



HHS Public Access

Author manuscript

J Acad Nutr Diet. Author manuscript; available in PMC 2014 August 01.

Published in final edited form as:

J Acad Nutr Diet. 2013 August ; 113(8): 1084–1089. doi:10.1016/j.jand.2013.04.026.

Assessing foods offered to children at child-care centers using the Healthy Eating Index-2005

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Abstract

The Healthy Eating Index-2005 (HEI-2005) has been applied primarily to assess the quality of individual-level diets, but was recently applied to environmental-level data. Currently, no studies have applied the HEI-2005 to foods offered in child-care settings. This cross-sectional study used the HEI-2005 to assess the quality of foods/beverages offered to preschool children (three-five years old) in child-care centers. Two days of dietary observations were conducted, and 120 children (six children per center) were observed, at 20 child-care centers in North Carolina between July 2005 and January 2006. Data were analyzed between July 2011 and January 2012 using t-tests. The mean total HEI-2005 score (59.12) was significantly ($p < 0.01$) lower than the optimal score of 100, indicating the need to improve the quality of foods offered to children. All

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CONFLICT OF INTEREST STATEMENTS

Temitope O. Erinosh has no financial disclosures.

Sarah C. Ball has no financial disclosures.

Philip P. Hanson has no financial disclosures.

Amber E. Vaughn has no financial disclosures.

Dianne Stanton Ward has no financial disclosures.

centers met the maximum score for milk. A majority also met the maximum scores for total fruit (17 of 20 centers), whole fruit (15 of 20 centers), and sodium (19 of 20 centers). Mean scores for total vegetable (mean=2.26±1.09), dark green/orange vegetables and legumes (mean=0.20±0.43), total grain (mean=1.09±1.25), whole grain (mean=1.29±1.65), oils (mean=0.44±0.25), and meat/beans (mean=0.44±0.25) were significantly ($p<0.01$) lower than the maximum scores recommended. Mean scores for saturated fat (mean=3.32±3.41; $p<0.01$), and calories from solid fats and added sugars (mean=14.76±4.08; $p<0.01$) suggest the need to decrease the provision of foods high in these components. These findings indicate the need to improve the quality of foods offered to children at the centers to ensure that foods provided contribute to children's daily nutrition requirements.

INTRODUCTION

Dietary behaviors are established in early childhood.¹ During this critical stage, 55% of preschool children (three to five years old) are in center-based child-care programs.² Preschool children spend about 25 hours/week in child-care centers,³ and consume a significant portion of their daily meals in such settings. It is essential that foods provided in childcare centers meet children's daily nutrition requirements for normal growth and development, and maintenance of healthy body weight.⁴ However, study findings indicate that foods offered in child-care centers do not supply an appropriate portion of children's daily requirements for energy and several micronutrients.⁵⁻¹²

Nutrition standards for evaluating foods offered in child-care centers vary,^{5-8, 13, 14} and include the Child and Adult Care Food Program (CACFP) Meal Pattern Requirements, the Dietary Reference Intakes, and the Academy of Nutrition and Dietetics' Benchmarks for Child-care Programs. The CACFP provides recommendations about food components that should be included on child-care center menus, and requires participating centers to provide components from the milk, fruit or vegetable, grain or bread, and meat or meat alternate food groups to children.¹³ The Dietary Reference Intakes (DRIs) define preschool children's daily nutrient requirements by age group; that is, one to three years, and four to eight years old.¹⁵ The Academy of Nutrition and Dietetics' provides recommendations about the proportions of children's daily nutrition requirements that should be supplied by child-care meals and snacks. The Academy of Nutrition and Dietetics' recommends that children consume at least one-third of their daily nutrition requirements at part-time child-care programs (four to seven hours/day), and half to two-thirds of their daily nutrition requirements at full-time child-care programs (eight or more hours/day).¹⁶

The Healthy Eating Index-2005 (HEI-2005) is another potential tool for assessing the quality of foods provided in child-care settings. The HEI-2005 measures compliance with key recommendations of the 2005 Dietary Guidelines and MyPyramid food-guide.¹⁷⁻²⁰ The HEI-2005 is comprised of 12 components, each assessed on a density basis as a percentage of total calories (or amounts per 1,000 calories), and assigned scores using standards established by the United States (US) Department of Agriculture (Table 1).^{17, 18} Nine components (i.e., total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grain, whole grain, milk, meat and beans, and oils) represent foods for

which adequate intake is recommended. Higher scores reflect higher intakes for these components, and intakes meeting or exceeding recommendations are assigned the maximum score. The remaining three components, saturated fat, sodium, and calories from solid fats, alcoholic beverages, and added sugars (SoFAAS), represent aspects of the diet that should be consumed in moderation. For these components, higher scores reflect lower intakes because lower intakes are preferred. Scores assigned to the 12 components are then summed together to generate a total HEI-2005 score ranging from zero to 100.^{17–20}

Researchers have applied the HEI-2005 primarily to assess individual-level diets.^{20–23} Recently, Reedy and colleagues²⁰ showed that the HEI-2005 can also be applied to environmental-level data to assess the quality of foods offered in such settings as restaurants, schools, and hospitals. Currently, no studies have applied the HEI-2005 to menus or foods provided in child-care settings. Nutrition standards used in previous studies of child-care center menus and foods assessed the adequacy of the quantities of foods and beverages offered to and consumed by children by comparing absolute amounts of food groups, calories, and nutrients in the foods/beverages to a proportion of children's daily nutrition requirement (that is, one-third of the daily nutrition requirements for children in part-time child-care programs, and half to two-thirds of the daily nutrition requirements for children in full-time child-care programs).^{5–8, 13, 15, 16} In contrast, the HEI-2005 assesses multiple components of the diet simultaneously, on a density basis, and provides a summary score that describes the overall quality of the diet.²⁰

The purpose of this study was to use the HEI-2005 to evaluate the quality of foods offered (served) to preschool children (ages three to five years) at child-care centers. The hypothesis was that foods and beverages offered to children at the child-care centers would be of average quality, meeting the maximum scores for some, but not all of the HEI-2005 components.

METHODS

Sample

Data for this cross-sectional study were collected between July 2005 and January 2006, prior to a statewide evaluation of the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) intervention.^{24, 25} The NAPSACC intervention was designed to improve the nutrition and physical activity environment in child-care centers, and was evaluated in 84 licensed child-care centers across North Carolina. A subset of 20 centers was randomly selected from the 84 NAP SACC centers to collect observational data about foods and beverages offered/served to preschool children during meals and snacks at the centers. The 20 centers were selected from each of the three regions of North Carolina. Eligible child-care centers were those that provided meals and snacks to children (i.e., children did not bring their food from home). Sixteen of the 20 centers reported participating in the CACFP, the federal food assistance program that reimburses child-care centers for meals and snacks provided to children, and 14 centers cooked meals on-site. The centers had been in operation for an average of 19 years, and enrolled an average of 36 children ages three to five years. No personal information was collected on the children observed. Approval for the study was obtained from the University of North Carolina's Institutional Review Board.

Dietary Observation

Research assistants, trained to use the Dietary Observation for Child Care system²⁶ observed foods and beverages offered to children in one preschool classroom (three to five year olds) at each center. A detailed description of the Dietary Observation for Child Care system used can be found elsewhere.²⁶ Briefly, the types and amounts of foods and beverages served at breakfast or morning snack, lunch, and afternoon snack were recorded for each child observed. Foods not easily discernible were clarified with food service staff. Dietary observations were conducted over a two-day period at each center. On Day One, before breakfast, after most children in the classroom arrived, a research assistant assigned a number to each child randomly, and three children, numbers One, Three, and Five, were observed. On Day Two, the same procedure was followed, excluding children observed on Day One. In all, six children were observed per center (three children per day), for a total of 120 children across all 20 centers. Only three of the 20 centers served at least one meal or snack family-style.

Data Analysis

Foods and beverages offered or served (not consumed) to children were entered into the Nutrition Data System for Research (NDSR) software (version 2005, University of Minnesota, Nutrition Coordinating Center, Minneapolis, MN) to generate ingredients, food groups, calories/energy, and nutrients. Each HEI-2005 component was generated and averaged across two days, following the methodology outlined by Miller and colleagues,²² describing how to calculate the HEI-2005 using NDSR. Total fruit, whole fruit, total vegetable, dark green and orange vegetables and legumes, total grain, whole grain, milk, and the meat and beans components were derived by summing foods that constituted each component, converting each from servings to the appropriate unit of measurement for computing HEI-2005 scores (cups for fruits, vegetables, and milk; ounce equivalents for grains, and meat and beans), and computing averages across two days for each center. Oils were derived by summing grams of total fat from non-hydrogenated oils, fish, nuts and seeds, mayonnaise, oil-based dressings, condiments, and snack items, and averaging these across two days for each center. The output from NDSR was used directly to compute average grams of saturated fat, sodium, and the added sugars subcomponent of SoFAAS. The solid fat subcomponent of SoFAAS was derived by computing excess fat from animal meat and dairy products, total fat from lard and meat drippings, dairy products that are primarily fat (e.g., butter, cream), stick margarine or other unspecified type of margarine with fat content >80%, and total fat from food items where the predominant fat was saturated and/or trans-fat (e.g., gravies, prepackaged cakes, chocolates), summing these for each center, and averaging across two days. These data were exported into the Statistical Analysis Software (SAS, version 9.2, 2008, SAS Institute, Inc., Cary, NC) to calculate HEI-2005 component scores and total HEI-2005 scores for each center, using publicly available SAS codes created by the US Department of Agriculture.²⁷ Means and standard deviations were calculated to generate HEI-2005 component scores and total HEI-2005 scores across all centers. T-tests were computed to assess whether mean HEI-2005 component scores and total HEI-2005 scores differed from the maximum recommended scores, with statistical significance set at $p < 0.05$.

RESULTS

Table 2 describes HEI-2005 component scores and total HEI-2005 scores for foods and beverages provided to children at all 20 child-care centers. The mean total HEI-2005 score was significantly lower than the optimal recommended score (59.12 versus optimal score of 100; $p < 0.01$), with total HEI-2005 scores ranging from 47.30 to 76 across all 20 centers. The mean scores for total fruit (mean = 4.69 ± 0.81 versus optimal score of 5; $p = 0.11$) and whole fruit (mean = 4.70 ± 0.74 versus optimal score of 5; $p = 0.08$) were not significantly different from the maximum recommended scores. At least 15 of the 20 centers met the maximum score for total fruit ($n = 17$ of 20 centers) and whole fruit ($n = 15$ of 20 centers). Mean scores for total vegetable (mean = 2.26 ± 1.09 versus optimal score of 5; $p < 0.01$) and dark green and orange vegetables and legumes (mean = 0.20 ± 0.43 versus optimal score of 5; $p < 0.01$) were significantly lower than the maximum recommended scores, and none of the centers met the maximum scores for both components. Mean scores for whole grain (mean = 1.29 ± 1.65 versus optimal score of 5) and total grain (mean = 1.09 ± 1.25 versus optimal score of 5) were low ($p < 0.01$), and two centers met the maximum score for whole grain, while none met the score recommended for total grain. All centers met the recommendation for milk. Four centers met the maximum score for meats and beans (mean = 6.51 ± 2.75 versus optimal score of 10; $p < 0.01$). None of the centers met the maximum score for oils (mean = 0.44 ± 0.25 versus optimal score of 10; $p < 0.01$). Two centers met the maximum score for saturated fat (mean = 3.32 ± 3.41 versus optimal score of 10; $p < 0.01$), all but one center met the recommendation for sodium (mean = 9.85 ± 0.67 versus optimal score of 10; $p = 0.33$), while four centers met the recommendation for calories from the solid fat and added sugars subcomponent of SoFAAS (mean = 14.76 ± 4.08 versus optimal score of 20; $p < 0.01$).

DISCUSSION

Many children in the US share a significant portion of their daily lives between the child-care center and home,^{2, 3} and such children's ability to meet their daily nutrition requirements is largely dependent on the quality and quantity of foods and beverages provided in child-care centers. This is the first study to use the HEI-2005 to assess the "quality" of foods and beverages provided to preschool children in child-care centers. Findings indicate the need to improve the overall "quality" of foods and beverages offered to children. Specifically, child-care centers need to provide more vegetables, including dark green and orange vegetables and legumes, total grain and whole grain, meats and beans, oils, and foods low in saturated fat, solid fat, and added sugars to children.

Consistent with the current study, prior studies that assessed the adequacy of the "quantities" of foods and beverages provided to or consumed by children in child-care centers found that these do not supply adequate proportions of children's daily nutrition requirements.^{5, 8, 10, 12, 29, 30} In a study of 171 child-care centers across seven US states, Briley et al⁵ found that foods often listed on menus were milk, cheese, bread, fruits, crackers, cookies, and cold cereal; child-care centers did not often include vegetables, provide or encourage children to eat a variety of foods, nor provide children opportunities to choose diets low in fat. Findings from the Early Childhood and Child Care Study⁸ showed meals offered during breakfast at 1,962 CACFP-participating child-care centers across the

US provided the recommended amounts of protein, carbohydrate, total fat, vitamins A and C, calcium, and iron, but provided less than the recommended amounts of calories, and exceeded the recommended amounts of saturated fat. Lunches provided at the centers also provided the recommended amounts of protein, vitamins A and C, and calcium, but provided less than the recommended amounts of calories and iron, and exceeded the recommended amounts of total fat, saturated fat, and sodium needed by children. In a more recent study of 240 children attending 40 child-care centers in New York City, Erinosho et al¹² found that less than half of the children observed ate at least half of the daily recommended intake for the milk, fruit, vegetable, grain, and meat/meat alternate food groups, and only 5% of children consumed at least half of the recommendation for vitamin E.

Nutrition education programs that target food service staff in child-care centers may help ensure that foods offered to children are in line with current dietary recommendations. Additionally, innovative interventions and programs that focus on the child-care center food environment may help ensure that foods and beverages provided meet children's daily nutrition requirements. These types of interventions/programs are, however, presently limited, and include NAP SACC, Let's Move! Child Care, Lunch is in the Bag, The Healthy Start Project, and The Healthy Kansas Kids Program.^{24, 31-34} While the majority of these interventions/programs led to positive improvements in the child-care environment and the types of foods and beverages offered to children, no studies have evaluated their impact on children's dietary intakes in child-care settings.

Children are more likely to consume healthful foods if such foods are made available to them.³⁵⁻³⁷ In the current study, environmental changes that may help improve the quality of foods offered at the child-care centers include: providing a variety of dark green and orange vegetables and legumes; increasing whole grain by offering such foods as brown rice instead of white rice, and whole wheat options instead of refined grains; and increasing meats and beans from such food sources as black beans, black-eyed peas, chickpeas, chicken, turkey, lean meats, and fish. Replacing high-fat meats with lean meats and fish will also help reduce saturated fat and solid fat in foods provided at the centers. Other changes that may help improve the quality of foods offered at centers in this study include, meeting children's requirements for oils by cooking with non-hydrogenated vegetable oils, and providing of such foods as, nuts/nut-based products, seeds, and oil-based dressings. In addition, centers may reduce excess calories from added sugars by providing less sweet snacks such as cakes, cookies, and doughnut, and condiments such as jellies and syrups, that were offered at most centers. Nutrition education activities in center classrooms that introduce children to healthful and unfamiliar foods may increase children's acceptance of such foods. Encouraging child-care providers to eat with, and consume the same foods as children may enhance children's acceptance and consumption of healthful foods offered. In addition, informing parents about healthful foods and beverages their children are consuming in child-care and the health benefits of such foods may also encourage them to provide the foods/ beverages to their children at home.

This study has some limitations. The small, convenience sample of centers and children observed, limit generalizability of findings to all child-care centers in North Carolina.

Although data were collected in 2005–2006, this study’s findings are important because, since 2005, limited studies of this type have been published,^{12, 30} and their findings are consistent with the current study. Moreover, there have been no significant changes to the CACFP requirements since 2005, and although new Dietary Guidelines were published in 2010,³⁸ the corresponding HEI-2010 has not been released. It is possible that child-care centers may have altered their usual practices because directors knew that children’s intakes were being observed. Nevertheless, research shows dietary observation is a reliable method for estimating children’s dietary intakes in child-care settings, considering that many states’ prohibit non-child-care staff from handling children’s food prior to consumption.²⁶ Strengths of the study are that multiple days of dietary data were collected from a relatively large sample of children using the Dietary Observation for Child Care protocol which is a reliable method for collecting observational dietary data in child-care centers.²⁶ Actual foods served to children were observed instead of analyzing menus that may not always correspond with actual foods served.^{9, 11}

CONCLUSIONS

This is the first study to use the HEI-2005 to assess the quality of foods and beverages provided to preschool children in child-care centers. Although based on a small convenience sample from a single state, findings of the study indicate the need for improvements in the overall quality of foods/beverages provided to preschool children in child-care centers. Specifically, child-care centers need to provide more vegetables, including dark green and orange vegetables and legumes, total grain and whole grain, meats and beans, oils, and foods low in saturated fat, solid fat, and added sugars. Future studies that use the HEI-2005 to assess the quality of foods provided in child-care centers should use larger samples of child-care centers and children. Studies are needed that compare the quality of foods provided in CACFP and non-CACFP centers. Future studies should also apply the HEI-2005 to assess the quality of foods provided in less formal child-care settings, such as family child-care homes.

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Table 1Components of the Healthy Eating Index-2005 (HEI-2005) and standards for scoring¹

Healthy Eating Index-2005 (HEI-2005) Component	Maximum Points	Standard for Maximum Score	Standard for Minimum Score of Zero
Total fruit (including 100% fruit juice)	5	0.8 cup/1,000 kcal	No fruit
Whole fruit	5	0.4 cup/1,000 kcal	No whole fruit
Total vegetables	5	1.1 cups/1,000 kcal	No vegetables
Dark green and orange vegetables and legumes ²	5	0.4 cup/1,000 kcal	No dark green and orange vegetables or legumes
Total grains	5	3.0 oz./1,000 kcal	No grains
Whole grains	5	1.5 oz./1,000 kcal	No whole grains
Milk ³	10	1.3 cups/1,000 kcal	No milk
Meats and beans	10	2.5 oz./1,000 kcal	No meat or beans
Oils ⁴	10	12 grams/1,000 kcal	No oil
Saturated fat	10	7% of energy ⁵	15% of energy
Sodium	10	0.7 gram/1,000 kcal	2.0 grams/1000 kcal
Calories from solid fats and added sugars	20	20% of energy	50% of energy

¹ Intakes between the minimum and maximum levels are scored proportionately, except for saturated and sodium (see note 5).

² Legumes counted as vegetables only after meat and beans standard is met.

³ Includes all milk products, such as fluid milk, yogurt and cheese, and soy beverages.

⁴ Includes non-hydrogenated vegetable oils and oils in fish, nuts, and seeds.

⁵ Saturated fat and sodium get a score of 8 for the intake levels that reflect the 2005 Dietary Guidelines, <10% energy from saturated fat, and 1.1 grams of sodium/1,000 kcal, respectively.

Table 2

Healthy Eating Index-2005 component and total scores for foods and beverages offered to preschool children at 20 child-care centers in North Carolina compared to the recommended scores^{1, 2}

Healthy Eating Index-2005 (HEI-2005) component	Recommended HEI-2005 Component Score	Mean Score (n=20 child-care centers)	Standard Deviation (n=20 child-care centers)	Range (n=20 child-care centers)	Range Percent Meeting Recommendation % (n)
Total fruit (including 100% fruit juice)	5	4.69	0.81	2.06 – 5.00	85 (17)
Whole fruit	5	4.70	0.74	1.81 – 5.00	75 (15)
Total vegetables	5	2.26*	1.09	1.01 – 4.76	0 (0)
Dark green and orange vegetables and legumes	5	0.20*	0.43	0.00 – 1.48	0 (0)
Total grains	5	1.09*	1.25	0.00 – 4.77	0 (0)
Whole grains	5	1.29*	1.65	0.00 – 5.00	10 (2)
Milk	10	10.00	0	10.00	100 (20)
Meats and beans	10	6.51*	2.75	1.14 – 10.00	20 (4)
Oils	10	0.44*	0.25	0.12 – 1.22	0 (0)
Saturated fat	10	3.32*	3.41	0.00 – 10.00	10 (2)
Sodium	10	9.85	0.67	7.03 – 10.00	95 (19)
Calories from solid fats and added sugars	20	14.76*	4.08	8.48 – 20.00	20 (4)
Total HEI-2005 score	100	59.12*	8.05	47.30 – 76.81	

¹ Total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meats and beans, and oils represent foods for which adequate intake is recommended. Higher scores reflect higher intakes for these components.

² Saturated fat, sodium, and calories from solid fats and added sugars (alcohol was not provided to children, as expected), represent aspects of the diet that should be consumed in moderation. For these components, higher scores reflect lower intakes because lower intakes are preferred.

* Mean scores were significantly different from the maximum recommended scores at the p<0.01 level.