Food assistance programs for children afford mixed dietary quality based on HEI-2010

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Dietary Quality of Weekend Food Assistance Programs for Children Better than the American Food Supply

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1. Introduction

In 2012, 20% of households with children in the United States (US) identified as food insecure, which compromises their physical, mental, behavioral, and emotional health [1-4]. Further, emerging evidence shows that children from food insecure households are at risk for overweight and obesity, likely persisting into adulthood [2,5-7].

Both federal policies (e.g., Healthy, Hunger-Free Kids Act of 2010) and community driven strategies exist to provide supplemental food assistance to food insecure children and their families [8,9]. For instance, the BackPack Program, which is run by Feeding America, works through food banks across the US to serve 230,000 children annually [10]. Communities around the US have implemented models of this program which distribute non-perishable and easy-to-prepare food items to potentially food insecure school students on Fridays in a backpack to help reduce weekend hunger [11,12]. The intention of the backpack program model is to supplement the food insecure participant with food items over a weekend, in addition to what the potentially food scarce home is able to provide.

While some supplemental food assistance programs have been shown to increase fruit and vegetable purchasing, fruit and vegetable consumption, and juice consumption among low-income women, scant information is available regarding the impacts of backpack programs on dietary behaviors of children [13-15]. A major determinant of healthy food intake among children is the availability and accessibility of these foods within their food environment [16–18]. Assessing the dietary quality of the foods offered as part of supplemental food assistance programs is one way to better understand whether healthy foods are made available and accessible to children.

The Healthy Eating Index-2010 (HEI-2010), which measures compliance with the 2010 Dietary Guidelines for Americans, is a potential tool to assess the diet quality of foods provided in supplemental food assistance programs, such as the BackPack program [19,20]. The Healthy Eating Index-2005 (HEI-2005), which preceded HEI-2010, has been utilized to assess the diet quality of foods consumed or offered for individual-level diets, community-, environmental-, and population-level data and other programs and settings [21-23]. For example, the US food supply received a score of 55 out of 100 in an analysis utilizing HEI-2005. Basiotis (2002) proposed that HEI scores > 80 suggest a "good" diet, HEI scores < 51 indicate a "poor" diet, and HEI scores in between "need improvement" [24]. The Center for Nutrition Policy and Promotion (CNPP) created HEI-2010 with the ability to assess nutrition intervention programs, food assistance packages, menus, and the US food supply [20].

Currently, no peer-reviewed published studies exist that analyze the diet quality of foods offered in the BackPack or similar programs, including utilizing HEI-2010 methodology [19]. The purpose of this study was to utilize HEI-2010 to evaluate the diet quality of foods offered in one state's backpack programs. These results may help to inform strategies for other large-scale, supplemental food assistance programs to improve diet quality among low-income and food insecure children. We hypothesized that resulting HEI-2010 scores would be of average dietary quality in a cross sectional sample of menus from backpack programs.

2. Methods and Materials

This study was conducted utilizing data collected from all existing backpack programs across the state of Montana. The Montana Food Bank Network (MFBN) first initiated the Feeding America BackPack Program model in 2008 [25]. Four other Montana food banks have adopted the same

66 model (i.e., Kid Packs, BackPack Program, Backpack for Kids, and Kids Pack Program).
67 Backpacks of food were distributed to 70 schools (reaching a total of 2,889 students) in 2011-
68 2012 every Thursday or Friday across Montana. The five programs are referred to as Montana
69 backpack programs throughout the remainder of the paper.

70 For the current study, participating Montana backpack programs first provided researchers with
71 at least four weeks of backpack menus from the 2011-2012 academic year. To measure diet
72 quality of foods in the Montana backpack programs, researchers then randomly selected one
73 weekly menu using a cross sectional approach. Weekly menus within the Montana backpack
74 programs were fairly standard, with the same general types and quantities of foods being offered
75 (e.g., Chef Boyardee, beef ravioli in tomato and meat sauce, canned or Chef Boyardee, Spaghetti
76 and Meatballs, canned). Researchers confirmed with each program that the menu provided was
77 representative of food items offered each week. Analysis occurred in 2013. The [blinded]
78 Institutional Review Board declared the study exempt, since no personal and/or identifying
79 information was collected.

80 ***2.1. Measurement***

81 This study utilized the HEI-2010 to measures conformance with the 2010 Dietary Guidelines for
82 Americans [19,26]. Methods for the development and validation and researcher use for HEI-
83 2010 are explained on the United States Department of Agriculture's (USDA) website [27].
84 Analysis using HEI-2010 results in an overall diet quality index, which is made up of 12
85 components for a total of 100 points [26] (Table 1). The sum of the scores for the 12 components
86 is the total HEI-2010 score, which ranges from 0 to 100, with a higher score indicative of a more
87 healthful diet. Of the 12 components, nine assess adequacy of the diet regarding total fruit, whole

88 fruit, total vegetables, greens and beans (dark green vegetables and legumes that were not
89 already counted as protein foods), whole grains, dairy, total protein foods, seafood and plant
90 proteins, and fatty acids ((polyunsaturated fatty acids + monounsaturated fatty acids): saturated
91 fatty acids) [26]. The other three components assess foods and nutrients that should be consumed
92 in moderation: refined grains, sodium, and empty calories (i.e., energy from solid fats, alcohol,
93 and added sugars) [26]. With the exception of the fatty acids ratio, HEI-2010 scores use
94 standards that are expressed as either a percent of calories or per 1,000 calories, separating diet
95 quality from quantity [26,27].

96 ***2.2. Statistical Analyses***

97 A series of steps occurred in order to determine HEI-2010 component and total scores for the
98 Montana backpack programs. First, each menu item with package size was entered into
99 Nutritionist Pro Diet Analysis Module (version 2.5; Axxya Systems, Stafford, TX, USA) and
100 analyzed for nutrient composition (Table 2). Concurrently, the USDA What's In The Foods You
101 Eat online search tool (version 5.0) [28] was utilized to assign the best matched USDA food
102 code to each menu item (Table 2). Next, MyPyramid Equivalents Database for USDA Survey
103 Food Codes, 2003-2004 Version 2 was then used to assign MyPyramid major food groups and
104 subgroups equivalents to each menu item. Finally, HEI-2010 component and total scores were
105 estimated using published SAS code (version 9.2 SAS Institute Inc., Cary, NC) [20]. Following
106 the methodology outlined by Erinosho and colleagues [29], the following analyses were
107 conducted: 1) means and standard deviations (±SD) were calculated to generate both HEI-2010
108 component scores and 2) total scores across all menus and t-tests were calculated to assess
109 whether mean HEI-2010 component scores and total scores differed significantly ($P < .05$) from
110 the maximum scores. Montana backpack program scores were compared to HEI-2010 maximum

recommended scores to measure conformance with the 2010 Dietary Guidelines for Americans, an achievable set of recommendations designed to promote health and prevent disease in the US population [19,26].

3. Results

Table 3 describes the HEI-2010 component and total scores for foods and beverages provided to children in the Montana backpack programs. The total HEI-2010 scores ranging from 41.90 to 75.14 across all five program menus. The mean total HEI-2010 score for the combined Montana backpack program was significantly lower than total HEI-2010 total maximum score of 100 (mean=58.65$\pm$15.59; $P = .004$). Mean scores for total vegetables (mean=2.26$\pm$1.37; $P = .011$), greens and beans (mean=0$\pm$0; $P < .001$), fatty acids (mean=0$\pm$0; $P < .001$), and sodium (mean=3.90$\pm$2.52; $P = .006$) were all significantly lower than the maximum values (5, 5, 10, and 10, respectively). Remaining component scores were not statistically significantly lower than the respective maximum scores.

Contributing to the combined Montana backpack program HEI-2010 score, three program menus (60%) met the requirements for seafood and plant proteins, refined grains, and empty calories. Two of five (40%) of the menus achieved the maximum score for total fruit, whole fruit, and whole grains. One of five (20%) of the menus achieved the maximum score for dairy. None (0%) of the menus achieved the maximum score for total vegetables, greens and beans, total protein foods, fatty acids, and sodium.

4. Discussion

Many children in Montana and around the nation participate in backpack programs to supplement their food intake over the weekend [11-12,25]. For many program participants, their

ability to meet nutrition requirements during the weekend depends on the quality of foods provided in weekend backpacks. The research supports the hypothesis that HEI-2010 were of average dietary quality in a cross sectional sample of backpack programs. The food items provided in this nationwide program and similar programs may be contributing to emerging evidence that poverty and food insecurity are not necessarily predictive of nutritional outcomes in children [30,31].

The HEI-2010 mean total score of 59 for the Montana backpack programs was slightly better than the American food supply (HEI-2005 score of 55) [22]. However, it was still statistically significantly lower than the maximum score of 100 and fell well below a "good" score of 80 [29]. Further, it scored similarly to HEI-2005 score for several groups that have marked overweight, obesity, and nutrition-related chronic diseases [32,33]: American children scored between 54.7 and 59.6 [34]. America adults scored 57.5 [21], and an American supplemental food assistance program scored between 55 and 58 [35]. Scores for each of the five programs in the current ranged from 42 to 75, demonstrating a wide variation in dietary quality. It would be beneficial to make nutrient-rich foods consistently available and accessible across programs [2,5-7].

Prior research has demonstrated a relationship between participation in food assistance programs and other supplemental food programs (e.g. school breakfast) and an increase in food security among children [36,37]. Though information on dietary behavior, especially among children, is limited [36], research shows that increasing promoting access to healthy foods is likely to increase consumption [18]. Specifically in the backpack programs in this current study, increasing the provision of total vegetables, greens and beans, fatty acids while decreasing sodium could enhance the diet quality of Montana backpack programs. Providing dried or

canned vegetables that are appealing to consume such as kale chips or hummus may increase dietary quality in backpack programs. Although the backpack program is limited in providing fresh fruits, vegetables, or other foods consistently due to distribution and storage schedules, programs could focus on providing a variety of non-perishable and easy-to-prepare foods that are high in nutrients. HEI-2010 does not value fresh over other types of preserved foods in calculating diet quality scores. For example, canned carrots or fresh carrots on a menu contribute equally to the total HEI-2010 score.

While increasing quality may potentially be challenging due to programs conventionally providing shelf-stable or non-perishable and easy-to-prepare food items, information sharing across programs about which food items adhere closely to 2010 Dietary Guidelines could assist in programs adopting healthier practices [19]. For example, several programs scored adequately in food components including seafood and plant proteins, refined grains, and empty calories, total fruit, whole fruit, and whole grains, and dairy. Together, the five programs have the ability to create a backpack program menu that meets the nutrient requirements in several food groups.

Backpack programs and many other food assistance programs aim to provide food that is supplemental to the participant's diet and not the substance of the participant's entire diet. Furthermore, backpack program participants may potentially share food items with other family members or friends, even though that is not the intention of the program [11]. In these scenarios, the entirety of the participant's dietary quality may not be captured through the HEI-2010 analysis presented in this paper. Even so, it is important for backpack programs and other food assistance programs to provide the highest quality nutrients possible as research shows that low-income individuals are likely to have lower quality diets overall [21].

This study has a few limitations to note. First, the sample of program menus collected from Montana may limit generalizing findings to all supplemental weekend food assistance programs for children in the US. However, all programs were based on the same national model and these findings may be suggestive of a pattern seen across programs in the US. Second, this study assessed foods offered through food assistance packages, which are meant to be supplementary to other foods. Because nutrient values of the food provided in the backpack packages were not provided, the authors estimated these values by determining foods that most closely met the descriptions given from the USDA What's In The Foods You Eat online search tool (version 5.0) [28]. This database is comprehensive and representative of nutrient averages found in the US food supply. The food items served in these programs were single serving items and likely to be consumed over a weekend, but larger or smaller food package sizes may influence the participant's overall dietary quality over varying amounts of times. Lastly, the sample size of backpacks was small. The authors accounted for this limitation by randomizing program menus and checking with programs for representative menus. Despite these limitations, this study adds to the evidence base of information available about the dietary quality of a food assistance package.

This is the first peer-reviewed study to evaluate a weekend supplemental food assistance program for children utilizing HEI-2010 or any other dietary quality measurement tool [20]. Although the programs examined in this study are designed to be supplemental, small improvements in the menu offerings in Montana backpack programs are warranted in order to promote food security and establish healthy eating patterns, while simultaneously reducing risk for obesity. Studies are needed to assess and compare dietary quality in backpack programs in other states and to test participant's acceptance of food items in the backpack program. In

addition, research should focus on increasing what is known about the larger effects of the backpack program on participants' and families' well-being. Practitioners, researchers, and the food industry should explore, compile, and share what healthy, non-perishable, easy-to-prepare, and affordable foods are both suitable for children and backpack program needs.

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Table 1. HEI-2010[a] Components and Scoring Standards

Component	Maximum Value	Standard for Maximum Score[b]	Standard for Minimum Score of Zero
Total Fruit[c]	5	≥0.8 cup equivalent per 1,000 kcal	No Fruit
Whole Fruit[d]	5	≥0.4 cup equivalent per 1,000 kcal	No Whole Fruit
Total Vegetables	5	≥1.1 cup equivalents per 1,000 kcal	No Vegetables
Greens and Beans[e]	5	≥0.2 cup equivalent per 1,000 kcal	No Dark Green Vegetables or Beans and Peas
Whole Grains	10	≥1.5 oz equivalents per 1,000 kcal	No Whole Grains
Dairy[f]	10	≥1.3 cup equivalents per 1,000 kcal	No Dairy
Total Protein Foods[g]	5	≥2.5 oz equivalents per 1,000 kcal	No Protein Foods
Seafood and Plant Proteins[g,h]	5	≥0.8 oz equivalent per 1,000 kcal	No Seafood or Plant Proteins
Fatty Acids[i]	10	(PUFAs+MUFAs)/SFAs >2.5	(PUFAs+MUFAs)/SFAs ≤1.2
Refined Grains	10	≤1.8 oz equivalents per	≥4.3 oz equivalents per 1,000

		1,000 kcal	kcal
Sodium	10	≤1.1 g per 1,000 kcal	≥2.0 g per 1,000 kcal
Empty Calories[j]	20	≤19% of energy	≥50% of energy
Total	100		

[a]HEI=Healthy Eating Index

[b]Intakes between the minimum and maximum standards are scored proportionately.

[c]Includes fruit juice.

[d]Includes all forms except juice.

[e]Includes any beans and peas not counted as Total Protein Foods

[f]Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.

[g]Beans and peas are included here (and not with vegetables) when the Total Protein Foods standard is otherwise not met.

[h]Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as Total Protein Foods.

[i]Ratio of polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) to saturated fatty acids (SFAs).

[j]Calories from solid fats, alcohol, and added sugars; threshold for counting alcohol is >13 g/1,000 kcal.

Table 2. Food Codes, Number Of Items, Food Items, and Package Size for Menus in Montana Backpack Food Assistance Programs

USDA[a] Food Code	No. of Items	Food Item	Package Size (in Grams)
Program Menu 1[b]			
63103120	1	Applesauce, unsweetened, canned	113.4
73102213	1	Carrots, canned	113.4
58130013	1	Chef Boyardee, beef ravioli in tomato and meat sauce, canned	198.4
53542200	2	Granola bar, oat, fruit and nut	34.01
42202000	2	Jif creamy peanut butter	31.2
64100110	1	Juice, fruit blend, 100% juice, with added vitamin c	209.6
58145114	1	Kraft macaroni and cheese, unprepared	175.0
11111160	2	Milk, low fat, 1%	244.0
57602100	1	Oats, raw	30.0
Program Menu 2			
58130013	1	Lasagna with meat, canned	212.6
58160150	1	Red beans and rice	212.6
61213220	1	Tangerine juice, canned, unsweetened	126.8
92530810	1	Grapefruit juice drink with vitamin C added	126.8
57305210	1	Malt-O-Meal Frosted Flakes	28.4
57305500	1	Malt-O-Meal Honey and Nut Toasty O's	28.4

53540200	1	Breakfast bar, cereal crust with fruit filling, lowfat	34.0
53206000	1	Cookie, chocolate chip	39.1
11111160	1	Milk, calcium fortified, cow's, fluid, 1% fat	244.0
Program Menu 3			
11111160	2	Milk, low fat, 1%	244.0
61210250	1	Orange juice, with calcium added, canned, bottled or in a carton, unsweetened	202.5
63103120	1	Applesauce, unsweetened, canned	113.4
74602100	1	Tomato soup, canned, low sodium, ready-to-serve	205.5
58407050	1	Instant soup, noodle with egg, shrimp or chicken	85.0
57123000	1	Cheerios	17.7
57602100	1	Oats, raw	30.0
91708030	1	Fruit leather	14.2
Program Menu 4			
11111160	2	Milk, low fat, 1%	244.0
57123000	1	Cheerios	34.0
42202000	1	Jif creamy peanut butter	31.8
57602100	1	Oats, raw	30.0
54202010	3	Crackers, saltine, low sodium	5.7
58145114	1	Kraft macaroni and cheese, unprepared	56.7
63103120	1	Applesauce, unsweetened, canned	113.4
53542200	1	Granola bar, oats, fruit and nuts, lowfat	34.0
64104010	1	Apple juice	180.0

Program Menu 5

11111160	2	Milk, low fat, 1%	244.0
91708100	1	Fruit snack candy, with added vitamin C	28.0
54401020	1	Salty snacks, corn or cornmeal base, corn chips, corn-cheese chips	60.2
57602100	1	Cheerios	36.9
57349000	1	Frosted Flakes, Kellogg	59.5
92510610	2	Fruit drink	210.0
58132313	1	Pasta with tomato sauce and meat or meatballs, canned	240.0
58130013	1	Chef Boyardee, beef ravioli in tomato and meat sauce, canned	198.4
53544200	1	Granola bar, chocolate-coated	24.0
53542200	1	Granola bar, oats, fruit and nuts, lowfat	35.0

[a]USDA=United States Department of Agriculture

[b]Program menus were randomly selected from backpack programs across the state of Montana. Menus are representative of weekly food item offerings.

Table 3. HEI-2010[a] Component and Total Scores for Foods and Beverages Provided to Children in Five Montana Backpack Food Assistance Programs

Component	Means (±SD)	Range	% Meeting Recommendation (n)
Total Fruit[b]	4.11 (±1.36)	1.74 – 5.00	0.40 (2)
Whole Fruit[b]	2.96 (±2.26)	0.42 – 5.00	0.40 (2)
Total Vegetables[b]	2.26 (±1.37)*	0-3.72	0.00 (0)
Greens and Beans[b]	0.00 (±0.00)***	0.00	0.00 (0)
Whole Grains[b]	7.57 (±2.40)	4.53 - 10	0.40 (2)
Dairy[b]	9.10 (±0.89)	7.79 – 10.00	0.20 (1)
Total Protein Foods[b]	2.93 (±1.89)	0.45 - 4.82	0.00 (0)
Seafood and Plant Proteins[b]	3.13 (±2.56)	0.22 - 5.00	0.60 (3)
Fatty Acids[b]	0.00 (±0.00)***	0.00	0.00 (0)
Refined Grains[c]	6.92 (±4.27)	1.35 – 10.00	0.60 (3)
Sodium[c]	3.90 (±2.52)**	0 - 6.64	0.00 (0)
Empty Calories[c]	15.76 (±6.17)	6.45 – 20.00	0.60 (3)
Total	58.65 (±15.59)**	41.90 - 75.14	--

*Mean scores were significantly different from the maximum recommended scores at the $P < .05$ level.

**Mean scores were significantly different from the maximum recommended scores at the $P <$ .01 level.

***Mean scores were significantly different from the maximum recommended scores at the $P <$ .001 level.

[a]HEI=Healthy Eating Index

[b]Higher score signifies higher consumption as adequate consumption of these foods is encouraged by the 2010 Dietary Guidelines.

[c]Higher score signifies lower consumption as moderate consumption of these foods is encouraged by the 2010 Dietary Guidelines.