y is whole fruit (52.9%) and another third is consumed as 100% fruit juice (33.5%). Drewnoski and Rehm found that 65% of total fruit intake could be attributed to whole fruit and 35% attributed to 100% fruit juice among a national sample of youth and adults aged 4y and over, from NHANES 2007–2010.²⁶ Drewnoski and Rehm²⁶ used the USDA MyPyramid Equivalents Database,²⁷ a precursor to the FPED files, which disaggregates mixed fruit dishes into component parts, potentially overestimating the contribution of whole fruits to total fruit intake.

Similar to Drewnoski and Rehm,²⁶ we found that non-Hispanic white and Hispanic youth consumed a larger percentage of their total fruit intake as whole fruit compared with non-Hispanic black youth. We also showed for the first time in a nationally representative population that non-Hispanic Asian youth consumed a larger percentage of their total fruit intake as whole fruit compared with non-Hispanic black youth.

Results from the current study demonstrate that over half of the fruit consumed by American youth comes from the most nutrient dense form: whole fruit, in line with the 2010 Dietary Guidelines for Americans. Fruit consumed in its whole form is most often its healthiest form, without added sugar or fat, plus it retains fiber.²⁸ Additionally, whole fruit is less energy dense and more nutrient dense than juice. We also found that over one-third of total fruit intake came from 100% fruit juice, which although lacks fiber still had no added sugar or fat.¹ However, liquid forms of calories have been shown to bypass many satiety cues^{29,30} and may contribute to excess caloric intake as individuals may not compensate for calories consumed in liquid form.³¹

There are a few limitations to our study. There were differences in who provided answers for the dietary recall by age. This could introduce measurement error. Another source of measurement error is the act of recalling diet itself because it relies on accurate memory of what was consumed and how much, plus there is the potential for bias related to under- or over-reporting of certain food items based on their social influences.³² The analysis is based on cross-sectional data; therefore no causal inferences can be made.

CONCLUSIONS

Twelve discrete fruits and 100% juices contribute almost 90% of total fruit intake in the diet of American youth. Variations in fruit intake exist by age and race and Hispanic origin. Youth aged 2–5 y consumed less of their total fruit as apples, while bananas, apple juice, citrus juice, dried fruits, and other fruit juices contributed a larger amount to their total fruit intake compared with youth aged 6–11 y. Consumption patterns also varied across non-Hispanic Asian, non-Hispanic white, non-Hispanic black and Hispanic youth. These findings provide insight into what fruits U.S. youth are consuming and demographic factors

that may influence that consumption adding to earlier papers that described who consumes fruit on a given day,¹¹ the amount of fruit consumed,¹⁰ and the form (whole or 100% fruit juice).²⁶

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Abbreviations

NHANES National Health and Nutrition Examination Survey

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What's Known on This Subject

Although whole fruit intake has increased among U.S. youth from 2003–2010, little is known about the specific types of fruits that youth consume and whether consumption varies by age, poverty, sex and race/Hispanic origin.

What This Study Adds

Twelve discrete fruits and fruit juices contribute almost 90% of total fruit consumed by US youth. Consumption of specific fruits and 100% fruit juices was associated with age and race/Hispanic origin, but not sex or poverty status.

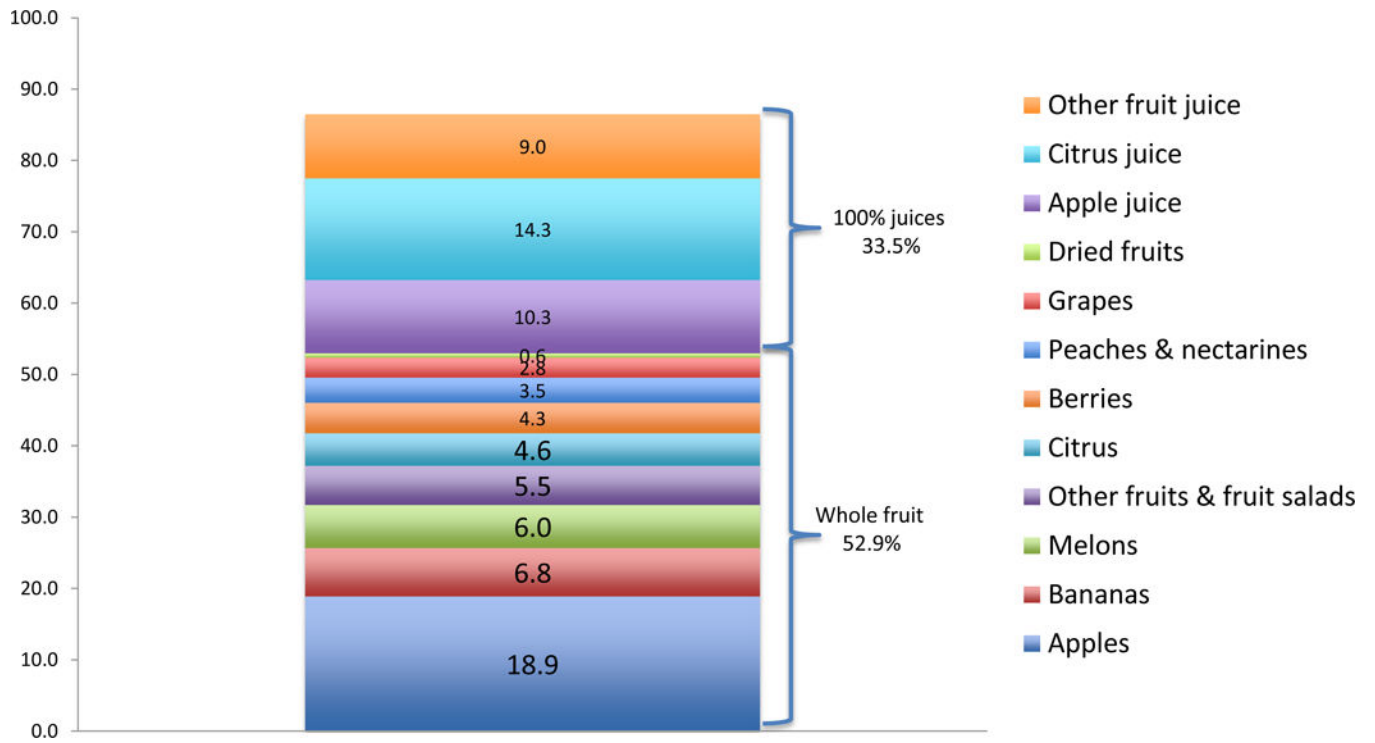


Figure 1. The contribution of 12 discrete fruits and fruit juices to total fruit intake, US youth 2–19 years, 2011–2012

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Table 1

Percent of total fruit intake by form (whole, 100% juice, mixed dish) and selected characteristics: US youth aged 2–19 y, 2011–2012

	n ¹	Fruit form					
		Whole fruit		100% fruit juice		Mixed dishes and fruit drinks	
		Percent	SE	Percent	SE	Percent	SE
Overall	3129	52.94	1.85	33.51	1.64	13.54	0.98
Age, y							
2–5	828	48.84	2.69	40.85	2.65	10.31	0.76
6–11	1148	57.21 ^a	2.10	28.15 ^a	2.16	14.64 ^a	1.88
12–19	1153	51.85	3.37	33.29	3.54	14.86 ^a	2.11
Sex							
Male	1582	52.33	2.18	35.03	2.04	12.65	1.24
Female	1547	53.72	2.51	31.60	2.40	14.67	1.34
Race/Hispanic origin ²							
Non-Hispanic white	689	54.58	3.79	30.68	3.21	14.74	1.85
Non-Hispanic black	936	42.81 ^b	2.62	42.50 ^b	2.17	14.69	1.57
All Hispanic	966	54.59 ^c	2.84	34.80 ^c	2.26	10.61 ^{b,c}	1.02
Non-Hispanic Asian	370	59.98 ^c	6.68	29.47 ^c	5.39	10.54	1.76
Poverty status							
130%	1411	51.10	1.77	34.13	1.51	14.77	1.45
>130%	1494	54.56	2.59	32.61	2.70	12.84	1.40

¹ Unweighted sample size includes responses from all reliable and complete recalls.

² Other race category not shown (n=168).

All statistical tests performed using adjusted Wald tests, (P < 0.05).

^a Significantly different from 2–5 yr.

^b Significantly different from non-Hispanic white.

^c Significantly different from non-Hispanic black.

SOURCE: NHANES

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Contribution of discrete fruits and 100% fruit juices to total fruit intake among US youth aged 2–19 y, by age, 2011–2012

Table 2

	Age					
	2–5 y		6–11 y		12–19 y	
	percent	SE	percent	SE	percent	SE
Apples	14.60	1.63	22.35 ^a	2.12	18.74	2.47
Apple juice ^b	16.78	3.17	8.83 ^a	1.17	6.82 ^a	1.36
Bananas	8.99	0.85	5.40 ^a	0.97	6.51	1.67
Berries	5.17	1.10	3.91	0.61	3.99	1.51
Citrus fruits	4.63	0.75	4.49	0.69	4.57	1.27
Citrus juice ^b	9.99	1.61	14.04 ^a	2.47	17.62 ^a	1.59
Dried fruits ^b	1.43	0.59	0.26 ^a	0.26	0.22 ^a	0.08
Grapes	3.22	0.42	3.28	0.79	2.06	0.47
Melons	3.77	1.57	8.34	1.62	5.50	2.12
Other fruits/fruit salads	5.22	0.68	6.48	1.22	4.67	1.04
Other fruit juice	14.08	2.37	5.28 ^a	0.78	8.84	3.39
Peaches and nectarines	1.81	0.86	2.70	0.56	5.59	2.62

All statistical tests performed using adjusted Wald tests, ($P < 0.05$). Linear trends tested using orthogonal contrast matrices ($P < 0.05$)

^a - significantly different from 2–5 yr

^b - Significant linear trend by age

Source: NHANES

Contribution of discrete fruits and 100% fruit juices to total fruit consumption among US youth aged 2–19 y, by race-Hispanic origin, 2011–2012

Table 3

	Race/Hispanic origin											
	Non-Hispanic White			Non-Hispanic Black			Non-Hispanic Asian			Hispanic		
	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
Apples	18.51	2.35	17.32	1.36	19.23	3.60	21.20	2.08				
Apple juice	10.38	2.13	10.49	1.64	7.66	2.14	9.77	1.61				
Bananas	6.87	1.44	5.96	0.97	7.73	1.62	6.89	1.22				
Berries	5.85	1.26	1.60 ^a	0.49	3.05	1.06	3.03	0.88				
Citrus fruits	3.35	0.90	4.54	0.43	10.22 ^a	4.19	6.17	0.97				
Citrus juice	11.63	1.72	16.27	1.79	17.04	4.96	18.27 ^a	2.17				
Dried fruits	0.76	0.33	0.35 ^c	0.18	1.11	0.34	0.20 ^{a,c}	0.10				
Grapes	2.99	0.66	3.46	0.71	4.05	1.49	1.87	0.45				
Melons	7.60 ^b	2.26	1.76	0.76	7.13 ^b	3.81	5.11	1.66				
Other fruits/fruit salads	4.39	0.91	6.29	1.89	6.68	2.13	6.45	0.97				
Other fruit juice	8.67	2.51	15.73	2.94	4.77	1.29	6.76	1.12				
Peaches and nectarines	4.25	1.76	1.52	0.36	0.78	0.62	3.67 ^b	1.31				

^a - Significantly different from non-Hispanic white

^b - Significantly different from non-Hispanic black

^c - Significantly different from non-Hispanic Asian

Source: NHANES