

6-2014

## Development, Implementation, and Validation of the Health Density Vending Machine Audit Tool (HDVMAT)

Melissa Matthews  
*Syracuse University*

Follow this and additional works at: <https://surface.syr.edu/thesis>



Part of the [Nutrition Commons](#), and the [Other Food Science Commons](#)

---

### Recommended Citation

Matthews, Melissa, "Development, Implementation, and Validation of the Health Density Vending Machine Audit Tool (HDVMAT)" (2014). *Theses - ALL*. 27.  
<https://surface.syr.edu/thesis/27>

This Thesis is brought to you for free and open access by SURFACE. It has been accepted for inclusion in Theses - ALL by an authorized administrator of SURFACE. For more information, please contact [surface@syr.edu](mailto:surface@syr.edu).

## **Abstract**

Vending machines may be contributing to the obesogenic food environment. The Health Density Vending Machine Audit Tool (HDVMAT) was developed to comprehensively evaluate and score vending machines based on machine accessibility, product healthfulness, price, and promotion. A novel nutrient-dense scoring system was created to determine the healthfulness of vended snacks based upon calories and macro/micro-nutrients and of beverages based on type and/or calories. The HDVMAT was implemented in snack and beverage university machines in different states. Nutrition Environment Measures Survey-Vending (NEMS-V) was used to validate the nutrient-density score. Significant differences in HDVMAT snack and beverage scores were found between states. Overall the HDVMAT is comparable to the NEMS-V, but uses a unique nutrient-dense scoring approach to evaluate snacks and beverages along a continuum of healthfulness criteria, offering a more accurate representation of the nutritional quality of vended products.

Development, Implementation, and Validation of the Health Density Vending Machine Audit  
Tool (HDVMAT)

by

Melissa Matthews

B.S., State University of New York at Geneseo, 2012

Thesis

Submitted in partial fulfillment of the requirement for the degree of Master of Science in  
Nutrition Science

David B. Falk College of Human Sport and Dynamics  
Syracuse University  
June 2014

Copyright © Melissa Matthews 2014  
All Rights Reserved

## **ACKNOWLEDGEMENTS**

I would like to first and foremost thank my family, especially Mom, for all of your continued love, support, and encouragement throughout not only this endeavor, but throughout all of my endeavors. To all of my friends and Tim, thank you for always putting up with and keeping me sane during this process. To Holly, Shelagh, and Kelly I cannot thank you enough for serving as research assistants and collecting data for this project. I would also like to thank the university partners of the United States Department of Agriculture Multi-state Research Project NC1193 and their research assistants for collecting data for this project. Finally, I would like to give a BIG thank you to my advisor, Tanya Horacek, and my committee members, Lynn Brann and Sudha Raj because without you none of this would have been possible. Your continued feedback, support, and patience has not only made me a better student, but a better professional. From your guidance I feel confident that I will become a contributing member to the dietetics profession.

## TABLE OF CONTENTS

<b>ACKNOWLEDGEMENTS .....</b>	<b>IV</b>
<b>TABLE OF CONTENTS .....</b>	<b>V</b>
<b>LIST OF TABLES .....</b>	<b>VI</b>
<b>SYSTEMATIC LITERATURE REVIEW MANUSCRIPT – VENDING MACHINE</b>	
<b>METHODOLOGY: A SYSTEMATIC REVIEW .....</b>	<b>1-30</b>
Abstract .....	1
Introduction.....	2-4
Methods.....	5-6
Results.....	6-11
Discussion .....	11-16
Conclusions.....	16
Tables .....	17-27
References .....	28-30
<b>THESIS MANUSCRIPT – DEVELOPMENT, IMPLEMENTATION, AND VALIDATION OF THE HEALTH DENSITY VENDING MACHINE AUDIT TOOL (HDVMAT).....</b>	
<b>Abstract .....</b>	<b>31</b>
<b>Introduction.....</b>	<b>32-36</b>
<b>Methods.....</b>	<b>36-45</b>
<b>Results.....</b>	<b>45-49</b>
<b>Discussion .....</b>	<b>49-56</b>
<b>Implications for Future Research and Practice .....</b>	<b>56</b>
<b>Tables .....</b>	<b>57-61</b>
<b>References .....</b>	<b>62-64</b>
<b>APPENDIX .....</b>	<b>65-121</b>
Appendix A: Table – Product Healthfulness Across All States .....	65
Appendix B: HDVMAT: Quick Form Training Instructions .....	66-84
Appendix C: NEMS-V Instructions .....	85
Appendix D: HDVMAT: Quick Form Training Powerpoint .....	86-95
Appendix E: Qualtrics HDVMAT Survey.....	96-100
Appendix F: Qualtrics HDVMAT Snack Survey .....	101-112
Appendix G: Qualtrics HDVMAT Beverage Survey .....	113-121
<b>BIBLIOGRAPHY .....</b>	<b>122-125</b>
<b>VITA.....</b>	<b>126</b>

## LIST OF TABLES

Table 1: Comparison of Vending Machine Environmental Assessment Studies .....	17-20
Table 2: Comparison of Vending Machine Environmental Intervention Studies.....	21
Table 3: Comparison of Snack Healthfulness Criteria .....	22-24
Table 4: Comparison of Beverage Healthfulness Criteria .....	25-26
Table 5: Comparison of Previous Conclusions Regarding Vended Product Healthfulness .....	27
Table 6: HDVMAT Healthfulness Criteria.....	57
Table 7: HDVMAT Scoring Instrument .....	58
Table 8: Campus Characteristics and Mean HDVMAT Snack and Beverage Scores.....	59
Table 9: Overall Distribution and Mean HDVMAT Scoring Criterion for All Evaluated Buildings .....	60
Table 10: Quick Method and NEMS-V Comparison of Product Healthfulness.....	61
Table 11: Product Healthfulness Across All States .....	65

# VENDING MACHINE ASSESSMENT METHODOLOGY: A SYSTEMATIC REVIEW

## Abstract

The nutritional quality of food and beverage products sold in vending machines has been implicated as a contributing factor to the development of an obesogenic food environment. How comprehensive, reliable, and valid are the current assessment tools for vending machines to support or refute these claims? A systematic review was conducted to summarize, compare, and evaluate the current methodologies for vending machine assessment. A total of 23 relevant research studies published between 1981 and 2013 met inclusion criteria for this review. The methodological variables reviewed in this study include assessment tool type, study location, machine accessibility, product availability, healthfulness criteria, portion size, price, product promotion, and quality of scientific practice. There were wide variations in the depth of the assessment methodologies and product healthfulness criteria utilized among the reviewed studies. Of the reviewed studies, 39% evaluated machine accessibility, 91% evaluated product availability, 96% established healthfulness criteria, 70% evaluated portion size, 48% evaluated price, 52% evaluated product promotion, and 22% evaluated the quality of scientific practice. Of all reviewed articles, 87% reached conclusions that provided insight into the healthfulness of vended products and/or vending environment. Product healthfulness criteria and complexity for snack and beverage products was also found to be variable between the reviewed studies. These findings make it difficult to compare results between studies. A universal, valid, and reliable vending machine assessment tool that is comprehensive yet user-friendly is recommended.



## **Introduction**

According to recent National Health and Nutrition Examination Survey (NHANES) data, in 2009-2010 the percentage of overweight children and adolescents (BMI  $\geq$  85<sup>th</sup> percentile) between the ages of 2 and 19 was 31.8% (Ogden et al., 2012). Additionally, the percentage of obese children and adolescents (BMI  $>$  95<sup>th</sup> percentile) 2 to 19 years old was 16.9% in 2009-2010 (Ogden et al., 2012). Childhood obesity is particularly problematic because it is a predictor of many chronic health conditions, such as obesity, type-2 diabetes, hypertension, and cardiovascular disease in adulthood (Deckelbaum & Williams, 2001). In the US, the increasing percentage of overweight and obese adults, currently 63%, has been associated with the increasing incidence of several chronic health issues, particularly type-2 diabetes and cardiovascular disease (Ogden et al., 2012).

Nutrition and food environments are implicated as contributing factors to the rising obesity and chronic health disease rates seen in the US (Voss et al., 2012). For children and adolescents, schools are a prominent source of calories, with as much as one third of a child or adolescent's daily caloric intake, regardless of nutritional quality, being consumed at school (USDA, n.d.). Although meals provided by the federally assisted school meal programs, the National School Lunch and Breakfast Programs (NSLP and NSB), must satisfy federal nutrition standards, competitive food items sold in schools currently do not (USDA, n.d.; Harnack et al., 2000). As defined by the United States Department of Agriculture (USDA), competitive foods are offered in schools that are supplemental to school meal programs, such as foods sold in vending machines and school stores (USDA, n.d.). Although steps have been taken to improve the competitive food environments of schools, such as the USDA Child Nutrition and WIC Reauthorization Act of 2004, efforts thus far have proven insufficient (Pasch et al., 2011; Kubik

et al., 2013). Previous research suggests that the majority of competitive food items offered in vending machines are high in fat, calories, and sugars than is recommended after the implementation of such policies (Pasch et al., 2011; Kubik et al., 2013). However, proposed amendments to the NSLP and NSB guidelines that are posited to address, regulate, and change the competitive food environment in schools have been approved (USDA, 2013). Amendments to these federally funded programs, which are to be fully implemented in all elementary, middle, and high schools by July 2014, establish inclusive nutrition standards and guidelines for all food and beverage items sold in schools, including competitive items sold a la carte, in school stores, and in vending machines (USDA, 2013)

Depending on the type of food items available for purchase, vending machines, a major source of competitive foods, can either positively or negatively affect the diets of children, adolescents, and adults (Rovner et al., 2011). The presence of vending machines in a multitude of settings influence the food choices of children, adolescents, and adults by providing convenient and easy access to a plethora of unhealthy snacks and beverages (New & Livingstone, 2003). Vending machines are becoming increasingly more common in a wide variety of settings including schools, universities, healthcare facilities, and various worksites. According to the *2011 State of the Vending Industry Report*, 28.5% of all vending machines in the US were located in offices, 26.8% in manufacturing buildings, 9.1% in retail sites, 8.8% in hospitals and nursing homes, 7.0% in restaurants, bars, and clubs, 6.8% in elementary, middle, and high schools, and 5.9% in universities and colleges (Maras, 2011).

Since vending machines are becoming increasingly more prevalent and available in the US, they are responsible for supplying a growing proportion of an individual's daily energy intake. In 2009, according to the third School Nutrition Dietary Assessment Study, 40% of

children and adolescents consumed at least one competitive food daily while at school, with the highest consumption rates seen among high school students (Fox et al., 2009). Beyond the primary and secondary school environment, 19% of a sample of staff and faculty (n=806) at a large urban university indicated that they purchase snacks from vending machines (Freedman & Rubsinstein, 2010). Additionally, although vending machines are more often used for snacking, a study of 1,918 US adults working outside the home, 4.4% indicated vending machines as their primary site for purchasing lunch items during work hours (Blanck et al., 2009). Furthermore, for individuals working long hours, vending machines may be the only available source of food at the worksite, thus demonstrating the importance of healthy product availability in vending machines (Escoto et al., 2010). Similarly, in university, manufacturing, and healthcare facility environments accessibility to dining options may be limited due to cafeteria location and hours of operation, rendering vending machines the sole source of foods and beverages readily available to individuals in these environments (Byrd-Bredbenner et al., 2012; Lawrence et al., 2009).

Since vending machines are becoming increasingly more prevalent and available, and thus supply a growing proportion of individuals' daily energy intake, it is important to accurately assess and monitor the nutritive value of vended products. Since diet and eating behaviors are strongly influenced by food availability and accessibility it is important to monitor and measure various aspects of the food and nutrition environment, which includes vending machines. The purpose of this systematic review is to summarize, compare, and evaluate the current available literature on vending machine assessment methodology. The information gathered from this systematic review will be used to earmark the variables important for inclusion in a universal vending machine assessment tool.

## **Methods**

A systematic literature review was conducted to determine the available information on vending machine assessment methodology. Only published peer-reviewed articles containing detailed methods for evaluating vending machines were reviewed. Specific databases searched included Scopus, PUBMED, MEDLINE, and Proquest. Article titles were searched within these databases for the specific keywords, (vending OR vending machine) AND (assessment OR evaluation OR audit) AND (snack OR food OR beverage OR drink). A total of 242 peer-reviewed articles, including duplicates, were retrieved from the databases that matched the search criteria for article title. The search results were all compiled into a master reference list and all duplicate studies were removed.

For all remaining research articles, the full text was read to determine if the research study met the inclusion criteria for this systematic review. Inclusion criteria for this review were as follows. (a) The research article must be peer-reviewed. (b) One of the primary aims or objectives of the research study was to assess vending machines and/or vending machine products and/or the effects of environmental interventions on vending machine use, product availability, and/or purchasing patterns by consumers. (c) The research article provided detailed methodology on how vending machines and/or vending machine products were evaluated. (d) The research study evaluated or manipulated at least one key vending machine assessment variable including accessibility, availability, healthfulness, portion size, price, and promotion. Additionally, abstracts from all references obtained from relevant first tier research articles secured from search engines that met the inclusion criteria were reviewed. Additional second tier research articles were selected if they met the aforementioned inclusion criteria. Research articles that evaluated vending machines in the context of a larger environmental audit were

excluded from this study. This systematic review includes research studies whose primary focus was to evaluate the vending machine environment. In total, 23 articles published between 1981 and 2013 are summarized, compared, and evaluated in this systematic review (Table 1, Table 2).

## **Results**

Of the 23 articles summarized, compared, and evaluated for this study, 78% (18 articles) evaluated vending machines and/or vending machine products (Table 1). Additionally, 22% (5 articles) investigated the effects of environmental interventions on vending machine use, product availability, and/or vending machine purchasing patterns (Table 2). All studies included in this systematic review evaluated or manipulated at least one key vending machine assessment variable: accessibility, availability, healthfulness, portion size, price, or promotion.

### *Study Location*

Of the 23 articles reviewed, 56% (13 studies) were conducted in primary and secondary schools, 17% (4 studies) in universities, 17% (4 studies) in healthcare facilities, and 13% (3 studies) in worksites. The majority of studies were conducted in only one type of environment, but one intervention study was implemented in both schools and worksites.

### *Assessment Tool Design*

A wide assortment of different assessment tools have previously been used and developed to evaluate vending machines. In the reviewed literature, the most commonly used method in 52% of studies evaluated vending machines was an environmental assessment, defined as a physical direct observation and review of the actual vending machines. Researchers or research assistants performed the majority of environmental assessments, but food service directors performed the environmental assessment in one study. Researchers in 39% of studies

administered questionnaires to a wide variety of respondents including students, child nutrition supervisors, principals, school personnel, worksite employees, and adults to evaluate respective vending machine environments. Additionally, 26% of studies recorded vending machine sales to track purchasing and consumption patterns of consumers. Additionally, 8% of studies utilized qualitative methods, telephone interviews and focus groups, to gather in-depth perceptions when assessing vending machines. Although studies have used similar methodologies to evaluate vending machines and/or vended products, there is wide variability between assessment tools. Each vending machine evaluation or intervention study developed a unique assessment tool to investigate vending machines, each with different evaluation components and criteria. Additionally, some studies utilized one assessment tool type, while others triangulated methodologies and utilized variety of different assessment tools to evaluate vending machines.

#### *Accessibility*

Of the 23 articles reviewed, 39% (9 studies) investigated vending machine accessibility. Researchers evaluated and recorded the location of vending machines in 35% of studies. Researchers also evaluated and recorded vending machine hours of operation in 30% of studies.

#### *Availability*

Product availability was the most common vending machine assessment variable found in 91% (21 studies) of studies: evaluated in 78% and manipulated in 13%. The majority of studies, 43%, recorded the number of all snacks and/or beverages within evaluated vending machines. Similarly, 39% recorded the percentage of 'healthy' snack and/or beverage products within evaluated vending machines based upon each study's respective healthfulness criteria standards (Table 3, Table 4). Additionally, 17% recorded the number of machines, 17% recorded the percentage of specific snack and/or beverage product types, and 13% evaluated consumer

perceptions of product availability within vending machines. Furthermore, 13% implemented interventions that increased the availability of ‘healthy’ snack and/or beverage products in vending machines.

### *Healthfulness Criteria*

The majority of reviewed studies, 96% (22 studies), previously established healthfulness criteria to evaluate the nutritional quality of vended snacks and/or beverages in order to classify products as healthy or unhealthy (Table 3; Table 4). Healthfulness criteria were established for snack products in 87% (20 studies). Combinations of three different types of classification methods have been employed to establish the healthfulness of vended snacks; 65% used macro- and/or micronutrient content as a basis for healthfulness, 34% used caloric content, and 9% used snack type. However, exact healthfulness criteria used to classify products as healthy or unhealthy was unspecified in 13%. Among the reviewed studies, the established healthfulness criteria for vended snack products have varied from simple to complex (Table 3).

Beverage products have been evaluated less extensively, with healthfulness criteria established in 70% (16) of the studies. Similar to snacks, combinations of several different types of classification methods have been employed to establish the healthfulness of vended beverages: 43% used beverage type, 17% used added sweetener content, 13% used caloric content, and 13% used macro- and/or micronutrient content. Among the reviewed studies evaluating beverage healthfulness, the specific healthfulness criteria for vended beverage products were variable.

### *Previous Conclusions on Vended Product Healthfulness and Vending Environment*

Of all reviewed articles, 87% (20 studies) reached conclusions that provided insight into the healthfulness of vended products and/or vending environment (Table 5). Only 30% of all reviewed studies reached conclusions regarding the healthfulness of both snack and beverage

products. Furthermore, 1 study reached conclusions regarding the healthfulness snacks alone and 1 study reached conclusions regarding the healthfulness of beverages alone. Collectively, results from these studies indicated that the majority of snacks and beverages available in vending machines were unhealthy and did not meet respective healthfulness criteria.

Additionally, 22% (5) of all reviewed articles reached conclusions regarding the effectiveness of previously implemented nutrition policies, programs, and interventions that were targeted at improving the vending machine environment. Results from 4 out of these 5 studies indicated that nutrition policies, programs, and interventions were effective at improving healthy product availability and consumption within the vending machine environment healthy product availability. However, 1 out of the aforementioned 5 studies indicated that the sales of healthy vending machine products did not increase when healthy product availability was increased.

Similarly, 22% (5) of all reviewed studies reached conclusions regarding the effects of environmental interventions that increased healthy product availability, increased healthy product promotional signage, and/or reduced healthy product price. Collectively, results from these studies indicated that healthy product sales increased following environmental interventions on vending machines. Although, 1 study indicated that a low percentage of consumers actually purchased healthy products from vending machines, despite their presence.

### *Portion Size*

Among the reviewed studies, when assessing the healthfulness of vended snacks and/or beverages, 70% (16 studies) differentiated product evaluation based on package size versus serving size. The majority of all reviewed studies, 43%, evaluated snack and beverage healthfulness based on package size, while few studies, only 30%, evaluated snack and beverage healthfulness based on serving size.



### *Price*

Prices of vended snack and beverage products have also been commonly evaluated and/or manipulated in 48% (11 studies) of the reviewed studies. Of the reviewed studies, 22% recorded the prices of all snacks and beverages within the evaluated vending machines, with one study recording the average price of 'healthy' and 'unhealthy' products. Additionally, only 9% of all reviewed studies evaluated consumer perceptions regarding the prices of healthy and unhealthy products sold in vending machines. Furthermore, 17% of all reviewed studies implemented interventions to investigate the effects of 'healthy' product price reductions on vending machine sales.

### *Promotion*

Product promotion was also a commonly assessed variable in vending machines, evaluated and/or manipulated in 52% (12 studies) of the reviewed studies. However, only 22% recorded the presence of promotional signage and advertisements on or surrounding vending machines within the environment. Additionally, 13% recorded the presence of machine front advertisements and logos, 13% recorded the presence of healthy and unhealthy identification labels on individual snack and/or beverage products within vending machines, and 9% evaluated consumer perceptions regarding product promotion regarding vending machines and vending machine products. Furthermore, 17% implemented interventions to investigate the effects of increased healthy production promotional signage and identification labels on vending machine sales.

### *Quality of Scientific Practice*

Although many vending machine assessment tools have been developed and implemented in a variety of settings, only 22% (5 studies) of the reviewed studies established

validity and/or reliability for their assessment tools. Only 9% implemented assessment tools that were validated, with only one study establishing face validity and one study establishing content validity. Additionally, only 13% evaluated the reliability of their respective assessment tools, with 2 studies establishing inter-rater reliability only, and 1 study establishing inter-rater and test-retest reliability.

## **Discussion**

Through a summary, evaluation, and comparison of the current literature on vending machine assessment methodologies, several key variables were identified as important to accurately evaluate the vending machine environment; price, promotion, accessibility, availability, package size, and healthfulness criteria. Product price is an important variable to evaluate because price can have a strong influence over the purchasing behaviors of consumers (Callaghan et al., 2010). Generally, energy-dense products are perceived to be less expensive than healthier nutrient-dense products, which can influence an individual's dietary choices from vending machines (Callaghan et al., 2010). Price is also commonly cited as a barrier to purchasing healthier products (Callaghan et al., 2010). Additionally, a pricing intervention study in Minnesota schools and worksites found that when the prices of low-fat snacks were reduced the sales of low-fat items increased (French et al., 2003). Although research demonstrates that the price of vended products is an important factor to consider during an evaluation of vending machines, only about 50% of the articles reviewed in this study included product price as an assessment variable.

Product promotion of both healthy and unhealthy vended snacks and beverages is also an important variable to include because brand logos and product advertisements are known to have

an influential effect on snack and beverage consumption. A survey of nearly 5,000 Canadian adolescents revealed that the presence of snack and beverage logos was positively associated with student purchase of vended snacks and beverages, particularly of unhealthy items such as salty snacks, candy, and sugar sweetened beverages (Minaker et al., 2011). Additionally, front of package nutrition claims and labels have also been shown to have an effect on product knowledge and consumption. Following an intervention at four schools in Ontario where healthier vended products were promoted to students and staff via promotional materials, nutrition information, and product flagging students indicated through focus groups that promotional signage and information raised their awareness of healthy products in vending machines (Callaghan et al., 2010). Although research demonstrates that the promotion of vended products is an important factor to consider during an evaluation of vending machines, only 52% of the articles reviewed in this study included product promotion as an assessment variable.

Machine accessibility is also an important factor to consider because if vending machines are not accessible or open to children, adolescents, and adults they cannot purchase vended snacks and beverages. Research has shown the students consume more sweets in schools when vending machines are more readily open and accessible (Rovner et al., 2011). However, only one third of the research studies included in this review evaluated machine accessibility as an assessment variable.

Similarly, product availability is an important factor to evaluate because if healthy food and beverage items are not readily available or present in vending machines, it is difficult for individuals to make healthy dietary choices. Surrounding food and nutrition environments have a strong influence on an individual's eating habits, thus if healthy snacks and beverages are available, individuals are capable of improving dietary intake. Following an intervention in bus

garages where the availability of healthy vended products was increased, the sales of healthy vended products also increased (French et al., 2010). In order to determine healthy product availability within vending machines, healthfulness criteria for vended snacks and beverages must be established. Vended product healthfulness should also be evaluated based on the product's package size instead of the product's serving size, because research has shown that consumers have a tendency to consume the entire package of a vended product rather than just consuming the recommended serving size (Antonuk & Block, 2006).

The majority of vending machine assessment and intervention studies have been targeted to evaluate and determine healthy product availability in vending machines. The nutritional quality of food and beverage products sold in vending machines has been implicated as a contributing factor to an obesogenic food environment. Findings from previous vending machine assessment studies provide support for this claim. An audit of vending machines in train stations in Australia found that only 8 out of the 3,048 identified snack items were considered to be healthier choices (Kelly et al., 2012). Similarly, an assessment of vending machines at secondary institutions in the US found that the majority of snacks in vending machines were high in fat and calories and the majority of beverages were high in calories and sugar (Byrd-Bredbenner et al., 2012). Overall, the majority of food and beverage products sold in vending machines are considered to be of low nutritional value.

Substantial variability was found between the reviewed studies with regards to the healthfulness criteria established to classify products as healthy. In previous studies the established healthfulness criteria for vended snack products have varied from simple to complex. Evaluating products using criteria that are too simplistic or lenient could result in overestimations of the presence of healthy products in vending machines. In a study that

evaluated snack product healthfulness solely on fat content, 35% of vended products were classified as healthy products, the majority of which were identified as hard candies (French et al., 2003). Hard candies, although low in fat and calories, have no real nutritive value and cannot really be considered healthy snacks. Similarly, evaluating products using criteria that are too inclusive or strict could result in underestimations of the presence of the healthy products in vending machines. The likelihood that a snack product will meet a substantive list of strict healthfulness criteria is relatively low.

Generally, combinations of three different types of classification methods have been employed to establish the healthfulness of vended snacks: macro/micronutrient content, caloric content, and snack type. However, the variability in established healthfulness criteria makes it difficult to compare results regarding healthy product availability between studies. If studies did not use the same healthfulness criteria to classify products, healthy product availability findings are not comparable between the studies. The majority of reviewed studies have focused primarily on the fat, sugar, sodium, and/or caloric content of snacks, which are all important criteria to consider as they are all food components that should be reduced in the American diet as outlined by the *2010 Dietary Guidelines for Americans* (USDA, 2010). However, in order to comprehensively evaluate the healthfulness of snacks, perhaps the content of beneficial nutrients that should be increased in the American diet in snacks should also be assessed.

Additionally, according to qualitative research, amongst the general public, many different cognitive definitions of healthy food and healthy eating practices exist (Bisogni et al., 2012). For instance, some individuals classify healthy and unhealthy foods based on food type (fruit, vegetables, etc.), others based on nutrient content (fat, sugar, fiber, etc.), and some based on eating behaviors (balance, variety, moderation, etc.) (Bisogni et al., 2012). Individuals also

interpret healthy foods differently based on their age, psychosocial experiences, and cultural backgrounds. Therefore, since healthfulness definitions and categorizations are largely personalized amongst the general population, it is unlikely that the healthy food definitions and classifications held by all individuals match professional and federal healthy food stipulations perfectly. Furthermore, nutrition guidelines and recommendations are constantly evolving and changing, and it may be difficult and overwhelming for the general public to remain informed about the most current recommendations, especially if they contain strict nutrient guidelines. Since there are a wide variety of ways to define foods as healthy, it may not be necessary or realistic for individuals to keep all of those definitions in mind when selecting food items. Whereas it may be more worthwhile to investigate the healthfulness of vended food and beverage items, rather than if each vended item meets every dietary guideline criteria.

A simple, comprehensive, and user-friendly vending machine assessment tool that evaluates caloric content, fat content, sugar content, sodium content, and key indicator micronutrient content of vended products should be developed. Healthfulness criteria standards should be partially derived from well-established nutritional guidelines disseminated by organizations such as the United States Department of Agriculture (USDA) and the Institute of Medicine (IOM), but nutritional criteria requirements should be individualized and evaluated separately. A food or beverage product should not have to meet every nutritional requirement to be considered healthy. A standardized approach that also evaluates healthfulness using the nutrient daily value (DV) percentages listed on the food label may be the simplest way to assess product healthfulness. Using DV percentages would also serve as an indication of a product's contribution to an individual's overall diet. A standard healthfulness criteria classification approach is just one component that should be included in a comprehensive vending machine

assessment tool. A comprehensive vending machine assessment tool should also evaluate machine accessibility, product availability, portion size, promotion, and price.

## **Conclusions**

A wide range of assessment tools and methodologies were found to be currently available to measure and evaluate different aspects of the vending machine environment. However, the substantial variability in methodologies and established healthfulness criteria make it difficult to compare results between studies. Additionally, the majority of vending machine evaluation and intervention studies have been focused on the primary and secondary school environments. However, vending machines are becoming increasingly more prevalent in a wide variety of settings including healthcare facilities, universities, and worksites. Furthermore, few previous vending machine assessment tools have been validated or tested for reliability. The development of a universal, valid, and reliable vending machine assessment tool that is both comprehensive and user-friendly is recommended. The development of such a tool would help to support and implement public health policies and environmental changes that could improve healthy food and beverage access and availability in vending machines.

**TABLE 1: COMPARISON OF VENDING MACHINE ENVIRONMENTAL ASSESSMENT STUDIES**

Study	Location	Assessment Tool	Variables Evaluated During Assessment						Validity and Reliability
			Accessibility	Availability	Healthfulness Criteria	Portion Size	Price	Promotion	
<b>Adachi-Mejia et al. (2013)</b>	schools	environmental assessment (researchers)	<b>Yes</b> hours of operation location	<b>Yes</b> number of machines percentage of beverage types	<b>Yes</b> beverages	<b>No</b>	<b>No</b>	<b>Yes</b> machine front advertisements	<b>No</b>
<b>Alaimo et al. (2013)</b>	schools	environmental assessment (food service directors)	<b>Yes</b> hours of operation location	<b>Yes</b> recorded all snacks and beverages percentage of 'healthy' products	<b>Yes</b> snacks	<b>Yes</b> package size	<b>Yes</b> recorded prices of all snacks and beverages	<b>No</b>	<b>No</b>
<b>Aljadir et al. (1981)</b>	university	environmental assessment (researchers)  questionnaire (students)  vending machine sales	<b>No</b>	<b>Yes</b> recorded number of 'healthy' products perceptions	<b>Yes</b> snacks	<b>Yes</b> serving size	<b>Yes</b> recorded prices of all snacks and beverages perceptions	<b>No</b>	<b>No</b>
<b>Bell et al. (2013)</b>	healthcare facilities	environmental assessment (researchers)  telephone interviews (parents and food service managers)	<b>No</b>	<b>Yes</b> recorded all snacks and beverages percentage of 'healthy' products perceptions	<b>Yes</b> snacks beverages	<b>Yes</b> package size	<b>No</b>	<b>Yes</b> signage identification labels perceptions	<b>No</b>



<b>Byrd-Bredbenner et al. (2012)</b>	universities	environmental assessment (researchers)	<b>Yes</b> location	<b>Yes</b> recorded all snacks and beverages  percentage of 'healthy' products	<b>Yes</b> snacks  beverages	<b>Yes</b> package size	<b>No</b>	<b>No</b>	<b>Yes</b> inter-rater reliability
<b>Callaghan et al. (2010)</b>	schools	focus groups (students)  vending machine sales	<b>No</b>	<b>Yes</b> perceptions	<b>Yes</b> snacks	<b>Yes</b> package size	<b>Yes</b> perceptions	<b>Yes</b> identification labels  student perceptions	<b>No</b>
<b>French et al. (2003)</b>	schools	environmental assessment (researchers)	<b>Yes</b> hours of operation  location	<b>Yes</b> number of machines  recorded all snack products  percentage of 'healthy' products	<b>Yes</b> snacks	<b>Yes</b> serving size	<b>No</b>	<b>No</b>	<b>No</b>
<b>Gemmill et al. (2005)</b>	schools	questionnaire (child nutrition supervisors)	<b>Yes</b> location	<b>Yes</b> percentage of product types	<b>Yes</b> snacks  beverages	<b>Yes</b> serving size	<b>No</b>	<b>No</b>	<b>Yes</b> face validity
<b>Jensen et al. (2012)</b>	schools	environmental assessment (researchers)  questionnaire (students)	<b>No</b>	<b>Yes</b> recorded all beverages  percentage of 'healthy' products	<b>Yes</b> beverages	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>
<b>Kelly et al. (2012)</b>	train stations	environmental assessment (researchers)	<b>No</b>	<b>Yes</b> recorded all snacks and beverages  percentage of 'healthy' products	<b>Yes</b> snacks  beverages	<b>Yes</b> serving size	<b>Yes</b> recorded average prices of 'healthy' and 'unhealthy' products	<b>Yes</b> machine front advertisements  advertisements	<b>No</b>

<b>Kubik et al. (2011)</b>	schools	environmental assessment (researchers)  questionnaire (principals)	<b>Yes</b> *hours of operation	<b>Yes</b> *recorded all snacks and beverages	<b>Yes</b> *snacks  *beverages	<b>Yes</b> *serving size	<b>No</b>	<b>No</b>	<b>Yes</b> *content validity
<b>Lawrence et al. (2009)</b>	healthcare facilities	environmental assessment (researchers)	<b>Yes</b> hours of operation  location	<b>Yes</b> recorded all snacks and beverages  percentage of 'healthy' products	<b>Yes</b> snacks  beverages	<b>Yes</b> package size	<b>Yes</b> recorded price of all snacks and beverages	<b>Yes</b> signage	<b>No</b>
<b>Minaker et al. (2011)</b>	schools	questionnaire (students)	<b>No</b>	<b>Yes</b> number of machines	<b>No</b>	<b>No</b>	<b>No</b>	<b>Yes</b> machine front advertisements	<b>No</b>
<b>Park et al. (2010)</b>	schools	questionnaire (students)	<b>No</b>	<b>Yes</b> percentage of product types	<b>Yes</b> snacks  beverages	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>
<b>Pasch et al. (2011)</b>	schools	questionnaire (school personnel)	<b>Yes</b> hours of operation	<b>Yes</b> recorded all snacks and beverages	<b>Yes</b> snacks  beverages	<b>Yes</b> serving size	<b>Yes</b> recorded prices of all snacks and beverages	<b>No</b>	<b>No</b>
<b>Voss et al. (2012)</b>	universities	environmental assessment (students)	<b>Yes</b> hours of operation  location	<b>Yes</b> percentage of 'healthy' products	<b>Yes</b> snacks  beverages	<b>Yes</b> serving size	<b>Yes</b> recorded prices of all snacks and beverages	<b>Yes</b> signage	<b>Yes</b> inter-rater reliability  test-retest reliability
<b>Whately Blum et al. (2007)</b>	schools	environmental assessment (researchers)	<b>No</b>	<b>Yes</b> number of machines  recorded all snacks and beverages  percentage of 'healthy' products	<b>Yes</b> snacks  beverages	<b>Yes</b> package size	<b>No</b>	<b>No</b>	<b>No</b>

<b>Winston et al. (2013)</b>	healthcare facilities	environmental assessment (researchers)	<b>No</b>	<b>Yes</b> recorded presence of certain snacks and beverages	<b>Yes</b> snacks beverages	<b>No</b>	<b>No</b>	<b>Yes</b> signage identification labels	<b>Yes</b> inter-rater reliability
------------------------------	-----------------------	--	-----------	---	-----------------------------------	-----------	-----------	--	---------------------------------------

**TABLE 2: COMPARISON OF VENDING MACHINE ENVIRONMENTAL INTERVENTION STUDIES**

Study	Location	Assessment Tool	Variables Evaluated During Intervention			Variables Manipulated During Intervention			Validity and Reliability
			Healthfulness Criteria	Portion Size	Accessibility	Availability	Price	Promotion	
<b>French et al. (1997)</b>	universities	vending machine sales	<b>Yes</b> snacks	<b>Yes</b> package size	<b>No</b>	<b>No</b>	<b>Yes</b> reduced prices of low-fat options	<b>Yes</b> information labels on products to indicate low-fat options  signage encouraging low-fat options	<b>No</b>
<b>French et al. (2001)</b>	schools and worksites	vending machine sales	<b>Yes</b> snacks	<b>Yes</b> package size	<b>No</b>	<b>No</b>	<b>Yes</b> reduced prices of low-fat options	<b>Yes</b> information labels on products to indicate low-fat options  signage encouraging low-fat options	<b>No</b>
<b>French et al. (2010)</b>	bus garages	vending machine sales  questionnaire (employees)	<b>Yes</b> snacks  beverages	<b>Yes</b> package size	<b>No</b>	<b>Yes</b> increased availability of 'healthy' options	<b>Yes</b> reduced prices of 'healthy' options	<b>No</b>	<b>No</b>
<b>Kocken et al. (2012)</b>	schools	vending machine sales	<b>Yes</b> snacks  beverages	<b>Yes</b> package size	<b>No</b>	<b>Yes</b> increased availability of lower calorie options	<b>Yes</b> reduced prices of lower calorie options	<b>Yes</b> information labels on products to indicate lower calorie options	<b>No</b>
<b>Van Hulst et al. (2013)</b>	healthcare facility	questionnaire (adults)	<b>Yes</b> snacks  beverages	<b>No</b>	<b>Yes</b> location	<b>Yes</b> increased availability of healthier beverages, meals, and snacks	<b>No</b>	<b>Yes</b> healthy habits signage and posters  interactive displays	<b>No</b>

**TABLE 3: COMPARISON OF SNACK HEALTHFULNESS CRITERIA**

Study	Snack Type	Calories	Fat	Saturated Fat	Sugar	Protein	Sodium	Fiber	Cholesterol	Vitamin A	Vitamin C	Niacin	Thiamine	Riboflavin	Iron	Calcium
Alaimo et al. (2013) <sup>A</sup>																
Aljadir et al. (1981) <sup>B</sup>						X				X	X	X	X	X	X	X
Bell et al. (2013) <sup>C</sup>																
Byrd-Bredbenner et al. (2012) <sup>D</sup>		X		X	X	X	X	X	X	X	X				X	X
Callaghan et al. (2010)			X <sup>E</sup>	X <sup>F</sup>			X <sup>G</sup>									
French et al. (1997)			X <sup>H</sup>													
French et al. (2001)			X <sup>H</sup>													
French et al. (2003)			X <sup>I</sup>													
French et al. (2010)		X <sup>J</sup>	X <sup>K</sup>		X <sup>L</sup>											
Gemmill et al. (2005) <sup>B</sup>						X				X	X	X	X	X	X	X
Kelly et al. (2012)		X <sup>M</sup>														
Kocken et al. (2012)		X <sup>N</sup>														
Kubik et al. (2011)		X <sup>O</sup>	X <sup>P</sup>													
Lawrence et al. (2009)		X <sup>Q</sup>	X <sup>R</sup>	X <sup>S</sup>	X <sup>L</sup>											

<b>Park et al. (2010)</b>	X <sup>T</sup>															
<b>Pasch et al. (2011)</b>		X <sup>P</sup>	X <sup>R</sup>													
<b>Van Hulst et al. (2013)<sup>U</sup></b>																
<b>Voss et al. (2012)</b>		X <sup>P</sup>	X <sup>V</sup>	X <sup>W</sup>	X <sup>X</sup>		X <sup>Y</sup>									
<b>Whately Blum et al. (2007)</b>			X <sup>K</sup>		X <sup>L</sup>											
<b>Winston et al. (2013)</b>	X <sup>Z</sup>															

<sup>A</sup> Exact criteria unspecified within study. Healthfulness criteria standards described as virtually identical to the new proposed *USDA Nutrition Standards for All Foods Sold in Schools* with some slight modifications. Snacks were considered healthy if nutrient content fell within 10% of the specified nutritional standards.

<sup>B</sup> Healthier products supplied at least 5% of the USRDA for 2 of 8 critical nutrients.

<sup>C</sup> Exact criteria unspecified within study. Healthfulness criteria standards were adapted from the ‘traffic light’ nutrition classification system created as part of a NSW Healthier Choices program.

<sup>D</sup> Nutrient Adequacy Ratios (NARs) calculated for each nutrient by dividing the amount in vended food item by its DV. A quality score was determined by dividing a Nutrients to Maximize Score (average of vitamin A, vitamin C, protein, dietary fiber, iron, and calcium NARs) by a Nutrients to Minimize Score (average of saturated fat, cholesterol, sodium, and total sugar NARs).

<sup>E</sup> Healthier products contain ≤ 6g fat/package.

<sup>F</sup> Healthier products contain ≤ 2g saturated fat/package.

<sup>G</sup> Healthier products contain ≤ 2g sodium/package.

<sup>H</sup> Healthier products contain ≤ 3g fat/package.

<sup>I</sup> Healthier products contain ≤ 5g fat/serving.

<sup>J</sup> Healthier products contain ≤ 150 calories/package.

<sup>K</sup> Healthier products contain ≤ 30% calories from fat/package.

<sup>L</sup> Healthier products contain ≤ 35% sugar by weight/package.

<sup>M</sup> Healthier products contain ≤ 600 kJ/serving.

<sup>N</sup> Healthier products contain ≤ 100 kcals/package.

<sup>O</sup> Healthier products contain ≤ 3g fat/serving.

<sup>P</sup> Healthier products contain ≤ 200 kcals/serving.

<sup>Q</sup> Healthier products contain ≤ 250 kcals/package.

<sup>R</sup> Healthier products contain ≤ 35% calories from fat/package.

<sup>S</sup> Healthier products contain ≤ 10% calories from saturated fat/package.

<sup>T</sup> Healthier products include trail mix, nuts, and granola bars.

<sup>U</sup> Exact criteria unspecified within study. Food and beverage options were selected according to *Eating Well with Canada’s Food Guide*, Institute of Medicine, and American Heart Association guidelines.

- <sup>v</sup> Healthier products contain  $\leq 35\%$  calories from fat/serving.
- <sup>w</sup> Healthier products contain  $\leq 10\%$  saturated fat/serving.
- <sup>x</sup> Healthier products contain  $\leq 35\%$  sugar by weight/serving.
- <sup>y</sup> Healthier products contain  $\leq 200$  mg sodium/serving.
- <sup>z</sup> Healthier products include baked chips and granola bars.

**TABLE 4: COMPARISON OF BEVERAGE HEALTHFULNESS CRITERIA**

Study	Beverage Type	Calories	Fat	Saturated Fat	Sugar	Protein	Sodium	Fiber	Cholesterol	Vitamin A	Vitamin C	Iron	Calcium	Niacin	Thiamine	Riboflavin	Added Sweeteners
Adachi-Mejia et al. (2013)	X <sup>A</sup>																
Bell et al. (2013) <sup>B</sup>																	
Byrd-Bredbenner et al. (2012) <sup>C</sup>		X		X	X	X	X	X	X	X	X	X	X				
French et al. (2010)		X <sup>D</sup>	X <sup>E</sup>		X <sup>F</sup>												
Gemmill et al. (2005) <sup>G</sup>						X				X	X	X	X	X	X	X	
Jensen et al. (2012) <sup>H</sup>	X																X
Kelly et al. (2012)	X <sup>I</sup>																
Kocken et al. (2012)		X <sup>J</sup>															
Kubik et al. (2011)	X <sup>K</sup>																
Lawrence et al. (2009)	X <sup>L</sup>																X
Park et al. (2010)	X <sup>M</sup>																
Pasch et al. (2011)	X <sup>N</sup>																X
Van Hulst et al. (2013) <sup>O</sup>																	



<b>Voss et al. (2012)</b>	X <sup>N</sup>																		X
<b>Whately Blum et al. (2007)</b>	X <sup>P</sup>																		
<b>Winston et al. (2013)</b>	X <sup>Q</sup>																		

<sup>A</sup> Beverage classifications included the following categories: sugar-sweetened beverages (regular soda, sports drinks, fruit drinks, non-diet iced teas, lemonades, and other sweetened drinks), diet soda, other diet beverages, plain water/zero-calorie seltzer waters, flavored/vitamin water, 100% fruit or vegetable juice, milk, and other.

<sup>B</sup> Exact criteria unspecified within study. Healthfulness criteria standards were adapted from the ‘traffic light’ nutrition classification system created as part of a NSW Healthier Choices program.

<sup>C</sup> Nutrient Adequacy Ratios (NARs) calculated for each nutrient by dividing the amount in vended food item by its DV. A quality score was determined by dividing a Nutrients to Maximize Score (average of vitamin A, vitamin C, protein, dietary fiber, iron, and calcium NARs) by a Nutrients to Minimize Score (average of saturated fat, cholesterol, sodium, and total sugar NARs).

<sup>D</sup> Healthier products contain  $\leq 150$  calories/package.

<sup>E</sup> Healthier products contain  $\leq 30\%$  calories from fat/package.

<sup>F</sup> Healthier products contain  $\leq 35\%$  sugar by weight/package.

<sup>G</sup> Healthier products supplied at least 5% of the USRDA for 2 of 8 critical nutrients.

<sup>H</sup> Healthier products include water, including carbonated water and water flavored or sweetened with 100% fruit juice and no added sweetener; nonfat milk, 1% fat milk, and dairy alternatives; and 100% fruit or vegetable juice that are composed of no less than 50% fruit juice and have no added sweetener.

<sup>I</sup> Healthier products include water (plain, mineral, or soda), diet soft drinks, 100% fruit or vegetable juice, and diet energy drinks.

<sup>J</sup> Healthier products contain  $\leq 100$  kcals/package.

<sup>K</sup> Unhealthy products include soft drinks (regular and diet), fruit drinks that were not 100% fruit juice, sports drinks, and reduced-fat or whole milk (plain or flavored).

<sup>L</sup> Healthier- products include fruit juice with  $\geq 50\%$  juice and no added sweeteners, milk with  $\leq 2\%$  fat, water with no added sweeteners, and sports drinks with  $\leq 42\text{g}$  of added sweetener per 20 oz. serving.

<sup>M</sup> Healthier products include 100% fruit juices, milk, chocolate milk, water, and diet soda.

<sup>N</sup> Healthier products include water without additives, carbonation, caffeine, or flavoring; low-fat and nonfat milk; flavored milk with  $\leq 22\text{g}$  of total sugar/serving; and 100% fruit juice.

<sup>O</sup> Exact criteria unspecified within study. Food and beverage options were selected according to *Eating Well with Canada’s Food Guide*, Institute of Medicine, and American Heart Association guidelines.

<sup>P</sup> Healthier products include nonfat or 1% low-fat milk (including flavored milk), 100% juice, and water.

<sup>Q</sup> Healthier products include water and diet soda.

**TABLE 5: COMPARISON OF PREVIOUS CONCLUSIONS REGARDING VENDED PRODUCT HEALTHFULNESS**

Study	Study Conclusions
Adachi-Mejia et al. (2013)	Common beverages found in evaluated vending machines were flavored water (34.8% of slots), sugar-sweetened beverages (23.6% of slots), and plain water (21.8% of slots).
Alaimo et al. (2013)	In schools where nutrition policies were implemented to improve the nutritional quality of vended food items, the nutritional quality of students' dietary intake improved.
Aljadir et al. (1981)	An almost exclusive selection of high calorie and/or low nutritional value snacks were found in evaluated vending machines.
Bell et al. (2013)	Following an intervention to improve the nutritional value of snacks and beverages in vending machines in a hospital, the percentage of healthy snacks and healthy beverages increased from 29% to 51% and 0% to 26%, respectively.
Byrd-Bredbenner et al. (2012)	The majority of snacks and beverages found in evaluated vending machines were not nutrient dense.
Callaghan et al. (2010)	Overall vending machine sales declined after implementation of an intervention that replaced 50% of vending machine slots with healthier snacks.
French et al. (1997)	During a price reduction and increased promotional signage intervention, low-fat snack sales increased 80%.
French et al. (2001)	During a price reduction and promotional signage intervention, low-fat snack sales significantly increased.
French et al. (2003)	The median percentage of low-fat snacks found in evaluated vending machines was 35%, but mostly due to a large number of hard candy items.
French et al. (2010)	During a price reduction and increased healthy snack and beverage availability intervention, healthy product sales significantly increased.
Gemmill et al. (2005)	The majority of snacks and beverages sold in vending machines were of minimal nutritional value.
Jensen et al. (2012)	Following an implementation of a healthy beverage policy in vending machines in schools, 78.8% of evaluated beverages were found to be in compliance with the policy.
Kelly et al. (2012)	Of all evaluated vending machines, 84% of slots contained high-energy snacks and beverages.
Kocken et al. (2012)	During a price reduction, increased promotional signage, and increased healthy product availability intervention, proportional sales of healthy snacks and beverages increased.
Kubik et al. (2011)	Low-nutrient energy dense snack and beverage prevalence was high in evaluated vending machines.
Lawrence et al. (2009)	Across all evaluated vending machines, 81% of snacks and 75% of beverages were classified as unhealthy.
Park et al. (2010)	Only 3.6% of surveyed students reported purchasing healthier snacks and beverages from vending machines.
Pasch et al. (2011)	The majority of snacks and beverages offered in evaluated vending machines were high in calories and fat.
Van Hulst et al. (2013)	During an increased promotional signage and healthy product availability intervention in a hospital participant perception and knowledge regarding healthy vended products improved and increased, respectively.
Whately Blum et al. (2007)	Following an intervention to improve the nutritional value of snacks and beverages in vending machines in schools, the percentage of healthy snacks and healthy beverages increased from 22.5% to 84% and 48% to 98.9%, respectively.

## References

- Adachi-Mejia AM, Longacre MR, Skatrud-Mickelson M, Li Z, Purvis LA, Titus LJ, Beach ML, Dalton MA. Variation in access to sugar-sweetened beverages in vending machines across rural, town, and urban high schools. *Public Health*. 2013;127:485-491.
- Alaimo K, Olekysk SC, Drzal NB, Golzynski DL, Lucarelli JF, Wen Y, Velie EM. Effects of changes in lunch-time competitive foods, nutrition practices and nutrition policies on low-income middle school children's diets. *Childhood Obesity*. 2013;9:509-523.
- Aljadir LP, Biggs WM, Misko JA. Consumption of foods from vending machines at the University of Delaware. *Journal of the American College Health Association*. 1981;30(3):149-150.
- Antonuk B, Block LG. The effect of single serving versus entire package nutritional information on consumption norms and actual consumption of a snack food. *Journal of Nutrition Education Behavior*. 2006;38:365-370.
- Bell C, Pond N, Davies L, Francis JL, Campbell E, Wiggers J. Healthier choices in Australian health service: A pre-post audit of an intervention to improve the nutritional value of foods and drinks in vending machines and food outlets. *BMC Health Services Research*. 2013;13:492-501.
- Bisogni CA, Jastran M, Seligson M, Thompson A. How people interpret healthy eating: Contributions of Qualitative Research. *Journal of Nutrition Education Behavior*. 2012;44:282-301.
- Blanck HM, Yaroch AL, Atienza AA, Yi SL, Zhang J, Masse LC. Factors influencing lunchtime food choices among working Americans. *Health Education & Behavior*. 2009;36:289-301.
- Byrd-Bredbenner C, Johnson M, Quick VM, Walsh J, Greene GW, Hoerr S, Colby SM, Kattelman KK, Phillips BW, Kidd T, Horacek TM. Sweet and salty. An assessment of the snacks and beverages sold in vending machines in US post-secondary institution campuses. *Appetite*. 2012;58(3):1143-1151.
- Callaghan C, Mandich G, He M. Healthier snacks in school vending machines: A pilot project in four Ontario high schools. *Canadian Journal of Dietetic Practice and Research*. 2010;71(4):L186-191.
- Deckelbaum RJ, Williams CL. Childhood obesity: The health issue. *Obesity Research and Clinical Practice*. 2001;9:S239-S243.
- Escoto KH, French SA, Harnack LJ, Toomey TL, Hannan PJ, Mitchell NR. Work hours, weight status, and weight-related behaviors: A study of metro transit workers. *International Journal of Behavioral Nutrition and Physical Activity*. 2010;7:91-92.
- Fox MK, Gordon A, Nogales R, Wilson A. Availability and consumption of competitive foods in US public schools. *Journal of the American Dietetic Association*. 2009;109:S57-S66.
- Freedman MR, Rubinstein RJ. Obesity and food choices among faculty and staff at a large urban university. *Journal of American College Health*. 2010;59(3):205-210.
- French SA, Hannan PJ, Harnack LJ, Mitchell NR, Toomey TL, Gerlach A. Pricing and availability intervention in vending machines at four bus garages. *American College of Occupational and Environmental Medicine*. 2010;52(1):29-33.

- French SA, Jeffery RW, Story M, Breitlow KK, Baxter JS, Hannan P, Snyder MP. Pricing and promotion effects on low-fat vending snack purchases: the CHIPS study. *American Journal of Public Health*. 2001;91(1):112-117.
- French SA, Jeffery RW, Story M, Hannan P, Snyder PM. A pricing strategy to promote low-fat snack choices through vending machines. *American Journal of Public Health*. 1997;87(5):849-851.
- French SA, Story M, Fulkerson JA, Gerlach AF. Food environment in secondary schools: A la carte, vending machines, and food policies and practices. *Journal of Public Health*. 2003;93(7):1161-1167.
- Gemmill E, Cotugna N. Vending machine policies in Delaware. *The Journal of School Nursing*. 2005;21(2):94-99.
- Harnack L, Snyder P, Story M, Holliday R, Lytle L, Neumark-Sztainer D. Availability of a la carte food items in junior and senior high schools: A needs assessment. *Journal of the American Dietetic Association*. 2000;100:701-703.
- Jensen CD, Sato AF, McMurty CM, Hart CN, Jelalian E. School nutrition policy: An evaluation of the Rhode Island healthier beverages policy in schools. *Infant, Child, & Adolescent Nutrition*. 2012;4:276-282.
- Kelly B, Flood VM, Bicego C. Derailing healthy choices: An audit of vending machines at train stations in NSW. *Health Promotion Journal of Australia*. 2012;23(1):73-75.
- Kocken PL, Eeuwuk J, Van Kesteren NMC, Dusseldorp E, Buus G, Bassa-Dafesh Z, Snel J. Promoting the purchase of low-calorie foods from school vending machines: A cluster-randomized controlled study. *Journal of School Health*. 2012;82:115-122.
- Kubik MY, Davey C, Nannery MS, MacLehose RF, Nelson TF, Coombes B. Vending and school store snack and beverage trends: Minnesota secondary schools, 2002-2010. *American Journal of Preventive Medicine*. 2013;44(6):583-588.
- Kubik MY, Lytle LA, Farbaksh K. School and district wellness councils and availability of low-nutrient, energy-dense vending fare in Minnesota middle and high schools. *Journal of the American Dietetic Association*. 2011;111(1):151-155.
- Lawrence S, Boyle M, Craypo L, Samuels S. The food and beverage vending environment in healthcare facilities participating in the healthy eating, active communities program. *Pediatrics*. 2009;123:S287-S292.
- Maras E. 2011 state of the vending industry report. *Automatic Merchandiser*. 2011.
- Minaker LM, Storey KE, Raine KD, Spence JC, Forbes LE, Plotnikoff RC, McCargar LJ. Associations between the perceived presence of vending machines and food and beverage logos in schools and adolescents' diet and weight status. *Public Health Nutrition*. 2011;14(8):1350-1356.
- New SA, Livingstone MB. An investigation of the association between vending machine confectionary purchase frequency by schoolchildren in the UK and other dietary and lifestyle factors. *Public Health Nutrition*. 2003;6:497-504.

- Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Journal of the American Medical Association*. 2012;307:484-490.
- Park S, Sappenfield WM, Huang Y, Sherry B, Bensyl DM. The impact of the availability of school vending machines on eating behavior during lunch: The youth physical activity and nutrition survey. *Journal of the American Dietetic Association*. 2010;110(10):1532-1536.
- Pasch KE, Lytle LA, Samuelson AC, Farbakhsh K, Kubik MY, Patnode CD. Are school vending machines loaded with calories and fat: An assessment of 106 middle and high schools. *Journal of School Health*. 2011;81(4):212-218.
- Rovner AJ, Nansel TR, Wang J, Iannotti RJ. Food sold in school vending machines is associated with overall student dietary intake. *Journal of Adolescent Health*. 2011;48:13-19.
- United States Department of Agriculture and United States Department of Health and Human Services. *Dietary Guidelines for Americans 2010*. 2010.  
<http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/PolicyDoc/PolicyDoc.pdf>. Accessed July 18, 2014.
- United States Department of Agriculture. *National school lunch program*.  
<http://www.fns.usda.gov/nslp/national-school-lunch-program-nslp>. Accessed on July 16 2013.
- United States Department of Agriculture Food and Nutrition Service. Proposed Rule: *National School Lunch Program and School Breakfast Program: Nutrition Standards for All Foods Sold in School as Required by the Healthy, Hunger-Free Kids Act of 2010*.  
<http://www.fns.usda.gov/cga/020113-snacks.pdf>. 2013. Accessed July 18, 2014.
- United States Department of Agriculture. *State competitive foods policies*.  
<http://www.fns.usda.gov/tags/competitive-foods>. Accessed on July 16 2013.
- Voss C, Klein S, Glanz K, Clawson M. Nutrition environment measures survey – vending: Development, dissemination, and reliability. *Healthy Promotion Practice*. 2012;13:425-430.
- Van Hulst A, Barnett TA, Dery V, Cote G, Colin C. Health-promoting vending machines: Evaluation of a pediatric hospital intervention. *Canadian Journal of Dietetic Practice and Research*. 2013;74:28-34.
- Whately Blum JE, Davie AM, Devore RL, Beaudoin CM, Jenkins PL, Kaley LA, Wigand DA. Implementation of low-fat, low-sugar, and portion-controlled nutrition guidelines in competitive food venues of Maine public high schools. *Journal of School Health*. 2007;77:687-693.
- Winston CP, Sallis JF, Swartz MD, Hoelscher DM, Peskin MF. Reliability of the hospital nutrition environment scan for cafeterias, vending machines, and gift shops. *Journal of the Academy of Nutrition and Dietetics*. 2013;113:1069-107

## DEVELOPMENT, IMPLEMENTATION, AND VALIDATION OF THE HEALTH DENSITY VENDING MACHINE AUDIT TOOL (HDVMAT)

### Abstract

**Objective:** Develop, implement, and validate a universal and comprehensive vending machine assessment tool.

**Design:** The Health Density Vending Machine Audit Tool (HDVMAT) was developed to comprehensively evaluate and score vending machines based on machine accessibility, product healthfulness, price, and promotion. A novel nutrient-dense scoring system was created to determine the healthfulness of vended snacks and beverages. Nutrition Environment Measures Survey-Vending (NEMS-V) was used to validate the nutrient-density score for a sub-sample of machines.

**Participants:** Eleven states implemented the HDVMAT in 90 snack machines and 116 beverage university vending machines in 11 states and NEMS-V in 33 snack and 49 beverage machines.

**Main Outcome Measures:** HDVMAT snack scores (6-24) and beverage scores (6-20) were calculated and compared between states and building types. Product nutrient dense scores were compared to NEMS-V.

**Analysis:** Kruskal-Wallis, Mann-Whitney U tests, Pearson correlations, t-tests, and Chi-square analysis.

**Results:** Mean HDVMAT scores were  $13.9 \pm 1.6$  and  $11.2 \pm 1.3$  for snack and beverage machines, respectively. Significant differences in HDVMAT scores were found between states, but not between building types. The percentage of healthy products via HDVMAT and NEMS-V were positively correlated for beverages ( $r = .686$ ,  $p < .001$ ) but not for snacks. The mean percentage of healthy products was significantly higher according to HDVMAT vs. NEMS-V for both snacks:  $15.1 \pm 9.6$  vs.  $7.1 \pm 10.0$  ( $p < .001$ ) and beverages:  $16.8 \pm 13.2$  vs.  $13.2 \pm 12.5$  ( $p < .05$ ).

**Conclusions and Implications:** The HDVMAT is comparable to NEMS-V, but uses a unique nutrient-dense scoring approach to evaluate snacks and beverages along a continuum of healthfulness criteria, offering a more accurate representation of the nutritional quality of vended snacks.

## Introduction

Depending on the type of food items available for purchase, vending machines, a major source of competitive foods, can either positively or negatively affect the diets of children, adolescents, and adults (Rovner et al., 2011). The presence of vending machines influences the food and beverage choices of children, adolescents, and adults by providing easy access to a plethora of predominantly unhealthy snacks and beverages (New & Livingstone, 2003). An assessment of vending machines at 11 US colleges and universities determined that the majority of snacks and beverages found in evaluated vending machines were not nutrient dense (Byrd-Bredbenner et al., 2012). Vending machines are ubiquitous, making them an appealing and convenient source of nutrition for many individuals. According to the *State of the Vending Industry Report*, 22.5% of all vending machines in the United States were located in manufacturing buildings, 20.1% in offices, 11.5% in restaurants, bars, and clubs, 8.8% in hospitals and nursing homes, 8.6% in retail sites, 8.2% in elementary, middle, and high schools, 6.6% in universities and colleges, and 5.2% in hotels and motels in 2012 (Refermat, 2013).

Access to a multitude of dining options may be limited or restricted in university, worksite, manufacturing, and healthcare environments due to location and hours of operation, potentially rendering vending machines a sole source of readily available foods and beverages for individuals in these environments (Blanck et al., 2009; Escoto et al., 2010; Byrd-Bredbenner et al., 2012; Lawrence et al., 2009). Vending machine prevalence and consumer frequency of use suggest vended snack and beverage products can substantially contribute to an individual's daily energy intake. Disconcertingly, a survey of middle school students (n=4,322) reported only 3.6% purchased healthy snacks and beverages from vending machines (Park et al., 2010). Thus, it is important to comprehensively assess and monitor the healthfulness of vended snacks and

beverages, as well as the overall vending machine environment. A systematic review revealed limited literature on vending machine assessment methodologies, however important evaluation criteria emerged (Matthews & Horacek, 2014).

Consumer vending machine purchasing patterns have been shown in the literature to be strongly influenced by product price (Callaghan et al, 2010; Van Hulst et al., 2013). During a Healthy Vending Machine Pilot Project (HVMPP) intervention study that stocked and supplied vending machines with a 50:50 ratio of healthier to conventional products in Canadian high schools, overall vending machine sales declined (Callaghan et al., 2010). Focus groups conducted at HVMPP schools revealed that high school students perceived unhealthy products to be less expensive than healthy products, citing price as a barrier to purchasing of healthy vending machine products (Callaghan et al., 2010). Additionally, prior to the implementation of a similar health-promoting machine intervention in a Canadian hospital, a survey of adults (n=118) within the hospital revealed that only 39.8% perceived healthy options in hospital vending machines as affordable (Van Hulst et al., 2013). During various vending machine environmental interventions where the prices of healthier products were reduced, sales of healthier products consequently increased (French et al., 1997; French et al., 2001; French et al., 2010; Kocken et al., 2012). A comprehensive vending machine assessment tool should include an evaluation of product price.

The persuasive and pervasive nature of brand marketing through product logos, labels, and advertisements has been shown to have an influential effect on snack and beverage consumption (Minaker et al., 2011). A survey of 4,936 adolescents demonstrated that the presence of snack and beverage logos on vending machines was positively associated with student consumption of vended snacks and beverages, particularly of salty snacks, candy, and sugar sweetened beverages (Minaker et al., 2011). Additionally, a study on front-of-pack



nutrition labeling formats found that front-of-pack labeling, regardless of format, is effective in helping consumers across multiple demographics make healthier snack and beverage choices (Antonuk & Block, 2006). Furthermore, during various vending machine environmental interventions where the promotion of healthier products was increased, sales of healthier products consequently increased (French et al., 1997; French et al., 2001; Kocken et al., 2012; Van Hulst et al., 2013). An evaluation of product promotion is another factor that should be included in a comprehensive vending machine assessment tool.

If vending machines are readily accessible, children, adolescents, and adults constantly have the option to purchase vended snacks and beverages. Research demonstrates that when vending machines are readily open and accessible to students in middle and high schools, students consumed more sweet vended products (Rovner et al., 2011). A comprehensive vending machine assessment tool should include an evaluation of machine accessibility. Similarly, if healthy snacks and beverages are not readily available within vending machines, consumers do not have the opportunity to make healthier choices. Consistently across the literature, snack and beverage items available in vending machines are almost exclusively of minimal nutritional value (Adachi-Mejia et al., 2013; Aljadir et al., 1981; Byrd-Bredbenner et al., 2012; Gemmill & Cotugna, 2005; Kelly et al., 2012; Kubik et al., 2011; Lawrence et al., 2009; Pasch et al, 2011). However, during various vending machine environmental interventions where the availability of healthier products was increased, sales of healthier products consequently increased (French et al., 2010; Kocken et al., 2012; Van Hulst et al., 2013). Thus product availability is an important evaluation component in a vending machine assessment tool.

In order to establish product availability, healthfulness criteria must be established to evaluate the nutritional quality of vended products. Generally, combinations of three different

types of classification methods have been employed to establish the healthfulness of vended snacks and beverages: macro/micronutrient content, caloric content, and product type (Matthews & Horacek, 2014). A review of intervention and evaluation studies on vending machines highlighted that substantial variability exists between studies with regard to healthfulness criteria, varying from simple to complex (Matthews & Horacek, 2014). The availability of healthy products in a vending machine can be overestimated if healthfulness criteria are too simplistic or lenient. Similarly, the availability of healthy products can be underestimated if healthfulness criteria are too strict and inclusive. The majority of healthfulness criteria established utilized an all-or-nothing dichotomy to classify vended snacks and beverages; meaning in order to be considered healthy a snack or beverage product was required to meet all established healthfulness criteria (Matthews & Horacek, 2014). It may not be reasonable to expect a snack-sized portion of a food or beverage product to meet a substantive list of nutrient requirements. Additionally, most criteria were based only upon nutrients consumers should limit in their diet (Matthews & Horacek, 2014). There are few perfect foods and not all snacks are bad. Snacks can potentially contribute some beneficial nutrients to a consumer's overall diet quality. Perhaps the development of a score-based healthfulness classification system in which various healthfulness criteria are evaluated on an individual basis is more appropriate to evaluate the nutritional quality of vended snacks and beverages.

A wide range of tools and methods were found to be currently available to measure the vending machine environment (Matthews & Horacek, 2014). However, the substantial variability in methodology and healthfulness criteria makes it difficult to compare results between studies. Additionally, many studies neglected reporting the reliability and/or validity of their assessment tool. Few previous assessment tools have comprehensively incorporated an evaluation of

machine accessibility, healthy product availability, promotion, price, and package/serving size. Assessment tools should evaluate healthy product availability, promotion, price, and package/serving size. Previously established healthfulness criteria for vended products have been either too lenient or too strict and may not accurately assess product healthfulness. Healthfulness criteria should include an evaluation of caloric content, fat content, sugar content, and key indicator nutrient content, but a product should not be required to meet all criteria to be considered healthy (Stallings & Yaktine, 2007; USDA, 2010; USDA, 2013; Bisogni et al., 2012). The purposes of this study are to (1) develop a comprehensive vending machine assessment tool that is universal, valid, and reliable, known as the Health Density Vending Machine Audit Tool, (HDVMAT), (2) implement the HDVMAT, and (3) validate the HDVMAT using the previously validated and reliable Nutrition Environment Measures Survey-Vending (NEMS-V) tool (Voss, 2012).

## **Methods**

As part of the United States Department of Agriculture Multi-state Research Project NC1193 “Promoting Healthful Eating to Prevent Excessive Weight Gain in Young Adults” researchers at 11 partner Universities evaluated the vending machine environment on their campus. Institutional Review Board approval was not necessary given this was an environmental assessment. Vending machine assessments were conducted over 3 months from December 2013 to February 2014.

### *Tool Development*

The Health Density Vending Machine Audit Tool (HDVMAT) was developed using information gathered from a literature review of the current available research on vending

machine assessment methodology (Matthews & Horacek, 2014). Following summary, evaluation, and comparison of the methodologies and conclusions of relevant research studies, assessment variables were selected for inclusion in tool development. The variables selected for inclusion and evaluation in the HDVMAT were machine accessibility, product availability, promotion, price, and package size (Callaghan et al., 2010; Van Hulst et al., 2013; French et al., 1997; French et al., 2001; French et al., 2010; Kocken et al., 2012; Minaker et al., 2011; Antonuk & Block, 2006; Rovner et al., 2011). Additionally, a novel nutrient-dense scoring system was created to determine the healthfulness of vended snacks and beverages that was based upon nutritional standards outlined by the Institute of Medicine (IOM), Daily Values (DV), *2010 Dietary Guidelines for Americans*, and *Smart Snacks in School: USDA's "All Foods Sold in Schools"* (Stallings & Yaktine, 2007; USDA, 2010; USDA, 2013). For the purpose of this tool, snacks are scored based on a 12-point scoring system. All snacks are evaluated for calorie, saturated fat, trans fat, sugar, sodium, fiber, calcium, iron, potassium, vitamin C, vitamin D, and Vitamin E content (Table 6) (Stallings & Yaktine, 2007; USDA, 2010; USDA, 2013). A snack receives 1 point for each individual healthy nutritional criterion met for a maximum health density score of 12 points and a minimum health density score of "0". Gum and mint products are not considered to have any real nutritive value and are excluded from analysis in this audit tool. All beverages are categorically evaluated based on beverage type and caloric content (Table 6) (Stallings & Yaktine, 2007; USDA, 2010; USDA, 2013). Beverages are scored based on a 2-point scoring system.

To facilitate the ease of scoring vended products, a master snack list and a master beverage list were created. An analysis of existing vending data from Byrd-Bredbenner et al. (2012) yielded detailed nutrient information for 123 unique snacks and 228 unique beverages,

from which health density scores were generated. Snacks and beverages of different product names, flavors, brands, and portion sizes were evaluated separately and considered to be unique products. Prior to pilot testing, the primary researcher and three research assistants surveyed products in vending machines in a variety of settings to add to the master lists of common vended snacks and beverages. The nutrition information for all new snacks and beverages found in these vending machines was secured online using these websites in the following order: USDA Nutrient Database for Standard Reference ([www.ndb.nal.usda.gov](http://www.ndb.nal.usda.gov)), USDA SuperTracker ([www.supertracker.usda.gov](http://www.supertracker.usda.gov)), MyFitnessPal ([www.myfitnesspal.com](http://www.myfitnesspal.com)), Calorie Count (<http://caloriecount.about.com>), and the product brand's website. Healthy dense snack or beverage scores were then calculated and recorded for each product. On each master list the product name, brand, serving size in oz./fl. oz., package size in oz./fl. oz., and healthy dense snack or beverage score for each product is noted.

Using post-hoc analysis of the full Byrd-Bredbenner et al. (2012) data set, the frequency distribution of snack scores on the snack master list identified appropriate score ranges for classifying snack products as healthy, somewhat healthy, and unhealthy. For scoring purposes, healthy snacks are snacks that receive a healthy dense snack score  $\geq 5$ . Somewhat healthy snacks are snacks that receive a healthy dense snack score of 3 or 4. Unhealthy snacks are snacks that receive a healthy dense snack score of  $\leq 2$ . For beverages, healthy beverages are beverages that receive a healthy dense beverage score of 2. Somewhat healthy beverages are beverages that receive a healthy dense beverage score of 1. Unhealthy beverages are beverages that receive a healthy dense beverage score of 0.

Two different methods of data collection were developed to record product availability within individual vending machines, the Detailed Method and the Quick Method. Both methods

involve the use of Excel spreadsheets containing the master lists of common vended snack and beverage products to record all products found within evaluated vending machines and calculate various aspects of product availability. The Detailed Method involves completion of the Detailed Snack Spreadsheet and the Detailed Beverage Spreadsheet. The Quick Method involves completion of the Quick Snack and Beverage Spreadsheet. The Detailed Method involves intensive and meticulous data collection and was initially intended to be the sole method used to evaluate vending machines. However, following pilot testing, the Detailed Method was found to be both labor and time intensive. A condensed and abbreviated version of the Detailed Method was then developed to make data collection simpler and quicker, which was termed the Quick Method. For the purposes of this tool, the Quick Method is the primary method of data collection. Through evaluating the same vending machine with the Quick Method and with the Detailed Method and comparing the results, we can determine if the simpler Quick Method is a viable and accurate way to evaluate vending machines.

Either the Quick Method or the Detailed Method can be used to complete the Qualtrics HDVMAT Survey. For both methods, all Excel spreadsheets contain protected formula/calculation boxes to facilitate correct arithmetic and the transfer of accurate data into the Qualtrics HDVMAT Survey. The Quick Method or Detailed Method is used to conduct an assessment of an individual snack or beverage machine. The Qualtrics HDVMAT Survey is designed to evaluate the whole vending environment for a building, so it is an average of vending machine data for all evaluated vending machines within a building. On the Qualtrics HDVMAT Survey the following data are recorded. *Machine accessibility* is evaluated based on vending machine hours of operation or percentage of empty slots, depending on the type of environment evaluated. For primary and secondary school environments, machine accessibility is

evaluated based on vending machine hours of operation. For all other environments, machine accessibility is evaluated based on how well stocked vending machines are throughout the day. *Machine availability* is evaluated by recording the number of each of type of machine found in the building. *Snack product availability* was evaluated based on the average healthy dense snack score, average healthy snack percentage, and average healthy snack variety percentage of all evaluated snack machines within a building. Likewise, *beverage product availability* was evaluated based on the average healthy dense beverage score, average healthy beverage percentage, and average healthy beverage variety percentage of all evaluated beverage machines within the building. Healthy product variety is based on the number of different healthy product options available within a snack or beverage machine. *Product price* is evaluated based on the average prices of healthy and unhealthy products of comparable type and size in vending machines within the building. *Product promotion* is evaluated based on the presence of nutrition information on vending machines and vending machine products, product logos, and green eating promotion information. General nutrition information refers to the presence of nutritional information labels on vended product packages. Examples of general nutrition information that may be found on products include, but are not limited to the following: no/low/reduced calories, no/low/reduced sugar, no/low/reduced sodium, high/good source of vitamins, and high/good source of minerals/ fruit/vegetable servings. Specific nutrition information refers to any labels on the vending machine or vended products that highlight or designate healthier options to consumers. The evaluation of green eating promotion serves as another indicator of healthy product promotion. Green eating promotion includes signage that describes products as local, organic, and sustainable.

Each HDVMAT snack score is a representation of the average of all snack machines evaluated within one building. Each HDVMAT snack score (range 6-24) is comprised of the average healthy dense snack score plus the scores for machine accessibility, pricing, and promotion for all snack machines within a building (Table 7). Similarly, each HDVMAT beverage score (range 6-20) is comprised of the average healthy dense beverage score plus the scores for machine accessibility, pricing, and promotion for all beverage machines within a building (Table 7). HDVMAT snack and beverage scores can be used to universally compare vending machine environments between different buildings.

All tools, protocols, and training materials were refined based upon the pilot-test for clarity and face and content validity by a team of five experts in the field of nutrition. All materials are available from the corresponding author upon request.

#### *Implementation of HDVMAT*

The HDVMAT was implemented on vending machines at the campuses of US post-secondary institutions in 11 states. Each campus independently selected buildings for evaluation. Building types evaluated in this study included residence halls, academic buildings, libraries, and recreation facilities. Student unions and administrative buildings were also evaluated and collapsed into one category referred to as other building types. Each building selected for inclusion was assigned a different numerical building code number. Each building was then surveyed and relevant information was recorded on a printed PDF copy of the Qualtrics HDVMAT Survey. Information recorded during this time was later entered into the corresponding online Qualtrics HDVMAT Survey.

Each campus evaluated at least one snack and one beverage in each building type, if present. Vending machines with the highest traffic flow were selected for evaluation, ie.



machines on the main floor of a building. Each vending machine was assigned a different numerical machine code. A unique machine ID was then generated for each vending machine evaluated (state – building code number – machine code number). To insure a consistent view of vending machines for each type of evaluation, research assistants used a digital camera or smartphone to take photographs of vending machines selected for evaluation. Photographs were taken of the front, right side, and left side of the vending machine. Photographs of machine contents were also taken. All vending machines were evaluated using the Quick Method. Vending machine photographs were used to complete the Quick Snack and Beverage Spreadsheet in Excel. Information generated from completion of the Quick Snack and Beverage Spreadsheet and vending machine photographs were then used to complete the Qualtrics HDVMAT Survey.

#### *Validation of HDVMAT*

Two approaches were planned for the validation study. Both approaches were implemented using the original photographs that were taken during the HDVMAT implementation study. Firstly, a subsample of at least 25% of the vending machines evaluated on each campus was evaluated using the Detailed Method (data not shared). Secondly, to validate product healthfulness and healthy product availability, a subsample of at least 50% of the vending machines evaluated on each campus were evaluated using the Nutrition Environment Measures Survey-Vending (NEMS-V) tool, a previously validated and reliable vending machine assessment tool (Voss, 2012). For this study, the NEMS-V protocol involved completion of an Excel spreadsheet that contained an Individual Vending Machine Graphic and a Food and Beverage Recording Sheet. To complete the Individual Vending Machine Graphic, an “X” was placed in the slots that did not contain products, an “E” was placed in the slots that were empty,

and a “G/M” was placed in slots containing gum and mints. The remaining slots were then numbered from left to right, proceeding down the rows. The slots designated with an “X” were not assigned a number. Individual slots on the vending machine graphic that contained a product (excluding gum and mints) were then marked green, yellow, or red, based on information gathered from the Food and Beverage Recording Sheet. This serves as a snapshot of the availability of healthy choices within the machine. To complete the Food and Beverage Recording Sheet, the slot number(s), item name, package size, price, food or beverage category, and color code for each individual product in the vending machine were recorded. Each product’s nutritional information was entered in the Healthy Choices Calculator (<http://www.nems-v.com/NEMS-VHealthyChoicesCalc.html>) to determine a product’s color code with green designating healthy products, yellow designating somewhat healthy products, and red designating unhealthy products (Voss et al., 2012).

Since the Qualtrics HDVMAT Survey is an audit of the vending environment per building it is an average of the vending machine data. However, the NEMS-V Method provides an assessment of individual vending machines. Since Quick Method assessments were conducted on each individual vending machine evaluated, validation comparisons were made between Quick Method and NEMS-V Method data.

#### *Data Collection*

Researchers on all campuses were trained to collect data uniformly via a detailed protocol and telephone conference led by the primary researcher (MM). Each campus independently established inter-rater reliability between research assistants. Research assistants evaluated the same photographs of at least two snack and/or beverage machines. Research assistants on each

campus were required to reach  $\geq 80\%$  inter-rater reliability or higher for these practice machines before continuing with data collection.

Data was collected on each campus by a team of trained research assistants. Data was entered into the corresponding Quick Method, Detailed Method, and NEMS-V Excel spreadsheets. All completed Excel spreadsheets and Qualtrics surveys were submitted to the primary researcher.

Following data cleaning, all training inter-rater reliability data were reviewed for acceptability and then eliminated; study data were analyzed using SPSS. Using Kolmogorov-Smirnov, the null hypothesis for normality of the HDVMAT data was rejected, indicating that the mean HDVMAT snack score distribution deviated significantly from a normal distribution ( $D = .156, p < .001$ ). Similarly, the mean HDVMAT beverage score distribution deviated significantly from a normal distribution ( $D = 1.61, p < .001$ ). Non-parametric statistics were then used to describe the data. Differences between mean HDVMAT snack and beverage scores by campus and building types were determined using Kruskal-Wallis tests. Post-hoc analysis was conducted using Mann-Whitney U tests with Bonferroni adjustment. Chi-square analysis was also applied to compare machine accessibility, product price, and product promotion on each campus.

Pearson's correlations and T-tests were applied between a subset of vending machines evaluated by both the NEMS and the Quick Method. Since the Qualtrics HDVMAT Survey is an audit of the vending environment per building, it is an average of the vending machine data. However, the Quick Method assessment was expected for each vending machine evaluated. Two of the 11 states used one Quick Form to assess more than one vending machine, therefore making it incomparable to the NEMS data. Data were included for analysis for a machine ID if the following conditions were met: (1) if the total number of snack or beverage products within

the vending machine was  $\leq 50$  and (2) if the total number of snack or beverage products within the vending machine recorded using NEMS was within  $\pm 10\%$  of the total number of snack or beverage products recorded using the Quick Method. To investigate whether the percentage of healthy products in a snack or beverage machine evaluated using NEMS differed significantly from the percentage evaluated using the Quick Form *t*-tests were conducted.

## Results

Campus characteristics and mean HDVMAT snack and beverage scores are reported in Table 8. A total of 206 vending machines were assessed on the 11 campuses. Vending machines were evaluated in an average of 9 different buildings on each campus; 63 academic buildings, 20 residential buildings, 9 recreation facilities, 8 libraries, and 11 other building types. Across all universities, an average of 8 snack machines were evaluated and the mean HDVMAT snack score for all buildings that evaluated snack machines was  $13.9 \pm 1.6$  (range 10-17). Similarly, an average of 10 beverage machines were evaluated and the mean HDVMAT beverage score for all buildings that evaluated beverage machines was  $11.2 \pm 1.3$  (range 8-15).

The overall distributions and means of each scoring criterion used to assign HDVMAT snack and beverage scores are shown in Table 9. About 26% of evaluated buildings containing snack machines received an average healthy dense snack score of 3.5 or higher. Additionally, roughly 34% of evaluated buildings containing beverage machines received an average healthy dense beverage score of 1 or higher. For machine accessibility, 20% of buildings had machines categorized as somewhat or not appropriately accessible. With regards to product price, 89% of buildings contained healthy products priced equal to or lower than unhealthy products. About

26% of evaluated buildings had machines without any nutrition information. Similarly, roughly 5% of machines had any green eating information.

Mean HDVMAT snack and beverage scores were compared between states (universities) and building types. HDVMAT scores differed significantly by state (Table 8), but not by building type (data not shown). Although there were significant differences by state, most scores were clustered around the mean with one Northeastern University having a significantly higher mean HDVMAT snack than six other states. Additionally, one Southern University had a significantly lower mean HDVMAT snack score than five other states. One Midwestern University and one Southern University had significantly higher mean HDVMAT beverage scores than one Midwestern University and one Southern University.

Chi-square analysis revealed a significant relationship between state and machine accessibility ( $N=110$ ,  $X^2 = 68.622$ ,  $p < .001$ ) (specific crosstab data not shared). Across all states, 88 (80%) of the evaluated buildings categorized machines as appropriately accessible. Five states categorized vending machines as somewhat accessible in 16 (15%) of the buildings. Whereas two Northeastern states categorized machines in the remaining 6 (5%) buildings as not appropriately accessible. The majority of evaluated buildings across all states contained appropriately accessible vending machines, with only two states accounting for buildings that contained vending machines designated as not appropriately accessible.

A significant relationship also existed between state and product price ( $N = 106$ ,  $X^2 = 126.968$ ,  $p < .001$ ). Across all states, 85 (80%) of buildings contained vending machines with equally priced healthy and unhealthy products. Forty percent of the evaluated buildings at Midwestern University 2 (4 buildings) and 100% at Northeastern University 2 (8 buildings) accounted for the 12 (11%) buildings with machines containing healthy products that were more

expensive than unhealthy products. Roughly 66% of Midwestern University 1, 40% of Midwestern University 2, and 10% of Southern University 3 buildings categorized the remaining 9 (9%) buildings as having machines with healthy products less expensive than unhealthy products. The majority of evaluated buildings across all states contained vending machines with equally priced healthy and unhealthy products, with three states containing machines with healthy products as more expensive and three states containing machines with healthy products as less expensive.

A significant relationship also existed between state and nutrition information ( $N = 108$ ,  $X^2 = 111.564$ ,  $p < .001$ ). Across all states, 80 (74%) of evaluated buildings categorized vending machines as having no nutrition information. Five states categorized 12 (11%) buildings as having vending machines with general nutrition information. The 100% of Southern University 2 buildings and both a Northeastern and Southern state had two buildings categorizing the remaining 16 (15%) buildings as having vending machines with specific nutrition information. The majority of evaluated buildings across all states contained vending machines with no nutrition information, with five states containing machines with general nutrition information and three states containing machines with specific nutrition information.

A significant relationship also existed between state and machine logos ( $N = 111$ ,  $X^2 = 41.118$ ,  $p < .01$ ). Across all states, 62 (56%) of evaluated buildings had vending machines with unhealthy logos only. Seven states categorized 19 (17%) buildings as having vending machines with healthy and unhealthy logos. Nine states categorized 30 (27%) buildings as having vending machines with only healthy logos or no logos.

A significant relationship did not exist between state and green eating promotion.

Chi-square analysis revealed there is not a significant relationship between building type and machine accessibility, nutrition information, machine logos, or green eating promotion. However, a significant relationship existed between building type and product price ( $N = 106$ ,  $X^2 = 16.098$ ,  $p < .05$ ). Across all building types, 85 (80%) of buildings contained vending machines with equally priced healthy and unhealthy products. Of the 12 (11%) buildings categorized as having healthy products more expensive than unhealthy products, 3 (3%) were residential buildings, 1 (1%) was a recreation facility, 4 (4%) were academic buildings, and 4 (4%) were all other building types. Additionally, of the 9 (8%) buildings categorized as having unhealthy products more expensive than healthy products, 1 (1%) was a library, 7 (7%) were academic buildings, and 1 (1%) was another building type.

Comparisons between healthy snack and beverage product availability evaluated using the Quick Form Method and the NEMS-V Method are shown in Table 10. The mean percentage of healthy snacks using the Quick Method was  $15.1 \pm 9.6$  (range 0-37.1) compared to  $7.1 \pm 10.0$  (range 0-36.4) using the NEMS-V method. No significant correlations existed between both methods regarding the mean percentage of healthy snacks or the mean number of somewhat healthy snacks. Both the mean percentage of healthy snacks and mean number of somewhat healthy snacks using the Quick Method are significantly different from the NEMS-V method. A significantly weak correlation exists between both methods regarding the mean number of healthy snacks, but the means are significantly different. The mean percentage of healthy snacks using the Quick Method was  $16.8 \pm 13.2$  (range 0-53.3) compared to  $13.2 \pm 12.5$  (range 0-53.3) using the NEMS-V method. A significant correlation exists between both methods regarding the mean percentage of healthy beverages, but the means are significantly different. A significantly strong correlation exists between both methods regarding the mean number of somewhat healthy

beverages, but the means are significantly different. A significantly strong correlation exists between both methods regarding the mean number of healthy beverages, but the means are significantly different.

## **Discussion**

For this study, HDVMAT snack and beverage scores were developed to evaluate multiple aspects of the vending machine environment in order to reflect the overall healthfulness of the snack and beverage vending machine environments within a single building. An evaluation of consumer purchasing and consumption habits from campus vending machines found that despite implementation of a vending policy that increased availability of healthy snacks, consumers frequently selected unhealthy snacks (Caruso et al., 2014). This finding suggests that simply increasing healthy product availability may not be sufficient enough to establish a healthy vending environment for consumers (Caruso et al., 2014). An extensive vending machine policy targeting multiple aspects of the vending machine environment may be necessary to promote a healthier vending environment (Caruso et al., 2014).

In this study machine accessibility, product availability, product price, and product promotion are categorized into subscores that can be added together to calculate a vending machine's HDVMAT snack or beverage score. Each HDVMAT snack score is a representation of the average of all snack machines evaluated within one building. Similarly, each HDVMAT beverage score is a representation of the average of all beverage machines in a building. Several previous vending machine assessment studies have evaluated multiple aspects of the vending environment including accessibility, availability, price, and promotion (Lawrence et al., 2009; Kelly et al., 2012; Bell et al., 2013). Additionally, other previous vending machine assessment



studies have developed methods to score vending machines, creating a means for comparison between different vending machines (Voss et al., 2012; Kubik et al., 2011; Winston et al., 2013). The HDVMAT snack and beverage scores established in this study can be used as comprehensive and comparable indicators of vending machine environments.

Overall, in this study the average HDVMAT snack score for all applicable evaluated buildings was about 14 out of 24 and the average HDVMAT beverage score for all applicable evaluated buildings was about 11 out of 20. These findings indicate that HDVMAT snack and beverage scores across all evaluated university campuses are relatively low, indicating that improvements can be made to vending machine environments. Through investigating HDVMAT subscores, variables contributing to low HDVMAT scores were identified.

Only about a quarter of all buildings contained snack machines that received an average healthy dense snack score of 3.5 or higher, indicating that the majority of snack machines contained more unhealthy products than healthy. Similarly, a third of all evaluated buildings contained beverage machines that received an average healthy dense beverage score of 1 or higher, indicating that the majority of beverage machines contained more unhealthy products than healthy. Additionally, approximately a quarter of all building had machines with general or specific nutrition information and less than 5% had information regarding green eating. Although, more than three quarters of the evaluated buildings contained machines categorized as appropriately accessible and nearly 90% contained machines with healthy products priced equal to or lower than unhealthy products. Overall HDVMAT scores and subscores can be used to identify healthy and unhealthy aspects of the vending machine environment. Interventions can then be targeted at improving aspects of the vending machines that are not conducive to an overall healthy vending environment.

HDVMAT snack and beverage scores were created as a way to compare vending machine environments. This scoring approach allowed us to compare HDVMAT snack and beverage scores between states (universities). Our findings indicate that significant differences exist between states and both HDVMAT scores. This suggests that vending machine environments can vary based on geographic region. However, it is unclear what factors are contributing to discrepancies in vending environments between states unless the HDVMAT subscores are investigated. Northeastern University 3 had a significantly higher mean HDVMAT snack score than more than half of the other states. Of the 25% of buildings that contained snack machines that received an average healthy dense snack score of 3.5 or higher, more than half of them were located at Northeastern University 3, indicating vended snacks in this state were slightly healthier than other states. Southern University 2 had a significantly higher mean HDVMAT beverage score than two other states. Investigation of HDVMAT subscores revealed that of the 16 buildings that contained specific nutrition information about products in vending machine, 14 (88%) of them were located in Southern University 2. This finding is particularly notable because in approximately 75% of evaluated buildings vending machines had no nutrition information. There were no significant differences between building type and HDVMAT snack or beverage scores. However, this may be due to an uneven distribution of building types included in the overall sample. The sample size for libraries (N = 8) and recreation facilities (N = 9) were relatively low compared to the sample size for residential buildings (N = 20) and academic buildings (N = 63). HDVMAT scores and subscores can thus be used to identify differences between vending environments. Larger samples of different building types may be necessary to better distinguish if differences in vending environments exist between building types.

One of the purposes of this study was to validate the HDVMAT using the previously validated and reliable Nutrition Environment Measures Survey-Vending (NEMS-V) tool (Voss et al., 2012). For validation purposes completed Quick Method assessments were compared to completed NEMS-V assessments. The Qualtrics HDVMAT Survey is an audit of the vending environment per building, it is an average of the vending machine data, but the NEMS-V is an assessment of individual vending machines. Since Quick Method assessments were conducted on individual vending machines, comparisons were made between Quick Method and NEMS-V Method data. Our findings demonstrate that there is a significantly weak correlation between the mean number of healthy snacks using the Quick Method and the NEMS-V Method. Furthermore, our findings indicate that there is a strong correlation between the mean percentage of healthy beverages, mean number of healthy beverages, and mean number of somewhat healthy beverages using the Quick Method and NEMS-V Method. The significant correlations that exist between the Quick Method and NEMS-V Method pertaining to snack and beverage healthfulness suggest that the HDVMAT is a valid method to evaluate vended product healthfulness, which is an important aspect of the overall vending environment.

Although significant correlations existed between the Quick Method and the NEMS-V Method, significant differences between vended snack and beverage healthfulness were also evident. For both snacks and beverages, the mean percentage of healthy, mean number of healthy, and mean number of somewhat healthy using the Quick Method and the NEMS-V Method were significantly different. These significant differences are likely due to differences in healthfulness criteria established in the HDVMAT and the NEMS-V tool. The NEMS-V evaluates product healthfulness using a strict categorical approach that requires a product to meet all healthfulness criteria to be considered healthy. However, the HDVMAT utilized a scoring

system to determine product healthfulness in which healthfulness criteria are evaluated individually with one point awarded for each criterion met. The mean percentage of healthy snacks in evaluated snack machines was determined to be about 15% using the Quick Method as opposed to about 7% using the NEMS-V Method. These findings are consistent with previous NEMS-V data that suggest the majority of snacks in vending machines are of low nutritional value (NEMS-V, n.d.). Across seven counties in Iowa, snack machines were evaluated using NEMS-V and the percentage of healthy snacks in these machines ranged from 0% to 20% (NEMS-V, n.d.). Similarly, the mean percentage of healthy beverages in evaluated beverage machines was determined to be about 17% using the Quick Method as opposed to about 13% using the NEMS-V Method. These findings are also consistent with previous NEMS-V data (NEMS-V, n.d.). Across nine counties in Iowa, beverage machines were evaluated using NEMS-V and the percentage of healthy beverages in these machines ranged from 6% to 33%. The significant differences between both methods regarding vended product healthfulness suggest that the scoring approach allows for more vended snacks and beverages to be classified as healthy. Differences were more pronounced with snacks because the scoring spectrum (0-12) is larger than the scoring spectrum for beverages (0-2). Healthfulness classifications for beverages using the HDVMAT and the NEMS-V are more similar, which likely contributed to the stronger correlations and less pronounced differences seen between the two methods with regards to beverage healthfulness. The healthfulness scoring approach may allow for a more inclusive representation of vended product healthfulness.

Overall our findings indicate that the healthfulness of snacks and beverages in vending machines is low. Roughly 25% of all buildings contained snack machines that received an average healthy dense snack score of 3.5 or higher, indicating that the majority of snack

machines contained more unhealthy products than healthy. Similarly, about 33% of all evaluated buildings contained beverage machines that received an average healthy dense beverage score of 1 or higher, indicating that the majority of beverage machines contained more unhealthy products than healthy. These findings are consistent with previous vending machine assessment studies that concluded the majority of snacks and beverages sold in vending machines were of minimal nutritional value (Pasch et al., 2011; Lawrence et al., 2009; Kubik et al., 2011; Gemmill & Cotugna, 2005; French et al., 2003; Byrd-Bredbenner et al., 2012).

A strength of this study was the innovative use of digital photography. Digital photography has been used previously as an assessment method in nutrition research, but has yet to be used in vending machine assessment studies (Williamson et al., 2003; Turconi et al., 2005; Swanson, 2008). Digital photography is minimally intrusive on food and nutrition environments and allows non-disruptive and unhurried evaluations of the environment to be conducted, unlike direct observation. Advantages of using digital photography in measuring the nutrition environment include rapid data acquisition, participant and researcher convenience, and unhurried and uninterrupted evaluation of the food environment (Williamson et al., 2003; Turconi et al., 2005; Swanson, 2008). Digital photography may be a highly accurate, reliable, and time-effective way to evaluate the food and nutrition environment, which includes the vending machine environment. Another strength of this study is the use of score-based healthfulness classification system in which various healthfulness criteria are evaluated on an individual basis. This may provide a more appropriate estimation of the nutritional quality of vended snacks and beverages. Another strength is the comprehensive nature of the HDVMAT. The HDVMAT provides a method to evaluate and score multiple aspects of the vending machine

environment, including machine accessibility, product availability, product price, and product promotion.

However, there are some limitations to this study. Through implementation of the HDVMAT some issues with the tool were encountered and identified. Some questions on the Qualtrics HDVMAT Survey were worded unclearly and were thus omitted from analysis. Additionally, there was some confusion regarding the protocol, two of the 11 states appeared to have used one Quick Form to assess more than one vending machine. A separate Quick Form should have been used to evaluate each separate vending machine. Therefore some data was excluded from the Quick Method and NEMS-V Method comparison, reducing the sample size for comparison. Additionally, although one of the purposes of this study was to create a validated tool, this study only provides validation for product healthfulness and healthy product availability. The machine accessibility, product price, and product promotion assessment variables in this tool were not validated in this study. Another limitation is that although the HDVMAT is a comprehensive vending machine assessment tool, it is a complicated tool. The HDVMAT involves the completion of multiple excel files before Qualtrics survey completion. HDVMAT snack and beverage scores also not automatically generated in the Qualtrics survey; they must be computed after survey data entry. Additionally, all data collected for vending machines within a building must also be averaged before being entered into Qualtrics.

Problems encountered during HDVMAT implementation suggest that it may be more useful to create separate surveys that evaluate individual snack and beverage machines, as opposed to evaluating the average of snack and beverage machines within a building. This should make data collection and data entry simpler and allow for individual snack and beverage machines to be compared. Following conclusion of this study appropriate modifications were

made to survey questions and a Qualtrics HDVMAT Snack Survey and a Qualtrics HDVMAT Beverage Survey were created. For machines that contain both snacks and beverages, snacks and beverages should be evaluated separately using both the Qualtrics HDVMAT Snack Survey and the Qualtrics HDVMAT Beverage Survey. Both surveys are available from the corresponding author upon request.

### **Implications for Future Research and Practice**

The HDVMAT can be used to comprehensively evaluate and compare vending machines. Future research should focus on evaluating different environments outside of the university setting using the Qualtrics HDVMAT Snack Survey and Qualtrics HDVMAT Beverage Survey. However, further HDVMAT tool validation and tool refinement is also necessary. The HDVMAT tool can be used to determine if any differences exist between vending machine environments in different settings (schools, worksites, hospitals, etc.). The HDVMAT was designed to be a universal vending machine assessment tool, but needs to be tested in different environments in order to determine generalizability. Additionally, consumer perceptions regarding vending machine environments should be evaluated in conjunction with an environmental assessment of the vending machine environment. Perceived and objective measures of the vending environment can then be compared.

**TABLE 6: HDVMAT HEALTHFULNESS CRITERIA**

<b>Snacks (Range 0-12)</b>	
<b>Nutrient</b>	<b>Healthfulness Criteria</b>
Calories	≤ 200 calories per package
Saturated Fat	≤ 10% DV per package <sup>A</sup>
Trans Fat	0% per package
Sugar	≤ 12.5 g per package <sup>B,C</sup>
Sodium	≤ 10% DV per package
Fiber	≥ 10% DV per package
Calcium	≥ 10% DV per package
Iron	≥ 10% DV per package
Potassium	≥ 10% DV per package
Vitamin C	≥ 10% DV per package
Vitamin D	≥ 10% DV per package
Vitamin E	≥ 10% DV per package
<b>Beverages (Range 0-2)</b>	
<b>Score</b>	<b>Healthfulness Criteria</b>
0	- Sports drinks/life water/vitamin water (>50 calories per 8 fl. oz.) - Sugar sweetened beverages/energy drinks/coffee drinks/lemonade/iced tea/all other beverages (>10 calories per 8 fl. oz.)
1	- Non-100% fruit or vegetable juice - Milk/flavored milk/non-dairy milk alternatives (>150 calories per 8 fl. oz.) - Sugar sweetened beverages/energy drinks/coffee drinks/lemonade/iced tea/all other beverages (≤10 calories per 8 fl. oz.)
2	- Water/flavored water - 100% fruit or vegetable juice - Milk/flavored milk/non-dairy milk alternatives (≤150 calories per 8 fl. oz.)

<sup>A</sup>In accordance with the *Smart Snacks in School: USDA’s “All Foods Sold in School” Standards* exemptions to the saturated fat standard include reduced fat cheese (including part-skim mozzarella), nuts, seeds, nut or seed butters, products containing only dried fruit with nuts and/or seeds with no added nutritive sweeteners or fats, and seafood with no added fats. These products will automatically meet the saturated fat standard and receive 1 point for meeting the saturated fat criteria.

<sup>B</sup>Although not consistent with IOM criteria, the 12.5g criteria was selected because it is equivalent to 25% of the recommended DV for sugar and establishes a simple cut-off point to quickly and effectively evaluate snack products.

<sup>C</sup>In accordance with the *Smart Snacks in School: USDA’s “All Foods Sold in School” Standards* exemptions to the sugar standard include dried whole fruits or vegetables, dried whole fruit or vegetable pieces, dehydrated fruits with no added nutritive sweeteners, dried whole fruits or pieces with nutritive sweeteners that are required for processing and/or palatability purposes (cranberries, tart cherries, blueberries, etc.), and products consisting of dried fruit with nuts and/or seeds with no added nutritive sweeteners or fats. These products will automatically meet the sugar standard and receive 1 point for meeting the sugar criteria.



**TABLE 7: HDVMAT SCORING INSTRUMENT**

Criterion	Standards for Awarding Scores									Subscore	
<b>Product Availability<sup>A</sup></b>											
Average healthy dense snack score <sup>B</sup>	1	2	3	4	5	6	7	8	9	1-9	
	1	1.5	2	2.5	3	3.5	4	4.5	5		
Average healthy dense beverage score <sup>C</sup>	1		2		3		4		5		1-5
	0		0.5		1		1.5		2		
<b>Machine Accessibility</b>											
Accessibility of vending machines and machine products <sup>B,C</sup>	1 Not appropriately accessible			2 Somewhat accessible			3 Appropriately accessible			1-3	
<b>Product Price</b>											
Average prices of similar type/size healthy and unhealthy products <sup>B,C</sup>	1 Healthy more expensive than Unhealthy			2 Healthy and Unhealthy equally priced			3 Healthy less expensive than Unhealthy			1-3	
<b>Product Promotion</b>											
Presence of nutrition information on machine and products <sup>B,C</sup>	1 No nutrition information			2 General nutrition information on machines			3 Specific nutrition information about products in machines			1-3	
Presence of product logos on machines <sup>B,C</sup>	1 Only unhealthy product logos			2 Both healthy and unhealthy product logos			3 Only healthy or no product logos			1-3	
Presence of green eating health promotion information <sup>B,C</sup>	1 No green eating promotion			2 General promotion of green eating			3 Creative/original specific green eating promotion			1-3	

<sup>A</sup>Product availability was also evaluated through average healthy snack percentage, average healthy snack variety percentage, average healthy beverage percentage, and average healthy beverage variety percentage. These variables were not included in overall HDVMAT snack or beverage scores.

<sup>B</sup>Variables included in HDVMAT snack score: average healthy dense snack score, machine accessibility, product price, and product promotion (nutrition information, machine logos, green eating information). Scores range from 6 to 24.

<sup>C</sup>Variables included in HDVMAT beverage score: average healthy dense beverage score, machine accessibility, product price, and product promotion (nutrition information, machine logos, green eating information). Scores range from 6 to 20.

**TABLE 8: CAMPUS CHARACTERISTICS AND MEAN HDVMAT SNACK AND BEVERAGE SCORES**

Campus	Students Enrolled*	Number of Different Buildings Evaluated	Total Number Snack Machines (n)	Mean HDVMAT Snack Score †	Total Number Beverage Machines (n)	Mean HDVMAT Beverage Score ‡
Midwestern University 1	24,445	6	6	13.2 ± 1.0 <sup>a,b,c</sup>	14	10.2 ± 1.2 <sup>a</sup>
Midwestern University 2	28,262	10	10	14.3 ± 1.6 <sup>b,c,d</sup>	10	12.6 ± 1.4 <sup>b</sup>
Midwestern University 3	12,554	10	10	13.8 ± 0.8 <sup>b,c</sup>	10	11.0 ± 0.0 <sup>a,b</sup>
Northeastern University 1	11,247	10	9	13.4 ± 0.8 <sup>a,b,c</sup>	9	10.7 ± 1.1 <sup>a,b</sup>
Northeastern University 2	15,301	8	9	12.8 ± 1.6 <sup>a,b</sup>	12	11.0 ± 0.8 <sup>a,b</sup>
Northeastern University 3	65,000	10	9	15.8 ± 1.2 <sup>d</sup>	11	11.6 ± 1.5 <sup>a,b</sup>
Northeastern University 4	21,267	7	9	13.5 ± 1.5 <sup>a,b,c</sup>	12	10.8 ± 1.6 <sup>a,b</sup>
Southern University 1	25,134	6	3	13.5 ± 0.7 <sup>a,b,c,d</sup>	5	11.0 ± 1.0 <sup>a,b</sup>
Southern University 2	49,913	10	10	15.0 ± 0.0 <sup>c,d</sup>	10	12.4 ± 0.5 <sup>b</sup>
Southern University 3	27,171	10	8	14.3 ± 1.2 <sup>b,c,d</sup>	10	11.4 ± 1.1 <sup>a,b</sup>
Southern University 4	25,796	11	7	12.5 ± 1.9 <sup>a</sup>	13	10.2 ± 0.9 <sup>a</sup>
<b>Totals</b>		<b>98</b>	<b>90</b>	<b>13.9 ± 1.6</b>	<b>116</b>	<b>11.2 ± 1.3</b>

\*Student enrollment (data from 2013) is an indication of campus size.

†  $sX^2 = 30.861$ ,  $p < .001$ . Values bearing similar lowercase superscripts are not significantly different.

‡  $X^2 = 48.656$ ,  $p < .001$ . Values bearing similar lowercase superscripts are not significantly different.

**TABLE 9: OVERALL DISTRIBUTION AND MEAN HDVMAT SCORING CRITERION FOR ALL EVALUATED BUILDINGS**

<b>Criterion</b>	<b>HDVMAT Criterion Score Distributions</b>									<b>Subscore</b>
<b>Product Availability</b>										
Average healthy dense snack score N = 97	<b>1</b> 1 (1.0%)	<b>1.5</b> 0 (0%)	<b>2</b> 3 (3.1%)	<b>2.5</b> 12 (12.4%)	<b>3</b> 56 (57.7%)	<b>3.5</b> 24 (24.7%)	<b>4</b> 1 (1.0%)	<b>4.5</b> 0 (0%)	<b>5</b> 0 (0%)	5.0 ± 0.9
Average healthy dense beverage score N = 105	<b>0</b> 5 (4.8%)		<b>0.5</b> 65 (61.9%)		<b>1</b> 31 (29.5%)		<b>1.5</b> 2 (1.9%)		<b>2</b> 2 (1.9%)	2.3 ± 0.7
<b>Machine Accessibility</b>										
Accessibility of vending machines and machine products N = 110	<b>Not appropriately accessible</b> 6 (5.5%)			<b>Somewhat accessible</b> 16 (14.5%)			<b>Appropriately accessible</b> 88 (80%)			2.8 ± 0.5
<b>Product Price</b>										
Average prices of similar type/size healthy and unhealthy products N = 106	<b>Healthy more expensive than Unhealthy</b> 12 (11.3%)			<b>Healthy and Unhealthy equally priced</b> 85 (80.2%)			<b>Healthy less expensive than Unhealthy</b> 9 (8.5%)			2.0 ± 0.4
<b>Product Promotion</b>										
Presence of nutrition information on machine and products N = 108	<b>No nutrition information</b> 80 (74.1%)			<b>General nutrition information on machines</b> 12 (11.1%)			<b>Specific nutrition information about products in machines</b> 16 (14.8%)			1.4 ± 0.7
Presence of product logos on machines N = 111	<b>Only unhealthy product logos</b> 62 (55.9%)			<b>Both healthy and unhealthy product logos</b> 19 (17.1%)			<b>Only healthy or no product logos</b> 30 (27.0%)			1.7 ± 0.9
Presence of green eating health promotion information N = 110	<b>No green eating promotion</b> 105 (95.5%)			<b>General promotion of green eating</b> 5 (4.5%)			<b>Creative/original specific green eating promotion</b> 0 (0%)			1.1 ± 0.2

**TABLE 10: QUICK METHOD AND NEMS-V COMPARISON OF PRODUCT HEALTHFULNESS**

Product Healthfulness	Quick Form Mean $\pm$ SD	NEMS-V Mean $\pm$ SD	P-Value	Pearson Correlation	P-Value
<b>Snack Machines Compared (n=33)</b>					
Mean Percentage of Healthy Snacks <sup>A</sup>	15.1 $\pm$ 9.6	7.1 $\pm$ 10.0	0.001	0.222	0.214
Mean Number of Healthy Snacks <sup>A</sup>	5.0 $\pm$ 3.6	2.5 $\pm$ 4.1	0.01	0.366	0.036
Mean Number of Somewhat Healthy Snacks <sup>B</sup>	14.2 $\pm$ 4.8	7.1 $\pm$ 6.0	0.001	0.254	0.154
<b>Beverage Machines Compared (n=49)</b>					
Mean Percentage of Healthy Beverages <sup>C</sup>	16.8 $\pm$ 13.2	13.2 $\pm$ 12.5	0.05	0.686	0.000
Mean Number of Healthy Beverages <sup>C</sup>	4.1 $\pm$ 5.3	3.1 $\pm$ 4.4	0.01	0.888	0.000
Mean Number of Somewhat Healthy Beverages <sup>D</sup>	5.4 $\pm$ 4.2	4.4 $\pm$ 3.3	0.01	0.812	0.000

<sup>A</sup>Healthy snacks are defined as snacks that have received a healthy dense snack score  $\geq 5$  using the Quick Method and as snacks color-coded as green using the NEMS-V Method.

<sup>B</sup>Somewhat healthy snacks are defined as snacks that have received a healthy dense snack score of 3 or 4 using the Quick Method and as snacks color-coded as yellow using the NEMS-V Method.

<sup>C</sup>Healthy beverages are defined as beverages that have received a healthy dense beverage score of 2 using the Quick Method and as beverages color-coded as green using the NEMS-V Method.

<sup>D</sup>Somewhat healthy beverages are defined as beverages that have received a healthy dense beverage score of 1 using the Quick Method and as beverages color-coded as yellow using the NEMS-V Method.

## References

- Adachi-Mejia AM, Longacre MR, Skatrud-Mickelson M, Li Z, Purvis LJ, Beach ML, Dalton MA. Variation in access to sugar-sweetened beverages in vending machines across rural, town, and urban high schools. *Public Health*. 2013;127:485-491.
- Aljadir LP, Biggs WM, Misko JA. Consumption of foods from vending machines at the University of Delaware. *Journal of the American College Health Association*. 1981;30(3):149-150.
- Antonuk B, Block LG. The effect of single serving versus entire package nutritional information on consumption norms and actual consumption of a snack food. *Journal of Nutrition Education Behavior*. 2006;38:365-370.
- Bell C, Pond N, Davies L, Francis JL, Campbell E, Wiggers J. Healthier choices in Australian health service: A pre-post audit of an intervention to improve the nutritional value of foods and drinks in vending machines and food outlets/ *BMC Health Services Research*. 2013;13:492-501.
- Bisogni CA, Jastran M, Seligson M, Thompson A. How people interpret healthy eating: Contributions of qualitative research. *Journal of Nutrition Education Behavior*. 2012;44:282-301.
- Blanck HM, Yaroch AL, Atienza AA, Yi SL, Zhang J, Masse LC. Factors influencing lunchtime food choices among working Americans. *Health Education & Behavior*. 2009;36:289-301.
- Byrd-Bredbenner C, Johnson M, Quick VM, Walsh J, Greene GW, Hoerr S, Colby SM, Kattelman KK, Phillips BW, Kidd T, Horacek TM. Sweet and salty. An assessment of the snacks and beverages sold in vending machines in US post-secondary institution campuses. *Appetite*. 2012;58(3):1143-1151.
- Callaghan C, Mandich G, He M. Healthier snacks in school vending machines: A pilot project in four Ontario high schools. *Canadian Journal of Dietetic Practice and Research*. 2010;71(4):186-191.
- Caruso ML, Klein EG, Kaye G. Campus-based snack food vending consumption. *Journal of Nutrition Education and Behavior*. 2014;1-5.
- Escoto KH, French SA, Harnack LJ, Toomey TL, Hannan PJ, Mitchell NR. Work hours, weight status, and weight-related behaviors: A study of metro transit workers. *International Journal of Behavioral Nutrition and Physical Activity*. 2010;7:81-92.
- French SA, Hannan PJ, Harnack LJ, Mitchell NR, Toomey TL, Gerlach A. Pricing and availability intervention in vending machines at four bus garages. *American College of Occupational and Environmental Medicine*. 2010;52(1):29-33.
- French SA, Jeffery RW, Story M, Breitlow KK, Baxter JS, Hannan P, Snyder MP. Pricing and promotion effects of low-fat vending snack purchases: the CHIPS study. *American Journal of Public Health*. 2001;93(7):1161-1167.
- French, SA, Jeffery RW, Story M, Hannan P, Snyder PM. A pricing strategy to promote low-fat snack choices through vending machines. *American Journal of Public Health*. 1997;87(5):849-851.

- French SA, Story M, Fulkerson JA, Gerlach AF. Food environment in secondary schools: A la carte, vending machines, and food policies and practices. *Journal of Public Health*. 2003;93(7):1161-1167.
- Gemmill E, Cotugna N. Vending machine policies in Delaware. *The Journal of School Nursing*. 2005;21(2):94-99.
- Kelly B, Flood VM, Bicego C. Derailing healthy choices: An audit of vending machines at train stations in NSW. *Health Promotion Journal of Australia*. 2012;23(1):73-75.
- Kocken PL, Eeuwuk J, Van Kesteren NMC, Dusseldorp E, Buus G, Bassa-Dafesh Z, Snel J. Promoting the purchase of low-calorie foods from school vending machines: A cluster-randomized controlled study. *Journal of School Health*. 2007;77:687-693.
- Kubik MY, Lytle LA, Farbaksh K, School and district wellness councils and availability of low-nutrient, energy-dense vending fare in Minnesota middle and high schools. *Journal of the American Dietetic Association*. 2011;111(1):151-155.
- Lawrence S, Boyle M, Craypo L, Samuels S. The food and beverage vending environment in healthcare facilities participating in the healthy eating, active communities program. *Pediatrics*. 2009;123:S287-S292.
- Matthews M, Horacek TM. VENDING MACHINE ASSESSMENT METHODOLOGY: A SYSTEMATIC REVIEW. *Appetite* In review. 2014.
- Minaker LM, Storey KE, Raine KD, Spence JC, Forbes LE, Plotnikoff RC, McCargar LJ. Associations between the perceived presence of vending machines and food and beverage logos in schools and adolescents' diet and weight status. *Public Health Nutrition*. 2011;14(8):1350-1356.
- New SA, Livingstone MB. An investigation of the association between vending machine confectionary purchase frequency by schoolchildren in the UK and other dietary and lifestyle factors. *Public Health Nutrition*. 2003;6:497-504.
- Nutrition Environment Measures Survey-Vending. *NEMS-V Success Stories*. (n.d.) <http://www.nems-v.com/NEMS-VResourcesSuccessStory.html>. Accessed April 12, 2014.
- Park S, Sappenfield WM, Huang Y, Sherry B, Bensyl DM. The impact of the availability of school vending machines on eating behavior during lunch: The youth physical activity and nutrition survey. *Journal of the American Dietetic Association*. 2010;110(10):1532-1536.
- Pasch KE, Lytle LA, Samuelson AC, Farbaksh K, Kubik MY, Patnode CD. Are school vending machines loaded with calories and fat: An assessment of 106 middle and high schools. *Journal of School Health*. 2011;81(4):212-218.
- Refermat, E. Special Annual Report: State of the vending industry. *Automatic Merchandiser*. 2013.
- Rovner AJ, Nansel TR, Wang J, Iannotti RJ. Food sold in school vending machines is associated with overall student dietary intake. *Journal of Adolescent Health*. 2011;48:13-19.
- Stallings VA, Yaktine AL, eds. *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*. Washington, DC: The National Academies Press. 2007.

- Swanson M. Digital photography as a tool to measure school cafeteria consumption. *Journal of School Health*. 2008;78:432-437.
- Turconi G, Guarcello M, Berzolari FG, Carolei A, Bazzano R, Roggi C. An evaluation of colour food photography atlas as a tool for quantifying food portion size in epidemiological dietary surveys. *European Journal of Clinical Nutrition*. 2005;59:923-931.
- United States Department of Agriculture and United States Department of Health and Human Services. *Dietary Guidelines for Americans 2010*. 2010. <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/PolicyDoc/PolicyDoc.pdf>. Accessed July 18, 2014.
- United States Department of Agriculture Food and Nutrition Service. Proposed Rule: *National School Lunch Program and School Breakfast Program: Nutrition Standards for All Foods Sold in School as Required by the Healthy, Hunger-Free Kids Act of 2010*. <http://www.fns.usda.gov/cga/020113-snacks.pdf>. 2013. Accessed July 18, 2014.
- Van Hulst A, Barnett TA, Dery V, Cote G, Colin C. Health-promoting vending machines: Evaluation of a pediatric hospital intervention. *Canadian Journal of Dietetic Practice and Research*. 2013;74:28-34.
- Voss C, Klein S, Glanz K, Clawson M. Nutrition environment measures survey-vending: Development, dissemination, and reliability. *Health Promotion Practice*. 2012;13:425-430.
- Williamson DA, Allen HR, Martin PD, Alfonso AJ, Gerald B, Hunt A. Comparison of digital photography to weighed and visual estimation of portion sizes. *Journal of the American Dietetic Association*. 2003;103:1139-1145.
- Winston CP, Sallis JF, Swartz MD, Hoelscher DM, Peskin MF. Reliability of the hospital nutrition environment scan for cafeterias, vending machines, and gift shops. *Journal of the Academy of Nutrition and Dietetics*. 2013;113:1069-1075.

**APPENDIX A**

**TABLE 11: PRODUCT HEALTHFULNESS ACROSS ALL STATES**

<b>Campus</b>	<b>Total Number Snack Machines (n)</b>	<b>Average Healthy Snack Percentage†</b>	<b>Average Healthy Snack Variety Percentage‡</b>	<b>Total Number Beverage Machines (n)</b>	<b>Average Healthy Beverage Percentage*</b>	<b>Average Healthy Beverage Variety Percentage</b>
Midwestern University 1	6	9.3 ± 3.1 <sup>a</sup>	92.5 ± 11.7 <sup>d</sup>	14	17.0 ± 5.2	38.2 ± 20.3 <sup>a,b,c</sup>
Midwestern University 2	10	17.3 ± 6.9 <sup>a,b</sup>	19.3 ± 7.8 <sup>a</sup>	10	38.0 ± 29.8	8.0 ± 14.5 <sup>a</sup>
Midwestern University 3	10	8.3 ± 3.8 <sup>a</sup>	85.5 ± 17.1 <sup>c,d</sup>	10	12.7 ± 6.4	77.7 ± 38.7 <sup>c</sup>
Northeastern University 1	9	16.9 ± 3.8 <sup>a,b</sup>	40.8 ± 8.6 <sup>a,b</sup>	9	16.4 ± 4.8	54.2 ± 34.0 <sup>a,b,c</sup>
Northeastern University 2	9	24.5 ± 10.0 <sup>b</sup>	61.8 ± 12.6 <sup>b,c,d</sup>	12	26.4 ± 14.0	42.8 ± 25.1 <sup>a,b,c</sup>
Northeastern University 3	9	21.6 ± 7.1 <sup>a,b</sup>	88.5 <sup>c</sup> ± 14.4 <sup>d</sup>	11	18.7 ± 10.1	42.6 ± 24.6 <sup>a,b,c</sup>
Northeastern University 4	9	18.0 ± 8.6 <sup>a,b</sup>	88.6 ± 20.8 <sup>c,d</sup>	12	34.3 ± 16.3	30.8 ± 13.7 <sup>a,b,c</sup>
Southern University 1	3	13.5 ± 4.9 <sup>a,b</sup>	75.0 ± 35.4 <sup>b,c,d</sup>	5	16.5 ± 4.9	57.0 ± 60.8 <sup>a,b,c</sup>
Southern University 2	10	11.3 ± 12.3 <sup>a,b</sup>	79.5 ± 39.1 <sup>b,c,d</sup>	10	10.9 ± 11.0	33.3 ± 37.3 <sup>a,b,c</sup>
Southern University 3	8	18.1 ± 3.9 <sup>a,b</sup>	49.8 ± 27.4 <sup>a,b,c</sup>	10	10.0 ± 12.2	18.5 ± 34.1 <sup>a,b</sup>
Southern University 4	7	13.1 ± 10.8 <sup>a,b</sup>	56.1 ± 39.9 <sup>a,b,c,d</sup>	13	24.9 ± 27.3	71.0 ± 43.2 <sup>b,c</sup>
<b>Mean Totals</b>	<b>8</b>	<b>16.8 ± 9.1</b>	<b>66.7 ± 32.3</b>	<b>10</b>	<b>22.2 ± 18.1</b>	<b>40.8 ± 33.7</b>

†  $F = 3.214, p < .001$ . Values bearing similar lowercase superscripts are not significantly different.

‡  $F = 9.665, p < .001$ . Values bearing similar lowercase superscripts are not significantly different.

\*  $F = 3.869, p < .001$ . Values bearing similar lowercase superscripts are not significantly different.



## APPENDIX B

### Health Density Vending Audit Tool: Quick Form Training Instructions

The nutritional quality of food and beverage products sold in vending machines has been implicated as a contributing factor to the development of an obesogenic food environment. How comprehensive, reliable, and valid are the current assessment tools for vending machines to support or refute these claims? A wide range of tools and methods were found to be currently available to measure different vending machine components. However, the substantial variability in methodology and healthfulness criteria makes it impossible to compare results between studies. Few previous assessment tools have comprehensively incorporated an evaluation of machine accessibility, healthy product availability, promotion, price, and package/serving size. Assessment tools should evaluate healthy product availability, promotion, price, and package/serving size. Previously established healthfulness criteria for vended products have been either too lenient or too strict and may not accurately assess product healthfulness. Healthfulness criteria should include an evaluation of caloric content, fat content, sugar content, and key indicator nutrient content, but a product does not necessarily have to meet all criteria to be considered healthy. A universal, valid, and reliable vending machine assessment tool that is comprehensive yet user-friendly is recommended.

This tool will help you assess the vending machines in your building(s) and environment(s). This tool is designed for use in a variety of different environments including, but not limited to primary schools, secondary schools, colleges/universities, office buildings, recreation facilities, malls, hotels, and community service buildings. This information will help you evaluate a component of your overall food environment, which influences healthy food options and choices at your location.

#### Purpose of this Document

1. Descriptions of how to use the healthy dense vending audit tool
2. Training protocol
3. Explanation of the pilot testing and validation study for this audit tool
  - a. This begins on page 19 of this document

#### Accompanying Files

- B\_Training Powerpoint
- C\_Example of Vending Machine Photographs
- C\_Example of Completed Quick Snack and Beverage Spreadsheet
- D\_Quick Snack and Beverage Spreadsheet
- E\_PDF Copy of Qualtrics Building Vending Survey (The link for the survey noted later)
- F\_Detailed Form Protocol (for validation study)
- G\_Detailed Snack Spreadsheet (for validation study)
- H\_Detailed Beverage Spreadsheet (for validation study)
- I\_NEEMS-V Protocol (for validation study)
- J\_NEEMS-V Spreadsheet (for validation study\_

#### Timeline

- Week 1
  - Select building(s) that will be evaluated in your audit
- Weeks 2-3
  - Survey the building(s) you are evaluating for vending machines
  - Select vending machines for evaluation in your building(s) (at least one snack and one beverage per building)
  - Take photographs of selected vending machines
- Weeks 4-6
  - Complete the **Quick Snack and Beverages Spreadsheet** in Excel
    - Complete the **Quick Snack List** and **Unlisted Snacks Table** for snack products found in the vending machines in your building
    - Complete the **Quick Beverage List** and **Unlisted Beverages Table** for beverage products found in the vending machine in your building
  - Complete the **Building Vending Survey** in Qualtrics

## Protocol for Completing the Vending Evaluation

### Selecting Buildings

This tool can be used to evaluate all of the buildings in your environment or a subsample of the total buildings in your environment. Identify the building(s) in your environment that you would like to use in your evaluation; you may use this tool to evaluate one building or multiple buildings. It is recommended that you evaluate a variety of different types of buildings in order to conduct a more complete assessment of the vending machine environment in your overall environment. For example, as part of the validation and implementation study for this audit tool, vending machines were selected from different buildings commonly accessed by students and/or faculty located on the Syracuse University campus. Specifically, vending machines located in five different types of buildings (student union, library, residence hall, academic building, and recreation facility) were evaluated. For each building being evaluated in your audit, assign a different numerical building code.

### Surveying a Building

Next, you will survey and record information regarding each building you have selected to include in your audit. When surveying a building, print off the **PDF copy of the Qualtrics Building Survey** and bring it with you to survey and explore the building. Use a different **Building Vending Survey** for each different building included in your evaluation. **The information collected on the PDF copy will later be entered into the online Building Vending Survey on Qualtrics.** Collect and record the following necessary information when surveying each building on the **PDF copy of the Qualtrics Building Survey**:

- **Evaluator Name:** Name of the person completing the evaluation.
- **Type of Audit:** Type of audit being conducted on the vending machines in the building.
  - Select one of the following options: individual data collection, pilot test, or data duplicate for inter-rater reliability.
- **Type of Data Collection:** The type of data collection method used to gather the data being used to complete the survey.
  - **Quick Form:** The primary data collection method that will be used for this audit, which uses a simplified, condensed, and quick data collection form.
  - **Detailed Form:** The data collection method used for evaluator training and to validate the results of the quick form data collection method, which uses a more extensive and in depth data collection form.
- **State:** State in which the building is located.
- **Building Name:** Name of the building being evaluated.
- **Type of Building:** Building type that is being evaluated.
  - Select from the following options: residential, library, recreation facility, academic, manufacturing, office, multifunctional (ex. union), or other (if other please specify type of building).
  - More than one response may be appropriate, select all options that apply to the building.
- **Type of Environment:** Type of environment being evaluated.
  - Select from the following options: elementary school, middle school, high school, community or technical college, college or university, work site, mall, hotel/motel, community services, or other (if other please specify type of building).
  - More than one response may be appropriate, select all options that apply to the environment.
- **Total Number of Buildings:** The total number of buildings evaluated in your audit. If you are evaluating more than one building in your audit, enter the total number of buildings you are evaluating.
- **Building Code Number:** Record the specific code number that you have assigned to the building being evaluated. This is particularly important if you are evaluating more than one building.
- **Building Hours:** The normal hours of operation for the building on a typical day.
  - Select one of the following options: <8 hours/day, 8 hours/day, 9-12 hours/day, 13-18 hours/day, or 19-24 hours/day.
- **Machine Accessibility:** How readily available vending machines and machine products are to consumers in the building being evaluated.

- Select one of the following options dependent on the type of environment (primary or secondary schools vs. all others) being evaluated: not appropriately accessible, somewhat accessible, or appropriately accessible.
  - **Not Appropriately Accessible**
    - Primary and Secondary Schools: if machine is on for  $\geq 50\%$  of the school day
    - All Other Environments: if  $\geq 50\%$  of vending machine slots are empty by the end of the day (when building closes)
  - **Somewhat Accessible**
    - Primary and Secondary Schools: if machine is on for 25-50% of the school day
    - All Other Environments: if 25-50% of machine slots are empty by the end of the day (when building closes)
  - **Appropriately Accessible**
    - Primary and Secondary Schools: if machine is on for  $\leq 25\%$  of the school day
    - All Other Environments: if  $\leq 25\%$  of the machine slots are empty by the end of the day (when building closes)
- *In order to determine machine accessibility, vending machines selected for evaluation will need to be visited **multiple times** throughout the day.*
- *Also, note that primary and secondary schools refer to elementary, middle, junior high, and high schools. Colleges and universities are not considered primary or secondary schools.*

**Machine Accessibility**

**Machine Accessibility**  
**Accessibility of vending machines and machine products\***

**\*Dependent on environment**  
Primary and Secondary Schools:  
 Not appropriate if machine is on for  $\geq 50\%$  of the school day.  
 Somewhat appropriate if machine is on for 25-50% of the school day.  
 Appropriate if machine is on for  $\leq 25\%$  of the school day.

All Other:  
 Not appropriate if  $\geq 50\%$  of machine items are empty by the end of the day (when building closes).  
 Somewhat appropriate if 25-50% of machine items are empty by the end of the day (when building closes).  
 Appropriate if  $\leq 25\%$  of the machine items are empty by the end of the day (when building closes).

Not Appropriately Accessible

Somewhat Accessible

Appropriately Accessible

- **Machine Availability:** Record and tally the number of each different type of vending machine and the total number of vending machines in the building. Also record and tally the number of each different type of vending machine you are evaluating in the building.
  - Different types of vending machines include cold beverage, snack, prepared food, dairy, hot beverage, and mixed snack and beverage. If a different type of vending machine is found please record the type of vending machine found in the building under “other.”

**Machine Availability**

Machine Availability		
Tally the number of each type of vending machine for this building and the number of each type of machine being evaluated in this building.		
	Total Number	Number Evaluated
Cold Beverage	<input type="text"/>	<input type="text"/>
Snack	<input type="text"/>	<input type="text"/>
Prepared Food	<input type="text"/>	<input type="text"/>
Dairy	<input type="text"/>	<input type="text"/>
Hot Beverage	<input type="text"/>	<input type="text"/>
Mixed Snack/Beverage	<input type="text"/>	<input type="text"/>
Other: <input type="text"/>	<input type="text"/>	<input type="text"/>
<b>Total</b>	<input type="text"/>	<input type="text"/>

**Vending Machine Selection**

This audit tool can be used to evaluate the total number of the vending machines in your environment or a subsample of the total vending machines in your environment. To select vending machines for evaluation consider machine placement and who uses them. If you are evaluating **one building**, all vending machines within the building should be evaluated. If you are evaluating **multiple buildings**, vending machines with the most traffic flow should be evaluated and at least two different vending machines (**ideally one snack and one beverage**) from each type of building should be evaluated in your assessment of your vending machine environment. If there is not an individual snack and/or beverage machine you can use a mixed snack/beverage machine and conduct separate evaluations on the snack and beverage products using the later described protocol. Additionally, the vending machines with the highest traffic flow should be used for your evaluation. If a unique or novel vending machine is found in a building (prepared food, sandwiches, frozen food, ice cream, etc.) evaluate that vending machine as well.

*Example of a vending machine with high traffic flow: machine on the main floor of building*

Assign a different numerical machine code number to each different vending machine being evaluated. More specifically, assign a **Machine ID** to each vending machine evaluated using the state in which the assessment is being conducted, the building code number, and the machine code number (State Abbreviation – Building Code Number – Machine Code Number). **Assigning a Machine ID to each vending machine is extremely important, the Machine ID keeps all data collected on an individual vending machine tied together in order to determine inter-rater reliability and for validation purposes (quick vs. long, quick vs. NEMS-V).**

**Photographing the Vending Machines**

After you have surveyed your building for vending machines and after you have chosen an appropriate vending machine to evaluate (one with high traffic flow), carefully photograph the vending machine and its contents using a

**digital camera or smartphone.** Follow these guidelines when taking photographs of the vending machine and its contents to ensure clarity, quality, and integrity of the images.

1. Take photographs of the front, right side, and left side of the vending machine.
2. Take photographs of the contents of the vending machine:
  - a. Get as close to the vending machine as possible; this will reduce any reflections that may interfere with picture quality.
  - b. Do **not** use flash; the light will create a glare that will interfere with picture quality.
  - c. Multiple pictures may need to be taken in order to capture all of the vending machines' contents.
  - d. You may need to take pictures of each row or product separately
3. **Carefully check each picture after it is taken in order to make sure that you have clearly captured all of the necessary information regarding the vending machine's contents.**
  - a. Before leaving the machine, make sure all of the required information has been captured in your photographs:
    - Product Name
    - Product Label
    - Product Package Size
    - Product Price
  - b. Make sure that anything that you can see when standing right in front of the machine has been captured in the photographs.
4. Upload all of the images for each vending machine onto a computer, create a file, and label each file using each machine's assigned **Machine ID** and **time at which the photograph was taken.**

### **Completing the Quick Snack and Beverage Spreadsheet**

In order to complete the rest of the **Building Vending Survey** you will have to use the photographs you have taken of the vending machine(s) you have selected for evaluation in the building to complete the **Quick Snack and Beverage Spreadsheet** in Excel. The **Quick Snack and Beverage Spreadsheet** is a simple data collection method that will allow you to easily record and organize vending machine products based on product healthfulness. **If a vending machine contains both snacks and beverages, use the Quick Snack List for the snack products and use the Quick Beverage List for the beverage products.**

Complete one **Quick Snack List** for one snack or mixed vending machine; each different vending machine should be evaluated using a new **Quick Snack List**. Similarly, complete one **Quick Beverage List** for one beverage or mixed vending machine; each different vending machine should be evaluated using a new **Quick Beverage List**. On each **Quick Snack List** and each **Quick Beverage List** record the following information:

- **Building Code Number:** Numerical code number assigned to the building being evaluated.
- **Machine ID:** Identification number that has been assigned to each individual vending machine (State Abbreviation – Building Code # - Machine #)
- **Time:** Time photographs of machine were taken
- **Evaluator Name:** Name of the individual completing the Quick Snack List
- **Total Number of Snacks/Beverages:** Total number of snack or beverage products in the machine
- **Total Number of Different Snacks/Beverages:** Number of different snack or beverage products in the machine

### **Completing the Quick Snack List**

In order to evaluate **healthy snack availability** of the snack products in the vending machine(s) in the building use the photographs you have taken of the vending machine(s) and **Quick Snack List**, which is located in the **Quick Snack and Beverage Spreadsheet**. The **Quick Snack List** is a compilation of snacks commonly found in vending machines that was developed following a survey of vending machines and their contents prior to pilot testing of this tool. Following this survey of vending machines, for each snack found the product name, brand, serving size in oz., and package size in oz. was determined and recorded. Nutritional analysis was then conducted on each product based on product package size to determine the number of individual healthfulness criterion met. Each snack

product was then assigned a **healthy dense snack score** based on the total number of individual healthfulness criterion met. The **Quick Snack List** was then generated to include the product name, brand, package size in oz., and healthy dense snack score for each commonly found snack. **Snack products on the Quick Snack List are listed alphabetically according to healthy dense snack score.**

Each snack product in the vending machine(s) will be evaluated for healthfulness and receive a **healthy dense snack score** (0-12) based on the presence of the following healthfulness criteria in the snack product:

1. **Calories:** The product must contain  $\leq 200$  calories per package.
2. **Saturated Fat:** The product must contain  $\leq 10\%$  of the DV for saturated fat per package.<sup>1</sup>
3. **Trans Fat:** The product must contain 0% trans fat per package
4. **Sugar:** The product must contain  $\leq 12.5\text{g}$  of sugar per package.<sup>2,3</sup>
5. **Sodium:** The product must contain  $\leq 10\%$  of the DV for sodium per package.
6. **Fiber:** The product must contain  $\geq 10\%$  of the DV for fiber per package.
7. **Calcium:** The product must contain  $\geq 10\%$  of the DV for calcium per package.
8. **Iron:** The product must contain  $\geq 10\%$  of the DV for iron per package.
9. **Potassium:** The product must contain  $\geq 10\%$  of the DV for potassium per package.
10. **Vitamin C:** The product must contain  $\geq 10\%$  of the DV for vitamin C per package.
11. **Vitamin D:** The product must contain  $\geq 10\%$  of the DV for vitamin D per package.
12. **Vitamin E:** The product must contain  $\geq 10\%$  of the DV for vitamin E per package.

<sup>1</sup> In accordance with the *Smart Snacks in School: USDA's "All Foods Sold in School" Standards* exemptions to the saturated fat standard include reduced fat cheese (including part-skim mozzarella), nuts, seeds, nut or seed butters, products containing only dried fruit with nuts and/or seeds with no added nutritive sweeteners or fats, and seafood with no added fats. These products will automatically meet the saturated fat standard and receive 1 point for meeting the saturated fat criteria.

<sup>2</sup> Although not consistent with IOM criteria, the 12.5g criteria was selected because it is equivalent to 25% of the recommended DV for sugar and establishes a simple cut-off point to quickly and effectively evaluate snack products.

<sup>3</sup> In accordance with the *Smart Snacks in School: USDA's "All Foods Sold in School" Standards* exemptions to the sugar standard include dried whole fruits or vegetables, dried whole fruit or vegetable pieces, dehydrated fruits with no added nutritive sweeteners, dried whole fruits or pieces with nutritive sweeteners that are required for processing and/or palatability purposes (cranberries, tart cherries, blueberries, etc.), and products consisting of dried fruit with nuts and/or seeds with no added nutritive sweeteners or fats. These products will automatically meet the sugar standard and receive 1 point for meeting the sugar criteria.

Each snack product will receive **one point for each individual healthfulness criterion met**, and the number of points a snack product receives will be totaled to give each product a **healthy dense snack score**. The **healthy dense snack score** is based on a 12-point scoring system, with 12 being the highest and healthiest score a snack can receive and 0 being the lowest and unhealthiest score a snack can receive. *As a general rule all gum and breath mint products are not considered to have any nutritional value, and so are these products will be excluded from this audit tool.* For scoring purposes, **healthy snacks** are snacks that receive a **healthy dense snack score  $\geq 5$** . Somewhat healthy snacks are snacks that receive a **healthy dense snack score of 3 or 4**. **Unhealthy snacks** are snacks that receive a **healthy dense snack score of  $\leq 2$** .



**Quick Snack List (Snapshot View)**

Score	Name and Flavor	Brand Name	Package Size (oz.)
1	Kit Kat Bar	Hershey's	2.04
1	Mini Sandwich Cremes Vanilla Cookies	Grandma's	3.71/4.1
1	Oreo Cookies	Nabisco	2.4
1	Shortbread Cookies (Blueberry or Raspberry)	Knotts Berry Farm	2.00/3.00
1	Snickers	Mars	2.07
1	Take 5	Hershey's	1.75
1	Twix	Mars	2
1	Other		
2	3 Musketeers	Mars	2/2.13
2	Baby Ruth	Nestle	2.1
2	Butterfinger	Nestle	2.1
2	Butterfinger Minis	Nestle	3.5

To complete the **Quick Snack List** only evaluate, record, and tally the face front products visible to consumers, if there is a different product behind one of the products, do not evaluate it. If there are different flavors of the same product, evaluate the two products separately. (ie. If there are different flavors of Lays Potato Chips, the two flavors will count as different products.) For each face front snack product identified from the images of the vending machine's contents check the **Quick Snack List** to determine if the snack has already been listed, evaluated for healthfulness, and assigned a **healthy dense snack score**. When looking up products make sure to pay close attention to package size and flavor of the snacks on the **Quick Snack List**, as package size and flavor can impact a product's **healthy dense snack score**.

Use the **Quick Snack List** to record and tally all of the snack products in a vending machine based on the photographs you have taken of the machine. Snacks on the **Quick Snack List** are arranged alphabetically according to **healthy dense snack score**. **Make sure to pay close attention to product package size, as this can affect the healthy dense snack score.** Once a listed snack has been located on the **Quick Snack List** record the number of slots that are occupied by that particular snack in the vending machine. Continue this process until all snack products in the vending machine have been accounted for. *Remember that different flavors of the same product are considered two different products.*

### Quick Snack List (Snapshot View)

# in Machine	Score	Name and Flavor	Brand Name	Package Size (oz.)
	1	Kit Kat Bar	Hershey's	2.04
1	1	Mini Sandwich Cremes Vanilla Cookies	Grandma's	3.71/4.1
	1	Oreo Cookies	Nabisco	2
1	1	Shortbread Cookies (Blueberry or Raspberry)	Knotts Berry Farm	2.00/3.00
2	1	Snickers	Mars	2.07
	1	Take 5	Hershey's	1.75
	1	Twix	Mars	2
	1	Other		
1	2	3 Musketeers	Mars	2/2.13
	2	Baby Ruth	Nestle	2.1
2	2	Butterfinger	Nestle	2.1
	2	Butterfinger Minis	Nestle	3.5

### Completing the Unlisted Snacks Table

If a snack is not listed on the **Quick Snack List**, you can purchase the snack to read the nutrition label to determine the product's serving size and nutritional information or you can look up the serving size and nutritional information for the product online. Use the following websites, in the following order, to determine an unlisted product's serving size and nutritional information.

1. USDA Nutrient Database for Standard Reference ([www.ndb.nal.usda.gov](http://www.ndb.nal.usda.gov))
2. USDA SuperTracker ([www.supertracker.usda.gov](http://www.supertracker.usda.gov))
3. MyFitnessPal ([www.myfitnesspal.com](http://www.myfitnesspal.com))
4. Calorie Count (<http://caloriecount.about.com>)
5. Product Brand's Website (ie. [www.fritolay.com](http://www.fritolay.com), [www.kelloggs.com](http://www.kelloggs.com), etc)

If the serving size information for a product cannot be determined, assume that the package contains one serving of the product.

For unlisted snacks for which serving size and nutritional information could be determined from the aforementioned online resources complete the **Unlisted Snacks Table**, which is located in the **Quick Snack and Beverage Spreadsheet** in Excel. This will allow you to determine and calculate **healthy dense snack scores** for each unlisted snack product. The **Unlisted Snacks Table** can be printed out and completed by hand or it can be filled out in the Excel file. For each unlisted snack product record the product name, number of slots occupied in the vending machine, the serving size, and the package size. Next use the nutritional analysis information obtained from one of the aforementioned websites to evaluate the healthfulness of the unlisted product. Each product will be evaluated for the presence of the following 12 individual healthfulness criterion.

1. **Calories:** The product must contain  $\leq 200$  calories per package.
2. **Saturated Fat:** The product must contain  $\leq 10\%$  of the DV for saturated fat per package.<sup>1</sup>
3. **Trans Fat:** The product must contain 0% trans fat per package.
4. **Sugar:** The product must contain  $\leq 12.5\text{g}$  of sugar per package.<sup>2,3</sup>
5. **Sodium:** The product must contain  $\leq 10\%$  of the DV for sodium per package.
6. **Fiber:** The product must contain  $\geq 10\%$  of the DV for fiber per package.
7. **Calcium:** The product must contain  $\geq 10\%$  of the DV for calcium per package.
8. **Iron:** The product must contain  $\geq 10\%$  of the DV for iron per package.
9. **Potassium:** The product must contain  $\geq 10\%$  of the DV for potassium per package.
10. **Vitamin C:** The product must contain  $\geq 10\%$  of the DV for vitamin C per package.



11. **Vitamin D:** The product must contain  $\geq 10\%$  of the DV for vitamin D per package.  
 12. **Vitamin E:** The product must contain  $\geq 10\%$  of the DV for vitamin E per package.

<sup>1</sup> In accordance with the *Smart Snacks in School: USDA's "All Foods Sold in School" Standards* exemptions to the saturated fat standard include reduced fat cheese (including part-skim mozzarella), nuts, seeds, nut or seed butters, products containing only dried fruit with nuts and/or seeds with no added nutritive sweeteners or fats, and seafood with no added fats. These products will automatically meet the saturated fat standard and receive 1 point for meeting the saturated fat criteria.

<sup>2</sup> Although not consistent with IOM criteria, the 12.5g criteria was selected because it is equivalent to 25% of the recommended DV for sugar and establishes a simple cut-off point to quickly and effectively evaluate snack products.

<sup>3</sup> In accordance with the *Smart Snacks in School: USDA's "All Foods Sold in School" Standards* exemptions to the sugar standard include dried whole fruits or vegetables, dried whole fruit or vegetable pieces, dehydrated fruits with no added nutritive sweeteners, dried whole fruits or pieces with nutritive sweeteners that are required for processing and/or palatability purposes (cranberries, tart cherries, blueberries, etc.), and products consisting of dried fruit with nuts and/or seeds with no added nutritive sweeteners or fats. These products will automatically meet the sugar standard and receive 1 point for meeting the sugar criteria.

If a product meets the specified healthfulness criterion, enter a 1 into the table. If a product does not meet the specified healthfulness criterion, enter a 0 into the table. Add up the number of healthfulness criterion met by the product to determine a score for the unlisted product. Therefore, each snack product will receive **one point for each individual healthfulness criterion met**, and the number of points a product receives will be totaled to give each product a **healthy dense snack score**. The **healthy dense snack score** is based on a 12-point scoring system, with 12 being the highest and healthiest score a snack can receive and 0 being the lowest and unhealthiest score a snack can receive. Again, all gum and mint products are excluded in this audit. Following completion of the **Unlisted Snacks Table** for a product and once a **healthy dense snack score** has been assigned to an unlisted snack enter the total number of slots occupied by that product into the "other" option in the corresponding **healthy dense snack score**.

Once all snacks and the number of slots occupied by each snack in the vending machine have been recorded in the **Quick Snack List** in Excel, the total number of snacks in the machine with each **healthy dense snack score** will be generated. Additionally, healthy dense machine snack subscore for each **healthy dense snack score** will also be generated. To generate each subscore, each healthy dense snack score is multiplied by the number of total snacks with that score in the vending machine.

**Quick Snack List (Snapshot View)**

Subscore	Total #	# in Machine	Score	Name and Flavor
		1	1	Kit Kat Bar
			1	Mini Sandwich Cremes Vanilla Cookies
		2	1	Oreo Cookies
			1	Shortbread Cookies (Blueberry or Raspberry)
		1	1	Snickers
			1	Take 5
<b>Score 1 X T</b>	<b>Total</b>		1	Twix
4	4		1	Other

Next, use the information you have collected on **Quick Snack List** to evaluate **healthy snack availability**. The following information will be calculated within the Excel file:

1. The total number of snacks
  - a. Tally of the number of snacks recorded in the **Quick Snack List** for a machine.
  - b. Since gum and breath mints have been excluded from this audit, the total number of snacks refers the total number of snacks in the machine minus the number of gum and breath mint products.
2. The total number of healthy snack slots in the vending machine
  - a. Tally of the total number of snacks that received a **healthy dense snack score of  $\geq 5$** .
3. The total number of different healthy snacks in the vending machine
  - a. Count of the number of different snacks that received a **healthy dense snack score of  $\geq 5$** .
4. The percentage of healthy snacks in the vending machine
  - a. Percentage calculated by dividing the number of healthy snack slots by the total number of snack slots in the machine and then multiplying by 100
5. The variety of healthy snack percentage in the vending machine
  - a. Percentage calculated by dividing the number of different healthy snack slots by the total number of healthy snack slots and then multiplying by 100
6. The total healthy dense machine snack score
  - a. Sum of the healthy dense machine snack subscores
7. The average healthy dense machine snack score
  - a. Calculated by dividing the total healthy dense machine snack score by the total number of snack products in the vending machine.

#### Quick Snack List (Snapshot View)

0	Total # of Snacks in Machine
0	Total # Healthy Snack Slots (Sum $\geq 5$ )
0	# Different Healthy Snacks (Count $\geq 5$ )
0	Percentage Healthy Snacks [(Total Sum $\geq 5$ Slots/Total # Snack Slots) x 100]
0	Percentage of Variety of Healthy Snacks [(Count $\geq 5$ /Sum $\geq 5$ ) x 100]
0	Total Healthy Dense Machine Snack Score
0	Average Healthy Dense Machine Snack Score

#### Completing the Quick Beverage List

In order to evaluate **healthy beverage availability** of the beverage products in the vending machine(s) in the building use the photographs you have taken of the vending machine(s) and **Quick Beverage List**, which is located in the **Quick Snack and Beverage Spreadsheet**. The **Quick Beverage List** is a compilation of beverages commonly found in vending machines that was developed following a survey of vending machines and their contents prior to pilot testing of this tool. Following this survey of vending machines, for each snack found the product name, brand, serving size in fl. oz., and package size in fl. oz. was determined and recorded. Nutritional analysis was then conducted on each product based on product package size to determine the number of individual healthfulness criterion met. Each beverage product was then assigned a **healthy dense beverage score** based on beverage type and/or caloric content. The **Quick Beverage List** was then generated to include the product name, brand, package size in oz., and healthy dense beverage score for each commonly found beverage. Beverage products on the **Quick Beverage List** are listed alphabetically according to **healthy dense beverage score**.

Each beverage product in the vending machine will be evaluated for healthfulness and receive a **healthy dense beverage score** (0-2) based on beverage type and/or caloric content.

- **Healthy Dense Beverage Scores**
  - Score of 0
    - Sports drinks/life water/vitamin water (>50 calories per 8 fl. oz.)
    - Sugar sweetened beverages/energy drinks/coffee drinks/lemonade/iced tea/all other beverages (>10 calories per 8 fl. oz.)
  - Score of 1
    - Non-100% fruit or vegetable juice
      - Ex. fruit juice cocktails
    - Milk/flavored milk/non-dairy milk alternatives (>150 calories per 8 fl. oz.)
    - Sports drinks/life water/vitamin water ( $\leq$ 50 calories per 8 fl. oz.)
    - Sugar sweetened beverages/energy drinks/coffee drinks/lemonade/iced tea/all other beverages ( $\leq$ 10 calories per 8 fl. oz.)
  - Score of 2
    - Water/flavored water
    - 100% fruit or vegetable juice
    - Milk/flavored milk/non-dairy milk alternatives ( $\leq$ 150 calories per 8 fl. oz.)

The **healthy dense beverage score** is based on a 2-point scoring system, with 2 being the highest and healthiest score a beverage can receive and 0 being the lowest and unhealthiest score a beverage can receive. For scoring purposes, **healthy beverages** are beverages that receive a **healthy dense beverage score of 2**. Somewhat healthy beverages are beverages that receive a **healthy dense beverage score of 1**. **Unhealthy beverages** are beverages that receive a **healthy dense beverage score of 0**.

**Quick Beverage List (Snapshot View)**

Score	Name and Flavor	Brand Name	Package Size (fl. oz.)
0	7 Up	7 Up	20
0	Arnold Palmer	Arizona	20
0	Barq's Root Beer	Coca-Cola	20
0	Brisk Iced Tea (Any Flavor)	Lipton	12, 16 or 20
0	Coke (Original or Cherry)	Coca-Cola	20
0	Cream Soda (Vanilla)	A&W	20

For the **beverage product availability** only evaluate, record, and tally the face front products visible to consumers, if there is a different product behind one of the products, do not evaluate it. If there are different flavors of the same product, evaluate the two products separately. (ie. If there are different flavors of Gatorade, the two flavors will count as different products.) For each face front beverage product identified from the images of the vending machine's contents check the **Quick Beverage List** to determine if the snack has already been listed, evaluated for healthfulness, and assigned a **healthy dense beverage score**. When looking up products make sure to pay close attention to package size and flavor of the beverages on the **Quick Beverage List**, as package size and flavor can impact a product's **healthy dense beverage score**.

Use the **Snack Beverage List** to record and tally all of the beverage products in a vending machine based on the photographs you have taken of the machine. Beverages on the **Quick Beverage List** are arranged alphabetically according to **healthy dense beverage score**. Once a listed beverage has been located on the **Quick Beverage List** record the number of slots that are occupied by that particular beverage in the vending machine. Continue this process until all beverage products in the vending machine have been accounted for. *Remember that different flavors of the same product are considered two different products.*

**Quick Beverage List (Snapshot View)**

# in Machine	Score	Name and Flavor	Brand Name	Package Size (fl. oz.)
1	0	7 Up	7 Up	20
	0	Arnold Palmer	Arizona	20
	0	Barq's Root Beer	Coca-Cola	20
	0	Brisk Iced Tea (Any Flavor)	Lipton	12, 16 or 20
5	0	Coke (Original or Cherry)	Coca-Cola	20
	0	Cream Soda (Vanilla)	A&W	20
	0	Double Shot Energy (Mocha)	Starbucks	15
2	0	Dr. Pepper	Dr. Pepper	20
	0	Energy Drink (Any Flavor)	Big Red Jack or SoBe	16
1	0	Fanta (Orange)	Coca-Cola	20
2	0	Frappucino (Any Flavor)	Starbucks	9.5 or 13.7
	0	Fresca	Coca-Cola	12
	0	Full Throttle	Coca-Cola	16
6	0	Gatorade (Any Flavor)	PepsiCo	20

**Completing the Unlisted Beverages Table**

If a beverage is not listed on the **Quick Beverage List**, you can purchase the beverage to read the nutrition label to determine the product's serving size and nutritional information or you can look up the serving size and nutritional information for the product online. Use the following websites in the following order to determine a product's serving size and nutritional information.

1. USDA Nutrient Database for Standard Reference ([www.ndb.nal.usda.gov](http://www.ndb.nal.usda.gov))
2. USDA SuperTracker ([www.supertracker.usda.gov](http://www.supertracker.usda.gov))
3. MyFitnessPal ([www.myfitnesspal.com](http://www.myfitnesspal.com))
4. Calorie Count ([www.caloriecount.about.com](http://www.caloriecount.about.com))
5. Product Brand's Website (ie. [www.pepsico.com](http://www.pepsico.com), [www.coca-cola.com](http://www.coca-cola.com), etc)

If the serving size information for a product cannot be determined, assume the package contains one serving of the product.

For unlisted beverages for which serving size and nutritional information could be determined from the aforementioned online sources, complete the **Unlisted Beverages Table**, which is located in the **Quick Snack and Beverage Spreadsheet** to determine **healthy dense beverage scores**. For each unlisted beverage product record the product name, number of slots occupied in the vending machine, the serving size, and the package size. Next use the product type and/or the nutritional information obtained from one of the aforementioned websites to evaluate the healthfulness of the unlisted product. Each product will be evaluated for healthfulness in the **Beverage Healthfulness Evaluation Table** in the following way:

- **Healthy Dense Beverage Scores**
  - Score of 0
    - Sports drinks/life water/vitamin water (>50 calories per 8 fl. oz.)
    - Sugar sweetened beverages/energy drinks/coffee drinks/lemonade/iced tea/all other beverages (>10 calories per 8 fl. oz.)
  - Score of 1

- Non-100% fruit or vegetable juice
    - Ex. fruit juice cocktails
  - Milk/flavored milk/non-dairy milk alternatives (>150 calories per 8 fl. oz.)
  - Sports drinks/life water/vitamin water (≤50 calories per 8 fl. oz.)
  - Sugar sweetened beverages/energy drinks/coffee drinks/lemonade/iced tea/all other beverages (≤10 calories per 8 fl. oz.)
- Score of 2
  - Water/flavored water
  - 100% fruit or vegetable juice
  - Milk/flavored milk/non-dairy milk alternatives (≤150 calories per 8 fl. oz.)

Following completion of the **Unlisted Beverages Table** for a product and once a **healthy dense beverage score** has been assigned to an unlisted beverage enter the total number of slots occupied by that product into the “other” option in the corresponding **healthy dense beverage score**. Once all beverages and the number of slots occupied by each beverage in the vending machine have been recorded in the **Quick Beverage List** tally and record the total number of beverages in the machine with each **healthy dense beverage score**. Additionally calculate a healthy dense machine beverage subscore for each **healthy dense beverage score**. To do this, multiply each healthy dense beverage score by the number of total beverages with that score in the vending machine.

Next, use the information you have collected on **Quick Beverage List** to evaluate **healthy beverage availability**.

1. The total number of beverage slots in the vending machine by
  - a. Tally of the number of beverage slots recorded in the **Quick Beverage List** for each machine
2. The total number of healthy beverage slots in the vending machine
  - a. Tally of the total number of beverage slots that received a **healthy dense beverage score of 2**.
3. The total number of different healthy beverages in the vending machine
  - a. Count of the number of different beverages that received a **healthy dense beverage score of 2**.
4. The percentage of healthy beverage slots in the vending machine
  - a. Percentage calculated by dividing the number of healthy beverage slots by the total number of beverage slots in the machine and then multiplying by 100
5. The variety of healthy beverage percentage in the vending machine
  - a. Percentage calculated by dividing the number of different healthy beverages by the total number of healthy beverages and then multiplying by 100
6. The total healthy dense machine beverage score
  - a. Sum of the healthy dense machine beverage subscores
7. The average healthy dense machine beverage score
  - a. Calculated by dividing the total healthy dense machine beverage score by the total number of beverage products in the vending machine

**Quick Beverage List (Snapshot View)**

0	<b>Total # of Beverage Slots in Machine</b>
0	<b>Total # Healthy Beverage Slots (Sum of Score 2)</b>
0	<b># Different Healthy Beverages (Count of Score 2)</b>
0	<b>Percentage Healthy Beverages [(Total Sum of 2 Slots /Total # Beverage Slots x 100]</b>
0	<b>Percentage of Variety of Healthy Beverages [(Count of 2/Sum of 2) x 100]</b>
0	<b>Total Healthy Dense Machine Beverage Score</b>
0	<b>Average Healthy Dense Machine Beverage Score</b>

### Completing the Building Vending Survey

After the **Quick Snack List** has been completed for all vending machines evaluated in the building, record the calculated **Average Healthy Dense Snack Score**, **Average Healthy Snack Percentage**, and **Average Healthy Snack Variety Percentage** on the **Building Vending Survey** in Qualtrics. If multiple **Quick Snack Lists** have been completed for multiple snack machines in the building, estimate or average the values of the snack machines in the building. Similarly, after the **Quick Beverage List** has been completed for all vending machines evaluated in the building, record the calculated **Average Healthy Dense Beverage Score**, **Average Healthy Beverage Percentage**, and **Average Healthy Beverage Variety Percentage** on the **Building Vending Survey** in Qualtrics. If multiple **Quick Beverage Lists** have been completed for multiple beverage machines in the building, average the calculated values.

#### Average Healthy Dense Snack Score

Average Healthy Dense Snack Score								
No Healthy Snacks		Mix of Primarily Unhealthy Snacks		Equal Mix of Unhealthy, Moderate, and Healthy Snacks		Mix of Mostly Healthy With Few Unhealthy Snacks		All Healthy Snacks
1	1.5	2	2.5	3	3.5	4	4.5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

#### Average Healthy Dense Beverage Score

Average Healthy Dense Beverage Score				
No Healthy Beverages	Mix of Primarily Unhealthy Beverages	Equal Mix of Unhealthy, Moderate, and Healthy Beverages	Mix of Mostly Healthy Beverages With Few Unhealthy Beverages	All Healthy Beverages
0	0.5	1	1.5	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>





- Healthy and Unhealthy equally priced
  - when healthy snacks/beverages cost the same as unhealthy snacks/beverages
- Healthy less expensive than Unhealthy
  - when healthy snacks/beverages cost less than unhealthy snacks/beverages

Next, use the photographs of the vending machine contents to evaluate product promotion on the **Building Vending Survey**. Look at the photographs of the snack and beverage vending machines' contents to identify nutrition promotional labels on snack and beverage products that could promote or influence an individual's decision to purchase the product. Examples of nutrition promotional labels that may be found on beverage products include, but are not limited to the following: no/low/reduced calories, no/low/reduced sugar, no/low/reduced sodium, high/good source of vitamins, high/good source of minerals/ fruit/vegetable servings, organic, and new or improved. Only labels that are visible on vended beverages at the point-of-purchase (visible when looking directly at the products in the vending machine) should be recorded. Based on your photographs indicate the level of nutrition promotion on vending machine products in the building.

<b>Product Promotion</b>		
<b>Presence of nutrition information on vending machine and vending machine products</b>		
No nutrition information	General nutrition information on machines	Specific nutrition information about products in machines
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select the most appropriate response.

- No nutrition information on machine or products
  - no nutrition information displayed anywhere on the machine or vended products
- General nutrition information on machine only
  - generalized nutrition information is displayed on the vending machine itself or on the vended products
- Specific nutrition information on machine and/or products
  - specific nutrition information is displayed on vending machine itself or on the vended products

Additionally, use the photographs to look at the front and sides of the evaluated snack and beverage vending machines to identify product logos. Based on your photographs indicate the healthfulness of the product logos on vending machines in the building.

<b>Product Promotion</b>		
<b>Presence of product logos on vending machines</b>		
Specific/large product logos on front & side of machine	Healthy and unhealthy product logos on machine	Only healthy or No product logos anywhere on machine
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select the most appropriate response.

- Unhealthy product logo on front and/or sides of machine
  - Pepsi®
- Healthy and unhealthy logos on front and/or sides of the machine



- ex. both Aquafina® and Pepsi® logos on machine
- Healthy or no product logos on front and/or sides of the machine
  - ex. Aquafina®

Finally, use the photographs of the vending machine and the vending machine’s contents to identify green eating labels on the vending machine or machine products. Examples of green eating labels include, but are limited to the following: local, organic, and sustainable. Only labels that are visible on vended snacks and beverages at the point-of-purchase (visible when looking directly at the products in the vending machine) should be recorded. Based on your photographs indicate the level of green eating promotion on vending machine products in the building.

<b>Product Promotion</b>		
<b>Presence of green eating (local, organic, sustainable) health promotion information</b>		
No green eating promotion	General promotion of green eating on machine	Creative/original promotion of specific green eating products
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select the most appropriate response.

- No green eating promotion
  - no local, organic, or sustainable labels on the machine itself or any vended products
- General promotion of green eating on machine
  - Local, organic, or sustainable labels on the machine itself or any vended products
- Creative/original promotion of specific green eating products
  - Detailed information pertaining to local, organic, or sustainable products

This will now complete the **Building Vending Survey**. To actually enter your data in the Qualtrics survey – here is the link [https://syracuseuniversity.qualtrics.com/SE/?SID=SV\\_6J4sNDuY4lucIiV](https://syracuseuniversity.qualtrics.com/SE/?SID=SV_6J4sNDuY4lucIiV)

Examples of the machines (via pictures) and a completed **Quick Snack List** and a **Quick Beverage List Beverage** have been provided in the **Quick Snack and Beverage Spreadsheet** and also on a separate handout for your reference.

### **How to Train Evaluators:**

- Read through the above **Quick Form Protocol**
- Practice using the **Quick Snack and Beverages Spreadsheet** to complete the **Building Vending Survey** on Qualtrics for at least 2 vending machines.
- Practice completing entire **Quick Form Protocol** and **Building Vending Survey** until 80% inter-rater reliability (IRR) can be established between 2 evaluators.

### **Inter-Rater Reliability for Training/Practice:**

The IRR for the **Quick Form Protocol** is located in the **Quick Snack and Beverage Spreadsheet**. For IRR record the results of two evaluators for the same snack or beverage machine regarding the number of snacks/beverages, number of healthy snacks/beverages, number of different healthy snacks/beverages, percentage of healthy snacks/beverages, percentage variety of healthy snacks/beverages, total healthy dense score, and average healthy dense score. Each snack and beverage machine will have 2 evaluators, and you will divide the higher value achieved by one of the evaluators by the lower value achieved by the other evaluator. The goal is to achieve a score >0.8 between two evaluators for any given machine during practice before advancing to the actual validation study. When evaluating IRR, the machine must be evaluated at the same time by each evaluator (they must use the same photographs). This same method may be used to establish IRR during your vending machine audit.

### **Pilot Testing:**

This tool is to be pilot tested by the primary researcher, research assistants, and experts in the field of nutrition. This tool will be pilot tested in a variety of different settings such as campuses, schools, worksites, and community buildings to test for generalizability. The tool will be assessed for both reliability and validity.

**Primary Investigators:** Please review all of the vending audit protocol/surveys and provide feedback regarding:

- **Construct Validity:**
  - Do the snack and beverage healthy dense scores and the vending survey items actually measure healthfulness?
  - How do we define healthy?
  - Given all other standards maintain a snack must meet all healthful criteria to be called healthy, how will our density score be accepted?
- **Content Validity:**
  - Are the Qualtrics survey items/healthy dense scores assessing what should be assessed to determine healthfulness of vending?
- **Representation Validity:**
  - How useful will this tool be in other environments?
  - Will others be able to implement/use these tools?
- **Face Validity**
  - How effective is criteria for assessing healthy?
- **Criterion Validity:**
  - Have we captured “healthy snacks”?
  - The snacks with a score  $\geq 5$ , how can they contribute to a healthful diet?
- **Concurrent Validity:**
  - By comparing these three tools: Quick, Detailed, and NEMS-V, have we sufficiently established validity?
- Is there anything confusing or unclear with the protocol or surveys?

Please provide all feedback by 12/20/13

During this pilot testing period the primary researcher and research assistants will survey products in vending machines in order to compile master lists of common vended snacks and common vended beverages. The nutrition information for all snacks and beverages found in these vending machines will be determined and recorded and each product will be assigned a **healthy dense snack score** or a **healthy dense beverage score** in the master lists.

Additionally, from the snack master list the frequency distribution of snack scores will determine the appropriate score distributions for classifying snack products as healthy, somewhat healthy, and unhealthy.

### Validation Study:

#### Timeline

- The validation study will be conducted from January 15th until February 15th, 2014
  - December 2013 – January 2014
    - i. Distribute protocol and accompanying files for expert review by experts in the field of nutrition
    - ii. PIs should begin training research assistants/evaluators on the above Quick Form protocol
    - iii. Research assistants/evaluators should practice using the Quick Form protocol to complete the Qualtrics Building Vending Survey on at least 2 vending machines  
[https://syracuseuniversity.qualtrics.com/SE/?SID=SV\\_6J4sNDuY4lucLiV](https://syracuseuniversity.qualtrics.com/SE/?SID=SV_6J4sNDuY4lucLiV)
    - iv. IRR (>80%) should be established between two raters for at least one vending machine in order to move forward with study
    - v. Select buildings and vending machines for evaluation (preferably at least one snack and one beverage machine from each building)
    - vi. Photograph each vending machine, upload photos, and label photos appropriately with Machine ID and time the photograph was taken.
    - vii. Evaluate all selected vending machines using the Quick Form protocol to complete the Building Vending Survey in Qualtrics
    - viii. Evaluate a subsample, at least 25% of your vending machine sample with the Detailed Form protocol to complete the Building Vending Survey in Qualtrics  
[https://syracuseuniversity.qualtrics.com/SE/?SID=SV\\_6J4sNDuY4lucLiV](https://syracuseuniversity.qualtrics.com/SE/?SID=SV_6J4sNDuY4lucLiV)
    - ix. Evaluate a subsample, at least 50% of vending machines using the NEMS-V protocol and NEMS-V spreadsheet
    - x. *\*Note, at subsample of at least 4 vending machines (2 snack and 2 beverage) should be evaluated using all three methods by two different evaluators, using photographs of machine and machine contents taken at the same time point.*
- **All data is due for analysis on February 15<sup>th</sup>, 2014**  
**Qualtrics data and accompanying excel data sheets for quick, detailed and NEMS-V assessments.**

For the validation study a total of twenty (20) vending machines from each campus location will be selected for inclusion in this study. Vending machines will be selected from different buildings on each participating university campus. Specifically, the vending machines with the most traffic flow in the student union, libraries, residence halls, academic buildings, and recreation facilities will be evaluated. At least one snack machine and one beverage machine from each type of building will be assessed. Two different individuals (the primary researcher and/or research assistants) will evaluate the selected vending machines in order to establish inter-rater reliability. One vending machine will be evaluated at a time. All selected vending machines at each location will be evaluated using the **Quick Method Protocol**. A subset of at least 25% of vending machines at each location will be evaluated using the **Detailed Method Protocol**. Additionally, a subset of at least 50% of vending machines will be evaluated using a previously validated and reliable vending machine assessment tool, the NEMS-V tool (7). **Each vending machine must be evaluated on the same day at the same time using all necessary methods to ensure accurate results.** (Evaluators will need to use the same photographs of the machine and its contents when completing all evaluations.)

#### Per campus:

- Evaluate at least 20 vending machines (Quick Method Protocol)
- Evaluate a randomly selected subsample of at least 25% of the vending machines using the Detailed Method Protocol
- Evaluate a randomly selected subsample of at least 50% of the vending machines using the NEMS-V Protocol

## APPENDIX C

### NEMS-V Protocol

(This is a modified and shortened version of the NEMS-V protocol found at: <http://www.nems-v.com/NEMS-VTools.html>)

#### Directions:

Use the following directions to complete the **NEMS-V Spreadsheet** in Excel.

#### Completing the Individual Vending Machine Graphic in Excel

- This will be completed for each vending machine you are evaluating with the NEMS-V protocol.
  1. Record the Machine ID of the machine being evaluated
  2. Place an “X” in the slots that do not have products and an “E” in slots that are empty because of sellouts. Place a “G/M” in the slots filled with gum or mints.
  3. Number the slots that do not have an “X”. Start moving left to right, proceed down the rows. Each slot will have one number assigned (including slots marked “E” or “G/M” for gum and mints.
  4. Complete the recording sheet information as described in **completing the food and beverage recording page**
  5. Using the information gathered from the recording page, mark the corresponding slot on the vending machine graphic with a green, yellow, or red marker. This will give a snapshot of the availability of healthy foods choices in the machine.

#### Completing the Food and Beverage Recording Sheet in Excel

- This will be completed for each vending machine you are evaluating with the NEMS-V protocol. Record the following information for each vending machine:
  1. **Slot number:** These numbers correspond to the individual vending machine graphic
  2. **Item:** the name of the food item in the corresponding slot
  3. **Package Size:** The size of this slot in ounces or grams. You do not need to buy the package; if you cannot see the size, write “not visible” in the comments section.
  4. **Price:** Cost of the product.
  5. **Category:** Check the food or beverage category that best describes the product in the machine. Choose only one of the following options:
    - a. Beverage
    - b. Salty
    - c. Fruit or Vegetable
    - d. Sweet
    - e. Refrigerator or Frozen
    - f. Entrees and Sandwiches
    - g. ? (cannot be determined)
  6. **Color Code:** Enter product information into the **Healthy Choices Calculator** on the NEMS-V website (<http://www.nems-v.com/NEMS-VHealthyChoicesCalc.html>) to determine how a product should be color coded
    - a. **Green:** healthy
    - b. **Yellow:** somewhat healthy
    - c. **Red:** unhealthy
  7. Additionally, record the number of slots with green items, the number of slots with yellow items, and the number of slots with red items.
    - a. Remember to go back and mark each slot on the vending machine graphic with the appropriate color marker.

## Appendix D: HDVMAT: Quick Form Training Powerpoint

### Healthy Dense Vending Audit Tool Training Powerpoint

### Quick Method

### Timeline

1. Survey building(s) you are evaluating for vending machines
2. Select vending machines for evaluation (at least 1 snack and 1 beverage machine per building)
3. Photograph selected vending machines
4. Complete Quick Snack and Beverage Spreadsheet in Excel
5. Complete Building Vending Survey in Qualtrics

### Selecting Buildings

- This tool may be used to evaluate the total number of vending machines in your environment or a subsample of the total vending machines in your environment
- Identify the building(s) in your environment that you would like to use in your evaluation
  - If evaluating **one building**: evaluate all vending machines in the building
  - If evaluating **multiple buildings**: evaluate at least one snack machine and one beverage machine per building
- For each building selected for inclusion in your evaluation, assign each building a different numerical **building code number**

### Evaluating a Building

- Next, you will survey and record information regarding each building you have selected to include in your evaluation
- Use a smartphone or table to access Qualtrics or print out a copy of the Qualtrics Building Vending Survey to bring with you to record the necessary information obtained through surveying a building
  - **Use a different Building Vending Survey for each different building included in your evaluation**
  - This information will later be entered into the online Qualtrics survey

### Evaluating a Building

- For each building in which vending machines are being evaluated, identify and record the following information on your printed off copy of the Qualtrics Building Vending Survey
  - Evaluator Name
  - Type of Audit
  - Type of Data Collection (Quick Form)
  - State
  - Building Name
  - Type of Building
  - Type of Environment
  - Building Code Number
  - Building Hours
  - Machine Accessibility
  - Machine Availability
- Enter this information into the online Building Vending Survey in Qualtrics

## Evaluating a Building

- Machine Accessibility
  - How readily available vending machines and machine products are to consumers in the building
  - Assess as **not appropriately accessible, somewhat accessible, or appropriately accessible**
  - Evaluation of machine accessibility is dependent on type of environment
    - Primary and secondary schools vs. all other environments

***\*Note: vending machines will need to be visited multiple times throughout a day***

## Evaluating a Building: Machine Accessibility

### Schools

- Not Appropriately Accessible
  - Machine is on  $\geq 50\%$  of school day
- Somewhat Accessible
  - Machine is on 25-50% of school day
- Appropriately Accessible
  - Machine is on  $\leq 25\%$  of school day

### All Other Environments

- Not Appropriately Accessible
  - $\geq 50\%$  of slots are empty when building closes
- Somewhat Accessible
  - 25-50% of slots are empty when building closes
- Appropriately Accessible
  - $\leq 25\%$  of slots are empty when building closes

## Evaluating a Building

- Machine Availability
  - Scan the building for vending machines
  - Record the number of different types of vending machines in the building
    - Cold Beverage
    - Snack
    - Prepared Food
    - Dairy
    - Hot Beverage
    - Mixed Snack/Beverage
    - Other
  - Record the total number of vending machines in the building

## Selecting Vending Machines

- If evaluating one building, all vending machines in the building should be evaluated
- If evaluating multiple buildings, evaluate at least one snack and one beverage machine per building

## Selecting Vending Machines

- To select vending machines for evaluation, consider machine placement and who uses them
- Evaluate vending machines with the **highest traffic flow**
  - Ex. machine on the main floor of building
- Assign a different numerical machine code to each vending machine evaluated in your audit
- Then, assign a **Machine ID** to each vending machine evaluated
  - State Abbreviation – Building Code # - Machine #
  - The **Machine ID** is extremely important, as it is will keep all data tied together for IRR and validation purposes.

## Selecting Vending Machines

- Additionally, if you find a vending machine with unique or novel vended products (prepared food, sandwiches, ice-cream, etc.) include that machine in your evaluation

### Photographing the Vending Machines

Next, after you have surveyed the building and selected vending machines for evaluation, carefully photograph each vending machine and each vending machine's contents using a digital camera or smartphone

### Photographing the Vending Machines

- Guidelines
  - Take photographs of the front, right side, and left side of the vending machine

### Photographing the Vending Machines

- Guidelines
  - Take photographs of the contents of the vending machine
    - Get as close as possible to the machine
    - Do not use flash
    - You may need to take multiple pictures
    - You may need to take pictures of each row or product separately

### Photographing the Vending Machines

- Guidelines
  - Before you leave make sure all of the following information can be collected from your photographs
    - Product name
    - Product label
    - Product package size
    - Product price
  - Make sure anything you see standing in front of the vending machine has been captured in your photographs

### Photographing the Vending Machines

- Guidelines
  - Upload all of the images for each vending machine onto a computer, create a file, and label the file with the vending machine's assigned **Machine ID**

### Completing the Quick Snack and Beverage Spreadsheet

- Use the photographs you have taken to complete the Quick Snack and Beverage Spreadsheet in Excel
- The Quick Snack and Beverage Spreadsheet in Excel contains:
  - Quick Snack List
  - Unlisted Snacks
  - Quick Beverage List
  - Unlisted Beverages

## Quick Snack List

- Use the Quick Snack List to evaluate the snack machines and/or the snacks in a mixed snack and beverage vending machine
  - Complete a different Quick Snack List for each different vending machine you evaluate
- The Quick Snack List is a compilation of snacks commonly found in vending machines
  - Snacks are listed alphabetically according to their predetermined **healthy dense snack score**

## Quick Snack List

- Healthy Dense Snack Score
  - Each commonly found vended snack has been evaluated for healthfulness and assigned a score based on the presence of the following 12 criteria:
    - **Calories** ( $\leq 200$  calories per package)
    - **Saturated Fat** ( $\leq 10\%$  DV per package)
    - **Trans Fat** (0% per package)
    - **Sugar** ( $\leq 12.5g$  per package)
    - **Sodium** ( $\leq 10\%$  DV per package)
    - **Fiber** ( $\geq 10\%$  DV per package)
    - **Calcium** ( $\geq 10\%$  DV per package)
    - **Iron** ( $\geq 10\%$  DV per package)
    - **Potassium** ( $\geq 10\%$  DV per package)
    - **Vitamin C** ( $\geq 10\%$  DV per package)
    - **Vitamin D** ( $\geq 10\%$  DV per package)
    - **Vitamin E** ( $\geq 10\%$  DV per package)
  - The healthy dense snack score is a 12-point scoring system, with each snack receiving one point for each healthfulness criteria met therefore scores range from 0 to 12

## Exceptions to Healthfulness Criteria

- All gum and breath mint products will automatically receive a score of 0 and will **not** be counted in the snack evaluation.
- All fresh whole fruits (apples, bananas, oranges, etc.) will automatically receive a score of 7.

## Exceptions to Healthfulness Criteria

- In accordance with the *Smart Snacks in School: USDA's "All Foods Sold in School" Standards* exemptions to the saturated fat standard include reduced fat cheese (including part-skim mozzarella), nuts, seeds, nut or seed butters, products containing only dried fruit with nuts and/or seeds with no added nutritive sweeteners or fats, and seafood with no added fats. These products will automatically meet the saturated fat standard and receive 1 point for meeting the saturated fat criteria.
- In accordance with the *Smart Snacks in School: USDA's "All Foods Sold in School" Standards* exemptions to the sugar standard include dried whole fruits or vegetables, dried whole fruit or vegetable pieces, dehydrated fruits with no added nutritive sweeteners, dried whole fruits or pieces with nutritive sweeteners that are required for processing and/or palatability purposes (cranberries, tart cherries, blueberries, etc.), and products consisting of dried fruit with nuts and/or seeds with no added nutritive sweeteners or fats. These products will automatically meet the sugar standard and receive 1 point for meeting the sugar criteria.

## Quick Snack List

- Healthy Dense Snack Score
  - Used to distinguish between healthy and unhealthy snacks
    - **Unhealthy Snacks**
      - Healthy Dense Snack Scores  $\leq 2$
    - **Somewhat Healthy Snacks**
      - Healthy Dense Snack Scores of 3 or 4
    - **Healthy Snacks**
      - Healthy Dense Snack Scores of  $\geq 5$

## Quick Snack List: Score 1

Score	Name and Flavor	Brand Name	Package Size (oz.)
1	Kiwi Kit Bar	Hershey's	2.04
1	Mini Sandwich Cremes Vanilla Cookies	Grandma's	2.71x4.1
1	Ono Cookies	Nabisco	2.4
1	Shortbread Cookies (Blueberry or Raspberry)	Kristin Berry Farm	2.00x3.00
1	Stickers	Mars	2.07
1	Take 5	Hershey's	1.75
1	Twee	Mars	2
1	Other		



## Quick Snack List: Score 2

1 Musketeers	Mars	22.13
2 Milky Way	Nestle	21
3 Butterfinger	Nestle	21
4 Butterfinger Mints	Nestle	13
5 Cheetos (Crunchy)	Frito Lay	2
6 Chocolate Chip Cookies	Farmhouse	2
7 Combos (Cheddar Cheese or Pizzeria Pretzel)	Mars	1.8
8 Crunch Bar	Nestle	1.9
9 Doritos (Cool Ranch, Four Cheese, or Nacho Cheese)	Frito Lay	1.75
10 Fritos (Corn Chips or Honey BBQ or Spicy Jalapeno Tostitos)	Frito Lay	22.1
11 Hershey's Milk Chocolate Candy Bar	Hershey's	1.55
12 Kit Kat (Extra Crispy)	Hershey's	1.61
13 Lorna Doone Shortbread Cookies	Nestle	1.5
14 M & M's (Plain or Peanut Butter)	Hershey's	1691.74
15 Milky Way	Mars	2.05
16 Nutella Butter Cookies	Nutella	5.25
17 Payday	Hershey's	2
18 Reese's Fast Break Candy Bar	Hershey's	2
19 Reese's Nutrageous	Hershey's	1.8
20 Reese's Peanut Butter Cups	Hershey's	2.1
21 Reese's Pies	Hershey's	1.53
22 Twizzlers (Original)	Hershey's	2.5
23 Vanilla Sandwich Cookies	Quaker's	1.21
24 Zoo Animal Crackers	Nutella	1
25 Other		

## Quick Snack List: Score 3

1 100 Grand Bar	Nestle	1.5
2 Almond Joy	Hershey's	2
3 Chees-It Crackers (Baked White Cheddar)	Farmhouse	3
4 Cream Cheese Bagel	Bagel Time	4.6
5 Doritos (Buffalo Ranch or Nacho Cheese)	Frito Lay	1.38
6 Duplex Cremes Cookies	Unice A's	5
7 Friday's Potato Skins (Bacon Cheddar)	TDI Friday's	1.55
8 Gummy Bears or Worms (Regular or Sour)	Stoney	4
9 Ham and Swiss Cheese Sandwich	Cuttakes	4.5
10 Hard Candy	Jolly Rancher	5
11 Junior Mints	Tootsie Roll	4
12 M & M's (Peanut)	Hershey's	1.74
13 PopTarts (Brown Sugar)	Kellogg's	5,523.67
14 Pretzels (Plain)	Onyder's Hanover	2.25
15 Pringles (Original, Cheddar Cheese, or Sour Cream and Onion)	Pringles	1.41
16 Reese's Pieces	Hershey's	3.5
17 Snackwells Vanilla Cookies Sandwich	Nutella	1.7
18 Tootsie Roll Twin Bar Pack	Tootsie Roll	2
19 White Cheddar Poppom	Smart Food	1
20 Other		

## Quick Snack List: Score 4

1 Baked Banana (Banana)	Frito Lay	1,151,185.75
2 Baked Apple (Banana or Apple)	Smart Food	
3 Cheese & Crackers (Baked Cheese)	Stoney	5
4 Chocolate Chip Cookies	Farmhouse	2
5 Cookies (Jelly Candy)	Stoney	5
6 Friday's Potato Skins (Bacon Cheddar)	TDI Friday's	1.55
7 Fruit Smoothie (Fruit or Honey BBQ or Spicy Jalapeno Tostitos)	Hershey's	1.55
8 Hershey's Original Snack Mix	Hershey's	1.5
9 M & M's (Peanut Butter)	Hershey's	1.6
10 Lorna Doone Shortbread Cookies	Nestle	1.5
11 Nutella	Nutella	1.4
12 Peanut Butter and Cheese Crackers	Frito Lay	1.38
13 Peanut Butter Cookies	Stoney	1.8
14 Popover Pretzels	Stoney	1.43
15 Reese's Fast Break Candy Bar	Hershey's	1,010.97
16 Reese's Nutrageous	Hershey's	1.8
17 Reese's Peanut Butter Cups	Hershey's	2.1
18 Reese's Pies	Hershey's	1.53
19 Twizzlers (Original)	Hershey's	2.5
20 Vanilla Sandwich Cookies	Quaker's	1.21
21 Zoo Animal Crackers	Nutella	1
22 Other		

## Quick Snack List: Score 5

1 Baked Lays Potato Chips (Plain, BBQ, or Sour Cream Onion)	Frito Lay	1,125
2 Bananilla Cheese	Samurai Orchard	1
3 Cashews (Salted)	Samurai	1.5
4 Chees Mix (Traditional, Sweet n Salty, Bold, or Pretzel Mix)	General Mills	1.75
5 Coffee Cake	Doritos's Honey	1
6 Creamsicle Bar (Cheese and Honey)	Nature Valley	1.5
7 Creamsicle Bar (Strawberry Yogurt)	Nature Valley	1.2
8 Creamsicle Bar (Sweet & Salty Not Almond)	Nature Valley	1.2
9 Low Sodium Yem Sandwich (12 Count Braid)	Samurai Chocbox	5
10 Muffin (Banana Nut, Blueberry, or Chocolate)	Doritos's	5.75
11 Nutrageous Bar (Blueberry or Strawberry)	Kellogg's	1.3
12 Peanut Butter	Samurai	1.5
13 Pita Chips (Salted or Parmesan Garlic)	Stoney's	1.375
14 Popcorn (Unpopped Light Butter)	Act II	2.75
15 Pretzels (Hard Sourdough)	Onyder's Hanover	1.65
16 Pretzels (Honey Wheat)	Stacy's	2
17 Quaker Rice Cakes (Plain or Chocolate)	Frito Lay	5.91
18 Quaker Rice Snacks	Frito Lay	5.95
19 Rice Krispies Treats	Kellogg's	1.7
20 Trail Mix	W. Nature	2
21 Trail Mix (Salty)	J&J's	2
22 Trail Mix (Sweet n Salty Mix)	Mars	2
23 Trail Mix (Unsalted Energizer Mix)	W. Nature	2
24 Trail Mix (Unsalted)	W. Nature	2
25 Other		

## Quick Snack List: Score 6

1 Banana Nut Bar	Orvala	2
2 Berries GoMega Bar	Orvala	2
3 Cashews (Roasted and Salted)	Samurai	1
4 Corn Muffin	Doritos's	5.75
5 Doritos (Cool Ranch)	Frito Lay	1
6 Fruit 'n Yogurt Snacks	Welch's	1.9
7 Creamsicle Bar (Crunchy Peanut Butter)	Nature Valley	1.5
8 Pita Chips (Cinnamon Sugar)	Stoney's	1.375
9 Other		

## Quick Snack List: Score 7

1 Apple (whole fruit)		
2 Banana (whole fruit)		
3 Orange (whole fruit)		
4 Other		

## Quick Snack List

- To complete the Quick Snack List use the photographs you have taken to record and tally all of the face front snack products in a vending machine
  - For each face front snack product identified from your photographs, check the Quick Snack List to determine if the snack has been listed, evaluated for healthfulness, and assigned a healthy dense snack score

## Quick Snack List

- Only evaluate face front snack products
  - If there is a different snack behind the front product, do not count it



\*Do not count the Sour Cream and Onion Pringles, as they are behind the Cheddar Pringles, only evaluate the Cheddar Pringles in your evaluation

## Quick Snack List

- If there are different flavors of the same product, the different flavors count as different products



These should be evaluated as 3 different products

## Quick Snack List

- Pay close attention to the package size of a snack product, as this may effect a snack's healthy dense score



Cool Ranch Doritos 1.75 oz. package:  
Score of 2



Cool Ranch Doritos 1 oz. package:  
Score of 6

## Snapshot of a Completed Quick Snack List

3	1	M&M's	M&M's	2 or 2.13
		Butterfinger	Nestle	2.1
		Butterfinger Mints	Nestle	3.5
2	2	Choco (Chocolate)	Frito Lay	2
		Chocolate Chip Cookies	Famous Amos	3
2	2	Combos (Cheddar Cheese or Pizana Pretzel)	Mars	3.5
		Candy Bar	Nestle	3.5
2	2	Doritos (Cool Ranch, Four Cheese or Nacho Cheese)	Frito Lay	1.75
3	3	Fritos (Corn Chips or Honey BBQ or Spicy Jalapeno Twists)	Frito Lay	2 or 2.1
		Harshy's Milk Chocolate Candy Bar	Harshy's	1.25
3	3	Kit Kat (Extra Chunk)	Harshy's	1.41
		Lena Doree Shortbread Cookie	Nabisco	3.5
2	2	M & M's (Plain or Peanut Butter)	Harshy's	1.65 or 1.74
3	3	M&M's	Mars	2.05
		Nutter Butter Cookies	Nabisco	3.25
		Payday	Harshy's	2
		Pease's Fast Break Candy Bar	Harshy's	2
		Pease's Nutmegous	Harshy's	1.5
2	2	Pease's Peanut Butter Cups	Harshy's	2.1
		Pease's Peanut	Harshy's	1.55
3	3	Pringles (Original)	Harshy's	2.5
		Vanilla Sandwich Cookies	Grandma's	3.71
		Wab Animal Crackers	Kraft's	1
		Wab		
Score 2 x 1	4	Total		

## Unlisted Snacks

- If a snack is not listed on the Quick Snack List, you will need to look up the product's nutritional information online
  - USDA Nutrient Database for Standard Reference ([www.ndb.nal.usda.gov](http://www.ndb.nal.usda.gov))
  - USDA SuperTracker ([www.supertracker.usda.gov](http://www.supertracker.usda.gov))
  - MyFitnessPal ([www.myfitnesspal.com](http://www.myfitnesspal.com))
  - Calorie Count ([www.caloriecount.about.com](http://www.caloriecount.about.com))
  - Product Brand's Website (ie. [www.fritolay.com](http://www.fritolay.com), [www.kelloggs.com](http://www.kelloggs.com), etc)

## Unlisted Snacks

- For each unlisted snack, complete the Unlisted Snacks Table to determine each snack's healthy dense snack score

SNACK	100% DV Added Fat	1% Trans Fat	≤15 g Sugar	100% DV Sodium	100% DV Fiber	100% DV Calcium	100% DV Iron	100% DV Protein	100% DV Vitamin C	100% DV Vitamin D	100% DV Vitamin E	Score

- If a product meets the specified healthfulness criteria, enter a 1 into the table
- If a product does not meet the specified healthfulness criteria, enter a 0 into the table
- This will allow a healthy dense snack score to be generated for each snack
- After a score has been generated for a snack, enter the number of slots occupied by that snack into the "other" row of the corresponding healthy dense snack score

## Quick Snack List

- Once you have entered this information, the following information will be generated in the Excel file

0	Total # of Snacks in Machine
0	Total # Healthy Snacks (Sum > 5)
0	# Different Healthy Snacks (Count > 5)
0	Percentage Healthy Snacks ((Total Sum > 5/Total # Snacks) x 100)
0	Percentage of Variety of Healthy Snacks ((Count > 5/Sum > 5) x 100)
0	Total Healthy Dense Machine Snack Score
0	Average Healthy Dense Machine Snack Score

## Quick Beverage List

- Use the Quick Beverage List to evaluate the snack machines and/or the snacks in a mixed snack and beverage vending machine
  - Complete a different Quick Beverage List for each different vending machine you evaluate
- The Quick Beverage List is a compilation of snacks commonly found in vending machines
  - Snacks are listed alphabetically according to their predetermined **healthy dense beverage score**

## Quick Beverage List

- Healthy Dense Beverage Score
  - Based on beverage type and/or caloric content
    - Score of 0
      - Sports drinks/life water/vitamin water (>50 calories per 8 fl. oz.)
      - Sugar sweetened beverages/energy drinks/coffee drinks/lemonade/iced tea/all other beverages (>10 calories per 8 fl. oz.)
    - Score of 1
      - Non-100% fruit or vegetable juice
      - Milk/flavored milk/non-dairy milk alternatives (>150 calories per 8 fl. oz.)
      - Sports drinks/life water/vitamin water (≤50 calories per 8 fl. oz.)
      - Sugar sweetened beverages/energy drinks/coffee drinks/lemonade/iced tea/all other beverages (≤10 calories per 8 fl. oz.)
    - Score of 2
      - Water/flavored water
      - 100% fruit or vegetable juice
      - Milk/flavored milk/non-dairy milk alternatives (≤150 calories per 8 fl. oz.)

## Quick Beverage List

- To complete the Quick Beverage List use the photographs you have taken to record and tally all of the face front beverage products in a vending machine
  - For each face front beverage product identified from your photographs, check the Quick Beverage List to determine if the snack has been listed, evaluated for healthfulness, and assigned a healthy dense beverage score

## Unlisted Beverages

For each unlisted beverage, complete the Unlisted Beverages Table to determine each beverage's healthy dense beverage score

Score of 0	Score of 1	Score of 2
Sugar sweetened beverages (soft drinks, energy drinks, coffee drinks, lemonade, iced tea, etc.) calories per 8 fl. oz. >10	Milk/flavored milk/non-dairy milk alternatives (>150 calories per 8 fl. oz.)	Water/flavored water
Sugar sweetened beverages (soft drinks, energy drinks, coffee drinks, lemonade, iced tea, etc.) calories per 8 fl. oz. >10	Sports drinks/life water/vitamin water (>50 calories per 8 fl. oz.)	100% fruit or vegetable juice
Sugar sweetened beverages (soft drinks, energy drinks, coffee drinks, lemonade, iced tea, etc.) calories per 8 fl. oz. >10	Sports drinks/life water/vitamin water (>50 calories per 8 fl. oz.)	Milk/flavored milk/non-dairy milk alternatives (>150 calories per 8 fl. oz.)

After a score has been generated for a beverage, enter the number of slots occupied by that beverage into the "other" row of the corresponding healthy dense beverage score

## Quick Beverage List

- Once you have entered this information, the following information will be generated in the Excel file

	Total # of Beverages in Machine
	Total # of Healthy Beverages (Sum of Score 2)
	# of Different Healthy Beverages (Count of Score 2)
%HVDI	Percentage Healthy Beverages [(Total Sum of 2/Total # Beverages) x 100]
%HVDIV	Percentage of Variety of Healthy Beverages [(Count of 2/Sum of 2) x 100]
	Total Healthy Dense Machine Beverage Score
%HVDI	Average Healthy Dense Machine Beverage Score

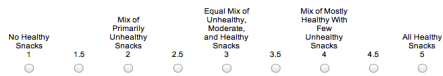
## Building Vending Survey

- After completing the Quick Snack and Beverage Spreadsheet(s) for a building use them along with the photographs of all vending machines evaluated within the building to complete the Building Vending Survey

## Building Vending Survey

- Average Healthy Dense Snack Score for all snack machines evaluated

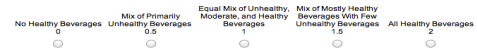
Average Healthy Dense Snack Score



## Building Vending Survey

- Average healthy dense beverage score for all beverage machines evaluated

Average Healthy Dense Beverage Score

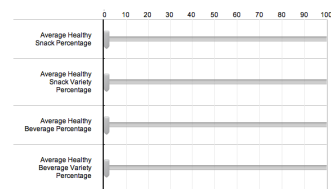


## Building Vending Survey

- Healthy Product Availability

Healthy Product Availability

Track the percentages of "healthy" products available based on the information obtained in snack and beverage audits of individual machines.



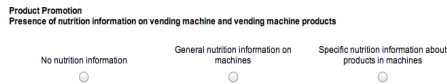
## Building Vending Survey

- Use photographs to compare the prices of healthy and unhealthy snacks of comparable type and size



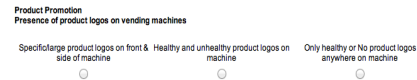
## Building Vending Survey

- Use photographs to evaluate the amount of product promotion of vending machine products of evaluated vending machines



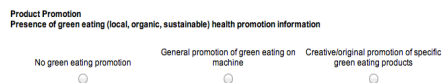
## Building Vending Survey

- Use photographs to evaluate the healthfulness of vending machine logos on evaluated vending machines



## Building Vending Survey

- Use photographs to evaluate the amount of green promotion of vending machine products of evaluated vending machines



## Summary

- Validation study will be conducted from January 15<sup>th</sup>, 2014 to February 15<sup>th</sup>, 2014
- Per Campus Timeline
  - Research assistants should practice using Quick Form protocol to complete the Qualtrics Building Vending Survey on at least 2 vending machines
  - IRR (>80%) should be established between two evaluators for at least one vending machine in order to move forward with study

## Summary

- Per Campus Timeline Cont.
  - Select buildings and vending machines for evaluation (preferably at least one snack and one beverage machine from each building)
  - Photograph each vending machine, upload photos, and label photos appropriately with Machine ID and time photograph was taken

## Summary

- Per Campus Timeline Cont.
  - Evaluate 20 vending machines and complete the Qualtrics Building Survey using Quick Method
  - Evaluate a randomly selected subsample of at least 25% (5) of the vending machines and complete the Qualtrics Building Survey using Detailed Method
  - Evaluate a randomly selected subsample of at least 50% (10) of the vending machines using the NEMS-V
    - Remember at least 4 machines (2 snack and 2 beverage) must be evaluated using the full protocol (Quick, Detailed, NEMS-V)

## Summary

- All data is due for analysis on February 15<sup>th</sup>, 2014
  - Completed Qualtrics Building Vending Surveys
  - All accompanying excel data sheets for quick, detailed, and NEMS-V assessments

**Qualtrics HDVMAT Survey**

**Evaluator Name**

**Type of Audit**

- Individual Data Collection
- Pilot Test
- Data Duplicate for Inter-Rater Reliability

**Type of Data Collection**

- Quick Form
- Detailed Form

**State**

**Building Name**

**Type of Building (Check All That Apply)**

Residential

Multifunctional

Other

Residential	Library	Recreation Facility	Academic	Manufacturing	Office	Multifunctional (Union)	Other
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Type of Environment (Check All That Apply)**

Elementary School	Middle School	High School	Community or Technical College	College or University	Work Site	Mall	Hotel/Motel	Community Services	Other
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Total Number of Buildings**

If you are evaluating more than one building for your audit, how many total will you evaluate?

**Building Code Number**

If you are evaluating more than one building for your environment, indicate the building identification number for this audit?

**Building Hours**

This building is open \_\_\_\_ hours/day

**Machine Accessibility**  
Accessibility of vending machines and machine products\*

\*Dependent on environment  
Primary and Secondary Schools:



Not appropriate if machine is on for  $\geq 50\%$  of the school day.  
 Somewhat appropriate if machine is on for 25-50% of the school day.  
 Appropriate if machine is on for  $\leq 25\%$  of the school day.

**All Other:**

Not appropriate if  $\geq 50\%$  of machine items are empty by the end of the day (when building closes).  
 Somewhat appropriate if 25-50% of machine items are empty by the end of the day (when building closes).  
 Appropriate if  $\leq 25\%$  of the machine items are empty by the end of the day (when building closes).

Not Appropriately Accessible

Somewhat Accessible

Appropriately Accessible

**Machine Availability**

Tally the number of each type of vending machine for this building and the number of each type of machine being evaluated for this building.

	Total Number	Number Evaluated
Cold Beverage	<input type="text" value="0"/>	<input type="text" value="0"/>
Snack	<input type="text" value="0"/>	<input type="text" value="0"/>
Prepared Food	<input type="text" value="0"/>	<input type="text" value="0"/>
Dairy	<input type="text" value="0"/>	<input type="text" value="0"/>
Hot Beverage	<input type="text" value="0"/>	<input type="text" value="0"/>
Mixed Snack/Beverage	<input type="text" value="0"/>	<input type="text" value="0"/>
Other: <input type="text"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
<b>Total</b>	<input type="text"/>	<input type="text"/>

**Average Healthy Dense Snack Score**

No Healthy Snacks (1)    
  1.5    
  Mix of Primarily Unhealthy Snacks (2)    
  2.5    
  Equal Mix of Unhealthy, Moderate, and Healthy Snacks (3)    
  3.5    
  Mix of Mostly Healthy With Few Unhealthy Snacks (4)    
  4.5    
  All Healthy Snacks (5)

**Average Healthy Dense Beverage Score**

Equal Mix of Unhealthy     Mix of Mostly Healthy

No Healthy Beverages Mix of Primarily Unhealthy Beverages Equal Mix of Unhealthy, Moderate, and Healthy Beverages Mix of Mostly Healthy Beverages With Few Unhealthy Beverages All Healthy Beverages  
 0 0.5 1 1.5 2

**Healthy Product Availability**

Track the average percentages of "healthy" products available based on the information obtained from snack and beverage audits of individual machines.

	0	10	20	30	40	50	60	70	80	90	100
Average Healthy Snack Percentage											
Average Healthy Snack Variety Percentage											
Average Healthy Beverage Percentage											
Average Healthy Beverage Variety Percentage											

**Product Price**

Average prices of similar type/size healthy and unhealthy products in vending machines

Healthy more expensive than Unhealthy Healthy and Unhealthy equally priced Healthy less expensive than Unhealthy

**Product Promotion**

Presence of nutrition information on vending machine and vending machine products

No nutrition information General nutrition information on machines Specific nutrition information about products in machines

**Product Promotion**

**Presence of product logos on vending machines**

Specific/large product logos on front & side of machine

Healthy and unhealthy product logos on machine

Only healthy or No product logos anywhere on machine

**Product Promotion**

**Presence of green eating (local, organic, sustainable) health promotion information**

No green eating promotion

General promotion of green eating on machine

Creative/original promotion of specific green eating products

**Qualtrics HDVMAT Snack Survey**

**Evaluator Name**

**Type of Audit**

- Individual Data Collection
- Data Duplicate for Inter-Rater Reliability

**State**

**Type of Environment (check all that apply)**

- |                          |                          |                          |                                |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Elementary School        | Middle School            | High School              | Community or Technical College | College or University    | Work Site                | Mall                     | Hotel/Motel              | Community Services       | Other                    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Building Name**

**Type of Building (check all that apply)**

Other

Residential

Library

Recreation Facility

Academic

**Building Code #**

**Machine Code #**

**Machine Identification # (State Abbreviation - Building Code # - Machine Code #)**

**Time Machine Evaluated**

**Total Number of Available Snack Slots**

**Total Number of Occupied Snack Slots**

**Total Number of Different Snacks Available in Machine**

**Machine Accessibility**

**Accessibility of vending machines and machine products\***

**Dependent on environment**

**Primary and Secondary Schools:**

Not appropriate if machine is on for  $\geq 50\%$  of the school day.

Somewhat appropriate if 25-50% of the school day.

Appropriate if machine is on  $\leq 25\%$  of the school day.

**All Other:**

Not appropriate if  $\geq 50\%$  of machine items are empty by the end of the day (when building closes).

Somewhat appropriate if 25-50% of machine items are empty by the end of the day (when building closes).

Appropriate if  $\leq 25\%$  of the machine items are empty by the end of the day (when building closes).

Not Appropriately Accessible

Somewhat Accessible

Appropriately Accessible

**Healthy Dense Snacks Score 1**

Tally all of the snacks in the machine that receive a score of 1.

Kit Kat Bar (Hershey's) 2.04

Mini Sandwich Cremes Vanilla Cookies (Grandma's) 3.71/4.10

Oreo Cookies (Nabisco) 2.40

Shortbread Cookies - Blueberry or Raspberry (Knotts Berry Farms) 2.00/3.00

Snickers (Mars) 2.07

Take 5 (Hershey's) 1.75

Twix (Mars) 2.00

Other

**Total**

**Healthy Dense Snacks Score 2****Tally all of the snacks in the machine that receive a score of 2**

3 Musketeers (Mars) 2.00/2.13	<input type="text" value="0"/>
Baby Ruth (Nestle) 2.10	<input type="text" value="0"/>
Butterfinger (Nestle) 2.10	<input type="text" value="0"/>
Butterfinger Minis (Nestle) 3.5	<input type="text" value="0"/>
Cheetos - Crunchy (Frito Lay) 2.00	<input type="text" value="0"/>
Chocolate Chip Cookies (Famous Amos) 3.00	<input type="text" value="0"/>
Combos - Cheddar Cheese and Pizzeria Pretzel (Mars) 1.80	<input type="text" value="0"/>
Crunch Bar (Nestle) 1.9	<input type="text" value="0"/>
Doritos - Cool Ranch, Four Cheese, or Nacho Cheese (Frito Lay) 1.75	<input type="text" value="0"/>
Fritos - Corn Chips, Honey BBQ, or Spicy Jalapeño Twists (Frito Lay) - 2.00/2.10	<input type="text" value="0"/>
Hershey's Milk Chocolate Candy Bar (Hershey's) 1.55	<input type="text" value="0"/>
Kit Kat - Extra Crispy (Hershey's) 1.61	<input type="text" value="0"/>
Lorna Doone Shortbread Cookie (Nabisco) 1.50	<input type="text" value="0"/>
M & M's - Plain or Peanut Butter (Hershey's) 1.69/1.74	<input type="text" value="0"/>
Milky Way (Mars) 2.05	<input type="text" value="0"/>
Nutter Butter Cookies (Nabisco) 5.25	<input type="text" value="0"/>
Payday (Hershey's) 2.00	<input type="text" value="0"/>
Reese's Fast Break Candy Bar (Hershey's) 2.00	<input type="text" value="0"/>
Reese's Nutrageous (Hershey's) 1.80	<input type="text" value="0"/>
Reese's Peanut Butter Cups (Hershey's) 2.10	<input type="text" value="0"/>
Reese's Pieces (Hershey's) 1.53	<input type="text" value="0"/>
Twizzlers - Original (Hershey's) 2.50	<input type="text" value="0"/>
Vanilla Sandwich Cookies (Grandma's) 3.71	<input type="text" value="0"/>
Zoo Animal Crackers (Austin's) 1.00	<input type="text" value="0"/>
Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Snack Score 3**

**Tally all of the snacks in the machine that receive a score of 3.**

100 Grand Bar (Nestle) 1.50	<input type="text" value="0"/>
Almond Joy (Hershey's) 2.00	<input type="text" value="0"/>
Cheez It Crackers - Baked White Cheddar (Sunshine) 3.00	<input type="text" value="0"/>
Cream Cheese Bagel (Bagel Time) 4.60	<input type="text" value="0"/>
Doritos - Buffalo Ranch or Nacho Cheese (Frito Lay) 1.38	<input type="text" value="0"/>
Duplex Cremes Cookies (Uncle Al's) 5.00	<input type="text" value="0"/>
Friday's Potato Skins - Bacon Cheddar (TGI Friday's) 1.95	<input type="text" value="0"/>
Gummy Bears or Worms (Sconza) 4.00	<input type="text" value="0"/>
Ham and Swiss Cheese Sandwich (Outtakes) 4.50	<input type="text" value="0"/>
Hard Candy (Jolly Ranchers) 3.00	<input type="text" value="0"/>
Junior Mints (Tootsie Roll) 4.00	<input type="text" value="0"/>
M & M's - Peanut (Hershey's) 1.74	<input type="text" value="0"/>
Poptarts - Brown Sugar (Kellogg's) 3.52/3.67	<input type="text" value="0"/>
Pretzels - Plain (Snyder's Hanover) 2.25	<input type="text" value="0"/>
Pringles - Original, Cheddar Cheese, or Sour Cream and Onion (Pringles) 1.41	<input type="text" value="0"/>
Reese's Pieces (Hershey's) 3.50	<input type="text" value="0"/>
Snackwells Vanilla Cookie Sandwich (Nabisco) 1.70	<input type="text" value="0"/>
Tootsie Roll Twin Pack (Tootsie Roll) 2.00	<input type="text" value="0"/>
White Cheddar Popcorn (Smart Food) 1.00	<input type="text" value="0"/>
Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Snacks Score 4**

**Tally all of the snacks in the machine with a score of 4**

Baked Doritos - Nacho (Frito Lay) 1.125/1.38/1.75	<input type="text" value="0"/>
Beef Jerky - Teriyaki Flavor (Trail's Best) 1.00	<input type="text" value="0"/>
Cheez It Crackers - Baked Cheese (Sunshine) 3.00	<input type="text" value="0"/>



On the Border Crackers - Baked Cheese (Sunshine) 3.00	0
Chocolate Chip Cookies (Famous Amos) 2.00	0
Chuckles Jelly Candy (Chuckles) 2.00	0
Friday's Potato Skins - Bacon Cheddar (TGI Friday's) 1.00	0
Fruit Snacks - Fat Freed (Welch's) 2.25	0
Gardetto's Original Snack Mix (General Mills) 1.6	0
Good 'n Plenty Licorice Candy (Hershey's) 1.80	0
Lays Potato Chips - Classic (Frito Lay) 1.50	0
Payday (Hershey's) 2.40	0
Peanut Butter and Cheese Crackers (Frito Lay) 1.38	0
Peanut Butter Crackers (Frito Lay) 1.38	0
Peppermint Patties (York) 1.43	0
Poptarts - Frosted Cherry or Frosted Strawberry (Kellogg's) 3.52/3.67	0
Potato Chips - Plain or Garlic and Herb (Dirty) 2.00	0
Pretzels - Plain (Rold Gold) 1.50	0
Pringles - Original, Cheddar Cheese, or Sour Cream and Onion (Pringles) 1.30	0
Quaker Oatmeal Bar - Brown Sugar & Cinnamon (Frito Lay) 1.40	0
Raisinets (Nestle) 1.58	0
Ruffles Potato Chips - Thick Cut Cheddar (Frito Lay) 1.50	0
Sea Salt Chips (Miss Vickies) 1.75	0
Skittles (Mars) 2.17	0
Starburst (Mars) 2.07	0
Sunchips - French Onion, Garden Salsa, or Harvest Cheddar (Frito Lay) 2.00	0
Swedish Fish (Swedish Fish) 2.00	0
Tuna Salad (Outtakes) 4.5	0
Veggie Chips (EatSmart or Flat Earth) 1.25	0
Veggie Crisps (Veggie Chips) 1.25	0
Wheat Thins - Original or Veggie Toasted Chips (Nabisco) 1.75	0
Other	0
<b>Total</b>	0

**Healthy Dense Snacks Score 5****Tally all of the snacks in the machine that receive a score of 5**

Baked Lays Potato Chips - Plain, BBQ, or Sour Cream and Onion (Frito Lay) 1.125	<input type="text" value="0"/>
Bruschetta Chips (Jensen's Orchard) 1.00	<input type="text" value="0"/>
Cashews - Salted (Planters) 1.50	<input type="text" value="0"/>
Chex Mix - Traditional, Sweet n Salty, Bold, or Pretzel Mix (General Mills) 1.75	<input type="text" value="0"/>
Coffee Cake (Drake's Hostess) 1.00	<input type="text" value="0"/>
Granola Bar - Oats and Honey (Nature Valley) 1.50	<input type="text" value="0"/>
Granola Bar - Strawberry Yogurt (Nature Valley) 1.20	<input type="text" value="0"/>
Granola Bar - Sweet & Salty Nut Almond (Nature Valley) 1.20	<input type="text" value="0"/>
Low Sodium Ham Sandwich on 12 Grain Bread (Balanced Choices) 6.00	<input type="text" value="0"/>
Muffin - Banana Nut, Blueberry or Chocolate (Daisy's) 5.75	<input type="text" value="0"/>
Nutrigrain Bar - Blueberry or Strawberry (Kellogg's) 1.30	<input type="text" value="0"/>
Peanuts - Salted (Planters) 1.50	<input type="text" value="0"/>
Pita Chips - Salted or Parmesan Garlic (Stacy's) 1.375	<input type="text" value="0"/>
Popcorn - Unpopped Light Butter (Act II) 2.75	<input type="text" value="0"/>
Pretzels - Hard Sourdough (Snyder's Hanover) 1.65	<input type="text" value="0"/>
Pretzels - Honey Wheat (Rold Gold) 2.00	<input type="text" value="0"/>
Quaker Rice Cakes - Plain or Chocolate (Frito Lay) 0.91	<input type="text" value="0"/>
Quaker Rice Snack (Frito Lay) 0.95	<input type="text" value="0"/>
Rice Krispies Treats (Kellogg's) 1.7	<input type="text" value="0"/>
Trail Mix (Mr. Nature) 2.00	<input type="text" value="0"/>
Trail Mix - Salty (Lear's) 2.00	<input type="text" value="0"/>
Trail Mix - Sweet n Salty Mix (Kar's) 2.00	<input type="text" value="0"/>
Trail Mix - Unsalted Energizer Mix (Mr. Nature) 2.00	<input type="text" value="0"/>
Trail Mix - Unsalted (Mr. Nature) 2.00	<input type="text" value="0"/>
Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Snacks Score 6**

**Tally all of the snacks in the machine that receive a score of 6**

Banana Nut Bar (Odwalla) 2.00	<input type="text" value="0"/>
Berries GoMega Bar (Odwalla) 2.00	<input type="text" value="0"/>
Cashews - Roasted and Salted (Kar's) 1.00	<input type="text" value="0"/>
Corn Muffin (Daisy's) 5.75	<input type="text" value="0"/>
Doritos - Cool Ranch (Frito Lay) 1.00	<input type="text" value="0"/>
Fruit n Yogurt Snacks (Welch's) 1.90	<input type="text" value="0"/>
Granol Bar - Crunchy Peanut Butter (Nature Valley) 1.50	<input type="text" value="0"/>
Pita Chips - Cinnamon Sugar (Stacy's) 1.375	<input type="text" value="0"/>
Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Snacks Score 7**

**Tally all of the snacks in the machine that receive a score of 7**

Apple (whole fruit)	<input type="text" value="0"/>
Banana (whole fruit)	<input type="text" value="0"/>
Orange (whole fruit)	<input type="text" value="0"/>
Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Snacks Score 8**

**Tally all of the snacks in machine that receive a score of 8**

Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

--	--

**Healthy Dense Snacks Score 9**

**Tally all of the snacks in machine that receive a score of 9**

Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Snacks Score 10**

**Tally all of the snacks in machine that receive a score of 10**

Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Snacks Score 11**

**Tally all of the snacks in machine that receive a score of 11**

Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Snacks Score 12**

**Tally all of the snacks in machine that receive a score of 12**

Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Total Healthy Dense Snack Score**

**Calculate the Total Healthy Dense Snack Score using the equations below**

**Calculate the Total Healthy Dense Snack Score using the equations below**

Total # of Snacks with Score 1 x 1	<input type="text" value="0"/>
Total # of Snacks with Score 2 x 2	<input type="text" value="0"/>
Total # of Snacks with Score 3 x 3	<input type="text" value="0"/>
Total # of Snacks with Score 4 x 4	<input type="text" value="0"/>
Total # of Snacks with Score 5 x 5	<input type="text" value="0"/>
Total # of Snacks with Score 6 x 6	<input type="text" value="0"/>
Total # of Snacks with Score 7 x 7	<input type="text" value="0"/>
Total # of Snacks with Score 8 x 8	<input type="text" value="0"/>
Total # of Snacks with Score 9 x 9	<input type="text" value="0"/>
Total # of Snacks with Score 10 x 10	<input type="text" value="0"/>
Total # of Snacks with Score 11 x 11	<input type="text" value="0"/>
Total # of Snacks with Score 12 x 12	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Average Healthy Dense Snack Score**

**Divide the Total Healthy Dense Snack Score by the Total Number of Snacks in the machine**

No Healthy Snacks		Mix of Primarily Unhealthy Snacks		Equal Mix of Unhealthy and Healthy Snacks		Mix of Primarily Healthy Snacks		All Healthy Snacks
1	1.5	2	2.5	3	3.5	4	4.5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Distribution of healthy snacks within the machine**

	Total # of Snacks
# of Unhealthy Snacks (snacks with a healthy dense score $\leq 2$ )	<input type="text"/>
# of Somewhat Healthy Snacks (snacks with a healthy dense score of 3 or 4)	<input type="text"/>
# of Healthy Snacks (snacks with a healthy dense score of $\geq 5$ )	<input type="text"/>
# of Different Healthy Snacks	<input type="text"/>

**Healthy Snack Availability**

**Healthy Snack Percentage = (# of healthy snacks/total # of snacks) x 100**

**Healthy Snack Variety Percentage = (# of different healthy snacks/# of healthy snacks) x 100**

	0	10	20	30	40	50	60	70	80	90	100
Healthy Snack Percentage											
Healthy Snack Variety Percentage											

**Product Price**

**Average prices of similar type/size healthy and unhealthy products in vending machine**

Healthy more expensive than Unhealthy

Healthy and Unhealthy Equally Priced

Healthy less expensive than Unhealthy

**Product Promotion**

**Presence of nutrition information on vending machine and vending machine products**

No nutrition information

General nutrition information on machine

Specific nutrition information about products in machine

**Product Promotion**

**Presence of product logos on vending machine**

Only unhealthy product logos on machine

Both healthy and unhealthy product logos on machine

Only healthy or no product logos on machine

**Product Promotion**

**Presence of green eating (local, organic, sustainable) health promotion information**

No green eating promotion

General promotion of green eating

Specific/creative/original promotion of green eating

**Qualtrics HDVMAT Beverage Survey**

**Evaluator Name**

**Type of Audit**

- Individual Data Collection
- Data Duplicate for Inter-Rater Reliability

**State**

**Type of Environment (Check All That Apply)**

- |                          |                          |                          |                                |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Elementary School        | Middle School            | High School              | Community or Technical College | College or University    | Work Site                | Mall                     | Hotel/Motel              | Community Services       | Other                    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Building Name**

**Type of Building (Check All That Apply)**

Other



Residential

Library

Recreation Facility

Academic

**Building Code #**

**Machine Code #**

**Machine Identification # (State Abbreviation - Building Code # - Machine Code #)**

**Time Machine Evaluated**

**Total Number of Available Beverage Slots**

**Total Number of Occupied Beverage Slots**

**Total Number of Different Beverages Available in Machine**

**Machine Accessibility**

**Accessibility of vending machines\***

**\*Dependent on environment**

**Primary and Secondary Schools:**

**Not appropriate if machine is on for  $\geq 50\%$  of the school day.**

**Somewhat appropriate if machine is on for 25-50% of the school day.**

**Appropriate if machine is on for  $\leq 25\%$  of the school day.**

**All Other:**

**Not appropriate if  $\geq 50\%$  of machine items are empty by the end of the day (when building closes).**

**Somewhat appropriate if 25-50% of machine items are empty by the end of the day (when building closes).**

**Appropriate if  $\leq 25\%$  of machine items are empty by the end of the day (when building closes).**

Not Appropriately Accessible

Somewhat Accessible

Appropriately Accessible

**Healthy Dense Beverages Score 0**

**Tally all of the beverages in the machine that receive a score of 0**

7 Up (7 Up) Any Size	<input type="text" value="0"/>
Arnold Palmer (Arizona) Any Size	<input type="text" value="0"/>
Barq's Root Beer (Coca-Cola) Any Size	<input type="text" value="0"/>
Brisk Iced Tea - Any Flavor (Lipton) Any Size	<input type="text" value="0"/>
Coke - Original or Cherry (Coca-Cola) Any Size	<input type="text" value="0"/>
Cream Soda - Vanilla (A&W) Any Size	<input type="text" value="0"/>
Double Shot Energy - Mocha (Starbucks) 15 fl. oz.	<input type="text" value="0"/>
Dr. Pepper (Dr. Pepper) Any Size	<input type="text" value="0"/>
Energy Drink - Any Flavor (Big Red Jack or SoBe) Any Size	<input type="text" value="0"/>
Fanta - Orange (Coca-Cola) Any Size	<input type="text" value="0"/>
Frappucino - Any Flavor (Starbucks) Any Size	<input type="text" value="0"/>

Fresca (Coca Cola) Any Size	<input type="text" value="0"/>
Full Throttle (Coca-Cola) Any Size	<input type="text" value="0"/>
Gatorade - Any Flavor (PepsiCo) 20 fl. oz.	<input type="text" value="0"/>
Ginger Ale (Seagram's) Any Size	<input type="text" value="0"/>
Grape Soda (Crush) Any Size	<input type="text" value="0"/>
Grapico (PepsiCo) Any Size	<input type="text" value="0"/>
Iced Black Tea (Tazo) 12 fl. oz.	<input type="text" value="0"/>
Iced Green Tea (Tazo) 16 fl. oz.	<input type="text" value="0"/>
Lemonade (Tropicana, Minute Maid, or Country Time) Any Size	<input type="text" value="0"/>
Lizard Lava (SoBe) Any Size	<input type="text" value="0"/>
Mellow Yellow (Coca-Cola) Any Size	<input type="text" value="0"/>
Monster Energy Drink - Lo Carb (Monster) Any Size	<input type="text" value="0"/>
Mountain Dew - Any Flavor (PepsiCo) Any Size	<input type="text" value="0"/>
Mountain Dew Amp - Any Flavor (PepsiCo) Any Size	<input type="text" value="0"/>
Moxie (PepsiCo) Any Size	<input type="text" value="0"/>
Nestea (Coca-Cola) Any Size	<input type="text" value="0"/>
Orange Soda (Crush) Any Size	<input type="text" value="0"/>
Pepsi - Regular or Wild Cherry (PepsiCo) Any Size	<input type="text" value="0"/>
Pibb Xtra (Coca-Cola) Any Size	<input type="text" value="0"/>
Pink Lemonade (Country Time or Tropicana) Any Size	<input type="text" value="0"/>
Powerade - Any Flavor (Coca-Cola) 20 fl. oz.	<input type="text" value="0"/>
Pureleaf Tea - Peach or Raspberry (Lipton) Any Size	<input type="text" value="0"/>
Riptide Rush (PepsiCo) Any Size	<input type="text" value="0"/>
Root Beer (A&W or Mug) Any Size	<input type="text" value="0"/>
Schwepps Ginger Ale (PepsiCo) Any Size	<input type="text" value="0"/>
Sierra Mist - Lemon Lime or Cranberry Splash (PepsiCo) Any Size	<input type="text" value="0"/>
Sprite (PepsiCo) Any Size	<input type="text" value="0"/>
Squirt (Squirt) Any Size	<input type="text" value="0"/>
Strawberry Melon Soda (Tropicana) Any Size	<input type="text" value="0"/>
Sunkist - Any Flavor (Sunkist) Any Size	<input type="text" value="0"/>

Twister Orange Soda (Tropicana) Any Size	<input type="text" value="0"/>
Vault (Coca-Cola) Any Size	<input type="text" value="0"/>
Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

### Healthy Dense Beverages Score 1

Tally all of the beverages in the machine that receive a score of 1

Arizona Lemonade - Light (Arizona) 20 fl. oz.	<input type="text" value="0"/>
Black Tea - Unsweetened (Lipton) 16 fl. oz.	<input type="text" value="0"/>
Chocolate Drink - YooHoo (YooHoo) 11 fl. oz.	<input type="text" value="0"/>
Chocolate Milk - 1% (Babcock) 8 or 16 fl. oz.	<input type="text" value="0"/>
Citrus Punch (Sunny D) 20 fl. oz.	<input type="text" value="0"/>
Coke Zero (Coca-Cola) Any Size	<input type="text" value="0"/>
Coke Zero - Vanilla (Coca-Cola) Any Size	<input type="text" value="0"/>
Cran-Grape or Cranberry Juice (OceanSpray) 15.2 fl. oz.	<input type="text" value="0"/>
Cranberry Juice Cocktail (OceanSpray) 15.2 fl. oz.	<input type="text" value="0"/>
Diet Coke (Coca-Cola) Any Size	<input type="text" value="0"/>
Diet Dr. Pepper - Plain or Cherry Vanilla (Dr. Pepper) Any Size	<input type="text" value="0"/>
Diet Ginger Ale (Seagram's) Any Size	<input type="text" value="0"/>
Diet Green Tea with Citrus (Lipton) 20 fl. oz.	<input type="text" value="0"/>
Diet Iced Tea - Lemon (Lipton) 20 fl. oz.	<input type="text" value="0"/>
Diet Mountain Dew (PepsiCo) Any Size	<input type="text" value="0"/>
Diet Pepsi - Plain or Wild Cherry (PepsiCo) Any Size	<input type="text" value="0"/>
Diet Pepsi Max (PepsiCo) Any Size	<input type="text" value="0"/>
Diet Root Beer (A&W) Any Size	<input type="text" value="0"/>
Diet Sierra Mist (PepsiCo) Any Size	<input type="text" value="0"/>
Fanta Zero (PepsiCo) Any Size	<input type="text" value="0"/>
Gatorade G2 - Any Flavor (PepsiCo) 16 or 20 fl. oz.	<input type="text" value="0"/>
Green Tea - Citrus or with Honey (Lipton or SoBe) 16 or 20 fl. oz.	<input type="text" value="0"/>

Hawaiian Punch - Any Flavor (Hawaiian Punch) 20 fl. oz.	<input type="text" value="0"/>
Iced Tea - Sweetened (Arizona or Lipton) 16 or 20 fl. oz.	<input type="text" value="0"/>
Iced Tea Unsweetened - Plain or Lemon (Lipton) 16 fl. oz.	<input type="text" value="0"/>
Lemonade Light (Minute Maid) 20 fl. oz.	<input type="text" value="0"/>
Life Water - Any Flavor (SoBe) 20 fl. oz.	<input type="text" value="0"/>
Orange Pineapple Juice (Welch's) 15.2 fl. oz.	<input type="text" value="0"/>
Orange Strawberry Banana Juice (Florida Natural) 16 fl. oz.	<input type="text" value="0"/>
Orangeade (Tropicana) 20 fl. oz.	<input type="text" value="0"/>
Powerade Zero - Any Flavor (Coca-Cola) 20 fl. oz.	<input type="text" value="0"/>
Strawberry Kiwi Juice Cocktail (OceanSpray) 15.2 fl. oz.	<input type="text" value="0"/>
Vitamin Water - Any Flavor (Coca-Cola) 20 fl. oz.	<input type="text" value="0"/>
Wild Berry Juice - non 100% (Dole) 15.2 fl. oz.	<input type="text" value="0"/>
Other	<input type="text" value="0"/>
<b>Total</b>	<input type="text" value="0"/>

**Healthy Dense Beverages Score 2**

**Tally all of the beverages in the machine that receive a score of 2**

100% Apple Juice (Any Brand) Any Size	<input type="text" value="0"/>
100% Cranberry Juice (Any Brand) Any Size	<input type="text" value="0"/>
100% Grape Juice (Any Brand) Any Size	<input type="text" value="0"/>
100% Orange Juice (Any Brand) Any Size	<input type="text" value="0"/>
100% Pineapple Peach Mango Juice (Any Brand) Any Size	<input type="text" value="0"/>
100% Ruby Red Grapefruit Juice (Any Brand) Any Size	<input type="text" value="0"/>
100% Strawberry Kiwi Juice (Any Brand) Any Size	<input type="text" value="0"/>
Aquafina - Plain Purified Water or Any Flavor Splash (PepsiCo) Any Size	<input type="text" value="0"/>
Dasani Flavored Water - Any Flavor (Coca-Cola) Any Size	<input type="text" value="0"/>
Dasani Water (Coca-Cola) Any Size	<input type="text" value="0"/>
Jack's Water (Chippiwa) Any Size	<input type="text" value="0"/>
Kiarburnn Water (Kiarburnn) Any Size	<input type="text" value="0"/>

Milk - 2% Milk (Babcock) 8 fl. oz.

Milk - 1% Skim (Any Brand) Any Size

Poland Springs Water (Poland Springs) Any Size

Propel Water - Any Flavor (PepsiCo) Any Size

V8 Splash - Any Flavor (V8) Any Size

V8 Vegetable Juice (V8) Any Size

Other

**Total**

**Total Healthy Dense Beverage Score**

Calculate the Total Healthy Dense Beverage Score using the equations below

Total # Beverages with Score 0 x 0

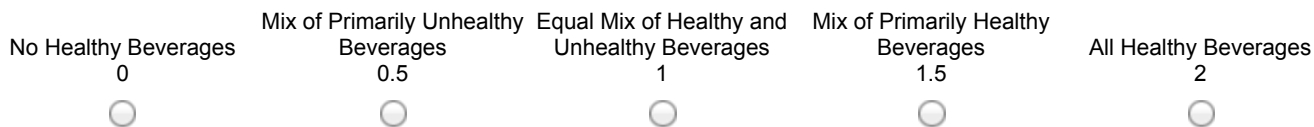
Total # Beverages with Score 1 x 1

Total # Beverages with Score 2 x 2

**Total**

**Average Healthy Dense Beverage Score**

Divide the Total Healthy Dense Beverage Score by the Total Number of Beverages in the machine



**Distribution of healthy beverages within the machine**

# of Unhealthy Beverages  
(beverages with a healthy dense score of 0)

# of Somewhat Healthy Beverages  
(beverages with a healthy dense score of 1)

Total # Beverages

# of Healthy Beverages  
(beverages with a healthy dense score of 2)

# of Different Healthy Beverages

**Healthy Beverage Availability**

**Healthy Beverage Percentage = (# of healthy beverages/total # of beverages) x 100**

**Healthy Beverage Variety Percentage = (# of different healthy beverages/# of healthy beverages) x 100**

	0	10	20	30	40	50	60	70	80	90	100
Healthy Beverage Percentage											
Healthy Beverage Variety Percentage											

**Product Price**

**Average price of similar type/size healthy and unhealthy products in vending machine**

Healthy more expensive than Unhealthy

Healthy and Unhealthy equally priced

Healthy less expensive than Unhealthy

**Product Promotion**

**Presence of nutrition information on vending machine and vending machine products**

No nutrition information

General nutrition information on machine

Specific nutrition information about products in machine

**Product Promotion**

**Presence of product logos on vending machine**

-----

Only unhealthy product logos on machine	Both healthy and unhealthy product logos on machine	Only healthy or no product logos on machine
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Product Promotion**  
**Presence of green eating (local, organic, sustainable) health promotion information**

No green eating promotion	General promotion of green eating	Specific/creative/original green eating promotion
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



## BIBLIOGRAPHY

- Adachi-Mejia AM, Longacre MR, Skatrud-Mickelson M, Li Z, Purvis LA, Titus LJ, Beach ML, Dalton MA. Variation in access to sugar-sweetened beverages in vending machines across rural, town, and urban high schools. *Public Health*. 2013;127:485-491.
- Alaimo K, Olekysk SC, Drzal NB, Golzynski DL, Lucarelli JF, Wen Y, Velie EM. Effects of changes in lunch-time competitive foods, nutrition practices and nutrition policies on low-income middle school children's diets. *Childhood Obesity*. 2013;9:509-523.
- Aljadir LP, Biggs WM, Misko JA. Consumption of foods from vending machines at the University of Delaware. *Journal of the American College Health Association*. 1981;30(3):149-150.
- Antonuk B, Block LG. The effect of single serving versus entire package nutritional information on consumption norms and actual consumption of a snack food. *Journal of Nutrition Education Behavior*. 2006;38:365-370.
- Bell C, Pond N, Davies L, Francis JL, Campbell E, Wiggers J. Healthier choices in Australian health service: A pre-post audit of an intervention to improve the nutritional value of foods and drinks in vending machines and food outlets. *BMC Health Services Research*. 2013;13:492-501.
- Bisogni CA, Jastran M, Seligson M, Thompson A. How people interpret healthy eating: Contributions of Qualitative Research. *Journal of Nutrition Education Behavior*. 2012;44:282-301.
- Blanck HM, Yaroch AL, Atienza AA, Yi SL, Zhang J, Masse LC. Factors influencing lunchtime food choices among working Americans. *Health Education & Behavior*. 2009;36:289-301.
- Byrd-Bredbenner C, Johnson M, Quick VM, Walsh J, Greene GW, Hoerr S, Colby SM, Kattelman KK, Phillips BW, Kidd T, Horacek TM. Sweet and salty. An assessment of the snacks and beverages sold in vending machines in US post-secondary institution campuses. *Appetite*. 2012;58(3):1143-1151.
- Callaghan C, Mandich G, He M. Healthier snacks in school vending machines: A pilot project in four Ontario high schools. *Canadian Journal of Dietetic Practice and Research*. 2010;71(4):L186-191.
- Caruso ML, Klein EG, Kaye G. Campus-based snack food vending consumption. *Journal of Nutrition Education and Behavior*. 2014;1-5.
- Deckelbaum RJ, Williams CL. Childhood obesity: The health issue. *Obesity Research and Clinical Practice*. 2001;9:S239-S243.
- Escoto KH, French SA, Harnack LJ, Toomey TL, Hannan PJ, Mitchell NR. Work hours, weight status, and weight-related behaviors: A study of metro transit workers. *International Journal of Behavioral Nutrition and Physical Activity*. 2010;7:91-92.
- Fox MK, Gordon A, Nogales R, Wilson A. Availability and consumption of competitive foods in US public schools. *Journal of the American Dietetic Association*. 2009;109:S57-S66.
- Freedman MR, Rubsinstein RJ. Obesity and food choices among faculty and staff at a large urban university. *Journal of American College Health*. 2010;59(3):205-210.

- French SA, Hannan PJ, Harnack LJ, Mitchell NR, Toomey TL, Gerlach A. Pricing and availability intervention in vending machines at four bus garages. *American College of Occupational and Environmental Medicine*. 2010;52(1):29-33.
- French SA, Jeffery RW, Story M, Breitlow KK, Baxter JS, Hannan P, Snyder MP. Pricing and promotion effects on low-fat vending snack purchases: the CHIPS study. *American Journal of Public Health*. 2001;91(1):112-117.
- French SA, Jeffery RW, Story M, Hannan P, Snyder PM. A pricing strategy to promote low-fat snack choices through vending machines. *American Journal of Public Health*. 1997;87(5):849-851.
- French SA, Story M, Fulkerson JA, Gerlach AF. Food environment in secondary schools: A la carte, vending machines, and food policies and practices. *Journal of Public Health*. 2003;93(7):1161-1167.
- Gemmill E, Cotugna N. Vending machine policies in Delaware. *The Journal of School Nursing*. 2005;21(2):94-99.
- Harnack L, Snyder P, Story M, Holliday R, Lytle L, Neumark-Sztainer D. Availability of a la carte food items in junior and senior high schools: A needs assessment. *Journal of the American Dietetic Association*. 2000;100:701-703.
- Jensen CD, Sato AF, McMurty CM, Hart CN, Jelalian E. School nutrition policy: An evaluation of the Rhode Island healthier beverages policy in schools. *Infant, Child, & Adolescent Nutrition*. 2012;4:276-282.
- Kelly B, Flood VM, Bicego C. Derailing healthy choices: An audit of vending machines at train stations in NSW. *Health Promotion Journal of Australia*. 2012;23(1):73-75.
- Kocken PL, Eeuwuk J, Van Kesteren NMC, Dusseldorp E, Buus G, Bassa-Dafesh Z, Snel J. Promoting the purchase of low-calorie foods from school vending machines: A cluster-randomized controlled study. *Journal of School Health*. 2012;82:115-122.
- Kubik MY, Davey C, Nanney MS, MacLehose RF, Nelson TF, Coombes B. Vending and school store snack and beverage trends: Minnesota secondary schools, 2002-2010. *American Journal of Preventive Medicine*. 2013;44(6):583-588.
- Kubik MY, Lytle LA, Farbakhsh K. School and district wellness councils and availability of low-nutrient, energy-dense vending fare in Minnesota middle and high schools. *Journal of the American Dietetic Association*. 2011;111(1):151-155.
- Lawrence S, Boyle M, Craypo L, Samuels S. The food and beverage vending environment in healthcare facilities participating in the healthy eating, active communities program. *Pediatrics*. 2009;123:S287-S292.
- Maras E. 2011 state of the vending industry report. *Automatic Merchandiser*. 2011.
- Matthews M, Horacek TM. VENDING MACHINE ASSESSMENT METHODOLOGY: A SYSTEMATIC REVIEW. *Appetite In review*. 2014.

- Minaker LM, Storey KE, Raine KD, Spence JC, Forbes LE, Plotnikoff RC, McCargar LJ. Associations between the perceived presence of vending machines and food and beverage logos in schools and adolescents' diet and weight status. *Public Health Nutrition*. 2011;14(8):1350-1356.
- New SA, Livingstone MB. An investigation of the association between vending machine confectionary purchase frequency by schoolchildren in the UK and other dietary and lifestyle factors. *Public Health Nutrition*. 2003;6:497-504.
- Nutrition Environment Measures Survey-Vending. *NEMS-V Success Stories*. (n.d.) <http://www.nems-v.com/NEMS-VResourcesSuccessStory.html>. Accessed April 12, 2014.
- Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Journal of the American Medical Association*. 2012;307:484-490.
- Park S, Sappenfield WM, Huang Y, Sherry B, Bensyl DM. The impact of the availability of school vending machines on eating behavior during lunch: The youth physical activity and nutrition survey. *Journal of the American Dietetic Association*. 2010;110(10):1532-1536.
- Pasch KE, Lytle LA, Samuelson AC, Farbaksh K, Kubik MY, Patnode CD. Are school vending machines loaded with calories and fat: An assessment of 106 middle and high schools. *Journal of School Health*. 2011;81(4):212-218.
- Refermat, E. Special Annual Report: State of the vending industry. Automatic Merchandiser. 2013.
- Rovner AJ, Nansel TR, Wang J, Iannotti RJ. Food sold in school vending machines is associated with overall student dietary intake. *Journal of Adolescent Health*. 2011;48:13-19.
- Stallings VA, Yaktine AL, eds. *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*. Washington, DC: The National Academies Press. 2007.
- Swanson M. Digital photography as a tool to measure school cafeteria consumption. *Journal of School Health*. 2008;78:432-437.
- Turconi G, Guarcello M, Berzolari FG, Carolei A, Bazzano R, Roggi C. An evaluation of colour food photography atlas as a tool for quantifying food portion size in epidemiological dietary surveys. *European Journal of Clinical Nutrition*. 2005;59:923-931.
- United States Department of Agriculture and United States Department of Health and Human Services. *Dietary Guidelines for Americans 2010*. 2010. <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/PolicyDoc/PolicyDoc.pdf>. Accessed July 18, 2014.
- United States Department of Agriculture. *National school lunch program*. <http://www.fns.usda.gov/nslp/national-school-lunch-program-nslp>. Accessed on July 16 2013.
- United States Department of Agriculture Food and Nutrition Service. Proposed Rule: *National School Lunch Program and School Breakfast Program: Nutrition Standards for All Foods Sold in School as Required by the Healthy, Hunger-Free Kids Act of 2010*. <http://www.fns.usda.gov/cga/020113-snacks.pdf>. 2013. Accessed July 18, 2014.

- United States Department of Agriculture. *State competitive foods policies*.  
<http://www.fns.usda.gov/tags/competitive-foods>. Accessed on July 16 2013.
- Voss C, Klein S, Glanz K, Clawson M. Nutrition environment measures survey – vending: Development, dissemination, and reliability. *Healthy Promotion Practice*. 2012;13:425-430.
- Van Hulst A, Barnett TA, Dery V, Cote G, Colin C. Health-promoting vending machines: Evaluation of a pediatric hospital intervention. *Canadian Journal of Dietetic Practice And Research*. 2013;74:28-34.
- Whately Blum JE, Davie AM, Devore RL, Beaudoin CM, Jenkins PL, Kaley LA, Wigand DA. Implementation of low-fat, low-sugar, and portion-controlled nutrition guidelines in competitive food venues of Maine public high schools. *Journal of School Health*. 2007;77:687-693.
- Williamson DA, Allen HR, Martin PD, Alfonso AJ, Gerald B, Hunt A. Comparison of digital photography to weighed and visual estimation of portion sizes. *Journal of the American Dietetic Association*. 2003;103:1139-1145.
- Winston CP, Sallis JF, Swartz MD, Hoelscher DM, Peskin MF. Reliability of the hospital nutrition environment scan for cafeterias, vending machines, and gift shops. *Journal of the Academy of Nutrition and Dietetics*. 2013;113:1069-1075.

## VITA

NAME OF AUTHOR: Melissa Matthews

PLACE OF BIRTH: Syracuse, New York

DATE OF BIRTH: July 2, 1990

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

Syracuse University, Syracuse, New York

State University of New York at Geneseo, Geneseo, New York

DEGREES AWARDED:

Bachelor of Science in Biology, 2012, State University of New York at Geneseo

DEGREES PURSUED:

Master of Science in Nutrition Science, 2014, Syracuse University