

# Characteristics of Vending Machines Available to Students in U.S. Schools:

Results from the School Health Policies and Practices Study, 2014



Centers for Disease Control and Prevention  
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## Background

School nutrition environments can influence students' eating habits<sup>(1)</sup>. School vending machines are one source of food and beverages that often have poor nutritional value<sup>(1)</sup>. The machines themselves also serve as a form of marketing to students<sup>(2)</sup>. The Healthy, Hunger-Free Kids Act of 2010 authorized the United States Department of Agriculture (USDA) to develop nutrition standards for all foods and beverages sold during the school day, including those in vending machines, which align with federal dietary guidance<sup>(3)</sup>. These Smart Snacks in School nutrition standards (Smart Snacks) went into effect at the beginning of the 2014-2015 school year and include limits on fat, sugar, sodium, and calories for foods, and identify allowable beverages for each school level<sup>(4)</sup>. Additionally, regulations for local school wellness policies require that foods and beverages marketed during the school day align with Smart Snacks standards<sup>(5)</sup>.

While surveys of school staff have been used to describe food and beverage availability in schools<sup>(6,7)</sup>, estimates based on more objective data collection methods (e.g., direct observation) are not widely available yet might provide more accurate data because school staff might not accurately report the contents of machines. CDC used photographs to describe the characteristics of a nationally representative sample of school vending machines available to students prior to Smart Snacks implementation including information on machine type, prevalence of specific foods and beverages, and marketing on machines.

## Methods

### Sample

Vending machine photographs were included as part of the 2014 School Health Policies and Practices Study (SHPPS). SHPPS is a periodic national survey that assesses school health policies and practices at multiple levels. In 2014, SHPPS collected data among a nationally representative sample of elementary, middle, and high schools. In the 2014 SHPPS sample, 828 schools were considered eligible, and 631 of these schools (76.2%) participated in the study. A detailed description of the SHPPS 2014 methods appears elsewhere<sup>(6)</sup>.

Participating schools provided lists of all vending machines accessible to students during the school day. In schools with five or fewer machines, all were sampled. Among schools with six or more machines, five were selected randomly with equal probability using a random numbers table or an online randomizer. Overall, 177 of 631 participating schools (28.1%) had vending machines available to students during the school day. The remaining schools did not have any vending machines (n=362) or did not provide information about whether they had vending machines (n=92).

### Vending Machine Photographs

Photographs of 446 machines (including 2 empty vending machines) were available from 163 (92.1%) of these schools. Trained data collectors photographed machines using a standard protocol. Data collectors filled out a Vending Machine ID Card before photographing each machine including state name, school name, school ID, vending machine location, and vending machine sequence number (i.e., 1 of 5, 2 of 5, etc.). Up to five photos were usually taken for each machine including the following:

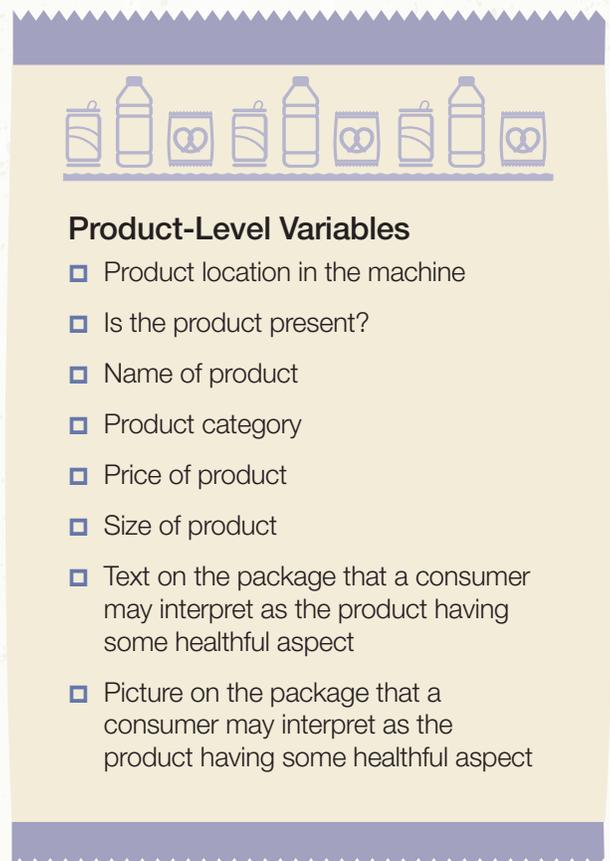
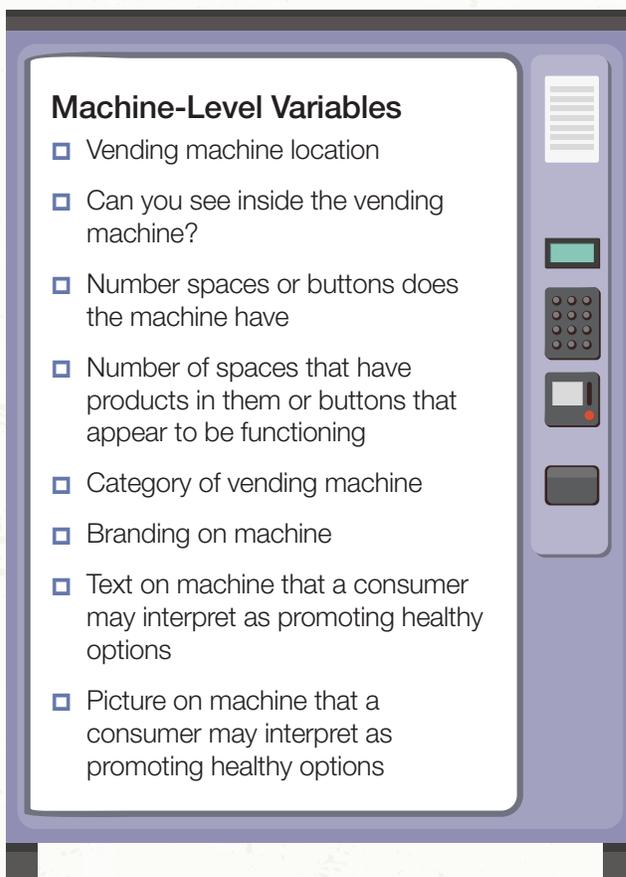
- Vending Machine ID Card;
- Full-length photo (to assess advertising visible on the front of machines); and
- Approximately three photos representing all of the offerings for sale.

## Data Abstraction

A team, comprised of three of the authors of this report, identified key variables to abstract from the photographs based on a review of published studies, existing vending machine assessment tools (e.g., Nutrition Environment Measures Survey-Vending)<sup>(6)</sup>, and other national surveillance systems that address school vending machines including the School Nutrition Dietary Assessment Study<sup>(7)</sup>. This review began with a search of peer-reviewed and grey literature on vending machines in schools, including manuscripts and reports that presented original research as well as review articles. To be included in the review, articles had to be published in English and focus on K–12 schools. Key search terms included: school vending machines, competitive foods, sugar-sweetened beverages, soda, soft drinks, vending machines, snacks machines, beverage vending machine, and food and beverage advertising in schools. Searches were conducted using the ERIC, PsycINFO, and Medline databases. The team also performed internet searches to identify other relevant dietary studies and documentation that may have not been identified in the databases. After reviewing relevant documents, the team created a list of potential study variables. The team discussed the potential variables and determined their final list by considering the following criteria:

- Consistency with other data sources;
- Whether there were important variables of interest not available in the literature; and
- Characteristics that could be consistently abstracted from photos.

The team developed an abstraction protocol for this project which described the initial testing of the abstraction tool, training of data coders, methods for reliability testing, and detailed guidance about the abstraction process. The abstraction protocol defined each of the 16 variables, including the location of the vending machine (e.g., cafeteria, hallway, quad), presence of branding on the machine, and details about all available products in the machine (e.g., name, price, package size). The final machine- and product-level variables are listed below.



The research team worked with consultants from CDC's Division of Population Health to develop an electronic abstraction form in Microsoft Access. Testing of the abstraction form and protocol took place to ensure the following:

- The variables included on the abstraction form could be assessed by the available photos;
- The abstraction form and included guidance were understandable and complete; and
- Team members were abstracting data from the photographs in a consistent manner.

The form and protocol were revised based on this initial testing.

Three of the report authors served as coders. They were trained on the protocol and performed abstraction on a subset of the dataset before conducting the main data abstraction. Reliability testing was conducted on this subset. The coders abstracted 25 vending machine records at this stage to resolve any differences until an overall kappa or ICC value of 0.80 could be reached. Once this target was met, the coders moved forward with the main data abstraction.

### ***Reliability Testing***

This project relied on photographs obtained of vending machines in schools. The data abstracted from the photos could not be compared against any other records, but the data from different coders were compared to determine internal consistency. Reliability testing was conducted by double coding a random sample of 72 records, including both spaces with products available and empty spaces. This resulted in double coding of 1,826 spaces.

Fleiss' kappa was calculated to assess binary and nominal (categorical) variables since there were more than two coders. Two-way mixed-effects consistency of agreement intra-class correlation (CA-ICC) was calculated for continuous variables because the targets were randomly selected (i.e., from the randomized sample of vending machine records), but the coders were fixed (i.e., the same coders were used throughout the entire process). The average measures of the consistency of agreement between the coders are reported.

Agreement for individual variables ranged from kappa=0.34-1.0 with an overall unweighted measure of agreement of kappa=0.85, which falls into the "almost perfect" agreement range<sup>(9)</sup>. Almost all machine level variables had almost perfect or perfect agreement (kappa=0.81–1.00) or substantial agreement (kappa=0.61–0.80) including vending machine location, and type of vending machine (e.g., beverage only). Text on machine promoting healthy options, and picture on machine promoting healthy options had moderate agreement. Identifying branding on the machine had fair agreement. Food and beverage product-level variables with almost perfect or perfect agreement (kappa=0.81–1.00) included plain water, regular soda, diet soda, candy; baked goods including cakes, cookies, and toaster pastries (e.g., Pop Tarts); chips (regular or baked) and crackers; and granola bars, cereal bars, or protein/meal replacement bars. Food and beverage product-level variables with only fair agreement (kappa= 0.21–0.40) included flavored waters (non-diet).

## **Data Cleaning**

Data were thoroughly inspected by the three coders for any missing fields in the abstraction form in Microsoft Access before exporting to Stata 14 statistical analysis software. Frequency checks ensured that there were no missing values in any field in any record, except for the expected 2 empty vending machines (where only vending machine level data could be obtained). School-, vending machine-, and product-level data were merged together to create the master dataset (see codebook for specific variable information <https://www.cdc.gov/healthyschools/nutrition/vendingmachine.htm>). For all text variables, any identified misspelled words were corrected. Limited data cleaning was also conducted to correct for entries with known errors (e.g., missing or misplaced periods in item price). Before analysis was conducted, the master dataset was flattened to the vending machine level to obtain prevalence estimates (see Tables 1-3).

## **Analysis**

Vending machine-level data were weighted to provide national estimates using Stata version 14 (College Station, TX) which accounts for the complex sample design. Prevalence estimates and 95% confidence intervals were computed for all variables, overall (all schools), and by school level (elementary, middle, and high school). For school-level analyses, prevalence estimates for elementary school machines are not presented because the number of machines in the sample (n=31) was too small to produce stable estimates. Differences in prevalence estimates between middle and high schools were assessed by t-test; p values <0.05 were considered statistically significant.

# **Key Findings**

## **Overall**

- In 2014, 28.1% of schools nationwide had a vending machine accessible to students during the school day.
  - More high schools had a vending machine (66.4%) than middle (33.0%) and elementary schools (10.1%)<sup>(5)</sup>.

## **Description of vending machines by location, type of machine, and branding on machine (Table 1)**

- Approximately one-third (32.8%) of vending machines were located in a hallway, 25.9% in the cafeteria, 9.7% in the gymnasium, 6.3% in a quad/courtyard, and 16.8% in another location (e.g., lobby).
  - High schools were more likely than middle schools to have vending machines located in gymnasiums (11.2% vs. 3.3%).
- Two-thirds (66.5%) of vending machines contained only cold beverages.
  - Half (50.5%) of all vending machines contained more than one type of beverage, 6.1% contained only plain water, 4.5% contained only sugar-sweetened beverages, and 4.1% contained only diet beverages.
  - Beverage machines containing only plain water were more prevalent in middle schools (16.1%) than high schools (2.6%).
  - Beverage machines containing more than one type of beverage (e.g., water and sports drinks) were more prevalent in high schools (55.0%) than middle schools (37.7%).
- More than one-fourth (28.5%) of vending machines contained food only, and 1.6% contained ice cream goods or frozen desserts.
- More than half (66.3%) of vending machines had text or a picture with a product's brand name (e.g., Aquafina®) shown on the front of the machine.
- Less than half (41.0%) of all vending machines had text on the front of the machine promoting healthy options, such as "Calories Count. Check then Choose," and 38.0% of vending machines had a picture promoting healthy options, such as an image of a fruit or vegetable.
  - Vending machines with text promoting healthy options were more prevalent in high schools (44.6%) than middle schools (24.0%).

**TABLE 1.** Percentage of vending machines by location, type of machine, and branding on machine — United States, School Health Policies and Practices Study, 2014

Location	Total School level (n=446) <sup>a,b</sup> %, (95% CI)	Middle School level (n=100) %, (95% CI)	High School level (n=315) %, (95% CI)
Cafeteria	25.9 (18.4-35.1)	28.1 (14.7-47.1)	24.5 (16.8-34.5)
Gymnasium	9.7 (5.9-15.4)	3.3 (1.0-9.9)	11.2 (6.3-19.4) <sup>c</sup>
Hallway	32.8 (23.5-43.6)	25.2 (11.2-47.4)	32.2 (22.5-43.7)
Quad/Courtyard	6.3 (2.6-14.5)	9.3 (2.4-30.3)	6.3 (2.2-16.5)
Other <sup>d</sup>	16.8 (10.3-26.2)	27.9 (12.0-52.2)	15.7 (9.1-25.7)
Unknown <sup>e</sup>	8.5 (4.2-16.4)	6.2 (1.5-22.0)	10.1 (4.7-20.1)

Vending machine type	Total School level (n=446) <sup>a,b</sup> %, (95% CI)	Middle School level (n=100) %, (95% CI)	High School level (n=315) %, (95% CI)
Food Only	28.5 (23.6-33.9)	31.6 (23.2-41.5)	27.2 (21.8-33.4)
Cold Beverage Only <sup>f</sup>	66.5 (61.4-71.2)	63.3 (54.7-71.2)	68.1 (61.9-73.7) <sup>c</sup>
Milk only	0.5 (0.1-1.8)	0	0.6 (0.2-2.4)
Plain Water only	6.1 (4.1-8.9)	16.1 (9.4-26.2)	2.6 (1.1-5.8) <sup>c</sup>
Sugar-sweetened beverage only	4.5 (2.5-7.9)	4.2 (1.1-14.9)	4.8 (2.5-9.1)
Diet beverage only	4.1 (2.1-7.8)	3.5 (1.2-9.3)	4.4 (2.0-9.3)
Mixed <sup>g</sup>	50.5 (45.4-55.7)	37.7 (26.3-50.7)	55.0 (49.0-60.8) <sup>c</sup>
Undetermined <sup>h</sup>	0.6 (0.1-2.6)	0	0.8 (0.2-3.5)
Ice cream goods or frozen dessert only	1.6 (0.7-3.5)	2.2 (0.5-8.5)	1.6 (0.6-4.2)
Mixed <sup>i</sup>	2.0 (1.0-4.1)	2.9 (1.0-8.6)	1.2 (0.5-3.1)
Undetermined <sup>j</sup>	1.4 (0.5-3.9)	0	1.9 (0.7-5.2)

Branding and other messaging	Total School level (n=446) <sup>a,b</sup> %, (95% CI)	Middle School level (n=100) %, (95% CI)	High School level (n=315) %, (95% CI)
Branding on machine	66.3 (61.0-71.2)	61.4 (52.0-70.0)	68.3 (62.0-74.0)
Text on machine promoting healthy options	41.0 (33.9-48.5)	24.0 (14.0-38.0)	44.6 (36.1-53.4) <sup>c</sup>
Picture on machine promoting healthy options	38.0 (31.4-45.0)	33.1 (21.1-47.7)	38.9 (31.0-47.5)

Abbreviation: CI = confidence interval

<sup>a</sup>Total (n=446) includes machines in elementary (not shown, n=31), middle (n=100), and high (n=315) schools.

<sup>b</sup>Among schools with any vending machines, the weighted average number of vending machines (95% CIs) was 3.6 (1.9-5.2) among elementary schools; 3.5 (2.9-4.2) among middle schools; and 5.5 (4.6-6.4) among high schools.

<sup>c</sup>Significant difference (p < 0.05) between middle and high schools.

<sup>d</sup>Vending machine location was identifiable, but the category was not listed as a coding option; therefore, the location was manually entered in the database.

<sup>e</sup>Vending machine location was not known.

<sup>f</sup>Percentages of cold beverage machine subcategories (e.g., milk only) are based on the weighted total vending machine count (n=446)

<sup>g</sup>Vending machine contained a mix of beverage products, such as diet and regular soda, or fruit juice, water, and sports drinks.

<sup>h</sup>There was not adequate information in the photographs to accurately assign the machine to a listed beverage category.

<sup>i</sup>Vending machine contained a mix of products, such as offering both food and beverages.

<sup>j</sup>Coder could not see inside the vending machine, or all of the items were obstructed and there was no signage on the machine indicating type of machine.

*Description of available food products in vending machines (Table 2)*

- The most prevalent food products were:
  - Chips (regular or baked) and crackers (30.0%)
  - Cakes, cookies, toaster pastries, and other baked goods (24.6%)
  - Granola bars, cereal bars, or protein/meal replacement bars (24.5%)
  - Candy (18.8%)
  - Fruit snacks (13.6%)
- Less than 1% of machines contained:
  - Fruit (dried or canned)
  - Vegetables
  - Yogurt
  - Cereal
  - Entrée items
- Food products that were not found in any vending machines include: fresh fruit (whole or cut); meal replacement shakes (e.g. Slim Fast); and salads (e.g. green salad, not tuna salad, not egg salad).
- There were no significant school-level differences in prevalence of food products.



**TABLE 2.** Percentage of vending machines containing specific categories of food products — United States, School Health Policies and Practices Study, 2014<sup>a</sup>

Vending machine type	Total School level (n=444) <sup>b</sup> %, (95% CI)	Middle School level (n=100) %, (95% CI)	High School level (n=313) %, (95% CI)
Cakes, cookies, toaster pastries (e.g., Pop Tarts), other baked goods	24.6 (19.8-30.1)	24.3 (16.3-34.6)	23.5 (17.8-30.4)
Candy (e.g., chocolate, candy bar, other candy)	18.8 (14.0-24.6)	18.4 (9.1-33.6)	19.4 (14.1-26.2)
Cereal (ready-to-eat, oatmeal)	0.3 (0.1-1.5)	1.2 (0.2-8.2)	0.1 (0.0-1.0)
Cheese (non-artificial cheese), hard boiled eggs, jerky, meat snacks, tuna, hummus	7.7 (5.1-11.6)	7.0 (3.3-14.2)	8.5 (5.2-13.4)
Chips (regular or baked), crackers (include cheese spread with crackers)	30.0 (25.3-35.3)	33.2 (25.0-42.5)	28.0 (22.7-34.1)
Entrée (e.g., Hot Pockets, sandwich, burger, frozen meal)	0.1 (0.0-0.5)	0.4 (0.0-2.6)	0
Frozen or dairy dessert (e.g., ice cream, milkshakes, popsicles, smoothies, or yogurt drinks)	1.6 (0.8-3.5)	2.5 (0.7-8.4)	1.6 (0.6-4.2)
Fruit - canned	0.3 (0.0-2.0)	0.7 (0.1-4.9)	0.2 (0.0-1.5)
Fruit - dried (not mixed with nuts or seeds)	0.4 (0.1-1.5)	1.0 (0.1-7.0)	0.3 (0.0-1.8)
Fruit snacks (e.g., fruit roll up, fruit leather)	13.6 (9.1-19.9)	10.1 (5.3-18.5)	12.3 (8.3-17.8)
Granola bar, cereal bar, protein/meal replacement bar	24.5 (19.3-30.5)	24.8 (16.4-35.7)	23.0 (17.9-29.1)
Gum	3.3 (1.5-7.0)	0.8 (0.1-6.1)	4.3 (1.9-9.1)
100% nuts or seeds	8.7 (5.8-12.9)	8.5 (3.7-18.5)	9.4 (5.9-14.8)
Popcorn	6.8 (4.3-10.5)	9.3 (3.7-21.6)	6.9 (4.2-11.1)
Trail mix	5.8 (3.5-9.4)	4.9 (1.4-15.5)	6.3 (3.6-10.9)
Vegetables (e.g. baby carrots)	0.1 (0.0-1.0)	0	0.2 (0.0-1.4)
Yogurt	0.2 (0.0-1.6)	0	0.3 (0.0-2.2)
Food (Undetermined) <sup>c</sup>	3.4 (1.6-7.0)	2.9 (0.9-9.1)	3.5 (1.5-8.2)
Other food <sup>d</sup>	0.9 (0.3-3.2)	0	1.3 (0.4-4.4)

Abbreviation: CI = confidence interval

<sup>a</sup>Food products not found in any vending machines include: fruit- fresh (whole or cut); meal replacement shake (e.g. Slim Fast); and salad (e.g. green salad, not tuna salad, not egg salad).

<sup>b</sup>Total (n=444) includes machines in elementary (not shown, n=31), middle (n=100), and high (n=313) schools. There were 2 empty vending machines; the coder was able to extract only machine-level data for these 2 machines.

<sup>c</sup>Coder was unable to clearly view and identify the food product.

<sup>d</sup>Food product was identifiable but the category was not listed as a coding option.

**Description of available beverages in vending machines (Table 3)**

- The most prevalent beverage products were:
  - Plain water (49.2%)
  - Diet soda (20.5%)
  - Diet flavored waters (18.1%)
  - Non-diet sports drinks (17.1%)
  - Fruit flavored drinks (not 100% juice) (14.6%)
- Few machines (11.9%) contained 100% fruit or vegetable juice and <5% contained milk.
- Beverage products not found in any vending machines include: nonfat (skim) plain milk; nonfat (skim) flavored milk; whole plain milk; and unsweetened coffee drinks.
- Three beverage products varied by school level and were more prevalent in high school machines than in middle school machines:
  - Diet sports drinks (15.1% vs. 3.3%),
  - Undetermined sports drinks (2.7% vs. 0%), and
  - Diet tea drinks (5.3% vs. 0%).

**TABLE 3.** Percentage of vending machines containing specific categories of beverage products — United States, School Health Policies and Practices Study, 2014<sup>a</sup>

Water	Total School level (n=444) <sup>b</sup> %, (95% CI)	Middle School level (n=100)%, (95% CI)	High School level (n=313)%, (95% CI)
Water (plain), with or without carbonation	49.2 (44.1-54.3)	49.3 (40.0-58.7)	48.9 (42.3-55.6)
Flavored/enhanced water (non-diet), with or without carbonation	7.1 (4.4-11.2)	6.0 (2.8-12.4)	7.8 (4.5-13.2)
Flavored/enhanced water (diet), with or without carbonation	18.1 (13.1-24.5)	10.5 (5.1-20.3)	19.2 (13.3-26.8)
Flavored/enhanced water (undetermined) <sup>c</sup>	1.0 (0.3-3.8)	0.3 (0.0-2.4)	0.5 (0.1-2.1)
Water (undetermined) <sup>c</sup>	0.2 (0.0-0.8)	1.0 (0.2-4.6)	0
Milk	Total School level (n=444) <sup>b</sup> %, (95% CI)	Middle School level (n=100)%, (95% CI)	High School level (n=313)%, (95% CI)
1% (low-fat) plain milk	0.2 (0.0-1.1)	0	0.2 (0.0-1.5)
1% (low-fat) flavored milk	0.8 (0.3-2.1)	2.5 (0.7-8.3)	0.5 (0.1-1.7)
2% plain milk	0.5 (0.1-1.8)	0	0.6 (0.2-2.5)
2% flavored milk	0.3 (0.1-1.1)	0.7 (0.1-4.9)	0.2 (0.0-1.5)
Whole flavored milk	0.4 (0.1-2.7)	0.7 (0.1-4.9)	0.4 (0.0-2.5)
Flavored milk (undetermined) <sup>c</sup>	1.9 (0.9-4.2)	1.9 (0.4-8.1)	2.2 (0.9-5.2)
Milk (undetermined) <sup>c</sup>	0.1 (0.0-0.5)	0	0.1 (0.0-0.6)

<b>Fruit Juice</b>	<b>Total School level (n=444)<sup>b</sup> %, (95% CI)</b>	<b>Middle School level (n=100)%, (95% CI)</b>	<b>High School level (n=313)%, (95% CI)</b>
100% fruit or vegetable juice	11.9 (8.2-17.1)	13.2 (5.9-27.1)	10.5 (6.8-15.9)
Fruit-flavored drink that is not 100% juice	14.6 (10.4-20.2)	10.8 (6.2-18.3)	15.9 (10.9-22.7)
Fruit or vegetable drink (undetermined) <sup>c</sup>	1.4 (0.6-3.5)	0.7 (0.2-2.9)	1.4 (0.5-4.0)
<b>Sports Drink</b>	<b>Total School level (n=444)<sup>b</sup> %, (95% CI)</b>	<b>Middle School level (n=100)%, (95% CI)</b>	<b>High School level (n=313)%, (95% CI)</b>
Sports drink (non-diet)	17.1 (12.4-23.1)	13.1 (6.0-26.1)	19.1 (13.6-26.4)
Sports drink (diet)	11.7 (8.0-16.8)	3.3 (1.1-9.6)	15.1 (10.6-21.1) <sup>d</sup>
Sports drink (undetermined) <sup>c</sup>	2.2 (1.0-4.9)	0	2.7 (1.1-6.2) <sup>d</sup>
<b>Energy Drink</b>	<b>Total School level (n=444)<sup>b</sup> %, (95% CI)</b>	<b>Middle School level (n=100)%, (95% CI)</b>	<b>High School level (n=313)%, (95% CI)</b>
Energy drink (non-diet)	1.0 (0.3-3.4)	0	1.1 (0.2-4.5)
Energy drink (diet)	0.1 (0.0-0.5)	0	0.1 (0.0-0.6)
<b>Iced tea/coffee/other beverages</b>	<b>Total School level (n=444)<sup>b</sup> %, (95% CI)</b>	<b>Middle School level (n=100)%, (95% CI)</b>	<b>High School level (n=313)%, (95% CI)</b>
Sweetened tea	7.5 (4.9-11.4)	5.5 (2.2-12.9)	8.3 (5.1-13.2)
Unsweetened tea	0.3 (0.1-1.1)	0	0.3 (0.1-1.4)
Diet tea	3.9 (2.0-7.6)	0	5.3 (2.7-10.2) <sup>d</sup>
Tea (undetermined) <sup>c</sup>	0.5 (0.1-1.9)	0	0.7 (0.2-2.6)
Sweetened coffee drink	0.5 (0.1-2.0)	1.4 (0.2-9.2)	0.4 (0.0-2.5)
Beverage (undetermined) <sup>c</sup>	5.0 (3.1-8.0)	8.6 (3.7-18.8)	4.7 (2.7-8.0)
Other beverages	1.4 (0.4-4.9)	0	2.0 (0.6-6.7)
<b>Soda</b>	<b>Total School level (n=444)<sup>b</sup> %, (95% CI)</b>	<b>Middle School level (n=100)%, (95% CI)</b>	<b>High School level (n=313)%, (95% CI)</b>
Soda (non-diet)	9.1 (6.4-12.8)	8.7 (4.6-16.0)	8.8 (5.7-13.3)
Soda (diet)	20.5 (15.4-26.9)	16.1 (8.1-29.5)	23.1 (16.6-31.1)
Soda (undetermined) <sup>c</sup>	2.2 (1.1-4.5)	2.0 (0.5-8.6)	2.1 (0.9-4.8)

Abbreviation: CI = confidence interval

<sup>a</sup>Beverage products not found in any vending machines include: nonfat (skim) plain milk; nonfat (skim) flavored milk; whole plain milk; and unsweetened coffee drink.

<sup>b</sup>Total (n=444) includes machines in elementary (not shown, n=31), middle (n=100), and high (n=313) schools. There were 2 empty vending machines; the coder was able to extract only vending machine-level data for these 2 machines.

<sup>c</sup>Coder was unable to clearly view and identify the product category.

<sup>d</sup>Significant p-value from t-tests between middle and high school levels; p<0.05.

<sup>e</sup>Beverage product was identifiable but the category was not listed as a coding option.

## Discussion

In 2014, students had access to a range of food and beverage products in school vending machines. Beverage machines were more prevalent than food machines. Although plain water was the most common beverage in school vending machines, sugar-sweetened beverages (e.g. regular soda, sports drinks, and fruit drinks) were also prevalent. Chips and crackers were the most common food in vending machines followed by baked goods, granola and other bars, and candy. Fruits, vegetables, yogurt, and milk were not commonly seen in school vending machines. There were few differences in product availability between middle and high schools. Other studies have reported that policies at state and district levels vary by school level, which would imply differences in vending machine contents<sup>(10-11)</sup>. Additionally, other national surveillance systems have observed food and beverage variability by school level, but those did not use photographs as data sources<sup>(6-7)</sup>.

This study also examined the marketing on the front of the vending machine since research indicates that food and beverage marketing influences children's preferences and dietary intake<sup>(12-15)</sup>. New requirements for local school wellness policies allow only foods and beverages that meet or exceed the Smart Snacks standards to be marketed to students during the school day, including products displayed on school vending machines<sup>(5)</sup>. This study found that most vending machines had a picture or text with a product's brand name on the machine, but it was not possible to compare this information with the Smart Snacks standards. To comply with federal marketing requirements, schools must ensure that pictures and text on machines meet Smart Snacks standards, and work with vending machine companies to replace those that do not.

This study is subject to limitations. Because data were abstracted from photographs, researchers were not able to consistently determine if the machines were operational when the photograph was taken. In some cases, photo quality and item placement limited researchers' ability to obtain full product information. For example, beverages in some vending machines were placed so that the back of the label was facing out, which prevented coders from identifying the brand name and product size. Also, some photos were blurry, or taken at an angle that prevented coders from identifying relevant information. Moreover, information on missing products from empty slots could not be obtained; therefore, this method could have missed additional items that were available to students. Furthermore, significance testing did not correct for multiple comparisons.

## Implications for Practice

These data were collected prior to the implementation of the Smart Snacks standards. Therefore, a follow-up study would likely show substantial improvements in the content of school vending machines. Regardless, federal and state agencies, non-governmental organizations, and school health councils<sup>(16)</sup> can continue to provide training and technical assistance on meeting the Smart Snacks standards to school nutrition professionals, other school departments (e.g., administration), and groups (e.g., Booster Clubs) that may be responsible for specific vending machines. There are several resources to help schools find compliant products. The Alliance for a Healthier Generation has communication materials to help inform everyone responsible for selling snacks and beverages across campus about Smart Snacks, a Smart Food Planner that identifies compliant products, and a Smart Snacks Product Calculator that determines if products are compliant based on the information on the Nutrition Facts Label<sup>(17)</sup>. USDA also has resources to help schools implement the Smart Snacks in School standards<sup>(18)</sup>. These ongoing efforts will help ensure that students have access to healthier foods and beverages in school vending machines.

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