The Journal of Child Nutrition & Management
Volume 40, Issue 1, Spring 2016
Published by School Nutrition Association

Beverage Selections and Impact on Healthy Eating Index Scores in Elementary Children's Lunches From School and From Home

Ethan A. Bergman, PhD, RDN, CD, FADA, FAND; Tim Englund, PhD; Dana Ogan, MS, RDN; Tracee Watkins, MBA, CHE; Mary Barbee, MS, CN; Keith Rushing, PhD, RD

ABSTRACT

Purpose/Objectives
The purposes of this study were to: 1) analyze beverage selections of elementary students consuming National School Lunch Program meals (NSLP) and lunches brought from home (LBFH), 2) compare overall meal quality (MQ) of NSLP and LBFH by food components using Healthy Eating Index 2010 (HEI-2010), and 3) investigate the impact of beverage selections on MQ.

Methods
Digital plate waste estimations were analyzed for 509 NSLP and 524 LBFH meals from 2nd-5th grade students in four elementary schools during the 2011-2012 academic year. Nutrient Data Software for Research (NDSR) was used to determine food groups and nutrients for calculations. Independent t-tests compared NSLP and LBFH meal components. Two one-way ANOVA tests compared HEI-2010 dietary component scores by the following beverage selections: 1% plain milk, non-fat flavored milk, 100% fruit juice, sugar-sweetened beverage (SSB), or water/no beverage.

Results
NSLP (90% non-fat flavored or 1% plain milk) and LBFH (75% water/none or SSB) varied widely in beverages selected. LBFH provided significantly ($p < 0.05$) more Whole Grains (NSLP 2.8/5pts vs LBFH 4.7pts) and Seafood & Plant Proteins (NSLP 0.5/5pts vs LBFH 1.7pts) than NSLP. NLSP provided more Dairy (NSLP 9.3/10pts vs LBFH 4.7pts). NSLP scored higher in Total Protein, and reduced Empty Calories. Both meal origins indicated a need for improvement in Greens/Bean Vegetables and Seafood/Plant Proteins. Selection of 1% plain milk resulted in significantly higher HEI-2010 scores (NSLP served 55.7/100pts, consumed 53.9pts and LBFH, served 62.1, consumed 60.2).

Applications for Child Nutrition Professionals
Child nutrition professionals consistently provide nutritious beverages like 1% plain milk, non-fat flavored milk, and 100% juice in NSLP meals. A "milk only" line for children with LBFH may encourage milk consumption and improve HEI scores of LBFH. LBFH would benefit from elimination of sugar sweetened beverages (SSB). Increased nutrition education to teachers, staff, parents, and children on the effects of various beverages on dietary quality would be appropriate to further improve beverage selection and meal quality.

Keywords: school nutrition; Healthy Eating Index; beverages; lunches from home

INTRODUCTION

Though the rate of obesity growth has slowed for the adult population of the U.S. in the past six years, the current proportion remains high at 32% (Ogden, Carroll, Kit, & Flegal, 2012). Overweight children tend to remain so as adults, facing reduced quality of life, underachievement in school, and shortened lifespan related to increased risk for various diseases (Cunningham, Kramer, & Venkat Narayan, 2014).

The Healthy, Hunger-free Kids Act of 2010 (HHFKA) was implemented during the 2012-2013 school year. HHFKA regulations helped to conform school meals with the Dietary Guidelines for Americans (U.S. Department of Health and Human Services (USDHHS], & U.S. Department of Agriculture [USDA], 2010). A primary change provided by HHFKA is a standardized universal food-based menu planning system. HHFKA's food-based menu requirements are consistent with Healthy Eating Index 2010 (HEI-2010) a dietary quality scoring system, which has been validated as an assessment tool for Meal Quality (MQ) in schools (Erinosho, Ball, Hanson, Vaughn, & Ward, 2013).

HEI-2010 produces scores ranging from 0 to 100, with higher scores indicating closer alignment with the Dietary Guidelines for Americans 2010 (Guenther, et al., 2013). Average HEI-2010 scores for U.S. adult meals were 50-53 points (Guenther et al., 2014), while average HEI-2010 scores for U.S. children were 47-50 points (Hiza, Guenther, & Rihane, 2013). Higher HEI-2010 scores indicate lower disease risks and are associated with lower Body Mass Index (Schwingshackl & Hoffmann, 2015). Higher scores also predict better physical performance (Xu et al., 2012). HEI-2010 is more useful in determining dietary quality than individual nutrient analysis because it eliminates the infuence of outliers which may skew data, and it closely aligns with current food component based dietary recommendations. As a ratio based on 1,000 calories, it also accounts for variation in caloric intake needs (Guenther, et al., 2014).

Consumption of sugar-sweetened beverage (SSB) or drinks with added sugar has been associated with weight gain in adults and children (Malik, Schulz, & Hu, 2006; Vartanian, Schwartz, & Brownell, 2007). Although SSB intake of U.S. children has decreased in recent years, consumption levels remain a primary health concern (Office of Disease Prevention and Health Promotion [ODPHP], 2015). Reducing SSB intake among children may assist in lowering prevalence of overweight and obesity (Hu, 2013; Mesirow & Welch, 2015).

Hydration is an important function of beverages in the diet. Children require 24 to 48 ounces of fluid daily (Campbell, 2004). More than half of all children, 54%, do not achieve adequate hydration, and furthermore, 25% of children do not drink any water as part of their fluid intake (Kenney, Long, Cradock, & Gortmaker, 2015). Proper hydration is necessary to avoid fatigue and other dehydration symptoms which may impair focus, visual memory, and mood, while increasing perception of task difficulty, anxiety, and general fatigue (Armstrong et al., 2012; Ganio et al., 2011). Students who select milk or juice at lunch show better quality academic performance and participation in physical education (Chen & Wang, 2013; Rausch, 2013). Children who consumed 100% juice showed improved Meal Quality (MQ) without increasing their risk of weight gain compared to those who consumed SSB (O'Neil, Nicklas, Rampersaud, & Fulgoni, 2011).

The use of flavored milk in school lunch has been widely debated. Early research indicated that introduction of flavored milk in the NSLP increased calcium consumption (Guthrie, 1977).

Subsequent studies showed similar results, although plain milk is more nutrient dense. Students who drink flavored milk tend to consume more milk overall, but they also consume more added sugars (Murphy, Douglass, Johnson, & Spence, 2008). Noel et al. revealed near daily consumption of flavored milk over time increased body weight in both normal weight and overweight children (Noel, Ness, Northstone, Emmett, & Newby, 2013). Sales of NSLP meals declined 7% when flavored milk was eliminated from menu options (Hanks, Just, & Wansink, 2014; Quann & Adams, 2013). Removing flavored milk may result in fewer students opting for a NSLP meal which may reduce their overall nutrient intake. When flavored milk was removed, milk consumption dropped by 37.4% (Quann & Adams, 2013). Furthermore, 25% of plain milk that is selected is then thrown away and wasted (Henry et al., 2015).

Food consumed away from home impacts overall dietary quality for children (Mancino, Todd, Guthrie, & Lin, 2010). Approximately 31 million children eat NSLP meals daily (School Nutrition Association, 2013; USDA, 2014a). During the academic year, children are at school a majority of their day; therefore, it is appropriate to address dietary policies associated with meals consumed at school (Juby & Meyer, 2011). In one 2011-2013 study in Massachusetts, lunches brought from home (LBFH) were consumed by 41% of the third and fourth grade elementary school children in the study (Hubbard, Must, Eliasziw, Folta, & Goldberg, 2014). Minimal research has been undertaken examining LBFH for individual food items (Hubbard, et al., 2014), nutrient content (Johnson, Bednar, Kwon, & Gustof, 2009), and food component groups (Johnston, Moreno, El-Mubasher, & Woehler, 2012).

The purposes of this study were to: 1) analyze beverage selections of elementary students consuming NSLP meals and LBFH, 2) compare overall MQ of NSLP and LBFH by food components using HEI-2010, and 3) investigate the impact of beverage selections on MQ.

METHODOLOGY

The current study was a secondary analysis of digital plate waste data gathered during the 2011-2012 academic year that examined individual nutrient differences between the NSLP and LBFH. Digital plate waste is valid, reliable, and comparable to the previous real-time method of plate waste estimation (Parent, Niezgoda, Keller, Chambers, & Daly, 2012; Williamson et al., 2003). Four Washington State elementary schools that were designated as HealthierUS School Challenge (HUSSC)(USDA Food and Nutrition Service [FNS], 2014b) schools with Gold designation participated in this study during April and May, 2012. Web cam pictures were taken of lunch trays before the students ate their lunches. Second pictures were taken after the students finished their lunches. The two pictures of each lunch were compared. The difference between the two pictures indicated the portion of the lunch items consumed. This difference was converted into calorie and nutrient intake data. Data were collected over a five day period in each school for a total of 20 days of data collection. Two schools had low free and reduced meal qualifications for less than 25% of students. Two schools had high free and reduced qualifications for more than 80% of students. Data were gathered from 834 students in 2nd-5th grades including 509 NSLP meals and 524 LBFH meals, 1,033 meals total. Additional demographic data were collected to control for sex, age, and socio-economic status. No demographic criteria confounded results in the investigation; further methods are available from a previous publication (Bergman et al., 2014a).

Dietary intake data were analyzed using Nutrition Data System for Research (NDSR) 2014 developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN. NDSR calculated food group/component breakdowns for each food item in serving equivalents and a comprehensive nutrient analysis for each item. Output data from NDSR were used to calculate each food component and total HEI-2010 score to analyze overall meal quality. A vital feature of NDSR is the ability to convert each food item to standard food groups/components utilized by USDA in the Dietary Guidelines for Americans 2010, the NSLP and HHFKA regulations (Guenther, et al., 2014; USDA-FNS, 2014a; USDA-FNS, 2014c).

For the current study, HEI-2010 scoring was utilized to evaluate food components related to the U.S. Dietary Guidelines. The Adequacy food components were scored with points accumulated with increased intake (shown with maximum point distribution): Total Fruit (5pts), Whole Fruit (5pts), Total Vegetables (5pts), Greens and Beans (5pts), Whole Grains (10pts), Dairy (10pts), Total Protein Foods (5pts), Seafood and Plant Proteins (5pts), and Fatty Acids (10pts). Moderation food components were scored with points accumulating with decreased intake (shown with maximum point distribution): Refined Grains (10pts), Sodium (10pts), Empty Calories from solid fats or added sugars (20pts). The awarding of maximum points or fractions of point values were given based on a ratio of the guideline for each food component amount per 1,000 calories in the diet (Guenther, et al., 2013).

Statistical analyses were completed with IBM's SPSS 21.0, with significance level set to $\alpha = 0.05$ (IBM Corp, 2013). Investigations within each meal origin (NSLP and LBFH) were made to determine the beverage selection distribution in each group. For each type of meal origin, a one-way analysis of variance (ANOVA) test was run. Similarly, for each meal origin post hoc Tukey's pairwise comparisons determined differences in HEI-2010 mean food component scores and mean total HEI-2010 scores by beverage selection.

Furthermore, multiple analysis of variance (MANOVA) with post hoc t-tests, determined significant differences in mean food component scores and mean total HEI-2010 scores between NSLP meals and LBFH, both as served (selected) and as consumed (eaten). Cohen's *d* calculations of effect size were performed for each significantly different pair along with the percent of the possible score.

RESULTS AND DISCUSSION

HEI-2010 Scores for LBFH

NSLP meals (n=509) had six beverage selection options: water/none (n = 45, 9%), 100% fruit juice (n = 4, 1%), non-fat flavored milk (n = 324, 64%), non-fat flavored milk plus 100% fruit juice (n= 13, 2%), 1% plain milk (n = 119, 23%), and 1% plain milk plus 100% fruit juice (n = 4, 1%). Some NSLP students (n= 17) selected two beverages for their meal. The beverages in LBFH (n=524) fell into five categories: water/none (n = 234, 45%), SSB (n = 153, 30%), 100% fruit juice (n = 63, 12%), non-fat flavored milk (n = 49, 10%), and 1% plain milk (n = 16, 3%). LBFH with no beverage as part of the meal occurred at a rate of 45%. It is notable that no NSLP meals included SSBs, even though, 45% of elementary age students bring snacks to school or purchase vending machine items in addition to reimbursable meals as reported in a study of 51 elementary schools in seven school districts in the states of California, Colorado, and Illinois. These observations spanned two years with mean student population for each school of 419 (Quann & Adams, 2013). Of students with NSLP meals, 90% selected either plain milk or flavored milk rather than less nutrient dense beverages, while students with LBFH selected milk options at a rate of 13%. Results are displayed in Figure 1.

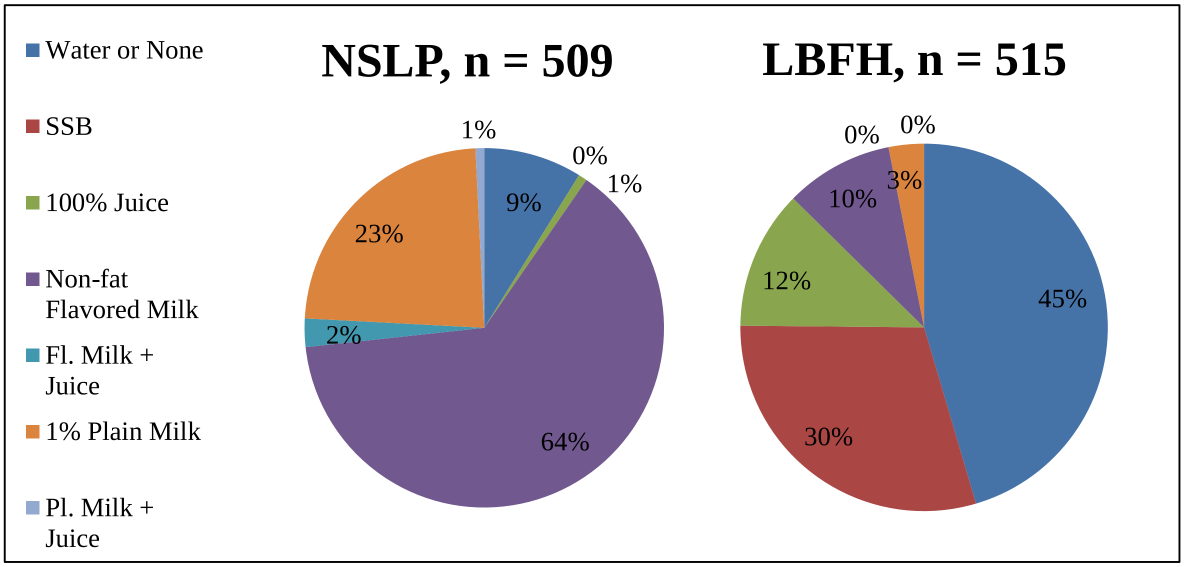

Figure 1. ***Beverage Selections by Meal Origin: National School Lunch Program (NSLP) and Lunches Brought From Home (LBFH)***

NSLP Meal Components and HEI-2010 score comparisons by beverage selected showed many differences, displayed in Table 1. HEI-2010 Total Index scores (100 points possible) for meals containing water/none (45.6 served, 44.6 consumed) were significantly lower compared to other solo beverage options. The highest solo score came from meals containing 1% plain milk (55.7 served, 53.9 consumed). Meals which contained non-fat flavored milk (51.2 served, 48.7 consumed) scored significantly higher in nutrition than those with water/none, but scored significantly lower in nutritional quality than meals containing 1% plain milk.

HEI-2010 scores in NSLP meals of students who chose two beverages, either 1% plain milk plus 100% Juice (65.1 served, 61.6 consumed) or non-fat flavored milk plus 100% juice (61.6 served, 55.1 consumed), were significantly higher than water/none, or non-fat flavored milk alone, but were not significantly different from 100% juice alone or 1% plain milk alone. See Table 1. A selection of multiple nutrient-rich beverages has the potential to improve HEI-2010 scores. Improvement is lost, however, when beverages with added sugars are selected. In non-fat flavored milks, added sugars increase empty calories (total solid fat and added sugars) to 40% of total calories. It is recommended to limit empty calories to ≤ 258 calories/2,000 calorie diet.

Nonfat flavored milks have more than double the empty calories present in 1% plain milk (USDA, 2015). Non-fat chocolate milk per 8 oz has 140 total calories, 56 of which are Empty Calories (solid fats calories 4 plus added sugars calories 52), while 1% plain milk has 102 total calories of which 18 are Empty Calories (solid fats calories 18 plus added sugars calories 0).

Table 1. ***Healthy Eating Index Meal Quality Scores for NSLP Lunches Based on Beverage Selections***

Beverage Selection by HEI Component	**Water/None** n = 45 *M ± SD*	**100% Juice** n = 4 *M ± SD*	**Flavored Nonfat Milk** n = 324 *M ± SD*	**Fl. Milk & Juice** n = 13 *M ± SD*	**Plain 1% Milk** n = 119 *M ± SD*	**Plain Milk & Juice** n = 4 *M ± SD*
NSLP Lunches--- As Served --- HEI Scores Means with Standard Deviations						
Total Fruit (5)	3.0 ± 2.3[abc]	4.7 ± 0.6[de]	2.6 ± 2.3[adef]	5.0 ± 0.2[bfg]	2.1 ± 2.2[cg]	3.8 ± 2.5
Whole Fruit (5)	3.2 ± 2.4[a]	5.0 ± 0.0[bc]	2.4 ± 2.5[abcd]	4.6 ± 1.4[de]	2.5 ± 2.5[e]	3.8 ± 2.5
Total Veg. (5)	1.9 ± 2.0[a]	0.0 ± 0.0[abc]	2.1 ± 1.9[bdef]	0.0 ± 0.0[dg]	2.5 ± 2.0[cegh]	0.0 ± 0.0[fh]
Greens/Beans (5)	0.2 ± 1.0	0.0 ± 0.0	0.5 ± 1.5	0.0 ± 0.0	0.6 ± 1.6	0.0 ± 0.0
Whole Grain (10)	2.2 ± 3.8[abc]	8.0 ± 2.3[ade]	2.6 ± 4.3[df]	5.4 ± 0.5[bf]	3.0 ± 4.5[e]	6.8 ± 2.2[c]
Dairy (10)	3.9 ± 4.4[abcde]	0.0 ± 0.0[afghi]	9.9 ± 0.4[bf]	9.6 ± 0.5[cg]	10.0 ± 0.2[dh]	9.9 ± 0.1[ei]
Total Protein (5)	3.6 ± 1.9	3.4 ± 2.4	3.6 ± 1.9	4.5 ± 1.4	3.8 ± 1.7	3.7 ± 2.5
Seafood/Plant (5)	1.0 ± 1.9[ab]	0.0 ± 0.0	0.4 ± 1.2[a]	0.0 ± 0.0[b]	0.6 ± 1.4	0.0 ± 0.0
Fats Ratio (10)	4.1 ± 4.0[ab]	9.2 ± 0.9[acd]	4.5 ± 4.1[ce]	8.2 ± 0.8[bef]	4.2 ± 4.1[df]	6.7 ± 2.3
Refined Grain (10)	3.1 ± 4.0[abcd]	7.2 ± 2.9[a]	5.3 ± 3.8[b]	5.8 ± 1.2[c]	5.4 ± 4.1[d]	6.4 ± 2.6
Sodium (10)	5.9 ± 3.6[abcd]	8.3 ± 2.1[ef]	4.7 ± 3.4[aegh]	9.2 ± 0.7[bgi]	4.6 ± 3.5[cfij]	10.0 ± 0.0[dhj]
Empty Calories (20)	13.5 ± 6.5[ab]	12.1 ± 5.3	13.6 ± 5.0[cd]	9.30 ± 1.8[ace]	16.6 ± 4.1[bde]	14.1 ± 4.0
Total Index (100)	45.6 ±15.9[abcd]	57.9 ± 8.6	51.2 ± 13.4[aefg]	61.6 ± 2.2[be]	55.7 ± 13.9[cf]	65.1 ± 6.9[dg]
NSLP Lunches-- As Consumed- HEI Scores Means with Standard Deviations						
Total Fruit (5)	2.7 ± 2.4[ab]	4.4 ± 1.1[cd]	2.0 ± 2.3[abce]	5.0 ± 0.1[e]	2.0 ± 2.3[d]	3.7 ± 2.5
Whole Fruit (5)	2.9 ± 2.4[a]	2.8 ± 2.7	2.2 ± 2.5[b]	4.6 ± 1.4[abc]	2.2 ± 2.5[c]	2.5 ± 2.9
Total Veg. (5)	1.9 ± 2.1[a]	0.0 ± 0.0[b]	1.8 ± 1.9[cd]	0.0 ± 0.0[ac]	2.5 ± 2.1[bd]	0.0 ± 0.0
Greens/Beans (5)	0.2 ± 1.0	0.0 ± 0.0	0.5 ± 1.4	0.0 ± 0.0	0.5 ± 1.5	0.0 ± 0.0
Whole Grains (10)	2.2 ± 4.0[abc]	8.0 ± 2.4[ade]	2.3 ± 4.1[dfg]	5.6 ± 2.4[bf]	2.7 ± 4.4[e]	6.8 ± 2.7[cg]
Dairy (10)	3.9 ± 4.4[abcde]	0.0 ± 0.0[afghi]	9.3 ± 2.1[bfj]	5.9 ± 4.4[cgjk]	9.1 ± 2.2[dhk]	7.5 ± 5.0[ei]
Total Protein (5)	3.2 ± 2.2	2.5 ± 2.9	3.2 ± 2.1[a]	3.4 ± 2.3	3.6 ± 1.8[a]	3.8 ± 2.5
Seafood/Plant Proteins (5)	0.7 ± 1.7	0.0 ± 0.0	0.4 ± 1.2	0.0 ± 0.0	0.5 ± 1.4	0.0 ± 0.0
Fats Ratio (10)	4.7 ± 3.8[ab]	8.9 ± 1.4[acd]	4.5 ± 4.1[ce]	8.0 ± 2.1[bef]	4.2 ± 4.2[df]	6.2 ± 2.6
Refined Grain (10)	3.5 ± 4.2[ab]	5.5 ± 3.2	5.3 ± 4.1[a]	4.6 ± 3.5	5.5 ± 4.2[b]	6.3 ± 2.6
Sodium (10)	5.6 ± 3.9[abc]	8.0 ± 2.8[d]	4.2 ± 3.6[adef]	9.1 ± 1.0[beg]	4.5 ± 3.7[gh]	9.7 ± 0.4[cfh]
Empty Calories (20)	13.5 ± 6.8[ab]	14.2 ± 4.6	13.1 ± 5.6[cd]	8.8 ± 4.6[acef]	16.6 ± 4.3[bde]	15.2 ± 4.2[f]
Total Index (100)	44.6 ± 14.1[abc]	54.3 ± 3.3	48.7 ± 13.9[d]	55.1 ± 5.9[a]	53.9 ± 12.9[bd]	61.6 ± 3.5[c]

Superscripts **[abcdefghijk]** show Tukey's pairwise significant differences (α <0.05) between beverage groups in each meal component row.

Table 2. ***Healthy Eating Index Meal Quality Scores for Lunches Brought from Home Based on Beverage Selections***

Beverage Selection by HEI Component	Water/None n = 234, *M ± SD*	Sugar Sweet. Bev. (SSB) n = 153 *M ± SD*	100% Juice n = 63 *M ± SD*	Flavored Nonfat Milk n = 49 *M ± SD*	Plain 1% Milk n = 16 *M ± SD*
LBFH--- As Served - HEI Scores Means with Standard Deviations					
Total Fruit (5)	2.7 ± 2.2^{abc}	2.2 ± 2.7^{ad}	4.5 ± 1.5^{bdef}	1.6 ± 2.0^{ceg}	2.8 ±2.2^{fg}
Whole Fruit (5)	3.1 ± 2.4^{ab}	2.3 ± 2.5^{a}	2.8 ± 2.5	2.0 ± 2.4^{b}	3.3 ± 2.3
Total Veg. (5)	1.3 ± 2.0	1.0 ± 1.7^{ab}	1.8 ± 2.2^{a}	1.9 ± 2.3^{b}	1.4 ± 2.0
Greens/Beans (5)	0.1 ± 0.8^{ab}	0.1 ± 0.6^{cd}	0.0 ± 0.0^{ef}	0.8 ± 1.8^{ace}	0.6 ± 1.7^{bdf}
Whole Grains (10)	5.1 ± 4.8^{a}	4.8 ± 4.6	3.5 ± 4.5^{a}	3.9 ± 4.8	5.4 ± 4.9
Dairy (10)	3.9 ± 4.3^{abc}	3.7 ± 4.2^{def}	5.1 ± 4.5^{adgh}	9.6 ± 1.4^{beg}	9.5 ± 1.2^{cfh}
Total Protein (5)	3.8 ± 1.8^{a}	3.5 ± 1.9	3.4 ± 2.1	3.2 ± 2.1^{a}	4.0 ± 1.6
Seafood/Plant Proteins (5)	1.8 ± 2.4	1.8 ± 2.4	1.2 ± 2.2	1.4 ± 2.3	1.9 ± 2.5
Fats Ratio (10)	6.1 ± 4.1^{a}	5.9 ± 4.3^{b}	4.9 ± 4.5	4.1 ± 4.4^{ab}	5.6 ± 4.4
Refined Grain (10)	5.0 ± 4.5	5.3 ± 4.1	5.2 ± 4.0	6.0 ± 4.2	5.0 ± 4.9
Sodium (10)	5.0 ± 4.4^{a}	6.0 ± 6.4^{a}	6.1 ± 4.1	5.5 ± 4.3	4.8 ± 4.1
Empty Calories (20)	14.6 ± 5.6^{ab}	9.4 ± 15.5^{acde}	15.6 ± 5.4^{cf}	13.0 ± 5.9^{dfg}	17.9 ± 3.6^{beg}
Total Index (100)	52.6 ±14.5^{ab}	45.9 ± 15.5^{acde}	54.0 ± 15.4^{c}	53.1 ± 15.4^{df}	62.1 ± 18.7^{bef}
LBFH--- As Consumed --- HEI Scores Means with Standard Deviations					
Total Fruit (5)	2.6 ± 2.3^{abc}	1.8 ± 2.2^{ad}	4.3 ± 1.8^{bdef}	1.2 ± 1.9^{ceg}	2.7 ± 2.4^{fg}
Whole Fruit (5)	2.9 ± 2.4^{ab}	1.9 ± 2.4^{a}	2.5 ± 2.5^{c}	1.6 ± 2.3^{bc}	2.9 ± 2.5
Total Veg. (5)	1.2 ± 2.0^{a}	0.9 ± 1.7	1.5 ± 2.1^{a}	1.5 ± 2.0	1.3 ± 1.9
Greens/Beans (5)	0.1 ± 0.8^{ab}	0.1 ± 0.6^{cd}	0.0 ± 0.0^{ef}	0.7 ± 1.8^{ace}	0.6 ± 0.7^{bdf}
Whole Grains (10)	4.9 ± 4.8^{a}	4.4 ± 4.6	3.4 ± 4.5^{a}	3.6 ± 4.7	4.5 ± 5.2
Dairy (10)	3.7 ± 4.3^{abc}	3.5 ± 4.2^{def}	5.3 ± 4.6^{adgh}	9.6 ± 1.4^{beg}	8.4 ± 2.8^{cfh}
Total Protein (5)	3.8 ± 1.9^{ab}	3.4 ± 2.0^{ac}	3.4 ± 2.1	3.1 ± 2.2^{bd}	4.4 ± 1.5^{cd}
Seafood/Plant Proteins (5)	1.8 ± 2.4^{a}	1.6 ± 2.4	1.1 ± 2.1^{a}	1.2 ± 2.2	1.9 ± 2.5
Fats Ratio (10)	6.1 ± 4.2^{a}	5.8 ± 4.4^{b}	4.9 ± 4.7	4.0 ± 4.3^{ab}	6.0 ± 4.5
Refined Grain (10)	5.7 ± 4.5	5.1 ± 4.2	5.0 ± 4.3	6.0 ± 4.1	5.4 ± 4.6
Sodium (10)	5.1 ± 4.5^{a}	6.1 ± 4.4^{a}	5.7 ± 4.2	5.4 ± 4.3	4.7 ± 4.2
Empty Calories (20)	14.7 ± 5.8^{abc}	8.7 ± 6.9^{adef}	15.0 ± 6.1^{dg}	12.3 ± 6.0^{begh}	17.5 ± 3.2^{cfh}
Total Index (100)	51.6 ± 14.9^{ab}	43.2 ±15.1^{acde}	52.1 ± 15.3^{cf}	50.4 ± 15.4^{dg}	60.5 ± 21.2^{befg}

Superscripts ^{abcdefghijk} show Tukey’s pairwise significant differences (α <0.05) between beverage groups in each meal component row.

HEI-2010 Scores for LBFH

LBFH Meal Components and HEI-2010 score comparisons by beverage selection are in Table 2. HEI-2010 scores for meals containing SSB (45.9 served, 43.2 consumed) were significantly lower compared to all other beverage options, while highest scores came from meals containing 1% plain milk (62.1served, 60.5 consumed). HEI-2010 scores for water/none (52.6), 100% juice (54.0) and non-fat flavored milk (53.1), although not significantly different from each other, were higher than SSB, but lower than 1% plain milk.

In LBFH, Dairy food group/component scores for non-fat flavored milk (of 10 points possible, 9.6 served, 9.6 consumed) or 1% plain milk (9.5 served, 8.4 consumed) were significantly higher than all other beverage categories (See Table 2). Dairy food group/component scores in LBFH meals including milk were similar to the Dairy food group/component mean of NSLP meals (9.3 served, 8.6 consumed, seen in Table 3). MQ of LBFH could be greatly improved by including milk, instead of a SSB.

HEI-2010 Comparison of NSLP and LBFH

Further comparisons between NSLP and LBFH meals by HEI food component and HEI-2010 scores were conducted and can be viewed in Table 3. "Good" quality HEI-2010 scores are greater than 80 as set by HEI-2010. Scores from 51 to 80 are considered "Need Improvement," while "Poor" quality diets scores are 50 or less (USDA-FNS, 2015). In the current study, NSLP meals scored 49.8 (as served) and 52.2 (as consumed), with LBFH scoring of 49.3 (as serve) and 51.1 (as consumed). HEI-2010 Score of both meal origins parallels the national average of U.S. children, which is 47 to 50 (Hiza, et al. 2013). Both meal origins in this study and the average diet of U.S. children fall in the "Poor" quality range while overlapping slightly into the "Needs Improvement" category according to HEI-2010 (Guenther, et al., 2014).

Although the HEI-2010 scores of NSLP and LBFH were not significantly different, nearly all food component categories showed significant differences between lunch origins among both the served and consumed data. NSLP meals were stronger suppliers of Total Vegetables (of 5 points possible, served: NSLP 2.1 vs. LBFH 1.3; consumed: NSLP 1.9 vs. LBFH 1.2), Greens and Beans (of 5 points possible, served: NSLP 0.7 vs. LBFH 0.2; consumed: NSLP 0.4 vs. LBFH 0.2), and Dairy (of 10 points possible, served: NSLP 9.3 vs. LBFH 4.7; consumed: NSLP 8.8 vs. LBFH 4.5). NSLP offered less Empty Calories (of 20 points possible, served: NSLP 14.2 vs. LBFH 13.1; consumed: NSLP 13.8 pts vs. LBFH 12.6 pts). Note that Empty Calories is one of the moderation food components in the HEI-2010 analysis, where lower quantities earn higher scores. LBFH, however, provided significantly more Whole Grains (of 5 points possible, served: NSLP 2.8 vs. LBFH 4.7; consumed: NSLP 2.6 vs. LBFH 4.4), Seafood and Plant Proteins (of 5 points possible, served: NSLP 0.5 vs. LBFH 1.7; consumed: NSLP 0.4 vs. LBFH 1.6), and a better Fatty Acid Ratio (of 10 points possible, served: NSLP 4.6 vs. LBFH 5.7; consumed: NSLP 4.6 vs. LBFH 5.7). Table 3 shows full results for the comparisons of component and HEI-2010 scores for NSLP meals and LBFH.

The effect sizes (See Table 3) for most findings were fairly small, meaning the actual effect of the differences seen, although they may be statistically significant, have a small impact overall. According to Cohen (1988), effect size greater than 0.8 has a large effect, 0.5 to 0.8 has a moderate effect, 0.2 to 0.5 has a small effect, and less that 0.2 has a minimal effect. LBFH served more Whole Grains and Seafood/Plant Proteins; the significantly higher amounts had moderate effect size of 0.6 in both food components. The NSLP provided significantly higher amounts of Dairy in comparison to LBFH, with a large effect size (1.8 served, 1.6 consumed). The high level of provision of Dairy foods by the NSLP suggests a need to improve the presence of dairy foods in LBFH.

Table 3. ***Comparisons of Healthy Eating Index Scores for NSLP Lunches and Lunches Brought From Home***

HEI Component		NSLP n = 509 *M* ± *SD*	% Max	LBFH n = 515 *M* ± *SD*	% Max	Effect Size[s]
Total Fruit (5)	served	2.3 ± 2.3[a]	46%	2.7 ± 2.3[a]	54%	0.18
	consumed	2.7 ± 2.3	54%	2.4 ± 2.3	48%	0.00
Whole Fruit (5)	served	2.6 ± 2.5	52%	2.7 ± 2.5	54%	0.00
	consumed	2.4 ± 2.5	48%	2.4 ± 2.4	48%	0.00
Total Veg. (5)	served	2.1 ± 2.0[b]	42%	1.3 ± 2.0[b]	26%	0.38
	consumed	1.9 ± 2.0[c]	38%	1.2 ± 1.9[c]	24%	0.34
Greens /Beans (5)	served	0.7 ± 1.6[d]	14%	0.2 ± 0.9[d]	4%	0.19
	consumed	0.4 ± 1.4[e]	8%	0.2 ± 0.9[e]	4%	0.17
Whole Grain (5)	served	2.8 ± 4.3[f]	56%	4.7 ± 4.7[f]	94%	0.60
	consumed	2.6 ± 4.2[g]	52%	4.4 ± 4.7[g]	88%	0.60
Dairy (10)	served	9.3 ± 2.3[h]	93%	4.7 ± 4.4[h]	47%	1.80
	consumed	8.6 ± 3.1[i]	86%	4.5 ± 4.9[i]	45%	1.50
Total Protein (5)	served	3.7 ± 1.9	74%	3.6 ± 1.9	72%	0.00
	consumed	3.3 ± 2.0[j]	66%	3.6 ± 2.0[j]	72%	0.10
Seafood /Plant (5)	served	0.5 ± 1.3[k]	1%	1.7 ± 2.4[k]	34%	0.60
	consumed	0.4 ± 1.3[l]	8%	1.6 ± 2.3[l]	32%	0.60
Fats Ratio (10)	served	4.6 ± 4.1[m]	46%	5.7 ± 4.3[m]	57%	0.40
	consumed	4.6 ± 4.1[n]	46%	5.7 ± 4.3[n]	57%	0.40
Refined Grain (10)	served	5.2 ± 3.9	52%	5.2 ± 4.3	52%	0.00
	consumed	5.2 ± 4.1	52%	5.3 ± 4.4	53%	0.00
Sodium (10)	served	4.6 ± 3.6[o]	46%	5.5 ± 4.4[o]	55%	0.31
	consumed	4.6 ± 3.7[p]	46%	5.5 ± 4.4[p]	55%	0.31
Empty Calorie (20)	served	14.2 ± 5.1[q]	71%	13.1 ± 6.3[q]	66%	0.31
	consumed	13.8 ± 5.7[r]	69%	12.6 ± 6.7[r]	63%	0.34
Total Index (100)	served	52.2 ± 13.9	52%	51.1 ± 15.6	51%	0.00
	consumed	49.8 ±13.7	50%	49.3 ± 15.8	49%	0.00

Healthy Eating Index Component maximum possible scores are in parentheses
Indicate significant difference pairs ($\alpha < 0.05$)
[s]Effect size, indicating the magnitude of the significant difference, calculated by Cohen's d. Scores: ≥ 0.20 indicate a small effect, ≥ 0.50 a moderate effect, and ≥ 0.8 a large effect.

LBFH provided more Total Fruit as served. There was no difference, however, as consumed (of 5 points possible, served: NSLP 2.3 vs. LBFH 2.7; consumed: NSLP 2.7 vs. LBFH 2.4). Scores reflect a tendency for children with NSLP meals to eat more of fruits served, while more fruit items present in LBFH remain uneaten or wasted. Though this difference's magnitude is small, it could originate in preparation. Research shows children are more likely to consume fruit cut into bite size pieces (Miller, 2013). Concern over quality deterioration from lack of a temperature control for LBFH may cause parents to send whole fruits, which are fairly shelf stable, rather than cut portions which are more perishable without refrigeration (Almansour et al., 2011; Hudson, & Walley, 2009).

CONCLUSIONS AND APPLICATIONS

Data analyzed in this study were collected in four elementary schools prior to the enactment of HHFKA. Nearly all food component categories in this study were below the HEI-2010 scores that would indicate "Good Meal Quality", both in NSLP and LBFH meals. This is most notable in the areas of Greens/Bean Vegetables and in Seafood/Plant Proteins, which showed selection and consumption levels at 1-14% of recommended amounts (See Table 1). To further improve school meal quality, three areas of focus are recommended: within the lunchroom, in the wider school environment, and within the broader community.

In the Lunchroom

Currently, in the lunchroom, child nutrition professionals (CNPs) provide nutritious beverages like 1% plain milk, non-fat flavored milk, and 100% juice, which meet NSLP guidelines. The current study revealed highest HEI-2010 scores with a beverage selection of 1% plain milk.

CNP's can further improve HEI-2010 scores by promoting consumption of 1% plain milk, or perhaps, offering non-fat flavored milk only on certain days. To ease selection and purchasing of healthful beverages, CNPs can provide a "milk only" line especially for children with LBFH. CNPs can create awareness of nutritional differences between beverages, and milk's availability at school for LBFH by providing educational materials in the lunchroom, classroom and to parents. Providing reliable cold storage for LBFH may also improve meal quality and beverage selection (Almansour et al., 2011; Hudson, & Walley, 2009).

Smarter lunchroom techniques can facilitate healthful selections. For example, placing sliced fruits and vegetables at the beginning of lunch lines may increase selection (Just & Wansink, 2009). Displaying pictures of fruits, vegetables, and nutrient-dense beverages on sample NSLP cafeteria trays improves motivation of healthful meal choices (Reicks, Redden, Mann, Mykerezi, & Vickers, 2012). Findings from the current study and Richie et al. (2015) both support selection of multiple nutritionally dense beverages per meal (100% juice, milk) to improve nutrient consumption and overall MQ.

Creating a Supportive Environment in Schools and Communities

In the larger school environment, comprehensive wellness policies and nutrition education programs are necessary. Greater attention to implementation of wellness policies can enhance nutrition education programs and promote greater support within the school and community. HUSSC participation facilitates writing a school district wellness policy that addresses foods given for reward/celebration in the classroom, activity/recess times, and nutrition education (USDA-FNS, 2014c). Starting in 2015-16 school year, districts are being held accountable for the implementation, assessment, and update of their wellness policies, providing further motivation to promote these positive changes (USDA, 2015b). Thus participation in HUSSC can help create a supportive environment for healthy nutrition in schools.

Increasing meal time duration may also improve MQ. Since fruits and vegetables are high in fiber, this requires extra chewing to break down the food. Because of this, fruits and vegetables can take longer to eat than processed foods, especially in children (Academy of Nutrition and

Dietetics, 2015). Hypothetically, short lunch periods may rush children to consume foods that are easier to chew. Policy development should address and ensure adequate time for meals to include time for walking to the cafeteria, standing in line, serving the meal, finding a place to sit, consuming the meal, disposing of waste, and visiting with those at the table. Although findings are not conclusive, some studies have shown recess before lunch (RBL) improves food component selection and consumption (Bergman et al., 2004; Rainville, Wolf & Carr, 2006). With nutrient-rich beverages available to thirsty students, overall MQ consumed may improve with RBL due to increases in milk consumption as indicated by Hunsberger, McGinnis, Smith, Beamer, & O'Malley (2014). Their research in one Madras Oregon elementary school (15 classes, n = 261) showed RBL corresponded positively to greater intake of milk, and students were 1.5 times more likely to meet nutritional guidelines for calcium and fat (Hunsberger, et.al., 2014). If meal times cannot be adjusted, perhaps allowing selection of two nutrient dense beverages to maximize the amount of nutrients that can be consumed in a short lunch period.

The current study was completed prior to HHFKA enactment, which now requires schools participating in the NSLP to provide access to water during mealtimes (Centers for Disease Control and Prevention, 2015). While many children do not drink any water, those that do tend to have more healthful diets and normal weight status (Kenney et al., 2015; Park, Blanck, Sherry, Brener, & O'Toole, 2012). Water consumption is one method for ensuring both hydration and limiting caloric consumption. Unlimited access to water throughout the day, not just at meal times, improves fluid intake in children (Kaushik, Mullee, Bryan, & Hill, 2007). Attractive water bottle filling stations, have been shown to increase water consumption and reduce waste from plastic water bottles (Franklin & Madalinski, 2009). While water would not overtly increase any particular component area of HEI-2010 scores, it may decrease or replace SSB consumption, thus reducing Empty Calories and resulting in higher HEI-2010 scores, while ensuring adequate hydration.

School gardens can provide hands-on nutrition education and may be written into wellness policies to promote optimal nutrition in schools. Children who participate in school garden programs have improved nutritional quality in school lunch meals, perform better academically, and have fewer absences due to illness based on anecdotal findings from Stone and Barlow (2012) and further supported by a literature review study spanning 1990-2010 (Williams & Dixon, 2013). Small vegetable gardening lessons improved attitudes toward vegetables (Lineberger & Zajicek, 2000). Students in school garden projects have increased fruit and vegetable intake, at home and school, resulting in increased vitamin A, vitamin C and fiber intake (McAleese & Rankin, 2007).

HHFKA regulations are continuing to improve MQ in NSLP meals (Bergman et al., 2014b). An additional suggestion to improve MQ in schools, is to increase vegetable selections allowed. If student's vegetable selection increases or replaces another meal component selection, HEI-2010 scores will drastically improve (Cullen, Chen, Dave, & Jensen, 2015). Selection does not always equate into consumption; however, by continually exposing students to various options, likelihood of consumption will improve. In a 2014 study conducted after HHFKA implementation, consumption of fruit remained steady while consumption of both entrée and vegetables expanded by 15-16% and milk consumption decreased (Cohen, Richardson, Parker, Catalano, & Rimm, 2014). Cohen et al. (2014) concluded that the decrease in milk consumption was related to a recent district policy change banning flavored milk just prior to data collection.

A 2012 study revealed that milk consumption returned to normal after acclimating to a similar policy change (Cohen et al., 2012).

The Academy of Nutrition and Dietetics (formerly the American Dietetic Association [ADA]) (2010) supports a multifaceted approach to improvements in school nutrition. Approaches include: new product/recipe development, farm-to-school, fresh fruit/vegetable programs, wellness policies, and integrated nutritional instruction at school and in the home and community. Disclosure of nutrient content and marketing nutritional programs through media should also be pursued (ADA, 2010).

Results of the current study show that NSLP meals are marginally higher than the national average for MQ compared to the overall the diet of U.S. children. NSLP meals are performing well in providing children with Dairy, Total Protein, and Reduced Empty Calories, while improvements are still necessary for Greens/Bean Vegetables and Seafood/Plant Proteins. The most profound finding from this study was that offering two nutrient dense beverage choices at a meal can profoundly increase HEI-2010 and overall MQ, especially when choosing 1% plain milk or nonfat flavored milk and 100% juice. Further research is called for, however, as HHFKA regulations are implemented, to investigate changes in MQ. This additional research should include the influence of beverages on NSLP MQ.

Limitations

This study was limited due to all four schools having HUSSC with Gold designations during the time frame of data acquisition (USDA-FNS, 2014b). The schools participating in the study were early voluntary adopters of the type of changes that are mandated in the HHFKA of 2010. (Bergman et al., 2014; Jordan et al., 2008; USDA-FNS, 2014c). The results of this study may not be generalizable to all schools because, currently only 7,022 U.S. schools (USDA-FNS, 2014c) participate in the HUSSC program out of the 98,328 U.S. schools on record with the U.S. Department of Education (2015). This study only included data from four elementary schools in the state of Washington. Because of this, the results may not be generalized to schools in other parts of the U.S.

ACKNOWLEDGEMENTS

This research project was partially funded by the U.S. Department of Agriculture, Food and Nutrition Service through an agreement with the National Food Service Management Institute (NFSMI) at The University of Mississippi. The contents of this publication do not necessarily reflect the views or policies of the U.S. Department of Agriculture, nor do mentions of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

REFERENCES

Academy of Nutrition and Dietetics. (2015). Position of the Academy of Nutrition and Dietetics: Health implications of dietary fiber. *Journal of the Academy of Nutrition & Dietetics.* 115(11), 1862-1870. http://dx.doi.org/10.1016/j.jand.2015.09.003

American Dietetic Association. (2010). Position of the American Dietetic Association: Local support for nutrition integrity in schools. *Journal of the American Dietetic Association.* 110(11), 1244-1254. http://dx.doi.org/10.1016/j.jada.2010.06.014

Almansour, F. D., Sweitzer, S. J., Magness, A. A., Calloway, E. E., McAllaster, M. R., Roberts-Gray, C. R., ... & Briley, M. E. (2011). Temperature of foods sent by parents of preschool-aged children. *Pediatrics*, *128*(3), 519-523. http://dx.doi.org/10.1542/peds.2010-2885

Armstrong, L. E., Ganio, M. S., Casa, D. J., Lee, E. C., McDermott, B. P., Klau, J. F., ... & Lieberman, H. R. (2012). Mild dehydration affects mood in healthy young women. *Journal of Nutrition*, *142*(2), 382-388. http://dx.doi.org/10.3945/jn.111.142000

Bergman, E. A., Buergel, N. S., Englund, T. F., Clem, A., Hansen, E. A., Kutrich, L. A., & Wiseley, L. M. (2004). Elementary students eat more and waste less when recess is scheduled before lunch. *Journal of the American Dietetic Association*, *104*(45). http://dx.doi.org/10.1016/j.jada.2004.05.130

Bergman, E., Cashman, L., Englund, T., Watkins, T., Saade, C., Shaw, E., Weigt Taylor, K., Rushing, K. (2014a). HealthierUS Schools Challenge lunches are more nutritious than lunches brought from home. *Journal of Child Nutrition & Management*, *37*(2). Retrieved from: http://schoolnutrition.org/jcnm/fall2014/

Bergman, E.A., Englund, T., Weight Taylor, K., Watkins, T., Schepman, S., & Rushing, K. (2014b). School lunch before and after implementation of the Healthy, Hunger-Free Kids Act. *Journal of Child Nutrition & Management*, *38*(2). Retrieved from http://schoolnutrition.org/jcnm/fall2014/

Campbell, S. (2004). Dietary Reference Intakes: Water, potassium, sodium, chloride, and sulfate. *Clinical Nutrition Insight*, *30*(6). Retrieved from Wolters Kluwer Health Inc. website: http://journals.lww.com/clinnutrinsight/Abstract/2004/30060/Dietary_Reference_Intakes__Water,_Potassium,.1.aspx

Centers for Disease Control and Prevention. (2015). *Healthy schools: Water access in schools.* Retrieved from: http://www.cdc.gov/healthyschools/npao/wateraccess.htm

Chen, H. & Wang, Y. (2013) Influence of school beverage environment on the association of beverage consumption with physical education participation among US adolescents. *American Journal of Public Health*, 103,(11), e63-e70 http://dx.doi.org/10.2105/ajph.2013.301555

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* (2nd ed.). New York, New York. Lawrence Erlbaum Associates.

Cohen, J. F., Richardson, S., Parker, E., Catalano, P. J., & Rimm, E. B. (2014). Impact of the new U.S. Department of Agriculture school meal standards on food selection, consumption, and waste. *American Journal of Preventive Medicine*, *46*(4), 388-394. http://dx.doi.org/10.1016/j.amepre.2013.11.013

Cullen, K., Chen, T., Dave, J. & Jensen, H. (2015). Differential improvements in student fruit and vegetable consumption in response to the new National School Lunch Program regulations: A pilot study. *Journal of the American Dietetic Association*, 115(5), 724-730. http://dx.doi.org/10.1016/j.jand.2014.10.021

Cunningham, S.A., Kramer, M.R., & Venkat Narayan, K.M. (2014). Incidence of childhood obesity in the United States. *New England Journal of Medicine, 370*, 403-411. http://dx.doi.org/10.1056/NEJMoa1309753

Erinosho, T. O., Ball, S. C., Hanson, P. P., Vaughn, A. E., & Ward, D. S. (2013). Assessing foods offered to children at child-care centers using the Healthy Eating Index-2005. *Journal of the Academy of Nutrition & Dietetics*, *113*(8), 1084-1089. http://dx.doi.org/10.1016/j.jand.2013.04.026

Franklin, K. L., & Madalinski, M. J. (2009). Reducing bottled water use in dining services at the University of Colorado at Boulder. *University of Colorado at Boulder*. Retrieved from http://www.colorado.edu/envs/node/565/attachment/newest.

Ganio, M. S., Armstrong, L. E., Casa, D. J., McDermott, B. P., Lee, E. C., Yamamoto, L. M., ... & Lieberman, H. R. (2011). Mild dehydration impairs cognitive performance and mood of men. *British Journal of Nutrition*, *106*(10), 1535-1543. http://dx.doi.org/10.1017/S0007114511002005

Guenther, P.M., Casavale, K.O., Reedy, J., Kirkpatrick, S.I., Hiza, H.A.B., Kuczynski, K.J. . . ., Krebs-Smith, S.M. (2013). Update of the Healthy Eating Index: HEI-2010. *Journal of the Academy of Nutrition & Dietetics*, 113(1), 569-580. http://dx.doi.org/10.1016/j.jand.2012.12.016

Guenther, P. M., Kirkpatrick, S. I., Reedy, J., Krebs-Smith, S. M., Buckman, D. W., Dodd, K. W., & Carroll, R. J. (2014). The Healthy Eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 Dietary Guidelines for Americans. *Journal of Nutrition*, 144(3), 399-407. http://dx.doi.org/10.3945/jn.113.183079

Guthrie, H. A. (1977). Effect of a flavored milk option in a school lunch program. *Journal of the American Dietetic Association*, *71*(1), 35-40.

Hanks, A. S., Just, D. R., & Wansink, B. (2014). Chocolate milk consequences: A pilot study evaluating the consequences of banning chocolate milk in school cafeterias. *Public Library of Science One*, *9*(4), e91022. http://dx.doi.org/10.1371/journal.pone.0091022

Henry, C., Whiting, S. J., Phillips, T., Finch, S. L., Zello, G. A., & Vatanparast, H. (2015). Impact of the removal of chocolate milk from school milk programs for children in Saskatoon, Canada. *Applied Physiology, Nutrition, & Metabolism, 40*(999), 1-6. http://dx.doi.org/10.1139/apnm-2014-0242

Hiza, H. A. B., Guenther, P. M., & Rihane, C. I. (2013). Diet quality of children age 2-17 years as measured by the Healthy Eating Index-2010. *Nutrition Insight*, *52*. Retrieved from http://www.cnpp.usda.gov/sites/default/files/nutrition_insights_uploads/Insight52.pdf.

Hu, F. B. (2013). Resolved: There is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. *Obesity Reviews*, *14*(8), 606-619. http://dx.doi.org/10.1111/obr.12040

Hubbard K.L., Must, A., Eliasziw, M., Folta, S.C., & Goldberg, J. (2014). What's in children's backpacks: Foods brought from home. *Journal of the Academy of Nutrition & Dietetics*, 114(9,1424-31. doi: 10.1016/j.jand.2014.05.010.

Hudson, P. K., & Walley, H. (2009). Food safety issues and children's lunchboxes. *Perspectives in Public Health*, *129*(2), 77-84. http://dx.doi.org/10.1177/1757913908101607

Hunsberger, M., McGinnis, P., Smith, J., Beamer, B. A., & O'Malley, J. (2014). Elementary school children's recess schedule and dietary intake at lunch: A community-based participatory research partnership pilot study. *BMC Public Health*, *14*(1), 156. doi:10.1186/1471-2458-14-156

Johnson, C.M., Bednar, C., Kwon, J., & Gustof, A. (2009). Comparison of nutrient content and cost of home-packed lunches to reimbursable school lunch nutrient standards and prices. *Journal of Child Nutrition & Management. 33*(2). Retrieved from https:// schoolnutrition.org/JCNM/

Johnston, C. A., Moreno, J. P., El-Mubasher, A., & Woehler, D. (2012). School lunches and lunches brought from home: A comparative analysis. *Childhood Obesity*, *8*(4), 364-368. http://dx.doi.org/10.1089/chi.2012.0012

Jordan, K. C., Erickson, E. D., Cox, R., Carlson, E. C., Heap, E., Friedrichs, M., ... Mihalopoulos, N. L. (2008). Evaluation of the Gold Medal Schools program. *Journal of the American Dietetic Association*, *108*(11), 1916-1920. http://dx.doi.org/10.1016/j.jada.2008.08.002

Juby, C., & Meyer, E.E. (2011). Child nutrition policies and recommendations. *Journal of Social Work, 11*, 375-386. http://dx.doi.org/10.1177/1468017310379451

Just, D. R., & Wansink, B. (2009). Smarter lunchrooms: Using behavioral economics to improve meal selection. *Choices*, *24*(3), 1-7. Retrieved from http://smarterlunchrooms.org/SoftChalk_Lessons/NC_Module03/85225017-Smarter-Lunchrooms-Choices-2010.pdf.

Kaushik, A., Mullee, M. A., Bryant, T. N., & Hill, C. M. (2007). A study of the association between children's access to drinking water in primary schools and their fluid intake: Can water be 'cool' in school? *Child: Care, Health and Development*, *33*(4), 409-415. http://dx.doi.org/10.1111/j.1365-2214.2006.00721.x

Kenney, E.L., Long, M.W., Cradock, A.L., & Gortmaker, S.L. (2015). Prevalence of inadequate hydration among US children and disparities by gender and race/ethnicity: National Health and Nutrition Examination Survey, 2009–2012. *American Journal of Public Health*, *105*(8), e113-e118. doi:10.2105/AJPH.2015.302572

Lineberger, S. E., & Zajicek, J. M. (2000). School gardens: Can a hands-on teaching tool affect students' attitudes and behaviors regarding fruit and vegetables? *Horticulture Technology*, *10*(3), 593-597. Retrieved from http://horttech.ashspublications.org/content/10/3/593.full.pdf+html

Malik, V. S., Schulze, M. B., & Hu, F. B. (2006). Intake of sugar-sweetened beverages and weight gain: A systematic review. *American Journal of Clinical Nutrition*, *84*(2), 274-288. Retrieved from http://ajcn.nutrition.org/content/84/2/274.full

Mancino, L., Todd, J., Guthrie, J., Lin, B. (2010). How food away from home affects children's diet quality. *USDA, Economic Research Service*, ERR-104. Retrieved from http://www.ers.usda.gov/media/136261/err104_3_.pdf.

McAleese, J. D., & Rankin, L. L. (2007). Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *Journal of the American Dietetic Association*, *107*(4), 662-665. http://dx.doi.org/10.1016/j.jada.2007.01.015

Mesirow, M.S.C., & Welsh, J.A. (2015). Changing beverage consumption patterns have resulted in fewer liquid calories in the diets of U.S. children: National Health and Nutrition Examination Survey 2001-2010. *Journal of the Academy of Nutrition &* Dietetics, 115 (4), 559 - 566. http://dx.doi.org/10.1016/j.jand.2014.09.004

Miller, N. E. (2013). Increasing portion sizes of fruits and vegetables in an elementary school lunch program can increase fruit and vegetable consumption. *(*Doctoral dissertation, University of Minnesota). Retrieved from http://conservancy.umn.edu/bitstream/157503/1/Miller_umn_0130M_13903.pdf

Murphy, M. M., Douglass, J. S., Johnson, R. K., & Spence, L. A. (2008). Drinking flavored or plain milk is positively associated with nutrient intake and is not associated with adverse effects on weight status in U.S. children and adolescents. *Journal of the American Dietetic Association*, *108*(4), 631-639. http://dx.doi.org/10.1016/j.jada.2008.01.004

Noel, S. E., Ness, A. R., Northstone, K., Emmett, P., & Newby, P. K. (2013). Associations between flavored milk consumption and changes in weight and body composition over time: Differences among normal and overweight children. *European Journal of Clinical Nutrition*, *67*(3), 295-300. http://dx.doi.org/10.1038/ejcn.2012.123

Office of Disease Prevention and Health Promotion. (2015) What We Eat in America, NHANES 2009-2010. Retrieved from http://www.health.gov/dietaryguidelines/2015-scientific-report/06-chapter-1/d1-11.asp

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of obesity and trends in body mass index among U.S. children and adolescents, 1999-2010. *Journal of the American Medical Association*, *307*(5), 483-490. http://dx.doi.org/10.1001/jama.2012.40

O'Neil, C.E., Nicklas, T.A., Rampersaud, G.C., Fulgoni, V.L.. (2011). One hundred percent orange juice consumption is associated with better diet quality, improved nutrient adequacy, and no increased risk for overweight/obesity in children. *Nutrition Research. 31*(9):673-682. http://dx.doi.org/10.1016/j.nutres.2011.09.002

Parent, M., Niezgoda, H., Keller, H.H., Chambers, L.W., & Daly, S. (2012). Comparison of visual estimation methods for regular and modified textures: real-time vs. digital imaging.

Journal of the Academy of Nutrition & Dietetics, *112*, 1636-1641. http://dx.doi.org/10.1016/j.jand.2012.06.367

Park, S., Blanck, H. M., Sherry, B., Brener, N., & O'Toole, T. (2012). Factors associated with low water intake among U.S. high school students—National Youth Physical Activity and

Nutrition Study, 2010. *Journal of the Academy of Nutrition & Dietetics*, *112*(9), 1421-1427. http://dx.doi.org/10.1016/j.jand.2012.04.014

Quann, E. E., & Adams, D. (2013). Impact on milk consumption and nutrient intakes from eliminating flavored milk in elementary schools. *Nutrition Today*, *48*(3), 127-134. http://dx.doi.org/10.1097/NT.0b013e3182941d6a

Rainville, A. J., Wolf, K. N., & Carr, D. H. (2006). Recess placement prior to lunch in elementary schools: What are the barriers? *Journal of Child Nutrition & Management*, 30(2). Retrieved from http://docs.schoolnutrition.org/newsroom/jcnm/06fall/rainville/index.asp

Rausch, R. (2013). Nutrition and academic performance in school-age children: The relation to obesity and food insufficiency. *Journal of Nutrition & Food Sciences*, 3(2) 190-194. http://dx.doi.org/10.4172/2155-9600.1000190

Reicks, M., Redden, J. P., Mann, T., Mykerezi, E., & Vickers, Z. (2012). Photographs in lunch tray compartments and vegetable consumption among children in elementary school cafeterias. *Journal of the American Medical Association*, *307*(8), 784-785. http://dx.doi.org/10.1001/jama.2012.170

Richie, L., Sharma, S., Gildengorin, G., Yoshida, S., Braff-Guajardo, E. & Crawford, P. (2015). Policy improves what beverages are served to young children in childcare. *Journal of the American Dietetic Association*, 115(5), 724-730. http://dx.doi.org/10.1016/j.jand.2014.07.019

School Nutrition Association. (2013). *National School Lunch Program Tracker*. Retrieved from http://www.schoolnutrition.org/uploadedFiles/School_Nutrition/102_ResourceCenter/Rearching_SN_Industry/ParticipationTrackerforNSLPandSBP.pdf

Schwingshackl, L., & Hoffmann, G. (2015). Diet quality as assessed by the Healthy Eating Index, the Alternate Healthy Eating Index, the Dietary Approaches to Stop Hypertension Score, and health outcomes: A systemic review and meta-analysis of cohort studies. *Journal of the American Dietetic Association*, 115(5), 780-800. http://dx.doi.org/10.1016/j.jand.2014.12.009

Stone, M. K., & Barlow, Z. (2012). Living systems, sustainability education, and institutional change. *Learning for sustainability in times of accelerating change*. (pp. 386-388) Wageningen, The Netherlands: Wageningen Academic Publishers. http://dx.doi.org/10.3920/978-90-8686-757-8_24

U.S. Department of Agriculture, Food and Nutrition Service. (2014a), *National School Lunch Program*. Retrieved from http://www.fns.usda.gov/sites/default/files/NSLPFactSheet.pdf

U.S. Department of Agriculture, Food and Nutrition Service. (2014b). *USDA HealthierUS School Challenge.* Retrieved from http://www.fns.usda.gov/tn/HealthierUS/vision.html

U.S. Department of Agriculture, Food and Nutrition Service. (2014c). *HealthierUS School Challenge: Smarter lunchrooms*. Retrieved from http://www.fns.usda.gov/hussc/healthierus-school-challenge-smarter-lunchrooms

U.S. Department of Agriculture, Food and Nutrition Service. (2015a). *My Plate Super Tracker*. Retrieved from https://www.supertracker.usda.gov/foodtracker.aspx?CatgoryID=-1&FoodDescription=nonfat+chocolate+milk

U.S. Department of Agriculture, Food and Nutrition Service (2015b). *Team Nutrition.* Retrieved from: http://www.fns.usda.gov/tn/local-school-wellness-policy

U.S. Department of Education, National Center for Education Statistics. (2015). *Digest of Education Statistics, 2013* (NCES 2015-011), Retrieved from https://nces.ed.gov/programs/digest/d13/tables/dt13_105.50.asp

U.S. Department of Health and Human Services, & U.S. Department of Agriculture. (2011). *Dietary Guidelines for Americans, 2010*, 7th Edition. Washington, DC: U.S. Government Printing Office. Retrieved from http://www.dietaryguidelines.govUS

Vartanian, L.R., Schwartz, M.B., & Brownell, K. D. (2007). Effects of soft drink consumption on nutrition and health: A systematic review and meta-analysis. *American Journal of Public Health,* 97, (4), 667-675. http://dx.doi.org/10.2105/AJPH.2005.083782

Williams, D. R., & Dixon, P. S. (2013). Impact of garden-based learning on academic outcomes in schools: Synthesis of research between 1990 and 2010. *Review of Educational Research*, *83*(2), 211-235. http://rer.sagepub.com/content/early/2013/02/26/0034654313475824

Williamson, D. A., Allen, H. R., Martin, P. D., Alfonso, A. J., Gerald, B., & Hunt, A. (2003). Comparison of digital photography to weighed and visual estimation of portion sizes. *Journal of the American Dietetic Association*, *103*(9), 1139-1145. http://dx.doi.org/10.1016/S0002-8223(03)00974-X

Xu, B., Houston, D.K., & Locher, J.L. (2012). Higher Healthy Eating Index-2005 scores are associated with better physical performance. *Journals of Gerontology Series A.* 67(1),93-99. http://dx.doi.org/10.1093/gerona/glr159

BIOGRAPHY

Bergman, Englund, Ogan, Watkins, and Barbee are all associated with Central Washington University in Ellensburg, Washington. There Bergman is Associate Dean of the College of Education and Professional Studies, Englund is Professor and Dean of the College of the Sciences, Ogan is Dietetic Internship Director, Watkins was an Assistant Professor of Food Service Management and Nutrition, and Barbee is an adjunct professor in the Department of Nutrition, Exercise, and Health Sciences. Rushing is a Research Scientist with the Institute of Child Nutrition located in Hattiesburg, Mississippi.