Child Care Centers and the Infant and Toddler Feeding Environment: The Importance of Examining Feeding Practices Separately from Nutrition Guidelines.

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Background

The rising rate of overweight and obesity in the U.S. is a serious public health concern. These conditions are associated with increased mortality and morbidity from various diseases including heart disease, high blood pressure, and diabetes. Obesity is especially high among low income and minority populations. In addition there is an increasing rate of overweight among preschool children, including infants (Kim et al 2006). The prevalence of overweight (weight-for-length >= 95th percentile) among infants from birth through 23 months old in the United States is currently estimated at 11.4%. Non-Hispanic blacks have higher rates (18.5%) compared to non-Hispanic whites (10%) (Ogden et al, 2002).

As part of the effort to understand the cause of rising rates of overweight and obesity, researchers are investigating feeding patterns during infancy, the incidence of infant risk of obesity, and the role it plays in subsequent obesity (Stettler et al, 2002; Gunnarsdottir and Thorsdottir, 2003). Infancy is a time when parents and other caregivers have virtually total control of what, where, when, and how infants are fed. Therefore, it is important to examine the feeding environment which not only includes the types of food offered, but the interactions parents and caregivers have with children during feeding.

The rising labor force participation of mothers with young children over the last two decades motivates the need to examine the infant and toddler feeding environment in child care centers. The labor force participation of mothers with children under the age of 2 years in 2005 was 56.7%, a slight increase from 55.6%in 2004 (Bureau of Labor Statistics, 2006). National Center for Education Statistics (2004) data on child care report that 40% of nearly 4 million infants (0-11months) were in non-parental care in 2001. 8% or 309,440 children were in center care. The situation for toddlers (12-23 months) was that 50% of nearly 4 million toddlers are in non-parental care with 16% or 624,320 in center care. In addition, child care centers are the most prevalent type of non-relative care used by African American mothers (Johnson, 2005).

To our knowledge there is no research that investigates the child care feeding environment for infants and toddlers in a way that includes the nutritional value and safety of the foods offered as well as the feeding practices of caregivers. Most studies are descriptive, comparing several days of menus to one or more reference standards, such as a percentage of the recommended dietary allowance (RDA) based on the hours a child is in out-of-home care or the degree to which menus comply with the meal patterns mandated by the Child and Adult Care Food Program (CACFP), a U. S. Department of Agriculture (USDA) program that subsidizes the cost of meals and snacks for mostly low-income children (Bollella et al, 1999; Briley et al, 1989b, 1993, 1994, 1999; Cowell et al, 1979; Crepinsek et al, 2004; Domer, 1983; Drake, 1991, 1992; Fox et al, 1997; Glantz et al, 1983; Glantz and O'Neill-Fox, 1982; Padgett and Briley, 2005). The overall

results are that menus are commonly deficient in calories and iron as well as meal components, with the most common missing components being grains and vegetables. However, it is important to note that many of these studies are more than ten years old and use small, convenience samples of child care centers or homes in one state or region. The study by Fox et al. (1997) uses a national sample and does not find deficiencies in RDA, but reports meals missing the required food components.

Some studies compare meals in centers that participate in the Child and Adult Care Food Program (CACFP) to non-CACFP centers or compare meals provided by centers to those provided from home. Oakley (1995) finds that child care centers in Mississippi participating in CACFP are more likely to report using the Dietary Guidelines for Americans in their menu planning for preschoolers, but this self-report does not translate into healthier menus than non-CACFP centers. In fact, CACFP centers have lower nutritional quality. Conversely, Bruening et al (1999) do find nutritional benefits for African American preschoolers receiving CACFP meals compared to meals brought from home. Glantz and O'Neill-Fox (1982) also find nutritional benefits in CACFP participation of child care centers compared to centers who do not participate in CACFP. A more recent study by Ziegler et al (2006) uses 24-hour recall data from the Feeding Infants and Toddlers Study (FITS), a nationally representative sample of children 4 to 24 months of age, to compare the nutrient intake of toddlers (15 to 24 months) by three locations (home, daycare, or other away foods). They find that meals and snacks eaten at daycare compare favorably to those eaten at home and attribute this finding to increased milk consumption in child care versus home or other away settings.

Relative to the literature on the nutritional quality of menus, we find very few studies examining feeding practices and nutrition knowledge in child care settings. Nahikian-Nelms (1997) explores associations between a caregiver's feeding practices at mealtime and her nutrition attitude, nutrition knowledge, age, years of experience, level of education, and prior training in nutrition. She finds higher levels of education and prior training in nutrition do not predict whether teachers display optimal mealtime behaviors, such as sitting with children, consuming the same foods as children, and not forcing or rewarding the children to eat; however, positive attitudes toward nutrition and measures of nutrition knowledge are weakly correlated with positive teacher behaviors. Also, Gould-Gillis (1980) examines the nutrition knowledge and opinions of preschool teachers in relation to their education in early childhood and find no association. Both studies involve preschool populations. We find no studies examining teacher behavior or knowledge in relation to infant and toddler feeding in child care settings.

Other studies find that caregivers and food service personnel lack nutrition knowledge (Drake, 1992; Briley, 1989a, 1994) or a minority of food service personnel attended training (Pond-Smith et al, 1992). Dirige et al (1991) surveys day care providers on interest in nutrition topics and find that the least popular topics are infant feeding and breastfeeding.

The scarcity of research on feeding practices in child care centers is of special concern because research spanning decades indicates that children are able to self-regulate energy

intakes according to hunger and satiety cues and grow well (Adair 1984; Birch et al 1991; Davis 1928; Foman et al 1975, 1976; Johnson 2000, 2002). However, researchers point out that the child's self- regulatory mechanism can be distorted by parental feeding practices that may lead a child to eat too much and become overweight (Birch et al 1987; Birch and Fisher 2000; Fisher and Birch 2002; Johnson 1994, 2000; Spruijt-Metz et al 2002). Clinician Ellyn Satter (2005. p. vi) argues that "children gain too much weight because of how they are fed, not what they are fed." Despite persuasive evidence to support the role of parental feeding practices in explaining overweight, some studies fail to find an association between parental behavior and children's overweight (Baughcum et al, 2005; Saelens et al, 2000). Further research needs to be done to understand parental and other caregiver feeding practices and the role they play in child overweight.

In addition to the scarcity of research on feeding practices in child care centers, there is only a limited examination of the determinants of the feeding environment. The rich and large literature by developmental psychologists and other social scientists on child care quality and the effects of quality on the development of children can be used as a framework to examine structural determinants of the quality of the feeding environment. This literature takes a broad look at aspects of the child care environment in order to determine if the child care setting facilitates healthy cognitive, social, and physical development. Much of this research focuses on process quality: the quality of the interaction between child and provider. The findings of this literature are that structural inputs such as larger staff-child ratio, smaller group size, more teacher education and training do lead to improvements in child care process quality (Mocan et al, 1995). These results have important policy implications for how child care facilities are regulated. This research does study infants and toddlers as well as preschoolers; however, it examines a number of factors related to child development and does not focus on the feeding environment. Furthermore, not all researchers agree with the role of structural inputs. Blau, (1997, 2000) challenges the view that larger staff-child ratios, smaller group size, and some types of education increase quality.

This study seeks to fill the gap in our understanding of infant and toddler feeding in child care centers. We wish to expand the focus beyond the current nutrition literature, which focuses heavily on the nutritional value of menus of preschool children enrolled in CACFP, as well as the child development literature, which looks broadly at the quality of the larger child care environment, of which feeding is only one aspect. We want to examine feeding interactions as well as compliance with meal patterns. Specifically, we seek to answer the following questions: 1.What is the quality of the child care feeding environment for infants and toddlers? 2. Does the feeding environment differ with the overall quality of the child care center? 3. What are some of the determinants of feeding quality? 4. Do child care centers that serve predominantly African American children behave differently from those that serve mostly non-African Americans?

Data and Research Methods

Data

The data for this study are based on formative research of regulated child care providers in North Carolina. This study is part of a larger study, the Infant Care, Feeding, and Risk of Obesity Study, (cohort study), which examines infant feeding practices among low income African American mothers in North Carolina (Lederman, 2004). The data is drawn from a sample of 44 child care centers from Durham, Granville, Harnett, Orange, and Wake counties in the Piedmont region of North Carolina.

Centers were identified and recruited in two ways. First, 25 centers came from a random sample of centers stratified by county and three levels of overall (star) quality. Specifically, from the North Carolina Division of Child Development (NCDCD) website, we collected the names of star rated licensed child care centers in Durham, Orange, and Wake counties. Then, we divided each county's pool of centers into three groups based on the overall quality of the centers as measured by the North Carolina star rating system. NCDCD gives centers 1 star for meeting the minimal requirements for licensure. Centers can voluntarily receive 2 – 5 stars by meeting higher requirements and undergoing quality assessments. Centers with four and five stars were considered having high overall (star) quality, centers with three stars were considered having medium quality, and centers with one or two stars were considered having low quality. Our aim was a sample with an equal number of centers in each quality level. However, we attempted to make the county distribution of centers for each star quality level representative of the population. For example, if 20% of the three counties' four and five star centers were from Durham, then the goal was to have 20% of high quality centers coming from Durham. From our random sampling, 86 centers received letters inviting participation between January 2004 and April 2005. The overall participation rate was 29%; however, the rates differed by star quality with approximately 67% for high quality, 14% for medium and 27% for low.

The rest of the centers (19) were drawn from centers in Durham, Granville, Harnett, Orange and Wake counties that serve African American infants and toddlers in the cohort study. Recruitment letters were sent to these centers after the cohort research team received permission from the mother to contact the child care center. Cohort recruiting began in January 2004 and is ongoing; however, the last observation for this study was recruited in April 2006. The participation rate (after mother's permission) for cohort centers is 76%.

Data were gathered by the first author from four sources: 1) direct observation; 2) interview with child care administrator; 3) interview with classroom teacher; and 4) public information on the overall quality of the center. An infant or toddler classroom in each center was observed and the quality of the feeding environment was assessed using the meal/snack item from the revised Infant/Toddler Environment Rating Scale (ITERS-R) created by Thelma Harms, Debby Cryer, and Richard M. Clifford (2003). The child care administrator was interviewed about general features of the child care center including size, ethnic profile of children, ethnic and education profile of staff, and profit status, staffing ratios. The child care teacher of the observed classroom was interviewed about her feeding practices and knowledge, parental nutrition knowledge, and teacher's

concerns about nutrition and physical activity. Administrative data from NCDCD was used for the star rating of a center.

Outcome Variable: Measurement of the Feeding Environment

The meal/snack item of the ITERS-R is our measure of the feeding environment. It was chosen for its comprehensiveness and captures four basic dimensions of the feeding environment: food quantity/quality, teacher/child interaction, sanitation practices, teacher/parent communication. The first dimension, food quantity/quality, captures whether a center complies with CACFP meal pattern guidelines and whether the food is age-appropriate (e.g. does a food cause choking). The second dimension, teacher/child interaction, assesses feeding behaviors (e.g. does a teacher feed a child when he shows signs of hunger, does a teacher provide adequate supervision during feeding). The third dimension, sanitary practices, captures how well caregivers prevent viral and bacterial transmissions through food (e.g. does a teacher wash and sanitize eating surfaces before and after feeding). The fourth dimension, teacher/parent communication, measures how well the caregivers and parents work together to provide information about what and how the child is eating.

The scoring method for the meal/snack item is unique. An infant or toddler classroom is scored on a scale that ranges from 1 to 7, where 1 is inadequate, 3 is minimal, 5 is good, and 7 is excellent. Each scale (1, 3, 5, 7) has a list of indicators that are scored yes or no. For example, if any indicator under 1 (inadequate) is scored 'yes' then the whole meal/snack item receives a 1. Therefore a center that fails to comply with the meal pattern is scored a 1 even if other aspects of the feeding environment are good. A center can also score a 1 if the center fails to gain one half or more indicators on the 3 scale. Thus, receiving an inadequate score is not difficult. See figure 1 for the instrument and scoring method.

We create two measures of the quality of the feeding environment for our outcome variables based on the meal/snack item of the ITERS-R. Measure 1 includes all four dimensions (food quantity/quality, teacher/child interactions, sanitation practices, teacher/parent communication). It is the feeding quality when compliance with CACFP meal patterns and appropriate food choice is taken into account. Meal pattern compliance is assessed through an analysis of one week of menus collected from the centers or from observation of a meal when menus were not available. Menus were coded 'Yes' if all required components were present at each meal and snack and coded 'No' if any component was missing. Measure 2 excludes food quantity/quality; the specific indicators excluded are 1.2 and 3.2. This second measure allows us to focus more on feeding practices as well as practices that depend on teacher behavior like sanitary practices and teacher/parent interactions.

Explanatory variables

The explanatory variables were chosen based on the child care quality literature and drawn from the observations, interviews, and administrative data. We create three

categories for overall star quality with high quality equal to 4 or 5 stars, medium quality equal to 3 stars and low quality equal to 1 or 2 stars. The variables that measure participation in CACFP and for profit status are coded 1 if yes and 0 if no. Also, teacher education is measured as a dichotomous variable, coded 1 if a center has any teacher with a B.A. or B.S. or higher in child development and 0 if it has none. There are two measures of staff/child ratio: staff/infant and staff/toddler. Both are dichotomous variables where the variable is coded 1 if the staff/child ratio is above the regulated minimum and 0 if the ratio is at the regulated minimum. The regulated minimum in North Carolina is 1 teacher to 5 infants (0-12months) and 1 teacher to 6 toddlers (12-24months). The ethnic profile of infant and toddlers served is a dichotomous variable coded 1 if 50% or greater African American infants and toddlers and 0 otherwise. Other variables are the size of the center, a continuous variable, and a dichotomous variable for if the center is from the cohort study, coded 1 if a cohort recruit and 0 if not.

Statistical Methods

Bivariate analysis is used to test the relationship between all of our independent variables and our two measures of the dependent variable. We report means of the feeding quality measures but since these outcome measures are not normally distributed, we test the significance of the relationship between feeding quality and the three levels of overall quality using the Kruskal-Wallis test. We use the Wilcoxon rank sum test to examine the significance of the relationships between dichotomous explanatory variables and the two measures of the quality of the feeding environment.

The logistic regression analysis examines the determinants of the feeding environment while controlling for other factors. The outcome (dependent) variables are each coded 0 if the quality score is inadequate (1) and coded 1 if the quality score is greater than inadequate (1). All independent variables except the three levels of overall quality are included and entered simultaneously. The overall star quality is excluded since it is partly determined by a center's score on the ITERS-R and so is likely to be correlated with the error term. In addition, the staff/toddler ratio is excluded because it is highly correlated with the staff/infant ratio. We therefore run two models corresponding to the two measures of the feeding environment.

Results

Descriptive Statistics

Descriptive statistics on the total sample and by cohort are found in table 1. We find the average level of feeding quality to be very low (1.6) for Measure 1 when all four dimensions are included. For Measure 2 when we exclude food quantity/quality, the average feeding quality score is better (2.4), but still less than minimal. This indicates that CACFP non-compliance and lack of appropriate food choices has a deleterious impact on the feeding environment.

The centers which were recruited from the cohort study are different from the centers recruited at random. Cohort centers have significantly lower feeding quality for both measures. For the explanatory variables, cohort centers have significantly higher levels of African American infants and toddlers, lower staff education, fewer centers with above minimum staff/infant and staff/toddler ratios, a higher percent of for profit centers, and a distribution of star quality centers with proportionately fewer high quality, more medium quality, and no low quality centers. There is no statistically significant difference between cohort and non-cohort centers for center size or CACFP participation. The differences found between cohort and non-cohort centers are not unexpected given that cohort centers serve children of low income African American mother. However, these results suggest that low income African American children may be in lower quality child care centers.

Bivariate results

The results of the bivariate analyses are found in table 2. For Measure 1, we find significant results for staff/infant ratio, staff/toddler ratio, staff education, African American infant/toddler composition, and cohort status. Centers with above minimum staff/infant ratio have higher quality (2.25) than those centers at the regulated minimum (1.08) as is the case with above minimum staff/toddler ratio, 2.10 versus 1.21. Those centers with less than 50% African American infants and toddlers have higher quality (2.28) compared to those with 50% or more (1.15). Centers with at least one staff member with a bachelor's degree in early childhood education have higher quality (2.31) than those with none (1.21). Non-cohort centers have higher quality (2.00) than cohort centers (1.11). Star quality, CACFP subsidy, and for profit status are not significant.

For Measure 2 (food quantity/quality excluded), we find significant results for overall star quality, CACFP subsidy, staff/infant ratio, staff/toddler ratio, percent African American infants/toddlers, staff education, and cohort status. We find that high star quality centers have a higher mean level of the feeding environment (3.32) than medium star quality centers (1.47) or low star quality (2.38). We find that centers who participate in CACFP have a lower level of quality (1.82) than non-CACFP centers (3.05). Centers that served 50% or more African American infants and toddlers have lower ratings (1.38) than those who served less than 50% (3.94). Also, centers with at least one teacher having a B.A. or B.S. in child development have higher quality (3.94) than those centers for which no teacher has a college degree in child development (1.57). Finally, centers whose staff/infant ratios are above the regulated minimum have a higher score on the feeding quality (3.9) than centers who are at the regulated ratios (1.21). We find the same result for high staff/toddler ratio (3.75) compared to low (1.33). Centers recruited from the cohort study have lower quality (1.16) than those non-cohort centers (3.40). For profit status is insignificant.

In comparing the bivariate results for the two outcome measures, it is notable that significant differences in feeding quality are associated with star quality, CACFP participation, and cohort status for Measure 2 but not Measure 1. Furthermore, for staffing ratios, staff education, and percent African American infants and toddlers, the

relationships are in the same direction and of stronger significance for Measure 2. These results indicate that there is more variation in the quality of the feeding environment when food quantity/quality is excluded and so feeding practices related to classroom staffing levels and education are not obscured.

Logistic Regression Results

The bivariate results point to variables that may be associated with feeding quality. However, there is possible confounding between the explanatory variables, especially, staff/infant ratio, ethnic composition, staff education, cohort status. Therefore, we use logistic regression analysis to examine models of the two measures of the quality of the feeding environment to pinpoint the explanatory variables that have an impact after controlling for other factors. See table 3. The first model of feeding quality uses Measure 1 (includes all four dimensions) and none of the explanatory variables are significant. In model 2, the second measure of the feeding environment (food quantity/quality excluded) has two significant explanatory variables. Centers with staff/infant ratios above the legal minimum have an increased likelihood of higher quality ($p< .05$). Also, staff education is slightly significant with a higher likelihood of quality when at least one teacher in the center has a bachelor's degree in child development ($p<.10$) CACFP participation, for profit status, cohort status, African American infant and toddler composition, and center size are not found to be statistically significant.

The logistic regression results echo the bivariate results in that results for Measure 1 differ substantially from those for Measure 2. The fact that model 1 fails to predict feeding quality means that we need to look for other mechanisms to explain the feeding environment when meal compliance and appropriate food choices are included. Model 2's prediction that feeding quality depends on staffing levels and teacher education is consistent with a measure whose indicators depend more on classroom teacher behaviors. The logistic regressions results also reveal that confounding is an issue that must be addressed.

Discussion

Our study examines a sample of child care centers in North Carolina to understand the quality of the feeding environment for infants and toddlers and investigates the determinants of that environment. We find that the feeding environment is poor. Many centers not only fail to follow CACFP guidelines but do not foster the kind of teacher and child interaction that would promote a child's ability to self-regulate energy intakes according to hunger and satiety cues. In addition, we find that it is important to examine the feeding environment without food quantity/quality indicators (Measure 2) separately from the feeding environment with all dimensions (Measure 1). Our logistic regression model with Measure 1 fails to explain variation in the feeding environment; however, the model for Measure 2 finds that staffing levels and education are significant explanatory factors. Also, centers who participate in the CACFP do not have better feeding quality using either measure than non-participating centers. Finally, we conclude that North

Carolina's star rated licensed system of the overall quality of a center may not predict a healthy feeding environment for infants and toddlers.

The feeding environment when all dimensions: food quantity/quality, teacher/child interaction, sanitation practices, teacher/parent communication, are taken into account is poor. This result is driven largely by the fact that 52% of the 44 centers studied are not in compliance with CACFP guidelines (based on menus and observations). Given our scoring of the infant/toddler feeding environment instrument, those 23 centers that are not compliant are scored as inadequate for the whole feeding environment. Thus those centers contribute to an average quality of the feeding environment (Measure 1) being very poor with a score (1.6) barely above inadequate. Our findings are consistent with the literature on nutrition in child care centers that finds menus are commonly deficient in grain and vegetable components as well as calories and iron (Briley et al, 1989; Padgett and Briley, 2005). However, menu analyses look most often at "table food" prepared and served by centers. They do not often reflect what is being served to infants and toddlers not yet on table food. Thus, menu compliance analyses may underestimate how bad is the nutrient content of meals and the extent of compliance for infants and toddlers. We concur with the recommendations of Story et al (2006) and Glanz et al (2004) that a national study of nutrition in child care setting is needed, including comparing CACFP centers to non-CACFP centers and looking at meals (breastmilk, formula, cereals, and jarred food) served to young infants in addition to toddlers and preschoolers.

The Measure 2 quality of the feeding environment (excludes the food quantity/quality dimension) is better (2.4) than Measure 1 but still fails to meet minimal standards. Our results for Measure 2 are similar to findings from the North Carolina Rated License Assessment Project which assesses 327 centers and reports an average meal/snacks score from the ITERS-R of 2.31 **(**Cassidy et al, 2004). Measure 2 allows a clearer focus on aspects of the feeding environment that depend on teacher behaviors in the classroom. This is supported by the results of the logistic regression on Measure 2 that find that higher staffing levels and better staff education raises the quality of the feeding environment. The Measure 1 logistic regression model finds no significant factors to explain variation in feeding quality. These results support our view that there are different mechanisms underlying the feeding environment depending on if we are looking at the dimension of food quantity and quality or the dimensions of teacher/child interaction, sanitation practices, or parent/teacher communications that depend on teacher behaviors. Food quantity and quality depend mainly on the actions of those who create the menus: directors, cooks, and other administrators and those who prepare the food.

The fact that a better staff/infant ratio is associated with a higher quality feeding environment when the focus is on teacher behaviors is consistent with the child development literature findings that higher staff/child ratio leads to better overall process quality (Mocan et al, 1995). Furthermore, we find evidence for why staffing matters in examining the reasons for low scores on Measure 2. 19 out of 24 centers whose staff/infant ratios are at the regulated minimum of 1 to 5 are scored inadequate (1). The rest of the centers scored a 2. Inappropriate feeding practices are the predominant reasons for a score of inadequate. Examples include infants not being held for bottle

feeding but instead fed in an infant bouncer seat and older infants and toddlers being allowed to walk around with bottles or sippy cups. We believe these practices occur because one caregiver cannot adequately feed and care for five infants or six toddlers at the same time. Teachers push children to learn to comfort and feed themselves as early as possible. Other reasons for inadequacy such as not meeting each child's need, sanitizing tables and trays, and microwaving bottles also arise because teachers do not have enough time to meet the needs of all the infants and toddlers. On the other hand, when we examine the scores of centers with above minimum staffing, only 3 out of 20 centers score inadequate.

Further evidence of the time crunch faced by teachers is reflected in the answers to the question we posed to teachers about the challenges they face when feeding more than one infant or toddler at a time. Only 8 out of 40 teachers indicated that feeding was not a challenge. The rest indicated that feeding was a challenge. Here is a sample of responses:

> "My goodness, it is a mess. Children want to eat more once they are done. After the meal, they want to eat other children's food."
>
> "It can be very challenging because all need [to eat] at same time. We give two bottles at one time. We can call someone to come help."
>
> "When babies are hungry at the same time, we soothe a child with toys while feeding another. Try to feed one at a time."
>
> "Trying to feed some fast enough; get plates down fast enough."
>
> "Toddlers are impatient, stealing food, cry and whine if have to wait. Teacher can feed two at one time."
>
> "The ones that holler and let us know they are hungry. We have two bowls in each hand and [it is] difficult to keep apart. Put initials on bowls to not get them mixed up."

Interestingly, teachers at centers with above minimum staffing ratios mention the same challenges as those teachers at the minimum level. The issue of caregivers having enough time to feed children is crucial if caregivers are going to be able to recognize the hunger and satiety cues of individual children and support children's ability to self-regulate. Teacher staffing ratios are under the control of state regulators. The aim to keep child care affordable by maintaining low staffing ratios may be adversely affecting the health of children.

Lack of time may not be the only factor that leads to poor feeding practices. Lack of knowledge may also play a role. Our finding that centers with any teacher having a bachelor's degree in child development have a higher feeding quality (measure 2) is consistent with the findings of the child development literature (Mocan et al, 1995). However, it does not support the results of Nahikian-Nelms (1997). She finds that teachers with higher levels of education do not display better mealtime behaviors. However, since we are not measuring directly the training of the teacher in the classroom, our education variable may be a proxy for omitted characteristics of the center, e.g. director attitude and oversight that correlate with our teacher education measure.
A better measure of the kind and timing of nutrition training is needed to understand if it would make a difference in the feeding quality from a feeding practices standpoint. This research is needed to inform policymakers who can regulate the kind of training required.

CACFP is a federal program that has the most important impact on the quantity and quality of food being served in child care centers. It has an established structure and incentives through reduced price meals to meet the needs of low income children who also are at most risk for overweight. The program guidelines set the standards for child care menus and participants are monitored and have required annual training. However, the 50% of centers in our sample who participate in CACFP have significantly lower Measure 2 feeding quality in the bivariate analysis, Measure 1 results are insignificant. This result is consistent with Oakley (1995) who finds that in Mississippi, CACFP centers have lower nutritional quality than non-CACFP centers. However, CACFP participation is not significant in either of the logistic regressions. We did run a logistic regression on menu compliance only (not shown). That logistic regression analysis finds that centers who participate in the CACFP program are three times more likely to be compliant after controlling for center size, for profit status, ethnic composition, staff/infant ratio, staff education, and cohort status ($p < .10$). It is troubling that CACFP participation is not found to be positively associated with either measure of feeding quality in regression analyses although it is with compliance. CACFP needs to reassess the type of training and oversight it provides to improve the feeding environment in all domains.

In addition to measuring quality and exploring possible determinants, this research aims to examine the relationship between the overall quality of a center based on the North Carolina star rating system and our measures of the feeding environment quality. Our goal is to ascertain if parents can use the North Carolina star ratings as a good proxy for feeding quality. In the bivariate analysis of Measure 1 we fail to find any feeding quality difference between high, medium, and low overall quality centers. For measure 2, there is a feeding quality difference between centers ($p<.10$) with high quality centers having higher feeding quality than medium or low. It is notable that the average feeding quality for medium centers is lower than for low centers. This may be an artifact of our sample; however, it may be because centers who do not voluntarily seek higher stars will receive the minimum of one star even if they are of high quality. Given the evidence, we do not consider the star rating system a good proxy for the quality of the feeding environment. Centers with 4 or 5 stars may have better feeding and sanitary practices but not necessary be in compliance with CACFP regulations. Staffing ratios are a better predictor than star rating.

Our fourth goal is to examine the impact of centers with a predominantly African American clientele since African American infants and toddlers have a higher prevalence of overweight than white infants and toddlers (Ogden et al, 2002). The bivariate results for both measures indicate that centers with 50% or more African Americans infants and toddlers have a significantly lower quality feeding environment. However, none of the logistic regression models find a significant association between African American composition and feeding quality. These results suggest that when seeking to explain the racial disparities in overweight, we need to look at differences in the quality of the child care environment. In our sample, centers with 50% or more African American infants and

toddlers are also more likely to have the minimum staff/infant ratio (chi-square test, p = .02) and low staff education (chi-square test, p = .08).

Limitations

This study was designed to be exploratory and the results cannot be generalized. There are limitations including selection bias in the sample because centers volunteered to participate. Therefore, the quality may be higher in our sample than the general population of centers in North Carolina. In addition, selection bias enters in a center's choice of participating in CACFP or of having better staffing ratios. The sample size also limits the number of explanatory variables in the regression leading to the possibility of bias due to omitted variables. The small sample size also makes finding significant differences more difficult when there is multicollinearity among the explanatory variables. Also, we use one classroom to proxy for the quality of all infant and toddler rooms in a center and use center level explanatory variables. The benefit of using center level data is that these variables can be obtained from administrative sources and brief interviews with directors and thus predict the feeding quality of centers that are not observed. The disadvantage is that classroom factors may differ from center level factors.

Conclusions

Our study's main contribution is that it demonstrates that the factors that determine optimal nutrition may differ from the factors that will insure developmentally appropriate feeding practices. The staff/infant ratio is the single most important factor to predict the feeding quality when meal compliance and food appropriateness is excluded. We conclude that appropriate feeding practices, sanitary practices, and attention to hunger and satiety cues cannot be accomplished with the regulated minimum staffing ratios of 1 teacher to 5 infants. In addition, better teacher education and training is needed. Given the growing literature on the importance of parental feeding styles in child obesity risk and the increase in out-of-home care, research on the feeding styles of child care providers is long overdue.

From our study, the determinants of the feeding environment when food quantity and quality are included are unclear. We will further analyze our sample to understand what explains center differences in menu compliance and food appropriateness. However, research with larger samples needs to be undertaken on the whole feeding environment of children under the age of two years old to encompass a larger set of explanatory variables and allow for interactions. Only with a comprehensive approach will we be able to understand and improve the feeding environment for infants and toddlers in child care centers and help stem increasing obesity in children.

Figure 1

Inadequate 1	2	Minimal 3	4	Good 5	6	Excellent 7
1.1 Meal/snack schedule does not meet individual needs. 1.2 Food served does not meet nutrition guidelines or is not appropriate (Ex. Foods that cause choking; foods/beverages too hot). 1.3 Basic sanitary procedures usually neglected. 1.4 Inappropriate feeding practices used (Ex. Infants not held for bottle feeding; children eat or have bottles when walking, running, playing, lying down; children forced to eat). 1.5 No accommodations made for children's food allergies. *NA permitted.*		3.1 Meal/snack schedule meets each child's needs (Ex. Infants on individual schedules; toddler given snack if hungry before lunch). 3.2 Well-balanced age-appropriate food served for meals and snacks. 3.3 Basic sanitary procedures maintained at least half of the time. 3.4 Adequate supervision for ages and abilities of children (Ex. Staff near children while they are eating). 3.5 Allergies posted, and food/beverage substitutions made. *NA permitted.*		5.1 Children are fed separately or in very small groups. 5.2 Meals/snacks are relaxed and pleasant (Ex. Staff patient with messiness; slow eaters given plenty of time; infant's face wiped gently). 5.3 Basic sanitary procedures usually practiced with only a few lapses. 5.4 Staff talk with children and provide a pleasant time. 5.5 Menus posted for parents. *NA permitted.*		7.1 Staff sit with child(ren) and use feeding time to encourage learning (Ex. Make eye contact and talk to infant; name foods; encourage toddlers to talk and develop self-help skills). 7.2 Staff cooperate with parents to establish good food habits (Ex. Plan together to help child give up bottle; coordinate introduction of new foods).

When scoring, start reading from 1 (inadequate) and progress upward till the correct quality score is reached. Mark Yes if the indicator is true for the situation being observed. Mark No if the indicator is not true. (Ask yourself, "Is this true, Yes or No?"). Assign ratings as follows: 1=any indicator under 1 scored Yes; 2=all indicators under 1 scored No and ≥ half under 3 scored Yes; 3=all indicators under 1 scored No and all under 3 scored Yes; 4=all requirements of 3 met and ≥ half under 5 scored Yes; 5=all requirements of 3 and 5 are met; 6=all requirements of 5 met and ≥ half under 7 scored Yes; 7=all requirements of 5 and 7 are met.

Table 1. Sample characteristics total and by cohort (t-test, nonparametric tests, chi square test to compare cohort and non-cohort centers)

Child Care Centers	Total sample N=44	Cohort Sample n=19	Non-cohort sample n=25
Characteristics Percentage/Mean (SD)			
Measure 1 (all dimensions)	1.6 (1.4)	1.1 (0.3)*	2.0 (1.8)
Measure 2 (food quantity/quality excluded)	2.4 (2.0)	1.2 (0.4)****	3.4 (2.2)
Star quality High Medium Low	 43.2% 38.6 18.2	 35.3%** 64.7 00.0	 48.2% 22.2 29.6
CACFP subsidy 0 = no 1 = yes	 50.0% 50.00	 58.8% 41.2	 44.4% 55.6
For profit 0 = no 1 = yes	 84.1% 15.9	 94.1%* 05.9	 77.8% 22.2
High staff/infant ratio 0 = no 1 = yes	 45.5% 54.5	 17.7%*** 82.3	 63.0% 37.0
High staff/toddler ratio 0 = no 1 = yes	 45.5% 54.5	 29.4%** 70.6	 55.6% 44.4
Percent African American infants and toddlers 0 if < 50% 1 if >= 50%	 59.1% 40.9	 82.4%** 17.6	 44.4% 55.6
Percent of staff with BS/BA in early childhood 0 if none 1 if at least one	 36.4% 63.6	 11.8%** 88.2	 51.9% 48.1
Total Enrollment of Center	71.1 (42.7)	64.2 (40.4)	75.5 (44.2)

* p< 0.10 ** p< 0.05 *** p< 0.01 ****p< 0.001

Table 2. Bivariate Analysis (nonparametric tests)

Child Care Centers	Measure 1: Feeding (all dimensions)	Measure 2: Feeding Quality (food quantity/quality excluded)
Star quality		
High	2.11	3.32*
Medium	1.12	1.47
Low	1.50	2.38
CACFP subsidy		
0 = no	1.91	3.05*
1 = yes	1.32	1.82
For profit		
0 = no	2.00	2.57
1 = yes	1.54	2.41
High staff/infant ratio		
0 = no	1.08***	1.21****
1 = yes	2.25	3.90
High staff/toddler ratio		
0 = no	1.21*	1.33****
1 = yes	2.10	3.75
Percent African American infants and toddlers		
0 if < 50%	2.28*	3.94****
1 if >= 50%	1.15	1.38
Percent of staff with BS/BA in early childhood		
0 if none	1.21**	1.57****
1 if at least one	2.31	3.94
Cohort		
0 = no	2.00*	3.40****
1 = yes	1.11	1.16

* p< 0.10 ** p< 0.05 *** p< 0.01 ****p< 0.001

Table 3. Odds Ratios for Logistic Regression n = 44

	Measure 1: Feeding Quality (all dimensions)	Measure 2: Feeding Quality (food quantity/quality excluded)
CACFP subsidy 0 = no 1 = yes	0.46	0.53
For profit 0 = no 1 = yes	0.98	0.16
High staff/infant ratio 0 = no 1 = yes	4.15	10.67**
Percent African American infants and toddlers 0 if < 50% 1 if >= 50%	0.82	0.56
Percent of staff with BS/BA in early childhood 0 if none 1 if at least one	2.82	11.97*
Center size	0.99	0.98
Cohort 0 = no 1 = yes	0.98	0.58

* p< 0.10 ** p< 0.05 *** p< 0.01 ****p< 0.001

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