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Contributions of Early Care and Education Programs to Diet Quality in Children Aged 3 to 4 Years in Central North Carolina

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All authors contributed to conceptualization of this study. CTL supervised data management.

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Courtney Luecking, Stephanie Mazzucca, and Amber Vaughn declare that they have no conflicts of interest to report.

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1 **Research Snapshot**

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

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

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

12

13 **Abstract:**

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

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

20 *Design.* This cross-sectional analysis of a larger cluster randomized controlled trial used multiple
21 24-hour dietary intakes measured through a combination of the Dietary Observation in Child
22 Care protocol and parent-reported food diaries.

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

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

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

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

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

41 **Background**

42 Early childhood, defined as birth to 5 years of age, is a time of significant growth and
43 development that establishes the foundation for future physical, social, emotional, and cognitive
44 health.^{1,2} Dietary patterns and eating behaviors formed during this period have a lasting influence
45 on preferences, energy balance, and health in later childhood and into adulthood.³⁻⁷ To support
46 optimal growth and development, young children require nutrient dense diets so that nutrient
47 requirements may be achieved within appropriate levels of energy.^{8,9} The Dietary Guidelines for
48 Americans aged 2 years and older offer evidence-based recommendations for the prevention of
49 chronic disease over the lifespan, and have evolved from focus on individual dietary components
50 (e.g., nutrients and food groups) to focus on the dietary patterns, or combinations of foods
51 consumed.⁹ While evidence suggests most young children in the United States (US) consume
52 adequate amounts of many essential nutrients (e.g., protein, riboflavin),^{10,11} they also consume
53 inadequate amounts of vegetables, fruit, and whole grains^{12,13} and excessive amounts of sweet
54 and salty snacks and sugar-sweetened beverages.¹⁴⁻¹⁶ Overall, research indicates children in the
55 U.S. are not achieving dietary recommendations for healthy eating.¹⁷⁻¹⁹

56
57 Young children are dependent on their adult caregivers for the food and beverages provided. For
58 most children, the two most influential caregivers are their parents and early care and education
59 (ECE) providers.²⁰ Hence, the home/family and ECE settings are critical environments for
60 shaping children's dietary intake.^{21,22} Given the importance of ECE, a federal food program, the
61 Child and Adult Care Food Program (CACFP), offers reimbursement to ECE programs that
62 serve nutritious meals and snacks to low-income children.²³ There is evidence that participating
63 programs serve healthier foods and beverages and children consume healthier diets.²⁴⁻²⁶ While

64 several studies have described young children’s dietary intakes at home and/or at ECE
65 settings,²⁷⁻³⁹ there is little information, especially in the US,^{40,41} to account for or compare each
66 setting’s contribution to total dietary intake. Furthermore, reports have often commented on
67 specific nutrients or food groups consumed and lack a more general interpretation of food
68 patterns or quality. Because the establishment of healthy dietary patterns during early childhood
69 is critical for lifelong health,¹ a more nuanced and pragmatic understanding of the contributions
70 of home and ECE environments to the overall pattern and quality of children’s consumption is
71 needed.

72

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

81

82 **Materials and Methods**

83 Participants and setting

84 Data for this cross-sectional study were collected as part of a larger cluster randomized
85 controlled trial in central North Carolina evaluating the effectiveness of an 8-month social
86 marketing campaign (*Healthy Me, Healthy We*) to improve 3- to 4-year-old children’s dietary

87 and physical activity behaviors.⁴³ Eligibility criteria for the larger trial specified that ECE centers
88 have at least one classroom with 3-4-year-old children, provide lunch, have a quality rating of 3-
89 5 stars (on a 5-star scale) or be exempt from the quality rating, and not exclusively serve children
90 with special needs. Child participants had to be 3-4 years of age and enrolled at a participating
91 center. One parent participated with each child and provided written consent. The Institutional
92 Review Board at the University of North Carolina at Chapel Hill approved study protocols.

93

94 Measures

95 Data collection occurred in two waves, prior to randomization, between July and September in
96 2015 and 2016. Data collection procedures included a combination of self-administered surveys,
97 physical assessments, and observation.

98

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

103

104 *Anthropometrics.* Trained data collectors measured children's height and weight at their
105 respective ECE centers using standard protocols.⁴³ Height and weight were used to calculate
106 body mass index (BMI, kg/m²), and the Centers for Disease Control and Prevention growth
107 reference (2000) was used to determine age- and sex-specific BMI percentiles.⁴⁴ Children with a
108 sex specific BMI-for-age at or above the 85th percentile were classified as overweight or obese.

109 Parents completed self-report measures for their height and weight; BMI was calculated using
110 these self-reported values.
111

112 *Dietary Intake.* To assess 24-hour intake across multiple settings and caregivers, dietary intake
113 was measured using a combination of observation and parent-report.^{45,46} Data were collected for
114 three days – two consecutive weekdays (Tuesday/Wednesday or Thursday/Friday) and one
115 weekend day. On weekdays, data collectors trained and certified on the Dietary Observation in
116 Child Care (DOCC) protocol observed and recorded all food and beverages consumed by
117 participating children while at the ECE center.⁴⁷ Parents completed food records for
118 corresponding weekdays as well as one weekend day. Parents received instruction to document
119 all food and beverages consumed outside of child care in real-time, including brand names and
120 methods of preparation. A portion size estimation guide was provided and reviewed to aid
121 parents in estimating amounts children consumed. Members of the research team reviewed all
122 records – observation and parent-report – and contacted data collectors and parents, as needed,
123 within one week to clarify or collect additional information regarding the types or quantities of
124 food and drink consumed as well as potentially missing information (e.g., no drinks recorded).
125

126 Observed and parent-reported dietary intakes were merged to create 24-hour records that were
127 entered into the Nutrition Data System for Research (NDSR) software (versions 2015 and
128 2016).⁴⁸ During entry, NDSR prompts location of meals and snacks, which provided the ability
129 to capture whether food was eaten at ECE centers (i.e., DOCC data) or any other location (i.e.,
130 parent report). Final nutrient analyses were completed using NDSR version 2017 (July 2017)⁴⁹ to

131 obtain energy intake, macronutrients, micronutrients, and food group equivalents consistent with
132 units required to generate total and component HEI-2015 scores.

133
134 Dietary intake was summarized in regard to nutritional goals for the healthy US-style eating
135 pattern set forth by the 2015-2020 Dietary Guidelines for Americans for moderately active 3-4-
136 year-old boys and girls.⁹ Key elements include energy intake, macronutrient distribution (percent
137 energy intake from carbohydrates, fat, protein, as well as added sugar and saturated fat), trans fat,
138 sodium, and food group equivalents (fruit, vegetables, grains, protein, and dairy). Overall diet
139 quality was evaluated using the HEI-2015, a quantitative measure of alignment with the
140 Guidelines.^{42,50} The density-based scoring system (i.e., amount consumed per 1,000 kcal) allows
141 for the examination of quality of intake standardized for the quantity consumed.^{50,51} The HEI-
142 2015 includes 13 components – nine adequacy components (dietary components to increase) and
143 four moderation components (dietary components to decrease). While most components are
144 standardized per calorie, the fatty acid (adequacy) component represents the ratio of healthier
145 unsaturated to less healthy saturated fats. Component scores typically range from 0 to 10 points,
146 but for components where one is a subset of another (e.g., Total Vegetables and Greens and
147 Beans), each component is scored 0 to 5 points. All components sum for a maximum score of
148 100, with a higher total HEI score indicating greater consistency with the Dietary Guidelines.
149 Summarizing dietary intake in these two manners provided the ability to view the absolute intake
150 of key nutrients and food groups, the nutrient density of foods and beverages consumed, as well
151 as an overall indicator of diet quality.

152

153 *Generating HEI scores.* Distinct output files from the NDSR for total day and location-specific
154 (i.e., ECE center vs. all other locations) were imported to SAS version 9.4⁵² to calculate
155 component and total HEI-2015 scores for each child using publicly available SAS code from the
156 Nutrition Coordinating Center (University of Minnesota, Minneapolis). This simple HEI scoring
157 algorithm accounts for multiple days of intake per child by summing data across days prior to
158 generating a single set of standardized component and total scores for each child by setting and
159 weekday/weekend.⁵⁰

160

161 Statistical Analysis

162 This cross-sectional analysis comprised children for whom dietary intake was both observed at
163 the ECE center and reported for time outside of child care within a 24-hour period, including
164 children who provided only one of the intended two weekdays of record. Children with two
165 weekdays of intake were compared to children with only one weekday, but no differences were
166 detected between groups. Demographic characteristics of children and parents, characteristics of
167 centers, and children's dietary intakes and diet quality scores were summarized using descriptive
168 statistics, including frequencies for categorical data and means and standard deviations for
169 continuous data. Mixed effects models were used to determine whether mean HEI-2015
170 component and total scores differed by setting (i.e., ECE center or with parents) and weekdays
171 compared to weekend. These models included random intercepts to account for clustering within
172 ECE centers and children within families as well as accounting for repeated measures on
173 children. Children's age and sex were determined to be confounders *a priori* and were included
174 in adjusted models. In considering the opportunity for multiple comparisons within HEI-2015

175 total and component scores, the alpha was adjusted using a Bonferroni correction and set at
176 0.00019 (0.05/26 comparisons). All statistical analyses were performed in SAS version 9.4.⁵²

177

178 **Results**

179 Sample Characteristics

180 Of the 908 children from 98 ECE centers who provided baseline data for the larger cluster
181 randomized controlled trial, 840 children met inclusion criteria for this analysis (Table 1).

182 Children with no dietary information were excluded (n=2) as were those when weekday diet data
183 were missing corresponding pieces from the parent-reported records (n=40) or observations at
184 the ECE center (n=26). Most children (n=711) had two complete weekdays of record, while the
185 others (n=129) had one complete weekday of record. A majority of children had a day of record
186 for the weekend (n=826), including children who only had information for one weekday (93%).

187

188 A majority of children were white (45%) or African American (38%), and about one-quarter of
189 the children (26%) were classified as overweight or obese (sex-specific BMI-for-age \geq 85th
190 percentile). Parents completing study measures were primarily female (86%) and a majority of
191 parents (64%) were classified as overweight or obese (BMI \geq 25.0). Nearly half of the parents
192 (47%) reported having a college or graduate-level degree and family income was reflective of
193 that in North Carolina. A variety of types of ECE centers were represented in the sample (e.g.,
194 faith-based, Head Start), and most accepted child care subsidies (92%) and participated in the
195 CACFP (73%).

196

197 Dietary Intake

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

210
211 *Quality of Intake by Setting.* The mean total HEI-2015 scores for the food and beverage
212 consumed at ECE (58.3 ± 0.6) and with parents (52.5 ± 0.6) indicate children’s dietary patterns
213 on the measured days of intake did not coincide with national recommendations at either setting
214 (Table 3). However, differences in scores generally suggest that children consumed a healthier
215 assortment of foods and beverages while at ECE.⁵⁰ Statistically significant differences were
216 observed for 9 of the 13 HEI-2015 component scores, exceptions being greens and beans,
217 seafood and plant proteins, fatty acids, and sodium. Food and beverage consumed at ECE
218 appeared to provide more total fruit, whole fruit, whole grains, and dairy, as well as less added
219 sugars and saturated fats per calorie. Food consumed with parents provided more total vegetables
220 and total protein as well as fewer refined grains per calorie. Although many component scores

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

225
226 *Quality of Intake on Weekdays and Weekends.* The mean total HEI-2015 scores for weekdays
227 (58.5 ± 0.5) and weekends (51.3 ± 0.5) similarly showed that on the measured days of intake,
228 children did not consume diets consistent with recommendations for the prevention of chronic
229 disease (Table 3). The total HEI score for weekdays was higher than weekends. This difference
230 was statistically significant and may be clinically meaningful.⁵⁰ Statistically significant
231 differences were observed for 8 of the 13 component scores, exceptions being total protein foods,
232 seafood and plant proteins, fatty acids, refined grains, and sodium. Weekday consumption
233 provided more total fruit, whole fruit, total vegetables, greens and beans, dairy, and whole grains,
234 as well as less added sugars and saturated fats per calorie. Regardless of the day of the week,
235 many component scores were low to moderate at best, and highlight opportunity for
236 improvement. The lowest component scores across weekday and weekend included total
237 vegetables, greens and beans, whole grains, seafood and plant proteins, fatty acids, refined
238 grains, and sodium.

239

240 **Discussion**

241 This cross-sectional analysis of observed dietary intake of 3- to 4-year-old children at ECE
242 centers and corresponding parent-reported intake outside of child care revealed, similar to results
243 from nationally representative samples of children who may or may not attend child care, that the

244 quality of children's diets is low.¹²⁻¹⁹ Results also showed the quality of foods and beverages
245 children consumed at ECE centers was in fact higher than what was consumed elsewhere, as well
246 as on weekdays, when children are in child care, than on weekends, when they are not. Because
247 of the short-term and long-term effects of dietary intake during early childhood, improving diet
248 quality to ensure children meet nutrient recommendations within appropriate levels of energy
249 remains of critical importance.⁵⁴

250

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

262

263 Based on the amount of time children spend in care outside the home, national guidelines suggest
264 that ECE provide up to one-half to two-thirds of children's daily nutrient requirements.⁵⁵
265 However, results from this study, similar to findings estimating the proportion of preschool-aged
266 children's intake occurring outside of child care,³⁶ indicate children consume approximately 40%

267 of energy and nutrients at child care and instead consume about 60% of their diet with parents.
268 While this is less than current recommendations, the higher total HEI-2015 score at ECE centers
269 signifies children consumed more nutrient dense foods there than with parents. It is plausible that
270 participation in the CACFP provides children access to healthier foods and beverages within
271 ECE centers than what is provided by parents.^{33,38,39} In addition, lower total HEI-2015 scores
272 with parents may be related to the fact that approximately 12% of dietary intake of children aged
273 2 – 5 years comes from quick-service restaurants.⁵⁶ This not only affirms the critical role ECE
274 centers play in improving the overall quality of children’s dietary intake,²² but also the
275 importance of synergy and partnership between ECE providers and parents to ensure children
276 have consistent access and encouragement to consume healthier foods and drinks.^{21,40,57} Priorities
277 for improving quality of dietary intake are similar for ECE centers and families, and intervention
278 efforts should focus on improving the availability of healthy foods and encouraging children to
279 eat them. Specifically, the availability and consumption of more vegetables, particularly greens
280 and beans and seafood and plant proteins, less sodium and added sugars, and to substitute whole
281 grains for refined grains and polyunsaturated and monounsaturated fatty acids for saturated fats.
282
283 A key strength of the current study is the use of a quantitative measure of overall diet quality, the
284 HEI-2015 score. The density-based scoring system used to calculate the HEI-2015 separates diet
285 quality from quantity, which not only allows for interpretation of the nutrient density of the
286 combination of foods and beverages consumed but also for comparison across settings and days
287 in which absolute intake differed.⁵⁰ In addition, the component scores of the HEI-2015 make it
288 straightforward to identify specific targets for dietary interventions that can be translated to food-
289 based recommendations. For example, although children in this study, on average, consumed

290 amounts of protein foods within range of recommendations, use of the HEI-2015 component
291 scores provided more detailed information that the quality of sources of protein could be
292 improved through substituting seafood and plant proteins.

293

294 Other assets of this study include the collection and data management of 24-hour dietary intake
295 in a large sample of children using a highly regarded diet analysis program (NDSR) in which
296 data across multiple settings and caregivers could be both distinguished and linked. While
297 dietary assessment in general is not without limitations, combining a valid and reliable direct
298 observation method⁴⁷ with parent-reported food diaries minimized bias in obtaining 24-hour
299 intake for children who spend time with multiple caregivers.^{45,58} However, caution is warranted
300 when interpreting findings, as some differences may be the result of different methods of data
301 collection.

302

303 Other limitations include the generalizability of these results. This sample represents the types of
304 ECE centers and families receiving care in central North Carolina. However, results are
305 comparable to studies conducted in other states.^{28,32-35,40} Another limitation regarding
306 generalizability relates to the calculation of HEI-2015 scores with a simple scoring method. This
307 method is based on individuals' intake on the observed days; therefore it may not capture
308 episodic consumption of infrequently consumed food groups or subgroups, nor does it estimate
309 usual intake or adjust for measurement error.⁵⁹ However, it can be used to estimate individual-
310 level scores that can then be used in more advanced statistical models.^{50,60} To answer these
311 research questions, it was necessary to use mixed effects models to control for clustering within
312 ECE centers, relationships between HEI-2015 scores and individual children's characteristics

313 (i.e., age, sex), and the within subject comparison of looking at dietary intake by setting or
314 portion of the week (i.e., groups were not independent of one another).

315

316 **Conclusions**

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

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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	
	<i>mean ± SD^a</i>
Age, years (n=837)	4 ± 0.6
	<i>n (%)</i>
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)	<i>mean ± SD</i>
BMI ^b percentile	61.3 ± 27.8
	<i>n (%)</i>

BMI-for-age \geq 85th percentile	214 (25.6)
<hr/>	
Parents	<i>n</i> (%)
<hr/>	
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)
	<i>mean \pm SD</i>
BMI (n=779)	28.8 \pm 7.4
Weight status	
	<i>n</i> (%)
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 \geq 30.0)	269 (34.5)
<hr/>	
Centers	<i>n</i> (%)
<hr/>	
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)
	<i>mean, range</i>
Total child enrollment	87, 28-218

^a SD = standard deviation

^b BMI = body mass index, calculated as kg/m²

^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	Weekday with	Total Weekday	Total Weekend
		ECE^b	Parents		
		(n=840)	(n=840)	(n=840)	(n=826)
		(mean ± SD^c)	(mean ± SD)	(mean ± SD)	(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
<i>Trans</i> 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 Intake⁵³

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			Total Weekday (n=840) (mean ± SE)	Total Weekend (n=826) (mean ± SE)	p-value ^f
		Weekday at ECE ^{c,d} (n=840) (mean ± SE) ^e	with Parents ^d (n=840) (mean ± SE)	p-value ^f			
<i>Adequacy</i>							
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
<i>Moderation</i>							
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 ($p < 0.00019$)