

The use of 100% fruit juice as a fruit and vegetable equivalent in snacks served in federally-  
subsidized child care homes

Juli R. Louttit

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Committee:  
Donna Johnson  
Pablo Monsivais

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## **Background and significance**

### ***Rising rates of childhood obesity and the contribution of 100% fruit juice***

Childhood obesity has reached epidemic proportions in the United States. By age four, 18.4% of all children are considered obese, defined by a body mass index (BMI; weight in kilograms divided by height in meters squared) in the 95<sup>th</sup> percentile or greater for age and gender [1]. Increases in the per capita daily intake of caloric beverages, particularly sugar-sweetened beverages and 100% fruit juice, parallel the climbing rates of childhood obesity [2]. Consumption of 100% fruit juice is a common way for US children to meet government recommendations for daily fruit servings [3,4]. While 100% fruit juice contains nutrients that can increase diet quality, [3] it is also a considerable source of energy [5]. Fruit juices have energy densities similar to sugar-sweetened beverages and might contribute to excess energy intake, [6] weight gain, [7] and obesity [5]. Furthermore, data suggest that liquid calories may fail to trigger physiological satiety mechanisms [8,9]. Thus the attenuated satiety response associated with liquids could lead to increased overall energy intake, [9] adding to the implication that 100% fruit juice may be contributing to the increased rates of childhood obesity.

### ***Trend towards less 100% fruit juice and more whole fruit***

Although 100% fruit juice has not been systematically implicated with the rise in obesity, [11] limiting the consumption of caloric beverages, including 100% fruit juice, may be one practical and effective strategy to reduce positive energy imbalance. National dietary guidance and nutrition policies have begun to recommend limiting children's consumption of 100% fruit juice to address the obesity epidemic and promote overall health. The 2010 Dietary Guidelines for Americans recommend that no more than one-third of total daily fruit consumption be in the form of 100% fruit juice to encourage increased fiber intake [12]. A similar move away from 100% fruit juice and toward whole fruits and vegetables can be seen in the Institute of Medicine (IOM) recommendations for federal nutrition assistance programs [13-15]. Following recommendations from professional societies such as the American Academy of Pediatrics, [7] the IOM guidelines recommend no more than four ounces of 100% fruit juice per day for children ages 1 to 6 years.

### ***The Child and Adult Care Food Program***

A recent report from the White House Task Force on Obesity suggested that child care settings “present a tremendous opportunity to prevent obesity” [16]. With over 3 million preschool children enrolled, the Child and Adult Care Food Program (CACFP) of the US Department of Agriculture (USDA) is the largest federal program supporting nutrition in early child care settings [17]. The program provides monetary reimbursements to participating child care homes and centers for serving meals and snacks that follow an approved standard. During the 2011 fiscal year, over 3.2 million children received meals and snacks every day in CACFP-participating facilities, at a cost of almost \$2.6 billion [17]. Approximately 25% of the children served were cared for in family child care homes, which make up 73% of the facilities participating in CACFP [18]. Unlike large centers, which often have central kitchens, sophisticated menu planning, and highly trained staff, family child care homes often lack standardized practices and nutrition training [18].

#### ***Current CACFP meal patterns, limitations, and recommended revisions***

Because CACFP is administered individually by the states, each state has a list of their own “creditable,” or reimbursement-eligible, foods that must fall under the meal patterns outlined by CACFP [19]. These meal patterns are based on the *MyPyramid* food groups and do not include specific food or nutrient-based standards. Fruit and vegetables are currently combined as one food group, and 100% fruit juice is considered equivalent to whole fruits and vegetables during breakfast and snack [19-20]. Snacks in particular are an eating occasion during which child care providers have substantial flexibility in the foods that may be served. To qualify for reimbursement, snacks must contain at least two of the four current food group components: fruit/vegetable (including 100% fruit juice); grain/bread; meat/meat alternate (e.g. protein foods); or fluid milk [19]. However, providers are currently not required to meet minimum serving requirements for each food group component. This lack of explicit direction leads to considerable variation in the foods chosen by individual child care providers, and thus substantial variation in the nutrient and energy density of foods served [15]. Realizing the limitations in the current meal patterns, the USDA convened an IOM expert panel to review the existing dietary guidance being provided and to revise these recommendations to better reflect current nutrition science

and dietary guidelines <sup>[15]</sup>. The IOM's recommended revisions are significantly more detailed, and for the first time provide recommendations on specific foods to encourage and foods to limit <sup>[15]</sup>. One important recommendation includes the separation of fruits and vegetables into two categories, and the provision of minimum serving requirements for each. Specific recommendations were also made to the existing CACFP snack pattern. Providers may still choose to serve two of the now five food group components for a regular snack under the IOM's proposed pattern, but a minimum number of servings from each food group component must be met over the course of a five-day period. Additionally, whole fruit is encouraged over 100% fruit juice, and specifications on the types of vegetables that should be served are provided to further ensure diet quality and variety <sup>[15]</sup> (See **Appendix 1 and 2** for a comparison between the current and revised meal patterns).

#### ***Economic implications and food costs***

While the IOM's recommended revisions would bring CACFP meals and snacks into alignment with current dietary guidance, <sup>[12]</sup> implementing these higher standards is expected to require greater food spending by providers. In its report, the IOM Committee studied the cost implications of its recommendations and estimated the average cost of a recommended standard snack for children ages 2 to 4 would be \$0.29 per day, a 26% increase <sup>[15]</sup>. According to the IOM, the largest increase in the unit cost of the revised meal components would occur as a result of recommended changes in the fruit/vegetable and grain groups <sup>[15]</sup>. Furthermore, the recommended reduction in the proportion of 100% fruit juice that may be served was noted to substantially influence the price difference <sup>[15]</sup>. In related findings, a study which examined the food expenditures of CACFP-participating home child care providers in Seattle-King County, Washington found that higher food expenditures were significantly and positively associated with number of portions of fresh produce served <sup>[22]</sup>. The IOM Committee also expressly acknowledged that the economic impact of its recommendations would likely extend beyond food expenditures, especially since the recommended revisions would make the meal requirements considerably more complex than the current CACFP guidelines. Non-food costs noted in the IOM report include costs related to menu planning, food acquisition, food preparation, training and reporting. These costs, noted the IOM Committee, may be considerable for family child care

homes and small day care sites located in areas with limited access to fresh, nutrient-dense foods [15].

Furthermore, reimbursement rates for CACFP-participating family child care homes are not universal and instead are based upon income eligibility [17]. Home child care providers are eligible for the higher Tier 1 reimbursement rates if their household income is at or below 185% of the federal income poverty guidelines, are located in a low-income area, or if they serve income-eligible children. Home child care providers who do not meet these criterion receive a lower Tier 2 reimbursement rate [21]. During 2008-2009, the federal reimbursement rate for CACFP-participating home child care providers was \$0.65 per snack for those in the higher reimbursement tier, and \$0.18 for those in the lower reimbursement tier [21]. A recent study demonstrated that CACFP-participating child care homes receiving the higher federal reimbursement rate served foods of higher nutritional quality to their children than those receiving the lower Tier 2 rates, providing further evidence that food costs may be a barrier to improving nutrition [23].

#### ***Previous research examining fruits, vegetables and fruit juice served in child care settings***

Although the quality and types of meals and snacks served in child care settings deserve serious attention, surprisingly little research has been done to assess the types of foods served [24]. While the CACFP meal patterns are designed to serve as a tool to guide providers in serving a variety of nutritionally adequate foods, the current guidelines do not provide specific guidance. One study conducted in North Carolina [25] found that while in child care, preschool children received more than 50% of the daily maximum recommended amount of 100% fruit juice, yet received only 30% and 25% of the *MyPyramid* recommendations for whole fruits and vegetables, respectively. Similar results were noted by Padgett and colleagues [26] in a sample of Central Texas child care centers. A recent study examining snacks served in YMCA after-school programs found that 32% of the snacks served contained 100% fruit juice, whereas 27.5% included a whole fruit and 17.5% contained a vegetable [27]. The frequency and type of fruits, vegetables and 100% fruit juice served as a snack in family child care homes has not been adequately examined. Furthermore, the nutritional quality and price of snacks containing whole fruits and vegetables has not been compared to those containing 100% fruit juice.

## **Purpose**

The aims of this thesis report were to (1) describe the fruit/vegetable composition and associated costs of snacks offered by a sample of CACFP-participating child care providers, and (2) determine if snacks that include whole fruits and vegetables differ from those that include 100% fruit juice in terms of nutrient adequacy, cost and inclusion of food-based indicators of diet quality.

## **Research design and methods**

### ***Study background***

The present study uses data from the 2008-2009 *Cost and Quality* study, a cross-sectional study of 60 home child care providers who at the time of data collection were participating in CACFP and residing in Seattle-King County, Washington. The study was led by researchers at the University of Washington's Center for Public Health Nutrition, with Donna B. Johnson, RD, PhD as the principal investigator and Pablo Monsivais, PhD, MPH, as the primary co-investigator on the study. Other major contributors to the *Cost and Quality* study were members of a study advisory group which included Maria Consuelo Lopez, the vice-president of the Washington State Family Child Care Association and president of the North King County Family Child Care Association; Carol Griffith, MS, RD, CD from the Office of the Superintendent of Public Instruction which administers CACFP in Washington State; Carol Cartmell, RD from the City of Seattle Child Care Nutrition Program; and Adrienne Dorf, MPH, RD and Kari Fisher MPH, RD from the Child Care Health Program at Public Health-Seattle and King County. The *Cost and Quality* study was funded by the Robert Wood Johnson Foundation. All instruments and procedures were reviewed and approved by University of Washington's Institutional Review Board. Consent from each study participant was obtained prior to proceeding with data collection procedures.

### ***Study setting and design***

A sample of 60 home child care providers were recruited between July 2008 and September 2009 in King County, Washington. Recruitment procedures have been described in detail elsewhere [23]. The sample size and study design were determined for testing the effects of CACFP policies on nutritional quality of menus, the primary aim of the *Cost and Quality* study. Eligible providers had to currently participate in CACFP, and be in either of

two reimbursement strata: lower or higher. Thirty providers in each stratum were recruited. The *Cost and Quality* study collected data from a variety of sources including daily menu logs, shopping receipts, self-report surveys, and in-person semi-structured interviews. The present study primarily examined data collected from daily menu logs and food shopping receipts.

### ***Collection of daily menu logs and food shopping receipts***

As described in detail elsewhere, <sup>[23]</sup> each child care provider completed a daily menu log of meals and snacks served over five consecutive days when the child care program was in operation. Menus were recorded on forms provided by the study staff. These forms provided space and prompts for recording nutritionally relevant details of the food and beverages served (e.g. low-fat/non-fat, whole grain/refined grain) as well as characteristics of the purchased form of the produce (e.g. fresh, dried, canned, frozen). Providers also recorded the meals (breakfast, lunch) or snacks (AM snack or PM snack) at which food and beverages were served, as well as the ingredients and recipes for any food or beverages that were made from fresh or raw ingredients. Furthermore, four weeks of food shopping receipts were collected from each provider to capture the price of food and beverage items recorded on the daily menu logs.

### ***Menu characterization***

As previously reported, <sup>[23]</sup> all recorded menu items were standardized to portions appropriate for children aged 3 to 5 years, as specified by CACFP. For menu items that did not have recommended serving sizes (e.g. desserts, butter, condiments, and syrup), portion sizes were standardized to one-half *MyPyramid* serving for desserts and 1 teaspoon for butter, condiments and syrups. Recorded menu items were entered into dietary assessment software (*FoodProcessor SQL*, v. 10.5.0, ESHA Research, Salem OR). Analyses of the menus yielded values for dietary weight (g), energy (kcal, kJ), and the nutrient composition of the standardized portion of each food and beverage item.

The analyses conducted in the present study were restricted to the food and beverages served as a snack within these 60 child care homes. To assess the types of food and beverages served, two graduate students of nutrition and dietetics coded all menu items, working in Excel and using a detailed food coding protocol. The students worked in close collaboration and were able to discuss how to code any questionable items not addressed by the protocol. In Excel, menus were sorted and coded by the food group components and subgroups listed in **Table 1**. All foods and beverages served at snack were

**Table 1.** Food and beverage categorization used in menu analysis

<b>Fruit/vegetable</b>
Whole fruit
Fresh/frozen/canned/dried
Vegetable
100% fruit juice
<b>Grain/bread</b>
Whole grain
Refined
<b>Meat/meat alternates</b>
Lean
High fat
<b>Fluid milk</b>
Low-fat
High-fat

categorized into the four food group components according to the CACFP's creditable foods guidelines<sup>[20]</sup>: fruit/vegetable; grain/bread; meat/meat alternate; or fluid milk. Food and beverages were further categorized into subgroups guided by the IOM's recommended revisions to the CACFP's meal patterns<sup>[15]</sup> (see **Appendix 1** for details). Detailed classifications of the food and beverage subgroups are provided in **Appendix 3**.

### ***Food & beverage expenditures***

The detailed methods for deriving the cost of the recorded menu items in monetary terms have been previously reported<sup>[23]</sup>. Briefly, food expenditures were calculated by linking each food and beverage item served with the providers' food shopping receipt. Receipts were provided for approximately 80% of the food and beverages on the providers' menus. For missing prices, i.e. foods served but not identified in the provider's own receipts, prices were drawn from the receipts of other providers or from the websites of the three primary retailers that were used by this sample of child care providers. The expenditure for each food item was computed by multiplying the gram weight served (based on standardized portions) by the ratio of the purchase price over total grams purchased, correcting for edible portion using a standard reference database.

### ***Indicators of nutritional quality***

The nutritional quality of snacks was defined using both nutrient and food-based indicators. Nutrient-based indicators of snack quality included potassium, dietary fiber, and vitamin C, as fruits and vegetables are important sources of these nutrients. Potassium and dietary fiber are also nutrients of public health concern [12] and were thus a primary interest in this study. Mean Adequacy Ratio (MAR), which has been used as an indicator of diet quality in previous studies [22-23, 29], was also used as a composite nutrient-based indicator of snack quality. The MAR values were calculated for seven nutrients that were recognized by the 2010 Dietary Guidelines Advisory Committee as shortfall nutrients [12]: magnesium, potassium, vitamin A, vitamin D, vitamin E, calcium and dietary fiber. A nutrient adequacy ratio (NAR) was calculated for each individual nutrient by dividing the amount of the nutrient provided in each snack by 15% of the IOM's daily reference intake (DRI) of the nutrient for children aged 4 to 8 years [30]. This step was repeated for each of the seven nutrients of interest. As in other studies, each NAR was truncated at 1, so that a high content of one nutrient could not compensate for a low content of another nutrient [39]. Fifteen percent of the DRI was chosen as it reflects the approximate level of nutrients a child should receive from one snack, assuming two-thirds of the DRI are received in full time child care, as suggested by health authorities [31, 32]. The MAR was then calculated as the sum of each NAR divided by the number of nutrients evaluated (7), expressed as a percentage. Snacks that perfectly satisfied the recommended levels for these seven nutrients would have a MAR of 100%. Food-based indicators of snack quality included servings of whole grains, low-fat milk, and lean proteins, as these are foods considered to be of high nutritional quality in the IOM's recommendations [15].

### ***Statistical analyses***

To achieve study aim 1, descriptive statistics were examined to describe the fruit/vegetable composition and associated costs of snacks offered by this sample of child care providers. Snacks were included for the evaluation if they met CACFP standards for reimbursement (i.e. included two of the four food group components). A total of 471 snacks were evaluated. To achieve study aim 2, the nutritional quality and price of snacks that contained a whole fruit/vegetable were compared to those that contained 100% fruit juice.

Snacks were categorized into two groups and an indicator variable was created (“1” if the snack included a whole fruit/vegetable, “2” if the snack included 100% fruit juice). Snacks were excluded if they did not contain a fruit/vegetable component (n=137) or if they contained a combination of whole fruit/vegetable and 100% fruit juice (n=34). A total of 300 snacks were included in the analysis. Stratified analysis by reimbursement level revealed no significant differences between the reimbursement levels in servings of whole fruit/vegetable or 100% fruit juice. Thus a comparison between snacks containing a whole fruit/vegetable and those containing 100% fruit juice were made without adjusting for reimbursement level. Separate multivariate linear regression models were run for each outcome variable, adjusting for the total number of food components in the snack (range, 2-4). For all models the key independent variable was the fruit/vegetable composition of the snack, as classified by the indicator variables described above. The outcome measures were energy, potassium, dietary fiber, vitamin C, MAR, and cost. Bonferroni correction was used to adjust for multiple comparisons. Snacks containing a whole fruit/vegetable were the reference group, as this is ideal according to IOM standards. To examine differences in food-based indicators of diet quality between snacks containing a whole fruit/vegetable and those containing 100% fruit juice, a series of 2x2 tables were created. Fisher’s exact test was used to determine significant differences in the frequency of servings between groups, adjusting for multiple comparisons. All analysis was done using *Stata Statistical Software: Release 12* (StataCorp. 2011. College Station, TX: StataCorp LP) to account for clustering of snacks at the child care provider level. Significance was set at  $P < 0.05$ .

## Results

### *Sample Characteristics*

All 60 home child care providers were women, ranging in age from 29 to 64 with a mean age of 48.3 (SD 8.6) years. Demographic, socioeconomic and professional characteristics of the sample are shown in **Table 2**. Differences in personal and professional characteristics were not statistically significant between the higher and lower reimbursement levels. The majority of providers (38/60) in the sample served all meals daily, which were breakfast, lunch, and two snacks. All 60 providers served at least one snack.

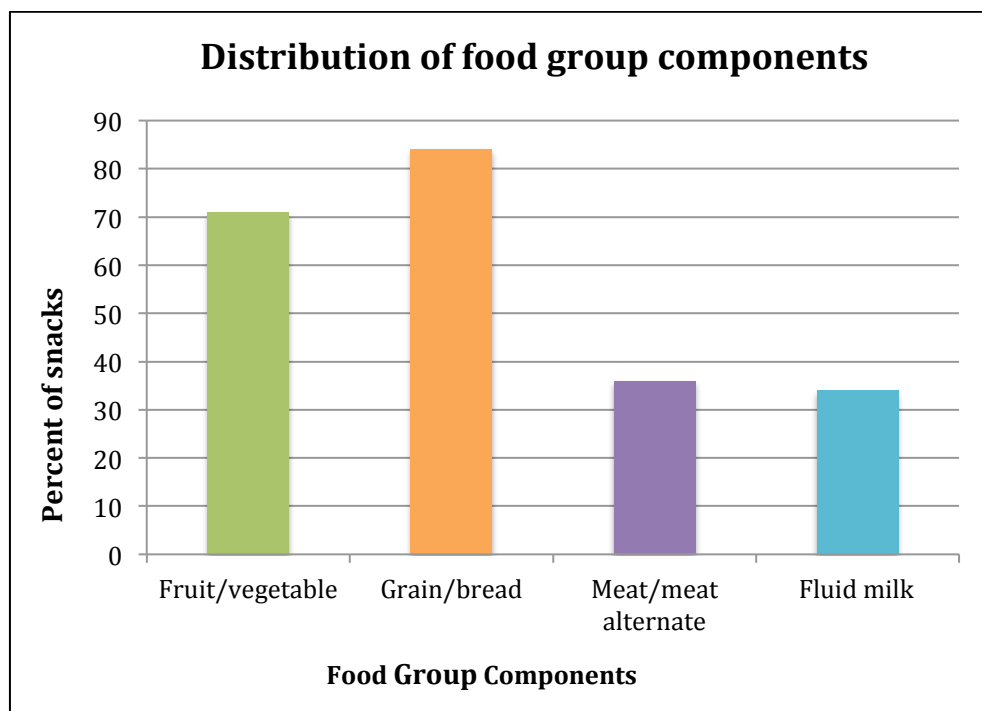
**Table 2.** Characteristics of the CACFP home-based child care provider sample, by reimbursement level and overall, King County, WA, 2008-2009

	Total (n=60)	Reimbursement level <sup>a</sup>	
		Lower (n=30)	Higher (n=30)
<b>Snacks, <i>n</i></b>	471	235	236
<b>Energy per snack, mean <math>\pm</math> SD, <i>kcal</i></b>	141.6 $\pm$ 40.8	138.4 $\pm$ 42.8	145.1 $\pm$ 44.7
<b>Snack price, mean <math>\pm</math> SD, \$<sup>c</sup></b>	\$0.44 $\pm$ 0.35	\$0.42 $\pm$ 0.33	\$0.46 $\pm$ 0.36
	← <i>mean <math>\pm</math> SD</i> →		
<b>Age,<sup>d</sup> <i>y</i></b>	48.3 $\pm$ 8.6	46.5 $\pm$ 1.6	49.9 $\pm$ 1.6
	← <i>n</i> →		
<b>Race or ethnicity<sup>e</sup></b>			
White	46	23	23
Hispanic	4	3	1
Black	3	3	0
Other races or mixed races	11	7	4
<b>Highest education</b>			
High School up to some college	28	13	15
Associate's degree (2 years)	17	10	7
Bachelor's degree or higher	15	7	8
<b>Household income<sup>f</sup></b>			
Up to 59,000	21	9	12
\$60,000-99,000	20	10	10
\$100,000-159,000	18	11	7
	← <i>mean <math>\pm</math> SD</i> →		
<b>Professional characteristics</b>			
Children in care, <i>n</i>	7.9 $\pm$ 3.0	7.8 $\pm$ 3.2	8.0 $\pm$ 2.8
Years working in CACFP	11.6 $\pm$ 8.3	12.1 $\pm$ 8.9	11.2 $\pm$ 7.8
Years working in child care	14.3 $\pm$ 8.7	13.3 $\pm$ 8.6	15.2 $\pm$ 8.9
<sup>a</sup> Differences by reimbursement level were tested with two-sample t-test. No significant differences were found between groups for provider characteristics, snack energy or price. <sup>b</sup> Based on 2008-2009 CACFP federal reimbursement rates for family home child care providers. <sup>c</sup> Based on provider receipts collected in 2008-2009, not adjusted for inflation. <sup>d</sup> Two providers did not report age. <sup>e</sup> Three providers identified with two different races. <sup>f</sup> One provider did not report income.			

A total of 471 snacks (93.6% of all snacks served) were consistent with current CACFP food pattern guidelines and were included for evaluation of study aim 1. A near equal number of snacks from each reimbursement level were evaluated; 235 from the lower reimbursement level and 236 from the higher reimbursement level. Average snack energy ranged from 93.5 to 241.8 calories. The mean energy per snack was 141.6 calories (SD 40.8). The price of snacks ranged from \$0.06 to \$1.07. The mean snack price among this sample of providers was \$0.44 (SD \$0.35). Differences in mean energy and snack price between the two reimbursement levels were not statistically significant.

**Aim 1: Fruit/vegetable composition of snacks**

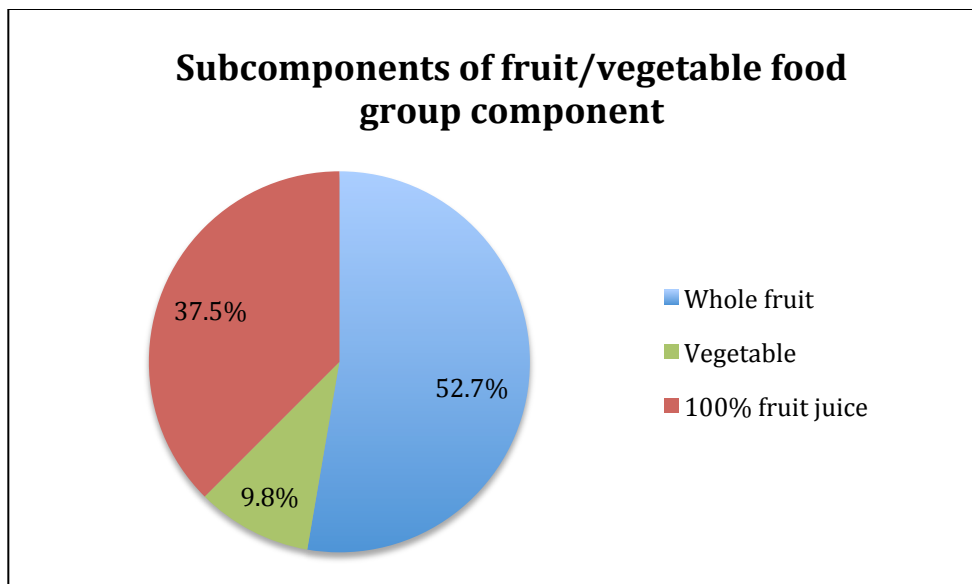
The distribution of food group components served as a snack by this sample of home child care providers are shown in **Figure 1**. The most commonly served food group components were the grain/bread and fruit/vegetable (including 100% fruit juice) components. Of the 471 snacks evaluated, 399 snacks (84%) contained a grain/bread component and 334 snacks (71%) contained a fruit/vegetable component. The meat/meat alternate and fluid milk food group components were served to a lesser degree among the snacks evaluated, at 36% and 34%, respectively.



**Figure 1: Distribution of food group components in snacks (n=471) served by sample of CACFP home child care providers during one week**

<sup>a</sup>Total is greater than 200 percent because current snack patterns require providers to serve at least two of the four items per snack.

Focusing on the fruit/vegetable food group component, **Figure 2** shows the distribution of fruit/vegetable subcomponents served. Of the 71% of snacks that contained a fruit/vegetable food group component, 52.7% of those servings were in the form of whole fruit, 9.8% were a vegetable and 37.5% were 100% fruit juice. Included within the whole fruit subcomponent were fresh, frozen, dried and canned fruits. The vast majority of the whole fruit served (167/194 or 86.1%) was fresh fruit.



**Figure 2: Distribution of the fruit/vegetable subcomponents in snacks (n=334) served by sample of home child care providers during one week**

Servings of fruit/vegetable subtypes were dominated by few varieties, as shown in **Table 3**. Apples were the most commonly served whole fruit, followed by bananas, oranges and strawberries. Vegetables were served infrequently and were led by two varieties: carrots and celery. Apple juice was the predominate type of 100% fruit juice served followed by 100% orange juice.

Also shown in **Table 3** is the mean price per serving and mean energy, potassium, fiber and vitamin C content of the most frequently served types of fruits, vegetables and 100% fruit juice. As expected, large variations in the price, energy and nutrient composition were observed among the different whole fruit, vegetable and 100% fruit juice varieties. However, on average, whole fruits were most expensive, costing 27.6% more than the mean price per portion of vegetables and 40.0% more than the mean per portion price of 100% fruit juice. Of the fruit/vegetable subcomponents served, vegetables were the lowest in mean energy per portion, containing 5.4% less than whole fruits and 31.4% less than 100% fruit juice. Whole fruits and vegetables contained less mean potassium per serving than the 100% fruit juices offered. Mean potassium levels of 100% fruit juice were 17.5% higher than the mean potassium levels of whole fruits and 20.9% higher than the mean per portion potassium levels of vegetables. Mean fiber per portion was similar between whole fruits and vegetables, which had approximately 85% more mean fiber per

servings than 100% fruit juice. Average vitamin C levels were similar per portion among the whole fruit, vegetable and 100% fruit juice subcomponents.

**Table 3.** Top fruit/vegetable food group component types served in snacks (n=471) at child care homes during one week, Seattle-King County, WA 2008-2009

Type of fruit/vegetable food group component		Price (\$)¹	Energy (kcal) per portion²	Potassium (mg) per portion²	Fiber (g) per portion²	Vit C (mg) per portion²
<i>Servings (% total servings)</i>		<i>mean ± SD</i>				
<b>Whole fruit</b>	<b>194</b>	<b>0.34 ± 0.27</b>	<b>40.8 ± 15.9</b>	<b>117.1 ± 75.7</b>	<b>1.4 ± 0.6</b>	<b>13.4 ± 17.1</b>
Apples	60 (30.9)	0.26 ± 0.17	29.3	58.3	1.3	2.5
Bananas	29 (14.9)	0.19 ± 0.09	66.8	268.5	2.0	6.5
Oranges	19 (9.8)	0.38 ± 0.16	42.3	162.9	2.2	47.9
Strawberries	18 (9.3)	0.60 ± 0.29	26.5	127.0	1.7	48.8
Grapes	16 (8.3)	0.35 ± 0.21	52.1	144.2	0.7	8.2
Watermelon	12 (6.2)	0.23 ± 0.14	25.8	85.1	0.5	3.75
Applesauce	10 (5.2)	0.18 ± 0.10	51.2	90.3	1.3	1.2
Raisins	8 (4.1)	0.08 ± 0.03	51.3	128.4	0.9	0.6
<b>Vegetable</b>	<b>36</b>	<b>0.29 ± 0.18</b>	<b>38.6 ± 12.8</b>	<b>112.3 ± 45.2</b>	<b>1.1 ± 0.4</b>	<b>13.9 ± 19.4</b>
Carrots	12 (33.3)	0.19 ± 0.06	26.7	134.2	1.3	2.8
Celery	11 (30.6)	0.10 ± 0.12	8.1	131.3	0.8	1.6
Cucumbers	4 (11.1)	0.10 ± 0.21	7.8	76.5	0.3	1.4
Broccoli	3 (8.3)	0.23 ± 0.19	15.0	115.4	1.7	53.1
Bell peppers	3 (8.3)	0.72 ± 0.26	19.1	130.8	0.9	95.7
<b>100% fruit juice</b>	<b>138</b>	<b>0.21 ± 0.17</b>	<b>56.3 ± 7.5</b>	<b>141.9 ± 78.6</b>	<b>0.2 ± 0.2</b>	<b>13.1 ± 22.3</b>
Apple	73 (52.9)	0.20 ± 0.17	55.0	151.5	0.1	1.1
Orange	33 (23.9)	0.23 ± 0.15	54.8	236.6	0.3	53.2
Grape	12 (8.7)	0.14 ± 0.10	75.0	110.4	0.1	0.1
Apple cider	5 (3.6)	0.14 ± 0.07	60.0	90.8	0.1	0.3
Pineapple	4 (2.9)	0.28 ± 0.18	65.0	162.5	0.1	6.5

¹Using provider receipts collected in 2008-2009. Not adjusted for price inflation.

²All portions were standardized to servings appropriate for children aged 3-5 years.

### **Aim 2: Nutritional quality and price**

To compare the nutritional quality and price of snacks containing a whole fruit/vegetable to those containing 100% fruit juice, adjusted means were estimated to ease interpretation of comparison between groups and can be comprehended as the adjusted mean at the population average for total number of food components in the snack.

**Table 4:** Adjusted mean energy, nutrient quality and price of snacks (n=300) containing a whole fruit/vegetable compared to snacks containing 100% fruit juice

	Snacks with a whole fruit/vegetable <sup>1</sup> n=185	Snacks with 100% fruit juice n=115
	<i>Adjusted mean (95% CI)</i>	
<b>Energy (kcal)</b>	132.8 (125.6-140.1)	140.2 (134.7-145.7)
<b>Potassium (mg)</b>	156.2 (142.4-170.0)	170.1 (154.0-186.2)
<b>Dietary fiber (g)</b>	2.1 (1.9-2.2)	0.8 (0.5-1.1)**
<b>Vitamin C (mg)</b>	13.1 (10.6-15.7)	13.0 (9.0-17.1)
<b>MAR (%)<sup>2</sup></b>	66.1 (56.8-78.4)	45.9 (35.9-55.9)*
<b>Cost (\$)</b>	0.55 (0.49-0.73)	0.36 (0.32-0.46)**

Data from linear regression model. Values can be interpreted as the adjusted mean at the population average for total number of food components. Adjusted for multiple comparisons using Bonferroni correction.

<sup>1</sup> P-value compared to reference group (whole fruit/vegetable) \* p<0.05, \*\* p<0.01, \*\*\* p<0.001.

<sup>2</sup> Mean Adequacy Ratio (MAR) is used as a composite indicator of nutrient quality. Based on vitamins A, D & E; Mg, K, calcium & dietary fiber.

The adjusted mean energy, nutrient quality and price of snacks containing a whole fruit/vegetable and those containing 100% fruit juice are shown in **Table 4**. Snacks that contained 100% fruit juice had 5.3% more energy on average than snacks containing a whole fruit/vegetable. Mean potassium content was higher among snacks that contained 100% fruit juice than those that contained a whole fruit/vegetable. Compared to snacks containing a whole fruit/vegetable, snacks containing 100% fruit juice had significantly less fiber (-1.3 g/snack or -62%/snack, p=0.008). Levels of vitamin C were similar between the snacks containing a whole fruit/vegetable and those containing 100% fruit juice. Snacks that contained a whole fruit/vegetable had a significantly higher nutrient adequacy score, as based on the MAR, than snacks containing 100% fruit juice (66.1% versus 45.9%, p=0.012). Finally, the mean price of snacks containing a whole fruit/vegetable was significantly higher (\$0.19/snack or 34.6% more, p=0.006) than snacks that contained 100% fruit juice.

**Table 5.** Food-based characteristics of snacks (n=300) containing a whole fruit/vegetable compared to snacks containing 100% fruit juice

Food Group Component	Snacks with whole fruit/vegetable <sup>1</sup> n=185	Snacks with 100% fruit juice n=115
	← servings (%) →	
<b>Grain/Bread</b>	<b>142 (76.8)</b>	<b>101 (87.8)</b>
Whole grains	31 (21.8)	14 (13.9)
Refined grains	111 (78.2)	87 (86.1)
<b>Fluid Milk</b>	<b>65 (35.1)</b>	<b>8 (7.0)*</b>
Low-fat	11 (16.9)	5 (62.5)
High-fat	54 (83.1)	3 (37.5)
<b>Meat/meat alternate</b>	<b>53 (28.7)</b>	<b>36 (31.3)</b>
Lean protein	36 (67.9)	15 (41.7)
High-fat protein	17 (32.1)	21 (58.3)

<sup>1</sup> P-values compared to reference group using Fisher's exact. Adjusted for multiple comparisons using Bonferroni correction.

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

Food-based indicators of snack quality are shown in **Table 5**. The overall relative distribution of food group components differed between snacks that contained a whole fruit/vegetable and those that contained 100% fruit juice. While grains were a frequently served food component among all snacks served, they were served more often in snacks that contained 100% fruit juice than in snacks containing a whole fruit/vegetable. Furthermore, the percentage of grains that were whole grains was higher among snacks that served a whole fruit/vegetable than snacks containing 100% fruit juice. Not surprisingly, fluid milk was served significantly less often in snacks that contained 100% fruit juice (p=0.04) than in those containing a whole fruit/vegetable. This can likely be attributed to the current CACFP guidelines, which prohibit two fluid components (i.e. milk and 100% fruit juice) from being served without a third food group component. Although rarely served, low-fat milk was served in greater frequency among snacks that contained 100% fruit juice than those containing a whole fruit/vegetable. Finally, the meat/meat alternate food group component was served in similar frequency between both snacks that contained a whole fruit/vegetable and those that contained 100% fruit juice. However, snacks containing 100% fruit juice included less lean protein and more high-fat protein than the snacks containing a whole fruit/vegetable.

## Discussion

Early childhood is a critical period for healthy growth, and research demonstrates its importance in the epidemiology of obesity [28]. The current CACFP meal requirements provide little standardized guidance for the snacks served in participating facilities, beyond the requirements to serve at least two of the four current food group components. By these standards, a reimbursable snack could be a highly processed and sugary toaster pastry such as a “Pop-Tart” (a grain) and 100% fruit juice (a fruit/vegetable). The overall goal of the IOM’s recommended revisions to the CACFP’s meal patterns are to better align the meals and snacks served in child care facilities with current dietary guidelines. Yet little quantitative information exists about the potential economic and dietary impacts of these proposed revisions [15, 24]. To address this information gap, the IOM Committee recommended the USDA support research in three primary areas: (1) collection of baseline data of all food provided to participants before the revised CACFP guidelines are implemented; (2) assessment of factors that may be barriers to implementing the revised regulations; and (3) evaluation of the impact of the revisions on the types of food eaten by participants and on the nutritional value of those foods [24]. Findings from this study can be used as a baseline, prior to the implementation of any future changes in CACFP meal requirements, for comparison purposes and to assess barriers to implementing the revised meal patterns.

In this study, the IOM recommendations were merely used as a guide to facilitate interpretation of the data and to gauge the degree to which providers were meeting established dietary guidance. However, direct comparisons were not made to the IOM revised meal patterns. The current study focused on the use of 100% fruit juice as a fruit/vegetable equivalent in snacks served by this sample of home child care providers. The IOM revised meal patterns will require 40% of all snacks served over the course of one week to include a vegetable component. Among this sample of child care providers, vegetables were served in only 7.6% of all snacks served during the 5-day period examined. This finding is consistent with previous studies that also found that servings of vegetables in home child care settings fell short of established recommendations [25, 26] and further supports the IOM’s recommendation to separate the fruit/vegetable component

into two categories, and require minimum servings of each <sup>[15]</sup>. Furthermore, results from the present study showed that 100% fruit juice was commonly served as a fruit/vegetable equivalent at snack. The IOM recommendations suggest limiting 100% fruit juice to no more than one 4 oz. serving per day. Thus the proportion of 100% fruit juice served at snack time will likely be substantially reduced, especially for providers serving breakfast, lunch and two snacks daily.

The comparison of snacks containing a whole fruit/vegetable to those containing 100% fruit juice indicates that serving whole fruits and vegetables instead of 100% fruit juice has the potential to reduce the overall energy content of snacks. Irrespective of the mixed evidence linking 100% fruit juice consumption and obesity, the intake of fruit juice has been associated with higher overall dietary energy intake <sup>[6]</sup>. Based on data from the 1999-2004 NHANES, 100% fruit juices contributed between 7% and 9% to the total dietary energy intakes of children who reported consumption of the beverage <sup>[2]</sup>. A recent study examining the effects of replacing 100% fruit juice with fresh fruit substitutes in the diets of US children found that this replacement had the potential to reduce daily energy intake by 54 calories <sup>[33]</sup>. The present study provides further support for the replacement of 100% fruit juice with whole fruits and vegetables as a way to decrease energy intake. However, the elimination of 100% fruit juice without a variety of whole fruits and vegetables to replace it may result in reduced intakes of potassium and vitamin C. As shown in this study, 100% fruit juices do contain considerable amounts of vitamin C and potassium. While vitamin C was not identified as a shortfall nutrient for children by the 2010 Dietary Guidelines Advisory Committee <sup>[12]</sup>, and was provided in greater amounts by whole fruits and vegetables, potassium content was found to be higher among snacks containing 100% fruit juice. Thus careful consideration must be made when planning snacks to ensure that a variety of whole fruits and vegetables high in potassium are incorporated into the diets of children. Snacks that included a whole fruit/vegetable contained significantly more fiber than snacks containing 100% fruit juice. This finding may be important, as recent evidence suggests that consuming fructose without fiber may be contributing to childhood obesity <sup>[34, 35]</sup>. Furthermore, US children's overall consumption of fiber remains low <sup>[36]</sup>, despite the association between fiber and a reduced risk for obesity in both children and adults <sup>[37, 38]</sup>. Finally, snacks containing a whole fruit/vegetable had significantly higher nutrient

adequacy than snacks containing 100% fruit juice, based on the seven nutrients used in computing the MAR, which were identified by the 2010 Dietary Guidelines for Americans as shortfall nutrients [12].

The food group components and food subgroups commonly paired with a whole fruit/vegetable may also contribute to the increased nutritional quality of these snacks. The present study indicates that the overall composition of snacks differs between snacks containing a whole fruit/vegetable and those containing 100% fruit juice. While grains commonly complemented snacks containing both a whole fruit/vegetable and those containing 100% fruit juice, refined grains were more frequently served in snacks containing 100% fruit juice. Furthermore, snacks that contained 100% fruit juice were significantly less likely to contain fluid milk. The concern that 100% fruit juice is displacing milk and other nutritious foods from the diets of children has been documented in other studies [6,7]. While current CACFP meal patterns do require milk to be served at breakfast and lunch they do not require milk to be served at snack. Studies have shown that preschool children are not meeting the recommendations for milk intake [6], thus the IOM revised meal patterns will require milk to be served in 40% of all snacks served over the course of a five-day period. Finally, snacks that contained a whole fruit/vegetable also included a higher percentage of lean protein servings than snacks containing 100% fruit juice. Although a recent study found that 100% fruit juice was associated with overall diet quality [3] the present study found that, with regard to individual snacking occasions, 100% fruit juice may be associated with more servings of less healthy foods such as refined grains and high-fat protein. This finding may warrant additional research into whether 100% fruit juice is a proxy indicator of overall diet quality.

This data also demonstrates that snacks containing a whole fruit/vegetable were significantly more expensive than those containing 100% fruit juice after controlling for the total number of food group components in the snack. Cost is one of several factors that may explain the high prevalence of 100% fruit juice in the diets of children. Fresh, whole produce is among the most costly sources of dietary energy [39], and 100% fruit juices tend to provide a lower cost per serving and more nutrients per dollar than many fresh fruits [40]. Thus 100% fruit juice is an economical way for child care providers to meet current requirements for fruits and vegetables. The results of this study suggest that the IOM

recommendations to increase the proportion of whole fruits and vegetables served, and recommendations from other advocates who recommend eliminating 100% fruit juice from CACFP environments altogether <sup>[41]</sup>, may lead to increased food costs for child care providers.

### **Limitations**

The design and analytic methods used in this study are not without limitations, thus results need to be interpreted cautiously. The findings are based on data from a cross-sectional descriptive study that utilized a convenience sampling method, therefore the 60 sites included in the analysis may not be representative of all child care providers in Seattle-King County or the greater United States. Furthermore, data was collected on the foods and beverages *served* within these child care homes, not what was actually consumed; more research is needed to determine the types and amount of food and beverages children actually consume. The reliance on menu records has intrinsic weaknesses similar to diet records used in traditional dietary assessment. However, menu records in this study were completed in real time by each care provider and were verified for accuracy and completeness. Furthermore, this study collected receipts of the foods and beverages purchased, providing further “validation” of the foods served <sup>[22, 23]</sup>. Price analyses did not account for labor, preparation, or overhead costs. Although one may expect such price differences to be small given the types of snacks served in these programs (i.e. crackers and apples), serving more whole fruits and vegetables may be less convenient for caregivers or come at the consequence of off-setting other programming activities. Lack of storage space, increased waste, and the additional time it takes to prepare and portion whole fruits and vegetables may also be barriers to implementation of the revised meal patterns. Additionally, food prices and availability vary based on metropolitan area, and some fruits and vegetables are less expensive in season than out-of-season. However, many frequently served fruits (e.g. apples, bananas) and vegetables (e.g. carrots, celery) are available year-round with little variation in price <sup>[42]</sup>. King County is an area with higher median income compared to the nation, suggesting that this sample could have served more healthful and expensive snacks than programs in less affluent areas. However, the strength of this study lies in the use of shopping receipts that included exact

expenditures of food and beverage items purchased by this sample of child care providers. Previous studies examining the increases in food costs have utilized national price databases, which do not account for regional variations in food prices and may not accurately represent what child care providers are actually spending. Finally, this study did not separately examine the nutrient adequacy and price of frozen, dried and canned fruit and vegetable varieties, as they were served infrequently by this sample of child care providers. These varieties have been cited in other studies [15, 33] as an affordable avenue to meeting recommendations of whole fruits and vegetables and thus more research should examine the nutritional and economic impacts of serving these varieties.

## **Conclusion**

Outside of the home, child care settings are the most common environments where young children spend their days [28]. The results of this research provide baseline data of the degree to which fruits, vegetables and 100% fruit juice were served as a snack among a sample of CACFP-participating child care homes. The findings also suggest that snacks containing a whole fruit/vegetable are of higher nutritional quality than snacks containing 100% fruit juice. However, the data indicate that serving whole fruits and vegetables rather than 100% fruit juice, as suggested by the IOM, may lead to higher food costs for child care providers. As such, this study may aid in determining the impact of this policy change on child care providers and the children they serve.

## Appendices

### Appendix 1

**Comparison of current meal requirements with IOM's revised meal patterns (Adapted from Table 7-10, p.132 in <sup>[15]</sup>)**

Eating occasion	Current meal pattern	Recommended Requirements and Specifications
<b>All</b>	Must meet daily pattern	Must meet daily and weekly patterns to provide more flexibility and better alignment with the <i>Dietary Guidelines</i>
Breakfast	3 meal components	4 or 5 meal components
Lunch or supper	4 meal components	5 meal components
Snack	Any 2 of 4 components	Variety specified for the week  Choice between 2 small snacks or 1 enhanced snack (enhanced snack only an option for children over age five).
<b>Meal Component</b>		
Fruit	Fruits and vegetables are combined as a category	Fruits are a separate category, and servings are increased; juice is not provided for infants and is limited for children; fruits containing added sugars are limited
Vegetable		Vegetables are a separate category from fruit, and servings are increased; must provide variety including dark green leafy, bright yellow/orange, legumes; sodium content is limited; starchy vegetables are limited
Grain	Enriched or whole grain, proportions not specified	At least half must be whole grain-rich; additional whole grains are encouraged; grain products high in solid fats and added sugars are limited to control calories and saturated fat; high-sodium grain products are also limited
Meat/meat alternate	None at breakfast	Included in weekly breakfast pattern
	No restrictions on high-fat, highly processed meats	Some types are limited to help control calories, solid fat, and sodium
Fluid milk	Any type of fluid milk	Milk must be low-fat (1%) or nonfat for children over 2 years of age (whole milk for children <1 years old)

## Appendix 2

### Current CACFP child meal pattern for snack (Adapted from Table E-6, p. 217 in <sup>[15]</sup>)

Food Components (Select 2 of 4 for a reimbursable snack)	1–2 Years	3–5 Years	6–12 Years
1 Milk (c)	½	½	1
1 Fruit/vegetable			
Juice, fruit, and/or vegetable (c)	½	½	¾
1 Grain/bread			
Bread (slice)	½	½	1
Cornbread, biscuit, roll, or muffin (svg)	½	½	1
Cold dry cereal (c)	¼	⅓	¾
Hot cooked cereal (c)	¼	¼	½
Pasta, noodles, or grains (c)	¼	¼	½
1 Meat or meat alternate			
Meat, poultry, or fish (oz)	½	½	1
Alternate protein product (oz)	½	½	1
Cheese (oz)	½	½	1
Egg	½	½	½
Cooked dry beans or peas (c)	⅛	⅛	¼
Peanut or other nut or seed butter (T)	1	1	2
Nuts and/or seeds (oz)	½	½	1
Yogurt (oz)	2	2	4

NOTE: c = cup; oz = ounce; svg = serving; T = tablespoon.

### IOM's revised pattern for regular snacks: number of servings from each food group per week and amount per serving, by age group (Adapted from Table 7-4, p. 121 in <sup>[15]</sup>)

Food Components	1 Year	2–4 Years	5–13 Years	14–18 Years	Adults
	Number of Servings per Week (Amount/Serving) <sup>c</sup>				
Fruit	2 (½ c)	2 (½ c)	2 (½ c)	2 (1 c)	2 (1 c)
Orange vegetable	1 (⅛ c)	1 (½ c)	1 (½ c)	1 (½ c)	1 (½ c)
Non-starchy vegetable	1 (⅛ c)	1 (½ c)	1 (½ c)	1 (1 c)	1 (½ c)
Grain/bread	2 (½ oz eq)	2 (1 oz eq)	2 (1 oz eq)	2 (2 oz eq)	2 (1 oz eq)
Lean meat or meat alternate	2 (½ oz eq)	2 (1 oz eq)	2 (1 oz eq)	2 (1 oz eq)	2 (1 oz eq)
Milk	2 (½ c)	2 (½ c)	2 (½ c)	2 (½ c)	2 (½ c)

NOTE: c = cup; oz eq = ounce equivalent.

<sup>c</sup>The patterns for each age group show number of servings and amount per serving for either a morning or afternoon snack. If both morning and afternoon snacks are provided daily, the same pattern is to be used for each. Over the course of a 5-day week, a total of 10 servings would be offered for the morning snack and the same number for the afternoon snack (if both were provided); 2 servings would be offered for each daily snack.

### Appendix 3

#### Definitions <sup>[15,20]</sup> of food and beverage groups used in coding food-based analysis

Meal Component	Select definitions or examples
<b>Fruit/vegetable</b>	
Whole fruit	Any variety of fresh, dried, frozen, canned, or pureed fruits.
Vegetables	Any variety of fresh, canned, or plain frozen vegetables. No deep-fried vegetables.
100% fruit juice	100 percent fruit or vegetable juice with no added sugars.
<b>Grain/bread</b>	
Whole	E.g. amaranth, brown rice, buckwheat, bulgur (cracked wheat), millet, muesli, oatmeal, popcorn, quinoa, sorghum, triticale, whole grain barley, whole grain cornmeal, whole rye, whole wheat bread, whole wheat cereal flakes, whole wheat crackers, whole wheat pasta, whole wheat sandwich buns and rolls, and wild rice.
Refined	E.g. biscuits, cornbread, corn flakes cereal, corn tortillas, taco shells, couscous, crackers (including animal crackers, teddy grahams, graham crackers and cheese crackers), grain-based chips (including bagel chips, tortilla chips, pretzel chips, and pretzels), trail mix/gorp/party mix, flour tortillas, grits, macaroni, noodles, pitas, spaghetti, white bread (including stuffing, English muffins, and white buns, rolls and bagels), white rice, cookies/bars/granola, multi-grain/fruit bars, brownies, and granola/cereal bars, cinnamon/sweet rolls, coffee cake, Danish pastry, donut, quick breads, pie, muffins, pop tarts/toaster pastries, pancakes and waffles.
<b>Meat/meat alternates</b>	
Lean protein	Fresh or plain frozen lean beef (10% ground, select or choice, trimmed of fat, ground roast, round, sirloin, tenderloin), pork (lean, chop, ham, tenderloin), lamb (roast, chop, leg), wild game (buffalo, ostrich, rabbit, venison), poultry (without skin), fish (fresh, shellfish, and fish), and prepared with lean methods, i.e. broiled, roasted, braised, stewed, stir fried in mixed dishes with nonstick spray or vegetable oil; whole nuts or seeds or their butters; eggs; natural and processed reduced-fat cheeses (e.g. cottage cheese, feta, mozzarella, or string cheese); non-fat or low-fat yogurt; beans, legumes and tofu.
High-fat protein	Fresh or plain frozen beef (corned beef, ground beef—unless ground lean, meatloaf, prime rib, short ribs, tongue), lamb (ground, rib roast), pork (cutlet, shoulder roast), poultry (fried, served with skin, ground turkey), sausage, fish (fried), or otherwise lean meat that is served with a high-fat sauces or other high-fat preparation/cooking method; meat that is prepared with methods such as smoking, curing, salting, and/or addition of preservatives, e.g. hot dogs, corndogs, bratwurst, fish sticks, chicken nuggets, lunch meat, canned stews/chilis, and other highly processed meat, poultry, and fish; natural and processed cheeses (American, bleu, Brie, cheddar, hard goat, Monterey Jack, queso, Swiss); whole (full fat) yogurt.
<b>Fluid milk</b>	
High-fat milk	Whole and 2% milk.
Low-fat milk	1% and nonfat (skim) milk. Alternative milk (e.g. almond, rice, soy, coconut, etc. were served sparingly by this sample of providers during snack time (n=6) thus were included within the low-fat category.
Flavored	Sweetened dairy drink made with milk, sugar, colorings, and artificial or natural flavorings. No flavored milk was served by this sample of providers at snack.
<b>Miscellaneous</b>	
Not-creditable	Items non-creditable under the CACFP meal, e.g. processed cheese, cheese food, or cheese spread; chips that are not grained base; bacon; candy and frozen treats; cake/cupcakes; soda; canned soups; high-sugar and high-fat yogurt, i.e. $\leq 17$ g of total sugars per 100 g yogurt (40 g/8 oz serving) or more than 1% milk fat; juice drinks ( $<100\%$ fruit juice); sweetened cereals.
Mixed dishes	Foods that could be placed in more than one major food group, e.g. pizza; stews; burritos; chili. No mixed dishes were served among this sample at snack.

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