HHS Public Access

Author manuscript

J Acad Nutr Diet. Author manuscript; available in PMC 2021 March 01.

Published in final edited form as:

J Acad Nutr Diet. 2020 March ; 120(3): 386–394. doi:10.1016/j.jand.2019.09.018.

Contributions of early care and education to 3- to 4-year-old children's diet quality in central North Carolina

Courtney T Luecking, MPH, MS, RDN [Doctoral Candidate],
Department of Nutrition, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Address: 1700 Martin Luther King Jr. Blvd, CB 7426, Chapel Hill, NC 27599-7426

Stephanie Mazzucca, PhD [Assistant Professor],
Prevention Research Center, Brown School, Washington University in St. Louis, Address: One Brookings Drive, Campus Box 1196, St. Louis, MO 63130-4838

Amber E Vaughn, MPH, RD [Associate Director],
Children's Healthy Weight Research Group, Center for Health Promotion and Disease Prevention, University of North Carolina at Chapel Hill, Address: 1700 Martin Luther King Jr. Blvd, CB 7426, Chapel Hill, NC 27599-7426

Dianne S Ward, EdD, MS [Professor]
Department of Nutrition, Gillings School of Global Public Health and Fellow, Center for Health Promotion and Disease Prevention, University of North Carolina at Chapel Hill, Address: 1700 Martin Luther King Jr. Blvd, CB 7426, Chapel Hill, NC 27599-7426

Abstract

Background.—Parents and early care and education (ECE) are the key influencers of young children's diets, but there is limited information about how each contribute to children's overall diet quality.

Corresponding author: Dianne S Ward, EdD, MS, Children's Healthy Weight Research Group, Center for Health Promotion and Disease Prevention, University of North Carolina at Chapel Hill, 1700 Martin Luther King Jr. Blvd, CB 7426, Chapel Hill, NC 27599-7426, Telephone number: (919)-843-0901, Fax number: n/a, dsward@email.unc.edu.

Author Contributions:

All authors contributed to conceptualization of this study. CTL supervised data management. CTL and SM performed data analysis. CTL and SM wrote the first draft. All authors reviewed and commented on subsequent drafts of the manuscript.

Conflict of interest disclosures:

Courtney Luecking, Stephanie Mazzucca, and Amber Vaughn declare that they have no conflicts of interest to report. Declarations for potential conflicts of interest for Dianne Ward within the last five years are as follows: consulting for Healthy Eating Research, Robert Wood Johnson Foundation (RWJF) as a co-leader for the early care and education workgroup (2013-2017, $1,000 per year); grant funding from Healthy Eating Research, RWJF to develop an online training to assess early care and education nutrition and physical activity environments (2014-2015, $97,000); consulting for Nestle Nutrition Institute to prepare a paper on nutrition in early care and education settings (2018, $3,000); consulting for Healthy Eating Research, RWJF to review grants (2018-2019; $550 for 3 reviews), and; grant funding from the Kellogg Foundation for farm-to-ECE programming (2018-2019, $180,600).

Objective.—This study aimed to determine what proportion of children's dietary intake occurs within the ECE setting and whether diet quality is higher at ECE centers and, consequently, on weekdays than weekends.

Design.—This cross-sectional analysis of a larger cluster randomized controlled trial used multiple 24-hour dietary intakes measured through a combination of the Dietary Observation in Child Care protocol and parent-reported food diaries.

Participants/setting.—Participants (n=840) included children 3-4 years of age enrolled in ECE centers in central North Carolina for whom 24-hour dietary intake was captured via observation of meals and snacks consumed at ECE and parent-report of all remaining meals and snacks. Data were collected from 2015 to 2016.

Main outcome measures.—Diet quality at ECE and elsewhere was evaluated using the Healthy Eating Index (HEI)-2015.

Statistical analyses performed.—Mixed effects models were used to determine differences in mean HEI-2015 component and total scores. Models were adjusted for children's age and sex and accounted for clustering within ECE centers and families.

Results.—Children consumed approximately 40% of daily energy, nutrients, and food groups at ECE centers. The mean total HEI-2015 score was higher for foods and beverages consumed at ECE centers (58.3 ± 0.6) than elsewhere (52.5 ± 0.6) ($p<0.0001$). The mean total HEI-2015 score was also higher on weekdays (58.5 ± 0.5) than on weekends (51.3 ± 0.5) ($p<0.0001$).

Conclusions.—Children consume a majority of dietary intake away from ECE centers. Overall, diet quality is low, but the quality of foods consumed by children at ECE centers is higher than that consumed elsewhere. ECE centers remain an important source of nutrition and further investigation is warranted to identify ways to support both ECE centers and families to provide healthier eating environments.

Keywords

nutrition; diet quality; child care; family

Background

Early childhood, defined as birth to 5 years of age, is a time of significant growth and development that establishes the foundation for future physical, social, emotional, and cognitive health.[1,2] Dietary patterns and eating behaviors formed during this period have a lasting influence on preferences, energy balance, and health in later childhood and into adulthood.[3–7] To support optimal growth and development, young children require nutrient dense diets so that nutrient requirements may be achieved within appropriate levels of energy.[8,9] The Dietary Guidelines for Americans aged 2 years and older offer evidence-based recommendations for the prevention of chronic disease over the lifespan, and have evolved from focus on individual dietary components (e.g., nutrients and food groups) to focus on the dietary patterns, or combinations of foods consumed.[9] While evidence suggests most young children in the United States (US) consume adequate amounts of many essential nutrients (e.g., protein, riboflavin),[10,11] they also consume inadequate amounts of

vegetables, fruit, and whole grains[12,13] and excessive amounts of sweet and salty snacks and sugar-sweetened beverages.[14–16] Overall, research indicates children in the U.S. are not achieving dietary recommendations for healthy eating.[17–19]

Young children are dependent on their adult caregivers for the food and beverages provided. For most children, the two most influential caregivers are their parents and early care and education (ECE) providers.[20] Hence, the home/family and ECE settings are critical environments for shaping children's dietary intake.[21,22] Given the importance of ECE, a federal food program, the Child and Adult Care Food Program (CACFP), offers reimbursement to ECE programs that serve nutritious meals and snacks to low-income children.[23] There is evidence that participating programs serve healthier foods and beverages and children consume healthier diets.[24–26] While several studies have described young children's dietary intakes at home and/or at ECE settings,[27–39] there is little information, especially in the US,[40,41] to account for or compare each setting's contribution to total dietary intake. Furthermore, reports have often commented on specific nutrients or food groups consumed and lack a more general interpretation of food patterns or quality. Because the establishment of healthy dietary patterns during early childhood is critical for lifelong health,[1] a more nuanced and pragmatic understanding of the contributions of home and ECE environments to the overall pattern and quality of children's consumption is needed.

The aims of this study were to: 1) describe the total dietary intake among 3- to 4-year-old children attending ECE centers in relation to age-appropriate recommendations from the Dietary Guidelines for Americans and identify the proportion of consumption coming from ECE centers; 2) evaluate whether the quality of dietary intake patterns, as measured by the Healthy Eating Index (HEI)-2015,[42] at ECE centers is different from that when children are with parents; and 3) assess whether the quality of dietary intake differs between weekdays (when children attend ECE centers) and weekends. The authors hypothesized diet quality would be higher at ECE centers than with parents and, subsequently, weekdays would exhibit higher diet quality than weekends.

Materials and Methods

Participants and setting

Data for this cross-sectional study were collected as part of a larger cluster randomized controlled trial in central North Carolina evaluating the effectiveness of an 8-month social marketing campaign (*Healthy Me, Healthy We*) to improve 3- to 4-year-old children's dietary and physical activity behaviors.[43] Eligibility criteria for the larger trial specified that ECE centers have at least one classroom with 3-4-year-old children, provide lunch, have a quality rating of 3-5 stars (on a 5-star scale) or be exempt from the quality rating, and not exclusively serve children with special needs. Child participants had to be 3-4 years of age and enrolled at a participating center. One parent participated with each child and provided written consent. The Institutional Review Board at the University of North Carolina at Chapel Hill approved study protocols.

Measures

Data collection occurred in two waves, prior to randomization, between July and September in 2015 and 2016. Data collection procedures included a combination of self-administered surveys, physical assessments, and observation.

Demographics.—Parents completed surveys containing questions about child age, sex, race, and ethnicity, as well as parent sex, education, and household income. Center directors completed surveys about the ECE center characteristics, including accreditation, subsidies, affiliations, and total number of children enrolled.

Anthropometrics.—Trained data collectors measured children's height and weight at their respective ECE centers using standard protocols.[43] Height and weight were used to calculate body mass index (BMI, kg/m^2), and the Centers for Disease Control and Prevention growth reference (2000) was used to determine age- and sex-specific BMI percentiles.[44] Children with a sex specific BMI-for-age at or above the 85^{th} percentile were classified as overweight or obese. Parents completed self-report measures for their height and weight; BMI was calculated using these self-reported values.

Dietary Intake.—To assess 24-hour intake across multiple settings and caregivers, dietary intake was measured using a combination of observation and parent-report.[45,46] Data were collected for three days – two consecutive weekdays (Tuesday/Wednesday or Thursday/Friday) and one weekend day. On weekdays, data collectors trained and certified on the Dietary Observation in Child Care (DOCC) protocol observed and recorded all food and beverages consumed by participating children while at the ECE center.[47] Parents completed food records for corresponding weekdays as well as one weekend day. Parents received instruction to document all food and beverages consumed outside of child care in real-time, including brand names and methods of preparation. A portion size estimation guide was provided and reviewed to aid parents in estimating amounts children consumed. Members of the research team reviewed all records – observation and parent-report – and contacted data collectors and parents, as needed, within one week to clarify or collect additional information regarding the types or quantities of food and drink consumed as well as potentially missing information (e.g., no drinks recorded).

Observed and parent-reported dietary intakes were merged to create 24-hour records that were entered into the Nutrition Data System for Research (NDSR) software (versions 2015 and 2016).[48] During entry, NDSR prompts location of meals and snacks, which provided the ability to capture whether food was eaten at ECE centers (i.e., DOCC data) or any other location (i.e., parent report). Final nutrient analyses were completed using NDSR version 2017 (July 2017)[49] to obtain energy intake, macronutrients, micronutrients, and food group equivalents consistent with units required to generate total and component HEI-2015 scores.

Dietary intake was summarized in regard to nutritional goals for the healthy US-style eating pattern set forth by the 2015-2020 Dietary Guidelines for Americans for moderately active 3-4-year-old boys and girls.[9] Key elements include energy intake, macronutrient distribution (percent energy intake from carbohydrates, fat, protein, as well as added sugar and saturated fat), trans fat, sodium, and food group equivalents (fruit, vegetables, grains, protein, and

dairy). Overall diet quality was evaluated using the HEI-2015, a quantitative measure of alignment with the Guidelines.[42,50] The density-based scoring system (i.e., amount consumed per 1,000 kcal) allows for the examination of quality of intake standardized for the quantity consumed.[50,51] The HEI-2015 includes 13 components – nine adequacy components (dietary components to increase) and four moderation components (dietary components to decrease). While most components are standardized per calorie, the fatty acid (adequacy) component represents the ratio of healthier unsaturated to less healthy saturated fats. Component scores typically range from 0 to 10 points, but for components where one is a subset of another (e.g., Total Vegetables and Greens and Beans), each component is scored 0 to 5 points. All components sum for a maximum score of 100, with a higher total HEI score indicating greater consistency with the Dietary Guidelines. Summarizing dietary intake in these two manners provided the ability to view the absolute intake of key nutrients and food groups, the nutrient density of foods and beverages consumed, as well as an overall indicator of diet quality.

Generating HEI scores.—Distinct output files from the NDSR for total day and location-specific (i.e., ECE center vs. all other locations) were imported to SAS version 9.4[52] to calculate component and total HEI-2015 scores for each child using publicly available SAS code from the Nutrition Coordinating Center (University of Minnesota, Minneapolis). This simple HEI scoring algorithm accounts for multiple days of intake per child by summing data across days prior to generating a single set of standardized component and total scores for each child by setting and weekday/weekend.[50]

Statistical Analysis

This cross-sectional analysis comprised children for whom dietary intake was both observed at the ECE center and reported for time outside of child care within a 24-hour period, including children who provided only one of the intended two weekdays of record. Children with two weekdays of intake were compared to children with only one weekday, but no differences were detected between groups. Demographic characteristics of children and parents, characteristics of centers, and children's dietary intakes and diet quality scores were summarized using descriptive statistics, including frequencies for categorical data and means and standard deviations for continuous data. Mixed effects models were used to determine whether mean HEI-2015 component and total scores differed by setting (i.e., ECE center or with parents) and weekdays compared to weekend. These models included random intercepts to account for clustering within ECE centers and children within families as well as accounting for repeated measures on children. Children's age and sex were determined to be confounders *a priori* and were included in adjusted models. In considering the opportunity for multiple comparisons within HEI-2015 total and component scores, the alpha was adjusted using a Bonferroni correction and set at 0.00019 (0.05/26 comparisons). All statistical analyses were performed in SAS version 9.4.[52]

Results

Sample Characteristics

Of the 908 children from 98 ECE centers who provided baseline data for the larger cluster randomized controlled trial, 840 children met inclusion criteria for this analysis (Table 1). Children with no dietary information were excluded (n=2) as were those when weekday diet data were missing corresponding pieces from the parent-reported records (n=40) or observations at the ECE center (n=26). Most children (n=711) had two complete weekdays of record, while the others (n=129) had one complete weekday of record. A majority of children had a day of record for the weekend (n=826), including children who only had information for one weekday (93%).

A majority of children were white (45%) or African American (38%), and about one-quarter of the children (26%) were classified as overweight or obese (sex-specific BMI-for-age ≥ 85th percentile). Parents completing study measures were primarily female (86%) and a majority of parents (64%) were classified as overweight or obese (BMI ≥ 25.0). Nearly half of the parents (47%) reported having a college or graduate-level degree and family income was reflective of that in North Carolina. A variety of types of ECE centers were represented in the sample (e.g., faith-based, Head Start), and most accepted child care subsidies (92%) and participated in the CACFP (73%).

Dietary Intake

Dietary Intakes.—Children's dietary intakes at ECE centers and with parents, as well as on weekdays and weekend days, are shown in Table 2. For parent-reported records, meals and snacks were most frequently consumed at home (68%) or 'other' locations that included restaurants (23%). Although specific dietary recommendations are dependent on the age and sex of a child, the average 24-hour dietary intake for weekdays and weekends consistently fell short of recommendations for vegetables, dairy, and whole grains and exceeded recommended limits for sodium and percent energy intake from saturated fat and added sugars. On weekdays when children consumed foods and beverages both at ECE and with parents, the majority of the total day's energy (61%), food groups (50-70%), sodium (61%), and added sugars (65%) were consumed with parents. When comparing weekdays and weekend days, children consumed more energy and sodium, as well as a higher percent of energy from added sugar and saturated fat, on weekends.

Quality of Intake by Setting.—The mean total HEI-2015 scores for the food and beverage consumed at ECE (58.3 ± 0.6) and with parents (52.5 ± 0.6) indicate children's dietary patterns on the measured days of intake did not coincide with national recommendations at either setting (Table 3). However, differences in scores generally suggest that children consumed a healthier assortment of foods and beverages while at ECE.[50] Statistically significant differences were observed for 9 of the 13 HEI-2015 component scores, exceptions being greens and beans, seafood and plant proteins, fatty acids, and sodium. Food and beverage consumed at ECE appeared to provide more total fruit, whole fruit, whole grains, and dairy, as well as less added sugars and saturated fats per calorie. Food consumed with parents provided more total vegetables and total protein as well as

fewer refined grains per calorie. Although many component scores across both settings were low, mean component scores less than 50% of the maximum component score help identify the greatest opportunities for improvement. Components with these very low scores were similar across settings and included: total vegetables, greens and beans, whole grains, seafood and plant proteins, and fatty acids.

Quality of Intake on Weekdays and Weekends.—The mean total HEI-2015 scores for weekdays (58.5 ± 0.5) and weekends (51.3 ± 0.5) similarly showed that on the measured days of intake, children did not consume diets consistent with recommendations for the prevention of chronic disease (Table 3). The total HEI score for weekdays was higher than weekends. This difference was statistically significant and may be clinically meaningful.[50] Statistically significant differences were observed for 8 of the 13 component scores, exceptions being total protein foods, seafood and plant proteins, fatty acids, refined grains, and sodium. Weekday consumption provided more total fruit, whole fruit, total vegetables, greens and beans, dairy, and whole grains, as well as less added sugars and saturated fats per calorie. Regardless of the day of the week, many component scores were low to moderate at best, and highlight opportunity for improvement. The lowest component scores across weekday and weekend included total vegetables, greens and beans, whole grains, seafood and plant proteins, fatty acids, refined grains, and sodium.

Discussion

This cross-sectional analysis of observed dietary intake of 3- to 4-year-old children at ECE centers and corresponding parent-reported intake outside of child care revealed, similar to results from nationally representative samples of children who may or may not attend child care, that the quality of children's diets is low.[12–19] Results also showed the quality of foods and beverages children consumed at ECE centers was in fact higher than what was consumed elsewhere, as well as on weekdays, when children are in child care, than on weekends, when they are not. Because of the short-term and long-term effects of dietary intake during early childhood, improving diet quality to ensure children meet nutrient recommendations within appropriate levels of energy remains of critical importance.[54]

Previous investigations into the dietary intake of young children attending ECE centers have either narrowly assessed setting (i.e., only ECE centers or only home),[36–39] a portion of the day,[41] or summarized total intake that was not identified by setting,[28,32–35] making it difficult to draw meaningful insights about the individual and complementary roles ECE centers and parents have on children's dietary intake. Only one report (from 1999) had previously distinguished consumption at ECE centers from home for an entire day.[40] Results from this study mirror previous findings in that children consumed inadequate amounts of food groups (e.g., vegetables and whole grains) and other dietary constituents important for healthy development while also consuming excess sodium and added sugars.[28,32–35,40] However, differences in these results from other studies signal that focusing on only portions of the day or absolute intake may misrepresent total dietary intake.[41]

Based on the amount of time children spend in care outside the home, national guidelines suggest that ECE provide up to one-half to two-thirds of children's daily nutrient

requirements.[55] However, results from this study, similar to findings estimating the proportion of preschool-aged children's intake occurring outside of child care,[36] indicate children consume approximately 40% of energy and nutrients at child care and instead consume about 60% of their diet with parents. While this is less than current recommendations, the higher total HEI-2015 score at ECE centers signifies children consumed more nutrient dense foods there than with parents. It is plausible that participation in the CACFP provides children access to healthier foods and beverages within ECE centers than what is provided by parents.[33,38,39] In addition, lower total HEI-2015 scores with parents may be related to the fact that approximately 12% of dietary intake of children aged 2 – 5 years comes from quick-service restaurants.[56] This not only affirms the critical role ECE centers play in improving the overall quality of children's dietary intake,[22] but also the importance of synergy and partnership between ECE providers and parents to ensure children have consistent access and encouragement to consume healthier foods and drinks.[21,40,57] Priorities for improving quality of dietary intake are similar for ECE centers and families, and intervention efforts should focus on improving the availability of healthy foods and encouraging children to eat them. Specifically, the availability and consumption of more vegetables, particularly greens and beans and seafood and plant proteins, less sodium and added sugars, and to substitute whole grains for refined grains and polyunsaturated and monounsaturated fatty acids for saturated fats.

A key strength of the current study is the use of a quantitative measure of overall diet quality, the HEI-2015 score. The density-based scoring system used to calculate the HEI-2015 separates diet quality from quantity, which not only allows for interpretation of the nutrient density of the combination of foods and beverages consumed but also for comparison across settings and days in which absolute intake differed.[50] In addition, the component scores of the HEI-2015 make it straightforward to identify specific targets for dietary interventions that can be translated to food-based recommendations. For example, although children in this study, on average, consumed amounts of protein foods within range of recommendations, use of the HEI-2015 component scores provided more detailed information that the quality of sources of protein could be improved through substituting seafood and plant proteins.

Other assets of this study include the collection and data management of 24-hour dietary intake in a large sample of children using a highly regarded diet analysis program (NDSR) in which data across multiple settings and caregivers could be both distinguished and linked. While dietary assessment in general is not without limitations, combining a valid and reliable direct observation method[47] with parent-reported food diaries minimized bias in obtaining 24-hour intake for children who spend time with multiple caregivers.[45,58] However, caution is warranted when interpreting findings, as some differences may be the result of different methods of data collection.

Other limitations include the generalizability of these results. This sample represents the types of ECE centers and families receiving care in central North Carolina. However, results are comparable to studies conducted in other states.[28,32–35,40] Another limitation regarding generalizability relates to the calculation of HEI-2015 scores with a simple scoring method. This method is based on individuals' intake on the observed days; therefore it may not

capture episodic consumption of infrequently consumed food groups or subgroups, nor does it estimate usual intake or adjust for measurement error.[59] However, it can be used to estimate individual-level scores that can then be used in more advanced statistical models.[50,60] To answer these research questions, it was necessary to use mixed effects models to control for clustering within ECE centers, relationships between HEI-2015 scores and individual children's characteristics (i.e., age, sex), and the within subject comparison of looking at dietary intake by setting or portion of the week (i.e., groups were not independent of one another).

Conclusions

This sample of 3- to 4-year-old children attending ECE centers in central North Carolina consumed about 60% of their diet with parents and 40% at ECE centers. In general, children fell short of recommendations for vegetables, dairy, and whole grains and exceeded recommendations for sodium and percent energy intake from added sugars and saturated fats as specified in the USDA Food Patterns. A deeper look at consumption specifically within ECE centers and with parents revealed that children consumed higher quality foods and beverages at ECE centers, most notably through more whole fruits, dairy, whole grains, and less added sugars and saturated fat per calorie. Similarly, in comparing weekdays to weekends, children consumed higher quality foods and beverages on weekdays than weekends. While ECE centers remain an important source of nutrition for young children, there is still room for improvement. These findings highlight the value of evaluating overall eating patterns, as opposed to specific nutrients or portions of the day, and warrant further investigation about how to more effectively include and support parents in fostering healthier eating environments so that children eat well across settings and ultimately achieve higher quality dietary intake that positively influences longer-term health.

Acknowledgements:

We would like to thank the child care centers and families who participated in the *Healthy Me, Healthy We* study as well as the project staff who supported participant recruitment, data collection, and quality assurance.

Funding/financial disclosures:

Funding for this project was provided by the National Heart, Lung, and Blood Institute of the National Institutes of Health (R01HL120969) The project was conducted out of the University of North Carolina at Chapel Hill at the Center for Health Promotion and Disease Prevention, a Prevention Research Center funded through a cooperative agreement with the Centers for Disease Control and Prevention (1U48DP005017). Support was also received from the Nutrition Obesity Research Center at the University of North Carolina at Chapel Hill (NIH DK056350) and the Washington University in St. Louis Center for Diabetes Translation Research (P30DK092950). Findings and conclusions of this article are those of the authors and do not necessarily represent the official position of the National Institutes of Health, National Heart, Lung, and Blood Institute, National Institute of Diabetes and Digestive and Kidney Diseases, or Centers for Disease Control and Prevention. The sponsor had no role in the study design; collection, analysis, or interpretation of the data; writing of the article; or decision to publish this article.

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Research Snapshot

Research question:

What proportion of 3-4-year-old children's dietary intake occurs at early care and education (ECE) centers? Is diet quality at ECE centers higher than away from ECE centers and higher on weekdays compared to weekends?

Key findings:

In this cross-sectional analysis of observed dietary intake of 840 3-4-year-old children at ECE centers and the corresponding parent-reported dietary intake outside of child care, children consumed approximately 40% of energy and nutrients at ECE centers. Diet quality, as measured by the Healthy Eating Index-2015, was higher at ECE centers than away from ECE centers and on weekdays than weekends (both $p<0.0001$).

Table 1.

Demographic and anthropometric characteristics of 840 parent-child dyads from 98 early care and education centers in North Carolina in 2015 – 2016 who had at least one weekday record containing dietary intake at both child care and with parents and characteristics of centers

Children	
	mean ±SD[a]
Age, years (n=837)	4 ± 0.6
	n (%)
Sex, female (n=838)	410 (48.9)
Race (n=797)	
White	362 (45.4)
Black or African American	305 (38.2)
Asian	18 (2.3)
American Indian or Alaska Native	3 (0.4)
More than one race	95 (11.9)
Not specified	14 (1.8)
Ethnicity (n=808)	
Hispanic or Latino	73 (8.7)
Anthropometric (n=836)	*mean ± SD*
BMI[b] percentile	61.3 ± 27.8
	n (%)
BMI-for-age ≥85th percentile	214 (25.6)
Parents	***n (%)***
Sex, female (n=819)	704 (86.0)
Highest level of education completed (n=804)	
High school diploma/GED or lower	134 (16.7)
Some college	191 (23.8)
Associate degree	101 (12.6)
College degree or higher	378 (47.0)
Annual family household income (n=717)	
Under $30,000	242 (33.8)
$30,000 - $59,999	158 (22.0)
$60,000 or more	317 (44.2)
	mean ± SD
BMI (n=779)	28.8 ± 7.4
Weight status	*n (%)*
Underweight (BMI <18.5)	11 (1.4)
Normal weight (BMI 18.5 to <25)	269 (34.5)
Overweight (BMI 25.0 to <30)	230 (29.5)
Obese (BMI ≥30.0)	269 (34.5)
Centers	***n (%)***

Children	
Accredited by the National Association for the Education of Young Children	22 (22.4)
Accepts child care subsidies	90 (91.8)
Participates in the Child and Adult Care Food Program	71 (72.5)
Other program affiliations[c]	
NC Pre-K or other pre-kindergarten	33 (33.7)
Faith-based	20 (20.4)
Head Start and/or Early Head Start	11 (11.2)
Military	3 (3.1)
Native American or Alaska Native tribe	1 (1.0)
	mean, range
Total child enrollment	87, 28-218

[a] SD = standard deviation

[b] BMI = body mass index, calculated as kg/m^2

[c] Centers could select all options that applied

Table 2.

Dietary intakes of 3-4-year-old children attending center-based early care and education in central North Carolina in 2015 – 2016

Dietary Component	Recommended Daily Intake[a]	Weekday at ECE[b] (n=840) (mean ± SD[c])	Weekday with Parents (n=840) (mean ± SD)	Total Weekday (n=840) (mean ± SD)	Total Weekend (n=826) (mean ± SD)
Energy, kcal[d]	1200 – 1400	503 ± 169	771 ± 278	1274 ± 301	1426 ± 468
Carbohydrate, % energy	45 – 65	58.7 ± 8.6	54.2 ± 10.01	54.8 ± 6.3	51.6 ± 20.3
Fat, % energy	25 – 35	27.2 ± 7.2	32.0 ± 7.7	29.6 ± 5.3	33.1 ± 7.4
Protein, % energy	10 – 30	15.9 ± 3.9	15.4 ± 4.6	15.7 ± 3.2	14.7 ± 3.9
Sodium, mg	<1200 - <1500[e]	782 ± 340	1219 ± 521	2000 ± 614	2322 ± 924
Saturated fat, % energy	<10	9.2 ± 3.2	10.6 ± 3.6	10.1 ± 2.5	11.0 ± 3.3
Trans fat, g	Limit	0.6 ± 0.5	0.9 ± 0.6	1.5 ± 0.8	1.6 ± 1.2
Added sugars, % energy	<10	11.1 ± 6.4	13.8 ± 8.7	12.9 ± 5.8	14.1 ± 8.2
Fruit, cup-equivalents	1 – 1.5	0.5 ± 0.4	0.6 ± 0.6	1.1 ± 0.7	1.0 ± 1.0
Vegetables, cup-equivalents	1.5	0.2 ± 0.2	0.4 ± 0.4	0.6 ± 0.4	0.6 ± 0.6
Grains, ounce-equivalents	4 – 5	2.1 ± 0.9	2.7 ± 1.5	4.8 ± 1.7	5.2 ± 2.6
Whole grains, ounce-equivalents	2 – 2.5	0.4 ± 0.5	0.4 ± 0.6	0.8 ± 0.8	0.7 ± 1.0
Protein foods, ounce-equivalents	3 – 4	0.9 ± 0.8	2.0 ± 1.4	2.9 ± 1.7	3.9 ± 2.6
Dairy, cup-equivalents	2.5	1.1 ± 0.6	1.0 ± 0.8	2.1 ± 1.0	1.7 ± 1.2

[a] Based on Dietary Reference Intakes and Healthy US-style USDA Food Patterns for moderately active 3-4-year-old girls and boys

[b] ECE = early care and education

[c] SD = standard deviation

[d] Energy is based on estimated average requirements, not a recommended daily intake

[e] Chronic Disease Risk Reduction Intake[53]

Table 3.

Healthy Eating Index-2015 scores[a] by setting and day of the week of 3-4-year-old children attending center-based early care and education in central North Carolina in 2015 – 2016

HEI-2015[b] Component	Maximum Points	Weekday at ECE[c,d] (n=840) (mean ± SE[e])	Weekday with Parents[d] (n=840) (mean ± SE)	p-value[f]	Total Weekday (n=840) (mean ± SE)	Total Weekend (n=826) (mean ± SE)	p-value[f]
Adequacy							
Total fruits	5	4.2 ± 0.1	3.0 ± 0.1	**<0.0001**	4.0 ± 0.1	3.1 ± 0.1	**<0.0001**
Whole fruits	5	4.3 ± 0.1	2.8 ± 0.1	**<0.0001**	4.1 ± 0.1	2.9 ± 0.1	**<0.0001**
Total vegetables	5	1.8 ± 0.1	2.3 ± 0.1	**<0.0001**	2.2 ± 0.1	1.9 ± 0.1	**<0.0001**
Greens and beans	5	0.9 ± 0.1	1.2 ± 0.1	0.001	1.4 ± 0.1	0.9 ± 0.1	**<0.0001**
Whole grains	10	4.3 ± 0.2	3.1 ± 0.2	**<0.0001**	4.1 ± 0.2	3.1 ± 0.2	**<0.0001**
Dairy	10	9.3 ± 0.1	7.2 ± 0.1	**<0.0001**	9.0 ± 0.1	7.0 ± 0.1	**<0.0001**
Total protein foods	5	2.9 ± 0.1	3.8 ± 0.1	**<0.0001**	3.8 ± 0.1	4.0 ± 0.1	0.004
Seafood and plant proteins	5	1.2 ± 0.1	1.4 ± 0.1	0.159	1.9 ± 0.1	1.6 ± 0.1	0.01
Fatty acids	10	4.6 ± 0.2	4.8 ± 0.2	0.245	4.5 ± 0.2	5.1 ± 0.2	0.0003
Moderation							
Refined grains	10	4.4 ± 0.2	5.5 ± 0.2	**<0.0001**	4.9 ± 0.1	4.9 ± 0.1	0.63
Sodium	10	5.3 ± 0.2	4.9 ± 0.2	0.009	4.9 ± 0.1	4.5 ± 0.1	0.002
Added sugars	10	7.4 ± 0.1	6.2 ± 0.1	**<0.0001**	6.7 ± 0.1	6.1 ± 0.1	**<0.0001**
Saturated fats	10	7.7 ± 0.1	6.5 ± 0.1	**<0.0001**	7.1 ± 0.1	6.1 ± 0.1	**<0.0001**
Total HEI-2015 Score	100	58.3 ± 0.6	52.5 ± 0.6	**<0.0001**	58.5 ± 0.5	51.3 ± 0.5	**<0.0001**

[a] Scores adjusted for child sex, age in years, and account for clustering by centers and repeated measures on children

[b] HEI-2015 = Healthy Eating Index-2015

[c] ECE = early care and education

[d] Based only on weekday records of intake

[e] SE = standard error

[f] p-values bolded denote those that reached statistical significance for correcting for multiple comparisons using Bonferroni correction (p<0.00019)