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Children's Dietary Intake in Child Care Centers by Body Mass, Age, and Sex

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Abstract

Objective: To determine the relationship between child characteristics (weight status, age, sex) and the nutrients and foods served to and consumed by 3-to-5-year-old children during lunch at childcare centers (CCC).
Design: Cross-sectional, observational study.

Setting: CCC across Oklahoma (n=25)

Participants: Multicultural children aged 3-to-5 years (n=230; mean age 3.8±0.7 years, 53%male)

Methods: All foods served and consumed at lunch were observed for at least one day by researchers using the Dietary Observation at Child Care (DOCC). Total energy and macronutrient content were calculated. Servings of fruits, vegetables, low fat dairy, whole grains, high-fat meat, and high sugar/high-fat foods were counted. Height and weight was measured, and body mass index (BMI) percentile was calculated.

Results: On average, children were served 430.1±174.3 calories, 50.4±19.9 grams carbohydrate, 21.9±8.9 grams protein, 31.6±8.9% fat, 1.2±1.0 servings fruit, 1.9±1.3 servings vegetables, 3.1±1.5 servings combined fruit and vegetables, 0.9±0.3 servings low fat dairy, 0.3±0.4 servings whole grains, and 0.2±0.3 servings high sugar/high-fat foods. Nutrients and foods served were correlated with consumption (r=0.633-0.900, p<0.01). BMI percentile was associated with low fat dairy served (β=-0.002, *SE*=0.001, p=0.020), calories consumed (β=0.778, *SE*=0.376, p=0.040), and % fat consumed (β=0.068, *SE*=0.025, p=0.007), independent of age, sex, and race. Age was associated with grams carbohydrate (β=4.338, *SE*=1.808, p=0.017), whole grains served (β=-0.076, *SE*=0.035, p=0.029), high sugar/high-fat foods served (β=0.079, *SE*=0.033, p=0.018), whole grains consumed (β=-0.103, *SE*=0.034, p=0.003), and high sugar/high-fat foods consumed (β=0.067, *SE*=0.029, p=0.021), independent of sex, race, and BMI percentile. Intake did not differ by sex.

Conclusion: The more food children were served, the more they ate. Higher BMI percentile was associated with higher energy consumption, particularly from fat, at the lunch meal. Older children were served and consumed more food and high sugar/high-fat foods, and fewer whole grains.

Keywords: Childcare; Dietary Patterns; Obesity; Preschool

Abbreviations:

CCC-Child Care Center;
BMI-Body Mass Index;
DOCC-Dietary Observation at Child Care

Introduction

In 2011-2012, 23% of young children in the U.S. were considered overweight: 8% were obese [1]. In Oklahoma, 31% of low-income 2-to-5-year-old children were considered overweight, and 14% were obese [2]. Although studies indicate that the increase in child obesity has plateaued, levels remain high, and consequences of childhood obesity pose important health risks [1,3,4]. Since many 3-to-6-year-old children (55%) in the U.S. attend child care centers (CCCs) full time (8 hours or more per day) [5], CCCs have an important role in the prevention of obesity and can influence healthy eating and dietary behaviors [6,7].

Dietary behaviors that promote obesity, such as food selection and preferences for energy-dense foods, can be modifiable and may be easier to change at a younger age [8,9].

Identifying the importance of adequate nutrition during early childhood, the United States Department of Agriculture developed the Child and Adult Care Food Program in 1968 to reimburse providers serving low-income children for the purchase of nutritious foods [10].
Regardless of CACFP participation, Oklahoma state regulations require all CCCs to provide nutritionally sufficient meals that meet 1/2 to 2/3 of the Recommended Dietary Allowances to children in full-day child care [11]. Even though requirements to facilitate the provision of adequate nutrition to young children exist, analyses of CCC menus indicated that nutrients and foods served to children did not meet dietary recommendations [12-18].

Researchers have observed nutrients and foods served to [19,20] or consumed by [21-24] preschool-age children in CCCs, but few have assessed both [25-27]. While the energy and nutrient profiles of foods observed at CCC generally meet dietary recommendations [25,27] food groups (i.e., fruits, vegetables, whole grains) served and consumed were less desirable [26], with high waste of nutrient-dense vegetables [25]. In addition to understanding the nutrients and foods served to and consumed by children in CCCs, researchers and practitioners must develop an understanding about characteristics that influence portion sizes and children's consumption. Nicklas et al [25] reported that children who are served a higher volume of food will eat a higher volume, although Rolls et al.28 indicated that portion size influences intake of older preschoolers, but not younger preschoolers.

Understanding the characteristics of children that may be associated with quantity and type of nutrients and foods served and consumed will add to the existing body of knowledge regarding strategies to reduce improve health of young children. Few studies have examined whether child characteristics, such as weight status, [25] age, [25-29] or sex, [29,30] are related to their dietary patterns within the CCC setting. Therefore, the purpose of this study was to determine the relationship between child characteristics (weight status, age, sex) and the nutrients and foods served to and consumed by 3-to-5-year-old children during lunch at a CCC.

Materials and Methods

Study Design

Conducted from 2011-2014, this was a cross-sectional, observational study that included observation of lunch at CCCs and measurement of children's height and weight. Licensed Oklahoma CCCs providing full-day (7:30 am-5:30 pm, at minimum) child care to 3-to-5-year-old children were contacted via telephone for an opportunity to participate in two days of observation. 76 CCCs were contacted; 25 were scheduled, 29 were interested, but were not scheduled due to demands involved with observations, and 22 were not interested or did not return telephone calls.

Participating families were recruited in person by trained researchers and CCC staff and consented to allow researchers to obtain anthropometric measures and observe dietary intake during lunch at the CCC. Demographic information (sex, age, race/ethnicity) was reported by parents at the time of consent. 706 children were eligible; 313 returned a completed consent form. The parents of one child withdrew consent after data collection, and their data were not included in analyses. Of the remaining 312 children, 82 were removed from analyses due to missing information, yielding an analytic sample size of 230 children. Attrition was due to parent refusal of the child's participation, lack of a signed consent form, or absenteeism on the day of observation. This study was approved by the University of Oklahoma Health Sciences Institutional Review Board.

Dietary Assessment

Dietary Observation for Child Care

The Dietary Observation for Child Care (DOCC) system was used to assess all foods and beverages served to and consumed by participating children during lunch in the CCC [31]. Each researcher could observe up to three individual children [31]. Researchers received plate waste proficiency through training and passing a plate waste practical exam, which had high reliability between observers across foods (ICC=0.968, $p<0.001$). The process consisted of visual estimates in tablespoons, teaspoons, and quantity counts (chicken nuggets, for example) of foods and ounces of beverages served to each child. The

amount of any food or beverage that was dropped, spilled or traded, any subsequent servings of food or beverage provided or pilfered from another plate, and food or beverage remaining at the end of the meal was recorded. Observed plate waste has been reported to be an accurate method (r=0.90-0.95) of measuring food intake when compared with measured plate waste [32].

Nutrient Analyses

Researchers obtained details from the CCC food service staff regarding brands of foods and beverages served, preparation methods, and recipes to yield accurate nutrient calculations. Nutrient data were processed using FoodWorks® nutrient analysis software in conjunction with the United States Department of Agriculture food database. Total energy (kilocalories) and macronutrients were consistent with the Dietary Reference Intakes (grams of carbohydrate, protein, and percent of kilocalories from fat) [33].

Classification of Foods Served and Consumed

Servings of fruits, vegetables, low fat dairy, whole grains, high-fat meat, and high sugar/high-fat foods were calculated from the DOCC forms by counting how many types of these foods were served and consumed at the lunch meal. As quantities for serving sizes vary between these foods and for preparation methods, one serving was counted for any amount served and/or consumed at the lunch meal, rather than using measurements like ¼ cup. The justification for this approach is that the actual serving sizes of different foods vary, and the liberal approach errs in favor of the CCC, which may try to increase exposure to different fruits and vegetables through mixed dishes (i.e., tossed salad with lettuce, carrots, broccoli, and tomato), none of the ingredients of which would reach a full serving alone [34].

The fruit and vegetable criterion included fresh, frozen, or canned varieties. The fruit criterion excluded fruited yogurt and fruit juice. The vegetable criterion excluded any fried preparation, small amounts of processed tomato products, pickles, and potato salad. The low fat dairy criterion included fat-free or 1% dairy products. The whole grain criterion included oatmeal, brown rice, whole grain bread, corn tortilla, and any whole grain pasta. The whole grain criterion excluded bread products made with refined white flour and products that could be classified as high sugar/high-fat foods. The high-fat meat criterion included meat that was over 20% fat. The high sugar/high-fat foods criterion included any food with nine grams or more of added sugar, and typical snack foods that contain three grams of fat or more per serving (i.e., cookies, muffins, potato chips, cheese puffs).

Height and Weight

Height and weight were measured by trained researchers using standard protocols with a portable SECA scale and stadiometer (Hanover, MD). Body mass index (BMI; kg/m2) and age-and sex- percentile were calculated, and overweight status was determined (≥85th percentile) [35].

Data Treatment

Due to child absenteeism on scheduled observation days, not all children had two lunch observations. 80% (n=183) had two observations that were an average of 8.1±27.4 days apart. There was not a significant difference between day 1 and day 2 lunch ($p \geq 0.05$; data not reported), so day 1 and day 2 were averaged for those children with two days of data, and data from a single day were used for the remaining 20% (n=47).

Statistical Analysis

Descriptive statistics, including means, standard deviations, and frequencies, were calculated. A Pearson correlation coefficient was calculated to determine the correlation between nutrients and foods served to and consumed by preschool children. Serial linear regression models were used to determine the relationship between BMI percentile, age, and dependent nutrient and food variables. In addition to adjusting each model for age, sex, and BMI percentile, as appropriate, all were adjusted for race/ethnicity. An independent t-test was used to determine the relationship between sex and dependent nutrient and food variables. Data were analyzed using SPSS (version 22, IBM Corporation, Somors, NY).

Results

14 CCCs were located within the Oklahoma City and Tulsa metropolitan areas, and 11 were located in rural communities. Table 1 describes the participants. 53% were male (n=121), average age was 3.8±0.7 years, and average BMI percentile was 64.1±28.3. Nutrients and foods served to and consumed by children and the associated correlation coefficients are shown in Table 2. There was a significant correlation between all nutrients and foods served and those consumed by children in the CCC setting.

After adjusting for age, sex, and race/ethnicity, higher BMI percentile was significantly associated with less low fat dairy served, more kilocalorie intake, and higher percent of kilocalories from fat consumed (Table 3). After adjusting for sex, race, and BMI percentile, older age was significantly associated with more grams of carbohydrate served, fewer whole grains served, more high sugar high/fat foods served, fewer whole grains consumed, and more high sugar/high-fat foods consumed (Table 4). There was no difference in nutrients or foods served to or consumed by boys and girls.

Variables (*n*=230)	**(%)**
Sex	
Male	52.6
Female	47.4
Age (years)	
3	40.4
4	43.5
5	16.1
Race/Ethnicity	
White	44.3
American Indian	29.1
African American	17.0
Hispanic	5.2
Other	3.9
Not Reported	0.4
Weight Status (BMI* Percentile)†	
Normal	69.6
Overweight	16.1
Obese	14.3

* Body Mass Index

† Normal weight: BMI <85th percentile

Overweight: BMI 85th percentile to <95th percentile

Obese: BMI ≥95th percentile

Table 1. Descriptive Characteristics of Participating 3-to-5-Year-Old Children at Child Care Centers in Oklahoma

	Mean ± SD **Served**	***Mean ± SD*** **Consumed**	**Correlation Coefficient (*r*)***
Nutrient			
Kilocalories (kcal)	430.1±174.3	317.5±159.8	0.681
Carbohydrate (g)	50.4±19.9	37.5±17.2	0.669
Protein (g)	21.9±8.9	16.0±8.8	0.581
Fat (% of kilocalories)	31.6±8.9	29.7±10.6	0.763
Food Serving			
Fruit	1.2±1.0	1.0±1.0	0.895
Vegetable	1.9±1.3	1.3±1.2	0.635
Combined fruit and vegetable	3.1±1.5	2.3±1.5	0.691
Low fat dairy	0.86±0.3	0.79±0.4	0.768
Whole grains	0.25±0.4	0.23±0.4	0.895
High-fat meat	0.35±0.4	0.30±0.4	0.871
High sugar/high-fat foods	0.17±0.3	0.15±0.3	0.926

A serving is any amount served or consumed, not a full measured serving size.

*Significant association at p<0.001 for all variables

Table 2. Mean Nutrients and Foods Served to and Consumed by 3-to-5 Year Old Children during Lunch at Child Care Centers in Oklahoma

		Served			Consumed	
	β	***SE***	***p*-value**	***β***	***SE***	***p*-value**
Nutrient						
Kilocalories	-0.122	0.40	0.761	0.778	0.376	0.040*
Carbohydrate (g)	-0.052	0.046	0.263	0.060	0.041	0.139
Protein (g)	-0.017	0.021	0.424	0.032	0.021	0.121
Fat (% of kilocalories)	0.36	0.20	0.079	0.068	0.025	0.007*
Food Serving						
Fruit	-0.002	0.003	0.417	-0.001	0.003	0.831
Vegetable	-0.002	0.003	0.474	-0.003	0.003	0.340
Combined fruit and vegetable	-0.004	0.004	0.244	-0.003	0.004	0.367
Low fat dairy	-0.002	0.001	0.020*	-0.001	0.001	0.084
Whole grains	-0.001	0.001	0.541	-0.001	0.001	0.424
High-fat meat	0.001	0.001	0.531	0.001	0.001	0.239
High sugar/high-fat foods	0.000	0.001	0.848	0.000	0.001	0.530

Linear regression analyses were adjusted for age, sex, and race. A serving is any amount served or consumed, not a measured serving size.
* Significant association at the p<0.05 level

Table 3. Association Between Body Mass Index Percentile and Nutrients and Foods Served and Consumed by 3-to-5-Year-Old Children during Lunch at Child Care Centers in Oklahoma

		Served			Consumed	
	β	***SE***	***p*-value**	***β***	***SE***	***p*-value**
Nutrient						
Kilocalories	19.028	15.696	0.227	18.713	14.661	0.203
Carbohydrate (g)	4.338	1.808	0.017*	2.723	1.585	0.087
Protein (g)	0.440	0.810	0.587	0.915	0.814	0.262
Fat (% of kilocalories)	-1.142	0.830	0.170	-0.718	0.980	0.465
Food serving						
Fruit	0.154	0.098	0.117	0.177	0.098	0.073
Vegetable	-0.075	0.126	0.551	0.014	0.111	0.900
Combined fruit and vegetable	0.079	0.145	0.586	0.191	0.141	0.176
Low fat dairy	-0.008	0.028	0.767	0.002	0.031	0.959
Whole grains	-0.076	0.035	0.029*	-0.103	0.034	0.003*
High-fat meat	-0.020	0.036	0.574	-0.011	0.033	0.730
High sugar/high-fat foods	0.079	0.033	0.018*	0.067	0.029	0.021*

Linear regression analyses were adjusted for BMI percentile, sex, and race. A serving is any amount served or consumed, not a measured serving size.
* Significant association at the p<0.05 level

Table 4. Association between Age and Nutrients and Foods Served and Consumed by 3-to-5-Year-Old Children during Lunch at Child Care Centers in Oklahoma

Discussion

Primary Findings

In the effort to prevent childhood obesity and undesirable immediate and long-term consequences, prevention efforts targeting children may be a key approach [36]. Since most preschool-age children attend CCCs full time in the U.S [5], CCCs have an important role in providing nutritious foods and influencing the development of children's healthy eating habits. The primary findings of the present study demonstrate that higher BMI percentile was significantly associated with fewer servings of low fat dairy, higher total energy intake, and higher percent of energy intake from fat, potentially perpetuating the development of excess weight gain. Older children consumed a less healthy nutrient profile at lunch, including more grams of carbohydrate served, fewer servings of whole grain served and consumed, and more servings of high sugar/high-fat foods. However, there were no differences between boys and girls regarding food served or consumed. Supporting previous findings, [25,28,37] there was a positive correlation between foods and nutrients served to children and subsequent consumption. Since eating habits are formed early in life [8], if CCCs are serving high amounts of energy-dense, nutrient-poor foods that may provide adequate energy, but insufficient nutrients for healthy growth and development, this may be a child health concern. However, if CCCs are serving more healthful foods, such as fruits, vegetables, low fat dairy and whole grains, children may consume a more nutritious diet and consequently develop healthy eating habits.

Child BMI Percentile and Energy Consumed

Our findings showed that higher BMI percentile was not associated with higher kilocalories served, but children with higher BMI percentile did consume more kilocalories during lunch. Previous research has shown conflicting results for children's dietary intake based on the child's weight status. [25,38-40]. Huang et al [38] Skinner et al [40], and Nicklas et al [25], observed 3-to-5-year-old children; Nicklas et al [25], exclusively examined meals at CCCs. Huang et al [38], and Skinner et al [40], used parent proxy 24-hour recalls to assess dietary intake, and did not show a difference in energy intake across weight status for 3-to-5-year-old children; however, differences in energy intake by sex were reported for 6-to-19-year-old children [38,40].Our findings support Nicklas et al [25]; at CCCs, children with higher weight status were not served more kilocalories, but did consume more over the lunch, as they may tend to eat more of the foods that are initially provided. This is important to note for obesity prevention efforts, especially if children are not physically active. Researchers have found that young children are physically inactive during most of their time in the CCC setting [41], which may be unfavorable to children with higher BMI percentiles who are consuming more total energy and a greater percent of kilocalories from fat, as this may lead to excess weight gain.

Child Age and Nutrients and Foods Served and Consumed

While previous researchers have examined what children eat by age, they did not examine the relationship of age and foods served to preschool-age children within the CCC setting. In the current study, older age was associated with more carbohydrates (grams) served. Older age was also associated with less fewer grain and more high sugar/high-fat foods served and consumed. These findings support previous findings that older children consume more food (volume [25], energy [28,30], fiber [30] and sweet snacks [30] than do younger children. Younger children may listen to their own body's satiety cues more than do older children, since researchers have reported that larger portion sizes influence intake of older children, but not younger children [28].

Sex Differences in Nutrients and Foods

There were no differences in foods served or consumed by boys and girls in the present study. This finding is congruent with one previous study [30], but contrasted with other studies that included older children [38,42]. Although Gubbels et al [29], found that boys consume more energy during the afternoon snack at the CCC, no sex differences were found in morning snack or lunch. The present study only examined the lunch meal, so a direct comparison between studies cannot be made.

CCC staff may influence children's dietary behaviors. It has been shown that CCC staff were less likely to encourage girls to try new foods and more likely to use food to control girl's behavior [29]. Staff also tend to talk with older children about healthy foods more often than younger children [29]. Nutrition education is important for development of healthy behaviors [43], and CCC staff can play an important role in this transfer of information, regardless of a child's age or sex [44]. Efforts should be made to talk with all young children about nutrition and healthy lifestyle behaviors.

Strengths and Limitations

Strengths of this study include the large sample size. Inclusion of CCCs from urban and rural areas increases the generalizability of findings. However, not all CCCs that were contacted were interested in participation, which may demonstrate some selection bias. Two observed meals for 80% of the children allows for enhanced representation of dietary patterns at CCC lunches. Observation of intake enhances data quality, since previous literature relied predominantly on intake reported by parents and teachers. While weighed plate waste would be ideal, weighing the children's lunches would be disruptive to the normal classroom schedule, especially for the number of children in the present study. All observers were trained and passed a practical exam, did not interact with the children, and encouraged classroom teachers to act according to their normal routine.

There were also limitations. Cooking staff at the CCCs could have altered the lunches during times of observation. However, this is unlikely, as menus for meals were often prepared weeks before study field observer's visits. Another potential limitation is the possibility of overestimation of fruits, vegetables, low fat dairy and whole grains, and underestimation of high-fat meat, and high sugar/high-fat foods served and consumed in the CCCs, since the actual volume or number (i.e. chicken nuggets) of these items were not assessed. However, the liberal definition of a serving errs in the favor of CCCs, as increased early exposure to food is associated with intake later in childhood [8, 9], Even with the possibility of overestimation of servings, the average fruit, vegetable, low fat dairy, and whole grains served and consumed was still a meager 0.25-1.9 servings.

Future Directions

Future investigations should include dietary assessment of all meals, including snacks, over several days to capture the usual foods and nutrients served to and consumed by children in the CCC setting. Energy expenditure should also be examined to fully elucidate the role of movement and diet at CCCs on a child's weight. An exploration of the influence of peers and caregivers would provide information regarding their influence on the foods that are served to children and what children consume. These suggested future directions are important so that researchers can begin to work with CCCs to create and implement nutrition education and childhood obesity prevention interventions.

Conclusion

The present study adds to the sparse literature regarding child characteristics, such as weight, age, and sex, influencing dietary intake in CCCs. Children that were served more food consumed more food in the CCC setting. This is important for CCCs to consider when developing meals for young children. Ideally, CCCs should provide a variety of nutrient-dense foods in order to promote a healthful diet, and be mindful of serving seconds with more healthful, nutrient-dense foods vs. energy-dense foods. These findings also revealed that children with a higher BMI percentile are served less low fat dairy and consume a higher percent of calories from fat and higher overall energy intake, potentially perpetuating the development of excess weight gain. Older children were served more carbohydrate (grams), more high sugar/high-fat foods, and fewer whole grains. Older children also consumed more servings of high sugar/high-fat foods and fewer whole grains. However, sex was not related to foods served or consumed in the CCC setting. Public health nutrition personnel are in important positions to influence CCC staff and policy makers to ensure that preschool-age children receive the best nutrition possible.

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