

## **IMPACT OF CHILD NUTRITION PROGRAMS OFFERED IN SCHOOLS ON DAILY NUTRITION AND DIETARY QUALITY**

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### **ABSTRACT**

#### **PURPOSE/OBJECTIVES**

The average Healthy Eating Index-2015 (HEI) score for children 2-17 years is 53.9/100, which needs improvement. HEI scores for dietary quality (DQ) directly and positively impact children's health, academic performance, and their future. Because school Child Nutrition Programs impact a large proportion of U.S. children, it is important to evaluate these programs to determine the nutrition they are providing and their impact on DQ. The purpose of this study is to determine the overall nutrition provided by the four Child Nutrition Programs that can be implemented consistently and collectively each school day [School Breakfast Program (SBP), National School Lunch Program (NSLP), Fresh Fruit and Vegetable Program (FFVP), Afterschool Snack Program (ASSP)] and to determine the DQ achieved collectively by serving all four Child Nutrition Programs.

#### **METHODS**

This cross-sectional content analysis included four-week sample menus for each Child Nutrition Program for elementary-aged children. SBP and NSLP menus were actual menus from Cooking for Kids. FFVP and ASSP menus were created by two Child Nutrition Program expert researchers. Nutrient content was determined using nutrient analysis. DQ was determined using HEI-2015 for all four program menus combined.

#### **RESULTS**

The proportion of daily nutrient needs met by combined menus ranged from 0.15–403.7% (average proportion = 124.0%). Combined sample menus exceeded child daily nutrient needs for 18 of 30 nutrients and met at least 50% of needs for 8 nutrients. Combined menus had a total HEI score of 83.3/100, 54.5% higher than the 2–17-year-old U.S. child's diet. DQ of combined menus was significantly greater than that of the average U.S. child's diet for whole grains, dairy, added sugar, and total score.

#### **APPLICATION TO CHILD NUTRITION PROFESSIONALS**

Results of the study show possible support for why schools might implement all four Child Nutrition Programs. This may be especially important in low-income areas where children may not be provided adequate nutrition outside of school, thus allowing high DQ meal patterns and contributing to daily nutrient needs.

**KEYWORDS:** Dietary Quality, Child Nutrition Programs, School Breakfast Program, National School Lunch Program, Fresh Fruit and Vegetable Program, Afterschool Snack Program.

## INTRODUCTION

From the What We Eat in America (WWEIA) component of the 2015-2016 National Health and Nutrition Examination Survey (NHANES), it was determined that the average Healthy Eating Index-2015 (HEI) score for children 2-17 years of age was 53.9 out of 100. This score indicates that the average diet of children is far from alignment with federal dietary recommendations (United States Department of Agriculture [USDA], 2019a). Research has found that improving nutrition and dietary quality (DQ) has a positive impact on children's health and academic performance, including decreasing the risk of overweight and obesity, school absences, all-cause mortality, cardiovascular disease mortality, cardiovascular disease, cancer mortality, and all cancers (Belot & James, 2011; Perry et al., 2015; Wirt & Collins, 2009). In terms of impact academically, improving DQ results in increased mental health status, classroom alertness, and academic performance in areas of English and science (Belot & James, 2011; Golley et al., 2010; O'Neil et al., 2014), now and as an adult (Dahm et al., 2016; Okubo et al., 2015). Noting the average HEI-2015 score for children coupled with research on the impact of DQ, it can be inferred that the current diets of children may be setting them up for poor outcomes with regards to health and academics, as children and also later in life. The process of increasing child DQ is daunting, however Child Nutrition Programs may be a large impact solution and a place to start.

In 2019, 14.8 million children, roughly 28% of the U.S. child population, participated in the School Breakfast Program (SBP) and 29.6 million children, roughly 55% of the U.S. child population, participated in the National School Lunch Program (NSLP) (Kids Count Data Center, 2020; USDA, 2020a). While the SBP and the NSLP are the most recognized Child Nutrition Programs, there are other programs that also provide foods in school that contribute additional nutrition. These additional programs include the Fresh Fruit and Vegetable Program (FFVP) and the Afterschool Snack Program (ASSP). Because of the influence that school Child Nutrition Programs have on the nutrition provided to a large proportion of U.S. children throughout the school year, it is important to evaluate these programs more closely to determine the nutrition they are providing to children individually and collectively, as well as their impact on overall DQ. Improving access to and the healthfulness of the selection of foods served in schools could directly contribute to improving DQ of children's diets and thus, theoretically, improve overall health and academic performance, as children and later in life.

There are no known studies to date, however, that determine the collective nutrition and DQ achieved if Child Nutrition Programs were to be implemented consistently and collectively each school day (i.e., SBP, NSLP, FFVP, and ASSP all served together in a day in a school). The purpose of this study is to determine the overall potential nutrition provided by the four Child Nutrition Programs that can be implemented consistently and collectively each school day (SBP, NSLP, FFVP, ASSP) and to determine the DQ achieved collectively by serving each of these four Child Nutrition Programs combined throughout the school week. Theoretically, if school districts increase the amount of Child Nutrition Programs that they participate in, then they are also increasing the collective nutrition provided to and overall DQ of the children they serve. This theoretical increase is because Child Nutrition Program standards are based on the Dietary Guidelines for Americans, which is also the basis for several DQ scoring systems (Wirt & Collins, 2009), so it makes sense that the overall nutrition provided by Child Nutrition Programs would improve overall child DQ by complying with their standards and the Dietary Guidelines for Americans.

## METHODS

### Design and Participants

This cross-sectional content analysis included four-week sample menus for each Child Nutrition Program that can be implemented consistently and collectively each school day to elementary-aged children – SBP, NSLP, FFVP, ASSP. Nutrient content and DQ were determined and summarized per Child Nutrition Program and for the combined menu containing all four Child Nutrition Programs.

### Sample Menus

Four-week sample menus were created for the four Child Nutrition Programs following the respective program’s reimbursement standards (see Table 1). SBP and NSLP sample menus were obtained from Cooking for Kids, a culinary training program by Oklahoma State Department of Education and Oklahoma State University Nutritional Sciences to increase availability of freshly-prepared foods to schoolchildren (see Appendix A) (Cooking for Kids, 2021a; Cooking for Kids, 2021b; Cooking for Kids, 2021c). FFVP and ASSP sample menus were created by two researchers included in this study, who are experts related to Child Nutrition Programs in schools through professional and research experience, with the goal being realistic and thus similar to the current nutrition level provided by school districts (see Appendix A). Similar methods have been used in multiple previous studies by the research team (Hanson et al., 2020; Joyce et al., 2018; Joyce et al., 2020; Patel et al., 2020). Additionally, foodservice directors from schools within Oklahoma were consulted to determine common practices and foods commonly served within the FFVP.

**Table 1.** *Child Nutrition Program Standards and Meal Patterns for Grades K-5*

		Program			
		School Breakfast Program (SBP)	National School Lunch Program (NSLP)	Fresh Fruit and Vegetable Program (FFVP)	Afterschool Snack Program (ASSP)
Standards	Food Components	Amount of Food/Drink Per Week (Minimum Per Day)			Must Include at Least Two of the Four Food Components Listed Below
	Fruits (cups)	5 (1)	2 ½ (½)	Schools may choose the type and amount of fresh fruits and vegetables served throughout the week. Serving a minimum of two days/week and serving a variety are encouraged.	Fruits: ½, can include full-strength fruit juice
Vegetables (cups)	0	3 ¾ (¾)	Vegetables: ¾, can include full-strength vegetable juice		

**Table 1.** *Child Nutrition Program Standards and Meal Patterns for Grades K-5*

Dark green	0	½		
Red/Orange	0	¾		
Beans and peas (legumes)	0	½		
Starchy	0	½		
Other	0	½		
Additional Vegetables to Reach Total (cups)	0	1		
Grains (oz eq)	7-10 (1)	8-9 (1)		1 of whole grain or enriched bread or cereal
Meats/Meat Alternatives (oz eq)	0	8-10 (1)		1
Fluid milk (cups)	5 (1)	5 (1)		1
Other Specifications	Daily Amount Based on the Average for a 5-Day Week		Fresh fruit and vegetables must be served outside of the SBP and NSLP meal service times.	Juice must not be served when fluid milk is served as the only other component.
Mix-Max Calories (kcal)	350-500	550-650		
Saturated Fat (% of Total Calories)	<10	<10		
Sodium Target (mg)	≤485	≤935		
Trans Fat	Nutrition label or manufacturer specifications must indicate zero grams of trans fat per serving.			
<b>References</b>	USDA, 2019b	USDA, 2019b	USDA, 2017	USDA, 2013a; USDA, 2013b

## **Nutrient & Dietary Quality Analysis**

Each day of sample menus was portioned per respective Child Nutrition Program standards and entered into ESHA Food Processor Nutrient Analysis software (version 11.9.0, 2020) to determine nutrient content. ESHA codes were used for food items from previous studies, as quality of output depends on accuracy and quality of food item selection in the program (Hanson et al., 2020; Joyce et al., 2018; Joyce et al., 2020; Patel et al., 2020). Codes included USDA standard references and those commonly used in school meals (e.g., Aramark brand). DQ was assessed using the HEI-2015 (Krebs-Smith et al., 2018). The HEI evaluates DQ of meals or meal patterns based on the Dietary Guidelines for Americans for components of adequacy (total fruits, whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids) and moderation (refined grains, sodium, added sugars, and saturated fats) (USDA, 2018; USDA, 2020b). Higher scores for adequacy components reflect higher intakes, while higher scores for moderation components reflect lower intakes (USDA, 2019a). HEI-2015 total scores range from 0 to 100 with 0 being lowest possible score and 100 being highest possible score (USDA, 2020b). A score of 100 indicates the diet fully conforms to the Dietary Guidelines for Americans (USDA, 2020b). The HEI is standardized to eliminate impact of food quantity eaten by scoring per 1000 calories (USDA, 2018). The HEI is deemed a valid and reliable measure of DQ (Guenther et al., 2014). When specific characteristics of foods (e.g., fat content, flavored versions, sodium level.) needed for nutrient analysis were not specified in the menu or recipe, the researchers made assumptions based on expertise and experience related to items representative of typical school lunches and to ensure compliance with Child Nutrition Program standards (see Appendix B).

## **Statistical Analysis**

Descriptive statistics were determined for all four Child Nutrition Programs combined (SBP, NSLP, FFVP, ASSP) for nutrient content and DQ including overall average and standard deviation. The proportion, listed as a percentage, of daily nutrient needs using highest Dietary Reference Intake (DRI) value for age groups included in elementary school (males, 9-13 years old) provided by the combined menus was determined. Additionally, one-way ANOVA was used to determine significant differences in DQ between average U.S. child's diet (2-17-year age group, NHANES 2015-2016) and combined menus. Partial eta squared was calculated to show effect size of significant differences. Level of significance was set at  $p < 0.05$ . All statistical analysis were performed using SPSS statistical software (version 25, standard, IBM, Armonk, NY). Figure 1 was created using Excel (version 15.40, 2017 Microsoft).

# **RESULTS AND DISCUSSION**

## **Nutrient Content**

Table 2 shows the nutrient content of the combined SBP, NSLP, FFVP, and ASSP menus summarized and in proportion to child nutrient needs. The proportion of nutrient needs met by the combined menus ranged from 0.15%–403.7%. The average proportion of nutrient needs met by the combined menus was 124.0%. Nutrients for which the combined menus exceeded child nutrient needs include protein (182.2%), carbohydrates (141.4%), vitamin A (109.7%), vitamin B1 (104.5%), vitamin B2 (191.6%), vitamin B3 (104.5%), vitamin B6 (151.5%), vitamin B12 (212.1%), vitamin C (403.7%), vitamin K (265.8%), pantothenic acid (111.0%), fluoride (322.0%), iron (111.5%), magnesium (115.7%), manganese (171.1%), potassium (111.5%), selenium (180.5%), and zinc (101.0%). Nutrients for which the combined menus did not meet child nutrient needs include total fiber (55.1%), biotin (83.7%), vitamin D (5.4%), vitamin E

(54.2%), folate (91.0%), calcium (85.9%), chromium (7.7%), copper (0.15%), iodine (15.5%), molybdenum (60.0%), phosphorus (97.7%), and sodium (71.4%). One should keep in mind when interpreting these proportions that Child Nutrition Programs offered in schools are not meant to be the only source of nutrition during the day and are offered but may not be consumed fully by children, and thus are not expected to meet 100% of child nutrient needs. Additionally, exceeding nutrient needs is not always desired.

The 2020-2025 Dietary Guidelines for Americans lists calcium, potassium, dietary fiber, and vitamin D as “dietary components of public health concern for the general U.S. population” as a result of general under consumption of foods containing these dietary components (Dietary Guidelines for Americans, 2021). Relating the nutrient content of the combined menus to these dietary components of concern, the combined menus exceeded child nutrient needs for potassium (111.5%) and nearly met child nutrient needs for calcium (85.9%). The combined menus provided only 55.1% of child nutrient needs for dietary fiber despite frequent additions of fiber-rich foods throughout the four Child Nutrition Programs. The combined menus also provided only 5.4% of child nutrient needs for vitamin D despite milk being served daily within the SBP and NSLP and also occasionally through the ASSP. This may have been due to the specific ESHA nutrient analysis code used for milk and potentially that coded food item’s lack of fortifying with vitamin D. It should be noted that nutrient analysis was performed by a trained researcher and overseen by a senior researcher.

**Table 2.** *Nutrient Content of the Combined SBP, NSLP, FFVP, and ASSP Menus, Summarized and in Proportion to Child Nutrient Needs*

<b>Nutrient</b>	<b>Combined Menu Amount (mean ± standard deviation)</b>	<b>Daily Child Nutrient Needs*</b>	<b>Proportion (%) of Daily Child Needs Met by the Combined Menus</b>
Calories (kcal)	1295.9 ± 159.2		
Protein (g)	62.0 ± 14.2	34	182.2
Carbohydrate (g)	183.9 ± 27.7	130	141.4
Total Fiber (g)	20.9 ± 3.9	38	55.1
Sugar (g)	89.6 ± 15.8		
Added Sugar (g)	15.4 ± 10.4		
Fat (g)	40.5 ± 10.8		
Saturated Fat (g)	13.9 ± 4.3		
Monounsaturated Fat (g)	13.3 ± 4.9		
Polyunsaturated Fat (g)	8.6 ± 4.4		
Trans Fat (g)	0.78 ± 0.54		
Vitamin A (mcg)	658.1 ± 392.9	600	109.7
Vitamin B1 (mg)	0.94 ± 0.18	0.9	104.5
Vitamin B2 (mg)	1.7 ± 0.22	0.9	191.6
Vitamin B3 (mg)	12.5 ± 4.3	12	104.5
Vitamin B6 (mg)	1.5 ± 0.33	1	151.5
Vitamin B12 (mcg)	3.8 ± 0.98	1.8	212.1

**Table 2.** *Nutrient Content of the Combined SBP, NSLP, FFVP, and ASSP Menus, Summarized and in Proportion to Child Nutrient Needs*

Biotin (mcg)	16.7 ± 14.6	20	83.7
Vitamin C (mg)	181.7 ± 89.4	45	403.7
Vitamin D (mcg)	0.81 ± 0.78	15	5.4
Vitamin E (mg)	6.0 ± 2.6	11	54.2
Folate (mcg)	272.9 ± 67.7	300	91.0
Vitamin K (mcg)	159.5 ± 224.4	60	265.8
Pantothenic Acid (mg)	4.4 ± 0.54	4	111.0
Calcium (mg)	1116.6 ± 213.7	1300	85.9
Chromium (mcg)	1.9 ± 1.0	25	7.7
Copper (mg)	1.0 ± 0.44	700	0.15
Fluoride (mg)	6.4 ± 9.7	2	322.0
Iodine (mcg)	18.5 ± 16.6	120	15.5
Iron (mg)	8.9 ± 2.5	8	111.5
Magnesium (mg)	277.6 ± 60.1	240	115.7
Manganese (mg)	3.3 ± 1.3	1.9	171.1
Molybdenum (mcg)	20.4 ± 43.0	34	60.0
Phosphorus (mg)	1220.8 ± 190.6	1250	97.7
Potassium (mg)	2788.5 ± 406.4	2500	111.5
Selenium (mcg)	72.2 ± 23.8	40	180.5
Sodium (mg)	1712.7 ± 692.9	2400	71.4
Zinc (mg)	8.1 ± 2.0	8	101.0

\*Child needs represented by highest DRI value for the age groups included in elementary school (i.e., males, 9-13 years old)

### **Dietary Quality**

Table 3 shows the DQ of the combined SBP, NSLP, FFVP, and ASSP menus summarized and in comparison to the average DQ of the U.S. child's diet for the 2-17 years age group based off of the NHANES 2015-2016 (USDA, 2019a). The combined menus had an average 29.4-point or 54.5% higher HEI score compared to the average HEI score of the 2-17 year-old U.S. child's diet. The combined menus also scored higher than the average U.S. child's diet within each of the HEI components except total protein and seafood/plant protein and hit maximum possible HEI scores within the components of total fruit, whole fruit, dairy, and refined grains. The percentage differences between the combined menus and the average U.S. child's diet in HEI scores range from -16.8%–201.3%. Figure 1 visually compares the HEI scores of the combined menus to the average diet of U.S. children as a percentage of the maximum possible scores within each of the HEI components. Significant differences in HEI scores between the combined menus and the diet of the average U.S. child included whole grains [mean ± standard deviation, menu = 9.9 ± 0.25, U.S. child = 3.3, % difference (menu – U.S. child) = 201.3%, p < 0.001], dairy (menu = 10.0 ± 0.06, U.S. child = 8.1, % difference = 23.2%, p < 0.001), added sugar (menu = 9.8 ± 0.57, U.S. child = 6.4, % difference = 53.5%, p < 0.001), and total score (menu = 83.3 ± 8.0, U.S. child = 53.9, % difference = 54.5%, p = 0.002, partial eta squared = 0.405) favoring higher DQ in the combined menus. There were no significant differences in HEI scores between the combined menus and the diet of the average U.S. child favoring higher DQ in the

U.S. child's diet. Because the combined menus consistently achieved the maximum score for some HEI scoring components, no variation existed in scores, and thus limited the use of statistical analysis to detect differences. However, differences may exist between the combined menus and the diet of the average U.S. child for refined grains (menu = 10.0 ± 0.0, U.S. child = 4.7, % difference = 112.8%) and total fruit (menu = 5.0 ± 0.0, U.S. child = 3.3, % difference = 51.5%).

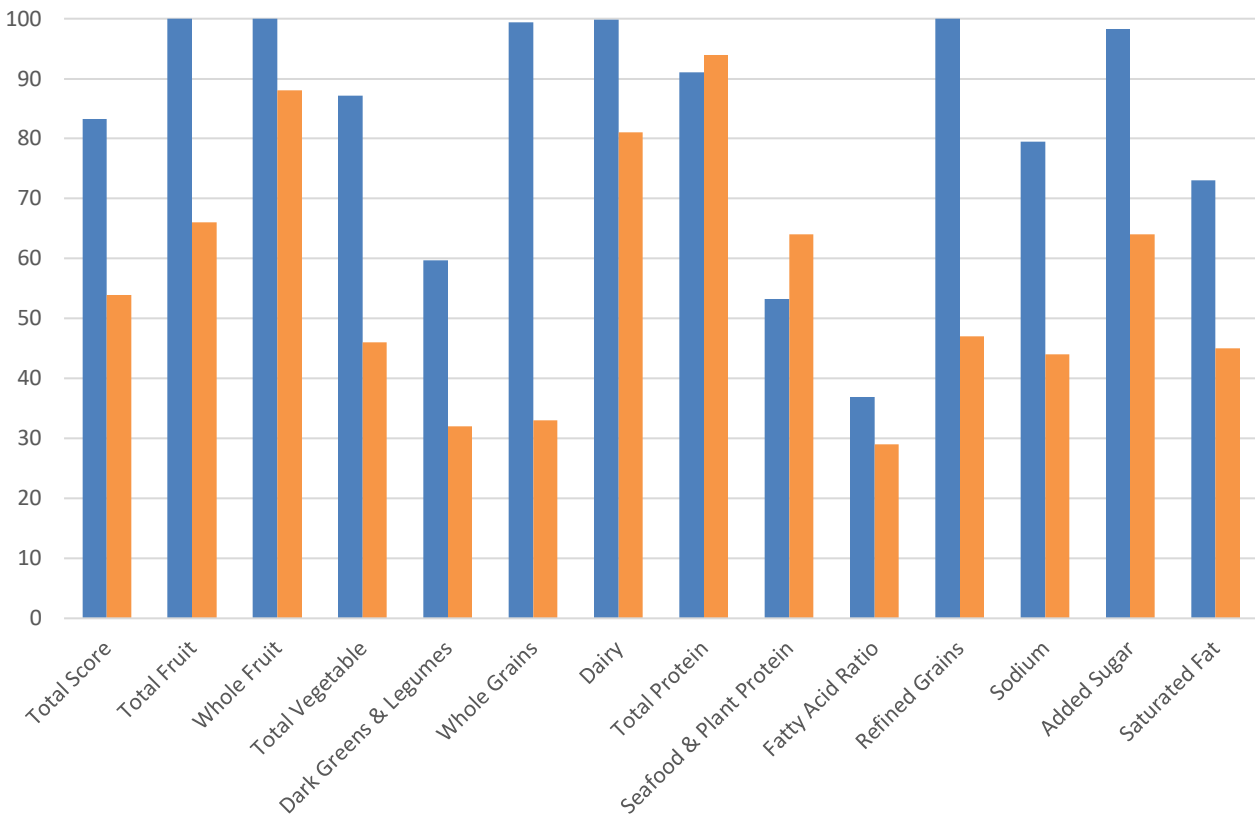
**Table 3.** *Dietary Quality of the Combined SBP, NSLP, FFVP, and ASSP Menus, Summarized and in Comparison to Average Dietary Quality Scores of U.S. Child's Diet [Child (2-17 Years) Age Group, NHANES 2015-2016]*

<b>HEI Scoring Component (Max Score)</b>	<b>Menu Score (mean ± standard deviation)</b>	<b>Average Score for U.S. Child's Diet</b>	<b>Mean Difference (Menu – U.S. Child's Diet)</b>	<b>% Difference (U.S. Child's Diet / Mean Diff. * 100)</b>	<b>p-value</b>
Total Fruit (5)	5.0 ± 0.0	3.3	1.7	51.5	
Whole Fruit (5)	5.0 ± 0.0	4.4	0.6	13.6	
Total Vegetable (5)	4.4 ± 1.1	2.3	2.1	89.5	0.086
Dark Greens/Legumes (5)	3.0 ± 2.5	1.6	1.4	86.7	0.595
Whole Grains (10)	9.9 ± 0.25	3.3	6.6	201.3	<0.001*
Dairy (10)	10.0 ± 0.06	8.1	1.9	23.2	<0.001*
Total Protein (5)	4.6 ± 0.70	4.7	-0.15	-3.1	0.840
Seafood/Plant Protein (5)	2.7 ± 2.5	3.2	-0.54	-16.8	0.835
Fatty Acid Ratio (10)	3.7 ± 3.2	2.9	0.80	27.4	0.812
Refined Grains (10)	10.0 ± 0.0	4.7	5.3	112.8	
Sodium (10)	8.0 ± 2.5	4.4	3.6	80.7	0.189
Added Sugar (10)	9.8 ± 0.57	6.4	3.4	53.5	<0.001*
Saturated Fat (10)	7.3 ± 2.6	4.5	2.8	62.2	0.302
Total (100)	83.3 ± 8.0	53.9	29.4	54.5	0.002*

\*Indicates significant difference ( $p < 0.05$ )



**Figure 1.** Comparison of HEI Scores of the Combined Menus (SBP, NSLP, FFVP, ASSP; in blue) and of the Average Diet of U.S. Children (in orange), As % of Max Possible Score for Each HEI Component.



In a study by Joyce et al. (2018), researchers found that the average total HEI scores of a typical school lunch menu meeting minimum NSLP standards was  $75.1 \pm 5.8$ . The current study used actual cycle menus and recipes to create the study menus, however instead of including just the NSLP, the current study included all four Child Nutrition Programs that can be implemented consistently and collectively each school day (SBP, NSLP, FFVP, ASSP) in the analysis. The results of the current study support the high HEI score provided through the NSLP and adds to the literature by also showing how increasing participation in Child Nutrition Programs in addition to the NSLP will lead to even higher average HEI scores of children's diets.

Furthermore, in a study by Patel et al. (2020), researchers found that school lunch (NSLP) menus created under the Healthy, Hunger-Free Kids Act (HHFKA) initiatives scored higher in total HEI scores and within components of total fruit, total vegetable, dark greens/legumes, whole grains, dairy, refined grains, added sugar, and saturated fat and scored lower within the component of seafood/plant protein compared to the average HEI score for the U.S. child's diet. The majority of the findings from Patel et al. (2020) support and agree with those from the current study. Findings from Patel et al. (2020) that do not coincide with those from the current study include that they found higher HEI scores within the total protein component and lower scores within whole fruit, fatty acid ratio, and sodium components compared to the average HEI scores for the U.S. child's diet. The latter disagreement in lower scores indicates areas in which participating in additional Child Nutrition Programs can further improve DQ of the average U.S. child's diet.

## CONCLUSIONS AND APPLICATIONS

The current analysis is the first study known to look at the overall, collective nutrition provided by the four Child Nutrition Programs that can be implemented consistently and collectively each school day (SBP, NSLP, FFVP, ASSP) and to determine the DQ achieved collectively by serving these four Child Nutrition Programs throughout the school week. As evident from the findings of the current study, higher total and subcomponent DQ scores compared to those of the average U.S. child's diet can be achieved using publicly available menus following the HHS/USDA guidelines. Previous studies have looked at the impact of improved DQ on children's lives in relation to health, academic performance, and later life outcomes. These studies have found:

- Lower DQ scores were significantly associated with overweight prevalence in children and normal weight children had higher DQ scores than overweight and obese children (Perry et al., 2015). Continued exposure to diets of lower DQ from six months of age to six years of age were strongly associated with higher adiposity at six years of age (Okubo et al., 2015).
- Significant relationships between low DQ and/or poor dietary patterns with poor mental health and high DQ with better mental health in children (O'Neil et al., 2014).
- Lower DQ scores measured using the Baltic Sea Diet Score were associated with poorer cognition in children (Haapala et al., 2015).
- School lunch interventions focused on improving DQ have positive impacts on children's alertness in the classroom (Golley et al., 2010).
- After implementing a healthy eating campaign in schools to raise DQ, children's academic performance significantly improved in areas of English and science and school absences decreased by 14% (Belot & James, 2011).
- Lower DQ scores were associated with higher rates of all-cause mortality and that higher DQ scores may have a moderate protective effect, as evidence by reducing all-cause mortality by 17-42%, cardiovascular disease mortality by 18-53%, cardiovascular disease risk by 14-28%, cancer mortality by 13-30%, and all-cancer risk by 7-35% (Wirt & Collins, 2009). Consuming diets of high DQ during adolescence was associated with lower risk of developing cardiovascular disease and related risk factors later in life (Dahm et al., 2016).
- With the combined menus having a higher DQ score than that of the average U.S. child's diet, participating in these four programs combined would likely increase DQ scores of children's diets and potentially decrease the risk of overweight and obesity and contribute to improved mental health, improved cognition, improved alertness in the classroom, improved academic performance, decreased absences, and decreased risk of chronic disease in adulthood.

The results of the current study, as well as previously mentioned studies, support why school districts should implement all four Child Nutrition Programs that can be implemented consistently and collectively each school day (SBP, NSLP, FFVP, ASSP) to achieve the highest possible DQ scores for children, which will ultimately improve children's health, academic performance, and later life outcomes.

The results of the current study show that when all four Child Nutrition Programs that can be implemented consistently and collectively each school day (SBP, NSLP, FFVP, ASSP) are implemented within school districts, the corresponding average total HEI score is higher than the

average score for the U.S. child's diet and is higher than the average total HEI score for the NSLP alone. This study provides compelling information for school districts and supports why school districts should implement all four Child Nutrition Programs within their schools if possible, especially those in low-income areas, to provide children with the highest DQ meal patterns.

## **LIMITATIONS AND FUTURE RESEARCH**

### **Limitations**

Limitations of this study regarding the menus were that they were representative of Oklahoma and may not be representative of the broader United States. In general, there is lower consumption of seafood proteins in Oklahoma, which may have contributed to lower scores within the HEI seafood/plant protein components. In addition, unpublished research shows that Cooking for Kids menus score on average 5 points higher in total HEI scores compared to typical school menus. Utilizing this program's menus and recipes for the SBP and NSLP may have slightly inflated DQ scores of the combined menus. Additional limitations of this study include that some nutrients included are so highly individualized to personal demographics (i.e., calories) that DRIs could not be assumed for comparison within the study. Because the combined menus frequently achieved maximum scores with no variation existing, certain statistic tests were unable to assess for differences. Lastly, the results showed that vitamin D was surprisingly low despite milk being served daily within the SBP and NSLP programs and also occasionally through the ASSP. This may have been due to the specific ESHA code used for milk and/or due to lack of fortifying with vitamin D

### **Directions for Future Research**

Future research should focus on performing nutrient and DQ analyses on menus that are more representative of the broader US to determine the overall nutrition and DQ of the menus in comparison to child daily nutrient needs and the average HEI score of the U.S. child's diet. Building off this study, future research should also look at the feasibility in terms of food costs and staffing needs required if schools were to implement all four Child Nutrition Programs (SBP, NSLP, FFVP, ASSP). Lastly, future research should look within schools that have implemented all four Child Nutrition Programs in comparison to schools that have only the SBP and NSLP implemented to determine the proportion of children participating within the Child Nutrition Programs, the food waste accumulated, if any, and the impact that these programs have individually and collectively on children's health, academic performance, and later life outcomes.

### **Implications for Practice**

The results of this study support that when all four Child Nutrition Programs that can be implemented consistently and collectively each school day (SBP, NSLP, FFVP, ASSP) are implemented within schools, the proportion of child daily nutrient needs that they collectively provide range from 0.15%–403.7% with an average proportion of 124.0% of nutrient needs provided. This implies that it may be beneficial for schools to implement all four of these programs to greatly contribute to children's daily nutrient needs. Implementing these programs would be especially beneficial in districts with a high number of students who qualify for free or reduced-price meals where children may not be provided with adequate nutrition outside of school. Data from 2020–2022 show that approximately 94% of all U.S. schools participate in the SBP, 95% in the NSLP, and 8,062 schools participate in the ASSP (FRAC, 2020; FRAC, 2021;

FRAC, 2022). Data on participation in the FFVP is limited. This study also provides support for Child Nutrition Programs and shows that they, on average, surpass child daily nutrient needs (average proportion of 124.0%). Additionally, when all Child Nutrition Programs that can be implemented consistently and collectively each school day are implemented, they result in an almost 30-point or 55% higher HEI score compared to the average HEI score of the 2–17-year-old U.S. child’s diet. These findings differ from common media reports that state that parents do not feel as though their children are being provided with adequate food and nutrition within schools since the HHFKA has been introduced. Patel et al. (2020) found that total HEI scores of school lunch (NSLP) menus increased by 20.5 points from  $47.9 \pm 11.3$  from the School Meal Initiatives (SMI) to  $68.4 \pm 10.0$  after the HHFKA was introduced. This increase supports the new initiatives brought by the HHFKA within school lunches.

This study’s findings along with those from Patel et al. (2020) support that the HHFKA initiatives are beneficial to children and bring the average HEI score for NSLP meals above the average HEI score of the U.S. child’s diet, which needs improvement (Gibson, 2005). When creating best practice menus for the NSLP, Patel et al. (2020) found that this action raised HEI scores by 11 points from 68 for HHFKA-qualifying NSLP menus to 79 for best practice NSLP menus. Comparing these results from Patel et al. (2020) to those of this study, which found that the average HEI score from the combined program menus was 83, supports why school districts should implement all four of these Child Nutrition Programs to continually raise the average HEI score of children’s diets. Finally, this study contributes to one of the recommended specific strategies for maximizing support for comprehensive nutrition programs and services in schools by the Academy of Nutrition and Dietetics, the Society for Nutrition Education and Behavior, and the School Nutrition Association by performing “quantitative and qualitative research documenting school nutrition program effectiveness” (School Nutrition Association, 2018). The results of this cross-sectional content analysis support the effectiveness of school Child Nutrition Programs and show that they greatly contribute to child daily nutrient needs and help achieve higher total and subcomponent DQ scores compared to those of the average U.S. child’s diet. Despite the possible benefits of serving all four Child Nutrition Programs, it should be noted that feasibility (i.e., labor, equipment, and food cost.) may be a barrier for many schools.

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## BIOGRAPHY

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## APPENDICES

### Appendix A. *Experimental Menus for All Four Child Nutrition Programs*

Week #: 1

\*Grades K-5

<b>SBP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1c)</b>	1c Grapes	1c Strawberries	1c Melon	1c Kiwi	1c Mango
<b>Grain (2oz, or 1oz Grain + 1oz Meat/Meat Alternative)</b>	1 piece Cowboy Muffin	1 square French Toast Bread Pudding (WG)	1 Peach Muffin (WG)	1 Oatmeal (WG)	1 Apple Cinnamon Muffin (WG)
<b>Milk (1c)</b>	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk
<b>NSLP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1/2c)</b>	1/2c Apple Slices	1/2c Pineapple	1/2c Grapes	1/2c Pear	1/2c Banana
<b>Vegetable (3/4c)</b>	1 Serving or 1/2c Kale Salad, (1/4c Red/Orange Vegetable)	1 Serving or 1/2c of Pico, 1 Serving or 1/2c Bean Medley	1 1/2 Serving or 3/4c Asian Corn Salad	1 1/2 Serving or 3/4c Italian Roasted Broccoli	1 1/2 Serving or 3/4c Italian Roasted Cauliflower
<b>Meat/Meat Alternative (2oz or 14g Protein)</b>	1 Serving or 1/2c of Bolognese (2oz Meat)	1 Serving or 3/4c Southwest Quinoa Enchilada (2oz Meat)	1 Serving or 1/2c Honey Sriracha Chicken (2oz Meat)	1 1/3 Serving or 1c Mac N Cheese (2oz Meat)	1 Serving or 1/2c Meatloaf Burger (2oz Meat)
<b>Grain (2oz on 4 Days, 1oz on 1 Day)</b>	1c Cooked Pasta (WG)	(2oz Grain) (WG)	1 Serving or 1/2c Brown Rice (1oz Grain) (WG)	(2oz Grain) (WG)	(2oz Bun in Recipe) (WG)
<b>Milk (1c)</b>	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk
<b>FFVP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit or Vegetable (1/2c, Daily)</b>	1/2c Cranberries	1/2c Zucchini Sticks	1/2c Pineapple	1/2c Cherry Tomatoes	1/2c Peaches
<b>ASSP Component (Must Include 2 of the 4)</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1/2c) or Vegetable (3/4c)</b>	1/2c Strawberries		3/4c Carrots	1/2c Apples	3/4c Salsa

**Appendix A. Experimental Menus for All Four Child Nutrition Programs**

<b>Grain (1oz)</b>		~5 Graham Crackers (WG)			10-12 (1oz) Tortilla Chips (WG)
<b>Meat/Meat Alternative (1oz)</b>	4oz Yogurt		2tbsp Hummus	2tbsp Peanut Butter	
<b>Milk (1c)</b>		1c Fat-Free Plain Milk			

Week #: 2

\*Grades K-5

<b>SBP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1c)</b>	1c Grapes	1c Strawberries	1c Melon	1c Kiwi	1c Mango
<b>Grain (2oz, or 1oz Grain + 1oz Meat/Meat Alternative)</b>	1 Breakfast Burrito (WG)	1 Honey Almond Granola Bar (WG)	1 Sausage English Muffin (WG)	2 Apple Breakfast Bars (WG)	1 Honey Chicken Biscuit (WG)
<b>Milk (1c)</b>	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk
<b>NSLP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1/2c)</b>	1/2c Apple Slices	1/2c Pineapple	1/2c Grapes	1/2c Pear	1/2c Banana
<b>Vegetable (3/4c)</b>	1 Serving or 1/2c Braised Kale, (1/4c Red/Orange Vegetable from Sauce)	1 1/2 Serving or 3/4c Roasted Autumn Vegetables	1 Serving or 1c Spinach Salad with Roasted Vegetables, (1/4c Red/Orange Vegetable from Sauce)	1 Serving or 1/2c Candied Sweet Potato (1/4c Red/Orange Vegetable from Carrots, 1/4c Legume from Peas)	1 1/2 Serving or 3/4c Roasted Corn
<b>Meat/Meat Alternative (2oz or 14g Protein)</b>	1 Serving or 1 Chicken Parmesan Sandwich (2oz meat)	2/3 Serving or 1/2c Beef Lo Mein (1oz Meat)	1 Serving or 3/4c Spaghetti and Meatballs (2oz Meat)	1 Serving or 3/4c Chicken Pot Pie (2oz Meat)	1 Serving or 1/2c Sloppy Joe (2oz Meat)
<b>Grain (2oz on 4 Days, 1oz on 1 Day)</b>	(2oz Grain) (WG)	(1oz Grain) (WG)	(2oz Grain) (WG)	(2oz Grain) (WG)	(2oz Grain) (WG)
<b>Milk (1c)</b>	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk
<b>FFVP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit or Vegetable (1/2c, Daily)</b>	1/2c Figs	1/2c Carrot Strips	1/2c Apples	1/2c Cucumbers	1/2c Grapes
<b>ASSP Component (Must Include 2 of the 4)</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1/2c) or Vegetable (3/4c)</b>	3/4c Broccoli Salad	1/2c Bananas			



**Appendix A. Experimental Menus for All Four Child Nutrition Programs**

<b>Grain (1oz)</b>	0.8oz Pretzels		1 Small Pita Bread (WG)	1c Cheerios (WG)	1/4c Granola (WG)
<b>Meat/Meat Alternative (1oz)</b>		2tbsp Peanut Butter	2tbsp Hummus		4oz Yogurt
<b>Milk (1c)</b>				1c Fat-Free Plain Milk	

Week #: 3

\*Grades K-5

<b>SBP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1c)</b>	1c Grapes	1c Strawberries	1c Melon	1c Kiwi	1c Mango
<b>Grain (2oz, or 1oz Grain + 1oz Meat/Meat Alternative)</b>	1 1/3 pieces of Sunshine Muffin (WG)	1 square French Toast Bread Pudding (WG)	1 Chocolate Chip Muffin (WG)	1 Apple Cinnamon Baked Oatmeal (WG)	1 Blueberry Muffin (WG)
<b>Milk (1c)</b>	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk
<b>NSLP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1/2c)</b>	1/2c Apple Slices	1/2c Pineapple	1/2c Grapes	1/2c Pear	1/2c Banana
<b>Vegetable (3/4c)</b>	1 Serving or 1/2c Stir Fried Cabbage, (1/2c Red/Orange Vegetable from Chicken)	1 Serving or 1/2c Garlic Steamed Broccoli (1/4c Other Vegetable from Tacos)	1 1/2 Serving or 3/4c Carrot Raisin Apple Salad	1 1/2 Serving or 3/4c Stir Fried Cabbage (1/4c Other Vegetable from Lettuce Cups)	1 Baked Potato (1c Starchy Vegetable)
<b>Meat/Meat Alternative (2oz or 14g Protein)</b>	1 Serving or 1/2c Orange Chicken (2oz Meat)	1 Serving or 1 Caribbean Pork Taco (2oz Meat)	1 Serving or 4 Each Meatball Sub Sandwich (2oz Meat)	1 Serving or 1/2c Stir Fry Beef Lettuce Cups (2oz Meat)	1 Serving or 3/4c Vegetarian Chili (1.75oz Meat)
<b>Grain (2oz on 4 Days, 1oz on 1 Day)</b>	1 Serving or 1c Lo Mein Street Noodles (2oz Grain) (WG)	(2oz Grain) (WG)	(2oz Grain) (WG)	1 Serving or 1/2c Cilantro Lime Rice (1oz Grain) (WG)	2oz Low Sodium Whole Wheat Crackers (WG)
<b>Milk (1c)</b>	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk
<b>FFVP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit or Vegetable (1/2c, Daily)</b>	1/2c Sugar Snap Peas	1/2c Sweet Potato Cubes	1/2c Bananas	1/2c Red Peppers	1/2c Grapefruit
<b>ASSP Component (Must Include 2 of the 4)</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1/2c) or Vegetable (3/4c)</b>	1/2c Strawberries		3/4c Cucumber	1/2c Grapes	
<b>Grain (1oz)</b>	1/2c Oatmeal (WG)	1oz Crackers (WG)		0.8oz Goldfish Crackers	0.8oz Pretzels
<b>Meat/Meat Alternative (1oz)</b>		2tbsp Peanut Butter	4oz Yogurt Ranch Dip		1oz Mozzarella Cheese Stick
<b>Milk (1c)</b>					

**Appendix A. Experimental Menus for All Four Child Nutrition Programs**

Week #: 4

\*Grades K-5

<b>SBP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1c)</b>	1c Grapes	1c Strawberries	1c Melon	1c Kiwi	1c Mango
<b>Grain (2oz, or 1oz Grain + 1oz Meat/Meat Alternative)</b>	1 Breakfast Burrito (WG)	2 Granola Bars (WG)	1 Sausage English Muffin (WG)	2 Pumpkin Breakfast Bars (WG)	1 Banana Cranberry Muffin (WG)
<b>Milk (1c)</b>	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk
<b>NSLP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1/2c)</b>	1/2c Apple Slices	1/2c Pineapple	1/2c Grapes	1/2c Pear	1/2c Banana
<b>Vegetable (3/4c)</b>	1 1/2 Serving or 3/4c Roasted Butternut Squash	1 1/2 Serving or 3/4c Greek Salad	1 1/2 Serving or 3/4c Roasted Red Potatoes	1 Serving or 3/4c Garden Salad	1 Serving or 1/2c Refried Beans, 1/2 Serving or 1/4c Pico De Gallo
<b>Meat/Meat Alternative (2oz or 14g Protein)</b>	1 1/3 Serving or 1c of Chicken and Noodles (2oz Meat)	1 Serving or 1/2c of Meat Loaf (2oz Meat)	1 Serving or 2 Chicken Teriyaki Drumsticks (2oz Meat)	1 1/3 Serving or 1c of Chicken Spaghetti (2oz Meat)	1 Serving or 2 Green Chili Pork Tacos (2oz Meat)
<b>Grain (2oz on 4 Days, 1oz on 1 Day)</b>	1 1/3 Serving or 1c of Chicken and Noodles (2oz Grain)	1 Serving or 1 Whole Wheat Roll (2oz Grain)	1/2 Serving or 1/2c of Lo Mein Street Noodles (1oz Grain)	1 1/3 Serving or 1c of Chicken Spaghetti (2oz Grain)	1 Serving or 2 Green Chili Pork Tacos (2oz Grain)
<b>Milk (1c)</b>	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk	1c Low Fat Milk
<b>FFVP Component</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit or Vegetable (1/2c, Daily)</b>	1/2c Dragon Fruit	1/2c Green Bell Pepper	1/2c Pears	1/2c Broccoli	1/2c Oranges
<b>ASSP Component (Must Include 2 of the 4)</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Fruit (1/2c) or Vegetable (3/4c)</b>		3/4c Celery			1/2c Grapes
<b>Grain (1oz)</b>	1oz Crackers (WG)		1/4c Granola (WG)	1 Slice Bread (1oz) (WG)	
<b>Meat/Meat Alternative (1oz)</b>	1 Slice Cheddar Cheese (1oz)	2tbsp Peanut Butter		1 Slice Lunch Meat	1oz Cheddar Cheese Cubes
<b>Milk (1c)</b>			1c Fat-Free Plain Milk		

## **Appendix B. Menu Assumptions**

### **Breakfast Notes:**

- 2-week cycle menu with 2 options for most days → weeks 1 and 2 go through the cycle menu using the first option every day there is a choice, weeks 3 and 4 go through the cycle menu using the second option every day there is a choice
- Menu only specifies “fresh fruit,” so a pattern of fresh fruits typical in schools and meeting good menu planning principles was developed and repeated

### **Lunch Notes:**

- Week 2 does not meet NSLP requirements for legume. Will leave be as meeting daily minimum and all other vegetable categories, also do not have recipe to fit for day.
- No grain on week 3 Friday – add low-sodium whole wheat crackers as a complimentary grain to ensure a complete meal for the day.

### **FFVP Notes:**

- Contacted local FSD to the (blinded for review) area
- Those that reported participating said they provide 1/4-1/2c on 4-5d/wk
- Special, more expensive items (4x/mth) = cranberries, figs, Meyer lemons, sugar snap peas, mango, blood oranges, Jicama, dragon fruit, etc.
- Less expensive, normal items = zucchini sticks, sweet potato sticks, pineapple, kiwi, bell pepper strips, mini peppers, grapes, cherry tomatoes, apples, baby carrots, cucumbers

### **ASSP Notes:**

- Ideas:
  - Apples, peanut butter
  - Grapes, cheddar cheese cubes
  - Milk, graham crackers
  - Celery, peanut butter
  - Carrots, hummus
  - Granola, milk
  - Strawberries, yogurt
  - Cheerios, milk
  - Goldfish crackers, grapes
  - Pretzels, mozzarella cheese stick
  - Tortilla chips, salsa
  - Crackers, cheddar cheese slices
  - Crackers, peanut butter
  - Hummus, pita bread
  - Bread, lunch meat
  - Cucumber, yogurt ranch dip
  - Broccoli salad, pretzels
  - Oatmeal, strawberries
  - Yogurt, granola
  - Peanut butter, banana