

Comparison of children's food and beverage intakes with national recommendations in New York City child-care centres

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Abstract

Objective: The present study compared foods and beverages provided to and consumed by children at child-care centres in New York City (NYC) with national nutrition recommendations.

Design: The study used survey, observational and centre record data collected from child-care centres. Food and beverage intakes from two days of observation and amounts of energy and nutrients were estimated using the US National Cancer Institute's Automated Self-Administered 24 h Recall system.

Setting: Meal and snack time at 108 child-care centres in low-income communities in NYC.

Subjects: Children aged 3–4 years old in classrooms selected by the directors of the participating child-care centres.

Results: Foods and beverages provided to and consumed by children (n 630) met >50% of the Dietary Reference Intake (DRI) for most nutrients. Intakes of fibre and vitamins D and E were <30% of the DRI. Foods and beverages provided >50% of the recommended average daily intake amounts for total grains, fruits and fruit juices, and dairy, but <50% of the recommended amounts for whole grains, protein foods and vegetables. Intake of oils was below the allowance for energy levels, but foods and beverages with solid fats and added sugars exceeded the limits by 68%.

Conclusions: Providing more whole grains, vegetables and low-fat dairy and fewer foods with solid fats and added sugars may improve children's diet quality when at child-care centres. Centre staff may need training, resources and strategies in order to meet the nutrition recommendations.

Keywords
Dietary guidelines
Child care
Nutrition
Child nutrition

Nationally representative data from 2011–2012 show that 23% of children aged 2–5 years were overweight or obese⁽¹⁾. Child-care centres have been identified as an important setting to improve nutrition practices and prevent childhood obesity⁽²⁾. According to the recent White House Task Force on Childhood Obesity Report to the President, a quality child-care setting is one that provides nutritious foods, opportunities for children to be physically active and limits screen time⁽³⁾. In response, Let's Move! Child Care was released in June 2011 with a five-item checklist including recommendations for healthful eating, physical activity and screen time to be implemented in child-care centres throughout the USA⁽⁴⁾.

Efforts to improve the nutrition and physical activity environment in child-care centres in New York City (NYC) began in 2005 when high levels of overweight children were identified in Head Start centres⁽⁵⁾. Erinoshio *et al.*

worked with colleagues at the NYC Department of Health and Mental Hygiene to evaluate the nutrition practices in forty child-care centres in underserved communities in NYC⁽⁶⁾. Results from this work contributed to the development of formal regulations for beverages, physical activity and screen time in licensed group child-care centres in NYC. These regulations were added to the NYC Health Code and went into effect on 1 January 2007⁽⁷⁾.

The Academy of Nutrition and Dietetics recommends that all foods and beverages provided to children in child-care programmes meet the Dietary Guidelines for Americans and that children in full-time programmes receive foods and beverages that meet 50–67% of their daily nutrient needs⁽⁸⁾. One approach for evaluating the quality of children's dietary intakes at full-time child-care programmes is to compare the nutrient contents and amounts of foods and beverages with national recommendations including the Dietary Reference

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Intakes (DRI)⁽⁹⁾ and the Dietary Guidelines for Americans 2010⁽¹⁰⁾. A few studies have assessed the quality of children's dietary intakes at centres in different regions of the country; however, many of these studies compared only nutrients or foods (not both) with national recommendations^(6,11–16). The purpose of the present study was to evaluate children's diet quality at full-time centres in low-income communities in NYC by comparing both nutrient contents and amounts of foods and beverages with national recommendations and the recommendations of the Academy of Nutrition and Dietetics.

Methods

Study design and sample

The NYC Child Care Evaluation was a multi-method, cross-sectional study conducted to determine compliance with current city health department regulations for beverages, physical activity and screen time at licensed group child-care centres in NYC. In Evaluation Component I (October 2009–January 2010), 176 licensed child-care centres were randomly sampled from low-income neighbourhoods where survey, observational and centre record data were collected. In Evaluation Component II (April–June 2010), 110 of the 176 centres agreed to collection of children's dietary intake data from two days of observation⁽¹⁷⁾. In this study, six different children at each centre were observed over the two-day collection period. The final sample size was 630 children because two centres out of the 110 centres did not provide food, five centres only had one site visit and three children had observations with incomplete data (i.e. {3 children/centre × [(110 centres – 2 centres) × 2 site visits]} – [15 observations (due to 5 missing site visit days)] – (3 observations with incomplete data)).

Dietary assessment

In 2010, teams of two evaluation staff visited the 110 child-care centres on two consecutive days. In classrooms of children aged 3–4 years old selected by the centre director, one data collector recorded information about the quantity, content and preparation of all foods and beverages provided to children. When types of foods and beverages were unclear by direct observation (e.g. type of milk or juice), the data collector read labels on the food and beverage products and asked teachers and food-service staff for further information. The second data collector selected three children on each observation day and discreetly recorded all types and quantities of foods and beverages consumed. Direct observation by both data collectors was conducted from a distance. The children did not interact with the data collectors and were generally uninterested in their presence. Direct observation of children's food and beverage consumption has been shown to be a valid and reliable method in child-care

settings. A single trained evaluator can observe the dietary intakes of up to three young children⁽¹⁸⁾. Prior to the site visits, the data collectors were trained in estimating portion sizes of foods and beverages.

Data analysis

All information about the foods and beverages provided to and consumed by the children was entered into the US National Cancer Institute's Automated Self-Administered 24-h Recall (ASA24) system⁽¹⁹⁾. The ASA24 is linked to the Food and Nutrient Database for Dietary Studies version 4.1⁽²⁰⁾ and the MyPyramid Equivalents Database version 2⁽²¹⁾ from the US Department of Agriculture (USDA) and was used to generate estimates for energy, nutrients and amounts of food groups. Microsoft[®] Excel 2007 (v12.0) was used to average the nutrition values for all foods and beverages provided to and consumed by the observed children during the two site visit days.

Energy and nutrient intakes averaged from the two site visit days were compared with the DRI for 1–3-year-old children (1200 kcal (5021 kJ)) and 4–8-year-old children (1400 kcal (5858 kJ))⁽⁹⁾. Mean amounts of food groups and subgroups were compared with the recommended daily amounts for two energy levels of USDA Food Patterns in the Dietary Guidelines for Americans 2010⁽¹⁰⁾. Two sets of DRI recommendations and two energy levels of USDA Food Patterns were selected because they are appropriate for boys and girls aged 3–4 years old who are moderately active.

The Academy of Nutrition and Dietetics recommends that children in full-time programmes receive foods and beverages that meet at least 50–67% of their daily nutrient needs⁽⁸⁾. Therefore, 50–67% of the DRI and the 1200 and 1400 kcal (5021 and 5858 kJ) energy level plans from the Dietary Guidelines for Americans 2010 were used to evaluate the nutritional quality of the foods and beverages provided to and consumed by the observed children.

Results

Table 1 shows mean energy and nutrient intakes from foods and beverages provided to and consumed by children at full-time child-care centres during two days of data collection and the respective DRI for children aged 1–3 years and 4–8 years⁽⁹⁾.

Foods and beverages provided an average of 66% of the DRI for energy for 1–3-year-olds and 57% of the DRI for energy for 4–8-year-olds, and more than two-thirds of the DRI for macronutrients, minerals and most vitamins for both age groups. However, foods and beverages provided <40% for fibre, <36% for vitamin D and <46% of the DRI for vitamin E for both age groups of children.

During the two days of observation, foods and beverages consumed by the children met >50% of the DRI for most nutrients. However, children consumed between 40 and 47% of the DRI for energy, 20–27% of the DRI for

Table 1 Mean energy and nutrient intakes from foods and beverages provided to and consumed by 3–4-year-old children during two days of observation at child-care centres in New York City, April–June 2010

	DRI†		From foods and beverages provided (n 211)*		From foods and beverages consumed (n 630)*			
	1–3 years‡	4–8 years‡	Mean amount	% of DRI		Mean amount	% of DRI	
				1–3 years	4–8 years		1–3 years	4–8 years
Energy and macronutrients								
Energy (kcal)	1200	1400	791.8	66.0	56.6	564.3	47.0	40.3
Energy (kJ)	5021	5858	3313	66.0	56.6	2361	47.0	40.3
Carbohydrate (g)	130	130	110.5	85.0	85.0	78.5	60.4	60.4
Fibre (g)	19	25	7.6	40.0	30.4	5.2	27.4	20.8
Fat (g)	30–45	25–35	25.4	67.8	84.8	18.3	48.8	61.0
Protein (g)	13	19	33.6	258.6	176.9	23.7	182.6	125.0
Vitamins								
Thiamin (mg)	0.5	0.6	0.7	140.0	116.6	0.5	96.4	80.3
Riboflavin (mg)	0.5	0.6	1.3	262.4	218.7	0.9	173.9	145.0
Niacin (mg)	6	8	8.7	145.1	108.8	6.1	102.1	76.7
Pyridoxine (mg)	0.5	0.6	0.9	178.6	148.9	0.6	118.1	98.8
Folate (µg)	150	200	194.1	129.4	97.0	131.2	87.4	65.6
Vitamin B ₁₂ (µg)	0.9	1.2	3.2	359.9	269.9	2.1	233.5	175.1
Vitamin A (RE)	300	400	478.7	159.6	119.7	305.6	101.9	76.4
Vitamin C (mg)	15	25	49.9	332.5	199.5	35.8	238.3	143.0
Vitamin E (mg α)	6	7	2.8	45.8	39.2	1.8	29.6	25.4
Vitamin D (µg)	15	15	5.3	35.6	35.6	3.5	23.3	23.3
Vitamin K (µg)	30	55	54.6	181.9	99.2	31.9	106.6	58.1
Minerals								
Ca (mg)	700	1000	691.72	98.8	69.2	456.0	65.2	45.6
Fe (mg)	7	10	6.70	95.7	67.0	4.5	64.9	45.4
Mg (mg)	80	130	125.51	156.9	96.5	86.0	107.04	66.2
Zn (mg)	3	5	5.06	168.5	101.1	3.4	113.3	68.0

DRI, Dietary Reference Intake; RE, retinol equivalents.

*Mean amounts of energy and nutrients from foods and beverages provided to children were estimated from 211 centre visits; mean amounts of energy and nutrients from foods and beverages consumed by children were estimated from 630 observed children.

†Recommendations for individuals of the US Department of Agriculture, Food and Nutrition Service⁽⁹⁾.

‡Two age categories for DRI were selected for comparison because the observed children were 3 and 4 years old.

fibre, 23% of the DRI for vitamin D and 25–30% of the DRI for vitamin E. Children consumed 65% of the DRI for Ca and Fe for 1–3-year-old children but only 45% of the DRI for Ca and Fe for 4–8-year-old children.

Table 2 shows mean amounts of food groups and subgroups, oils, and solid fats and added sugars (SoFAS) in comparison with the recommended daily intake amounts for two USDA Food Patterns in the Dietary Guidelines for Americans 2010⁽¹⁰⁾. Fruits and fruit juices and dairy provided to the children were >50% of the recommended amounts for both age groups. Total grains were 52–66% of the recommendations but whole grains were <25% of the recommendations. Total and all subtypes of vegetables were 32–46% of the recommendations. Oils from foods were only 26% of the allowance for intake, but SoFAS were >68% of the maximum recommendation for both energy level food patterns.

Children's intakes of almost all food groups and subgroups were <50% of the recommended average daily amounts and were especially low for whole grains and most subgroups of vegetables for both energy level food patterns. Children's intake of fruits and fruit juices was >50% compared with the recommended amount for the 1200 kcal (5021 kJ) level but <50% compared with the recommended amount for the 1400 kcal (5858 kJ) level. For both energy

level food patterns, children's intake of oils was <15% of the allowance for intake, but children's intake of SoFAS was >23% of the maximum recommendation.

Discussion

Results from the present study suggest potential ways to improve the quality of children's dietary intakes at child-care centres. These suggestions include maintaining the amounts of total grains, fruits and fruit juices, protein foods and dairy; increasing the amounts of whole grains, vegetables, and dietary sources of fibre, vitamins D and E; and offering fewer foods and beverages with SoFAS.

Nutrition surveillance data show that many young children in the USA have low intakes of these foods and nutrients and high intake of SoFAS⁽²²⁾. Other studies have assessed dietary intakes of children at child-care centres in other regions of the country. Although the dietary recommendations (e.g. RDA *v.* DRI, original Food Guide Pyramid *v.* MyPyramid Equivalent Food Groups) differed between studies, results from these studies are similar to national surveillance data and to our results in NYC child-care centres. For example, in nine Head Start centres in New York State, Bollella *et al.*⁽¹²⁾ observed 358 children

Table 2 Mean amounts of MyPyramid Equivalent Food Groups from foods and beverages provided to and consumed by 3–4-year-old children during two days of observation at child-care centres in New York City, April–June 2010

MyPyramid Equivalent Food Groups*	Recommended daily amounts of food groups in two USDA Food Patterns†		From foods and beverages provided (n 211)‡			From foods and beverages consumed (n 630)‡		
	1200 kcal§	1400 kcal§	Mean amount	% of 1200 kcal Food Pattern§	% of 1400 kcal Food Pattern§	Mean amount	% of 1200 kcal Food Pattern§	% of 1400 kcal Food Pattern§
Grains (oz)	4.00	5.00	2.62	65.5	52.4	1.94	48.5	38.8
Whole grains	2.00	2.50	0.49	24.6	19.6	0.37	18.6	14.9
Vegetables¶ (c)	1.50	1.50	0.53	35.4	35.4	0.31	20.9	20.9
Dark green	0.14	0.14	0.06	39.7	39.7	0.03	22.4	22.4
Red and orange	0.43	0.43	0.16	36.4	36.4	0.11	24.7	24.7
Beans and peas (legumes)	0.07	0.07	0.03	42.4	42.4	0.02	26.1	26.1
Starchy	0.50	0.50	0.16	32.0	32.0	0.09	18.1	18.1
Other	0.37	0.37	0.17	45.8	45.8	0.09	23.2	23.2
Fruits and Fruit Juices (c)	1.00	1.50	0.94	94.0	62.7	0.71	71.2	47.5
Protein Foods¶¶ (oz)	3.00	4.00	1.27	42.2	31.6	1.00	33.2	24.9
Dairy** (c)	2.50	2.50	1.76	70.5	70.5	1.16	35.1	35.1
Oils†† (kcal)	153	153	39.05	25.5	25.5	22.83	14.9	14.9
SoFAS‡‡ (kcal)	121	121	203.43	168.1	168.1	149.04	123.2	123.2

USDA, US Department of Agriculture.

1 kcal = 4.184 kJ. 1 cup (c) is equivalent to 0.2366 litres; 1 ounce (oz) is equivalent to 29.5735 ml.

*Food Groups from the MyPyramid Equivalents Database version 2⁽²⁰⁾.

†Food Patterns from the Dietary Guidelines for Americans 2010⁽¹⁰⁾.

‡Mean amounts of energy and nutrients from foods and beverages provided to children were estimated from 211 centre visits; mean amounts of energy and nutrients from foods and beverages consumed by children were estimated from 630 observed children.

§Two USDA Food Patterns (1200 and 1400 kcal (5021 and 5858 kJ)) were selected for comparison because they are appropriate for 3- and 4-year-old children who are active for at least 30–60 min daily⁽¹⁰⁾.

||Whole grains includes all whole grain products that are both 100% and <100% whole grain and whole grains that are used as ingredients.

¶In the Dietary Guidelines for Americans 2010⁽¹⁰⁾, the recommended amounts for vegetables and protein foods subgroups are given as weekly amounts; the recommended amounts are converted to daily amounts in the current table. Protein foods include lean meat from beef, pork, veal, lamb, game, organ meats, frankfurters, sausages and luncheon meat; poultry; and fish and shellfish, soya, nuts and eggs.

**Dairy foods include milk, yoghurt, frozen yoghurt, dairy desserts and cheeses.

††Oils include vegetable, nut and fish oils and soft vegetable oil table spreads.

‡‡SoFAS are calories from solid fats and added sugars. According to the Dietary Guidelines for Americans 2010⁽¹⁰⁾, the limit for SoFAS is the remaining amount of calories in each food pattern after selecting the specified amounts in each food group in nutrient-dense forms (forms that are fat-free or low-fat and with no added sugars).

aged 4–6 years and found that intakes of energy, Ca and Fe were <50% of the RDA. In twelve child-care centres in central Texas, Briley *et al.*⁽¹³⁾ observed fifty-one children and found that less than half of the children consumed at least 50% of the RDA for energy and Fe. In two centres in New Jersey, Bruening *et al.*⁽¹⁴⁾ collected 14 d of diet records from forty children and found their mean intakes of vitamin E, folate, Ca, Fe and Zn to be <67% of the RDA. In four child-care centres in Missouri, Drake⁽¹⁵⁾ observed that energy and Fe intakes were <50% of the RDA for 4–6-year-old children.

With regard to food group intakes, in twenty centres in North Carolina, Ball *et al.*⁽¹¹⁾ observed 117 children and estimated that they consumed <50% of recommended servings for grains, vegetables, fruits and meats. Intakes of whole grains and dark green and orange vegetables were especially low (13% and 7% of the recommendations, respectively). In forty child-care centres in NYC, Erinosh *et al.*⁽⁶⁾ observed 240 children and found that only 17% of children had vegetable intakes >50% of the respective daily recommendations. In nine centres in central Texas, Padgett and Briley⁽¹⁶⁾ collected 3 d of food records from fifty children and showed that 3-year-old children consumed <67% of the recommended

number of servings for grains, vegetables and dairy, and 4- and 5-year-old children consumed <67% of the recommended number of servings for meats, grains, vegetables and dairy. In that study, amounts of fats, oils and sugars were not assessed because intakes were compared with the Food Guide Pyramid for Young Children and optimal intakes of those dietary components were not specified.

The mean amounts of protein determined from foods and beverages provided to and consumed by the children in the present study were greater than both sets of DRI recommendations. In contrast, the mean intake of the protein food group that includes meat, poultry, seafood, eggs, nuts, seeds and processed soya products was less than half that recommended by the USDA Food Plans for energy level of 1200 or 1400 kcal (5021 or 5858 kJ). This discrepancy can be explained by the fact that sources of protein also include dairy foods, grains and some vegetable food groups (i.e. beans and peas). Also, even though the estimate for mean daily protein intake was higher than the DRI for what was provided (i.e. 34 g) and what was consumed (i.e. 24 g), these values are about half of the amounts determined from 24 h dietary recalls from caregivers of 2–5-year-old children in the What We Eat In

America component of the National Health and Nutrition Examination Survey 2011–2012⁽²²⁾.

Implications for dietary guidance

In the last decade, there have been efforts at the local, state and federal levels to improve the nutrition practices in early child-care settings. In NYC, the nutrition policies for child-care centres as issued in Article 47 of the NYC Health Code focus on beverages, specifically to encourage consumption of low-fat (skimmed or 1%) milk and water and a maximum intake of no more than 6 ounces (177 ml) of 100% fruit juice⁽⁷⁾. The policies also state that 'Food supplied to children shall be wholesome, of good quality, properly prepared in accordance with nutritional guidelines provided or approved by the Department, and age-appropriate in portion size and variety'. Another source of guidance for child-care centres that serve low-income families is the Child and Adult Care Food Program (CACFP)⁽²³⁾. To qualify for reimbursement, the centres have to serve meals and snacks that meet the CACFP nutrition requirements in terms of amounts and types of foods and beverages for each meal or snack. In 2009, the New York State CACFP modified its Child Meal Patterns to be in accordance with the Dietary Guidelines for Americans to reduce risk of overweight, obesity and chronic disease⁽²⁴⁾. In 2010, the Institute of Medicine convened a panel of experts to revise the CACFP nutrition requirements to align with the Dietary Guidelines for Americans and the DRI⁽²⁵⁾. The Institute of Medicine committee recommended changes to meal patterns for breakfast, lunch, supper and snacks to 'increase the variety of fruits and vegetables, increase the proportion of whole grains, and decrease the content of solid fats, added sugars, trans fats, and sodium.'

Providing recommendations and policies is not sufficient, however, without training and technical assistance. Results from Evaluation Component I of the NYC Child Care Evaluation in 176 centres showed that prior training and technical assistance was associated with compliance with the physical activity regulations but not with the beverage regulations⁽²⁶⁾. Likewise, a survey of 118 child-care providers in 2011 and 2012 by the Academy of Nutrition and Dietetics showed that training of child-care providers was needed to teach positive eating behaviours and self-regulation to prevent childhood obesity⁽²⁷⁾. In the study by Erinoshio *et al.*, teachers and staff requested training and resources specifically about how to encourage children to eat more vegetables and whole grains, and to try foods and beverages that may not be familiar to them⁽⁶⁾.

Some studies have been successful at improving children's dietary intake in child-care settings. Sigman-Grant *et al.* showed that training providers to role model and adopt appropriate feeding strategies that support healthy weight in young children created a supportive mealtime environment for obesity prevention⁽²⁸⁾. In a study by

Benjamin *et al.*, parents recommended that meals and snacks be improved by adding fruits and vegetables⁽²⁹⁾. Roe *et al.* showed that serving a variety of vegetables and fruits in the afternoon snack did increase intake of these foods⁽³⁰⁾. Reicks *et al.* showed that adding photographs of vegetables to meal trays in cafeterias at elementary schools increased children's consumption of those foods⁽³¹⁾. Kharofa *et al.* found that staff behaviour at mealtime, including sitting with the children during mealtime and eating some of the same foods, increased vegetable intake⁽³²⁾.

It is also important to provide nutrition education to parents and primary caregivers of young children, especially because types of foods and beverages offered to children at home may be less healthful than those offered at child-care centres. For example, Erinoshio *et al.*⁽³³⁾ showed that children were more likely to consume high-fat milk (e.g. whole or 2% milk), soft drinks and French fries at home than when at child care. These unhealthy eating behaviours were associated with eating meals at fast-food or other restaurants more than once weekly and whether the child ate food while watching television. Other studies of similarly aged children have shown that food choices improved at home and saturated fat intake was lowered when children received nutrition education in child-care settings^(34,35).

Strengths and limitations

The present study has several strengths, most notably the careful collection of dietary intake data by direct observation of young children in classrooms at the centres. Although not perfect, direct observation by trained data collectors is considered to be the best method to assess foods and beverages consumed by young children⁽¹⁸⁾. Also, to improve accuracy, foods and beverages that were not readily identifiable (e.g. type of milk) were clarified with teachers and food-service staff. Another strength was the analysis of nutrient content of the foods and beverages provided and consumed. Use of the National Cancer Institute's ASA24 system⁽¹⁹⁾ allows estimation of energy and nutrient intakes and servings of foods from food groups and sub-food groups included in the MyPyramid Equivalents Database that align with the food groups included in the USDA Food Patterns in the Dietary Guidelines for Americans 2010⁽¹⁰⁾. Although other studies have compared children's food intakes with serving recommendations for food groups, the present study allowed for estimation of SoFAS which is a new feature of the National Cancer Institute's ASA24 system compared with other dietary analysis software systems. It is, however, important to recognize that assessment of dietary intakes of small children is still a difficult task due to possible errors throughout the process of observation and recording. Also, although two days of observations were conducted at the centres, different children were observed

for each day so the dietary data do not reflect usual intake of an individual child.

Conclusions

Results from the present study describe nutrition practices in a sample of licensed group child-care centres located mostly in low-income neighbourhoods in NYC. Serving more whole grains, vegetables and low-fat dairy and fewer foods with SoFAS may improve the overall dietary quality of young children in these child-care settings. Centre staff may need training, resources and strategies to encourage children to eat healthful foods that meet national nutrition recommendations and the recommendations by the Academy of Nutrition and Dietetics.

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