MATERNAL PERCEPTION OF BODY SIZE AS A DETERMINANT OF INFANT ADIPOSITY IN AN AFRICAN-AMERICAN COMMUNITY

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For 10 weeks, a sample of 105 postpartum African-American clients of three inner-city clinics, were recruited for this nine-month prospective study. Data from 54 mother-infant dyads were used to explore the associations between maternal perceptions of infant body size and the development of adiposity at six- to seven months of age. Correlations, chi-square, paired t-test, ANOVA, and logistic regression analyses were performed. Quantitative assessments of BMI using weight and length measures and qualitative assessments of body size perceptions using questionnaires, silhouette, and ranking scales were conducted.

At six- to seven months of age, 40% of the infants were above the 85th percentile and 31% were above the 95th percentile of the NCHS standards for weight for height. Maternal perception of infant body size was positively correlated with early introduction of nonmilk foods. Significantly, more infants perceived as small were introduced to nonmilk foods earlier, compared to infants perceived as average, p=0.03. Additionally, it was observed that the earlier the introduction of nonmilk foods, the greater the infant's BMI at six- to seven months of age (r=0.59, p=0.02). Finally, one-third of mothers were obese with BMI's exceeding 30, and 31.1% were overweight with BMI's between 25 and 30. (*J Natl Med Assoc.* 2004;96:351–362.)

Key words: infant adiposity ♦ obesity ♦ maternal perception ♦ body size perception ♦ infant feeding

The continual increase in the prevalence of obesity in the past two decades alarms public health practitioners because of its associated health consequences, but more importantly, because of the disproportionate burden of this disease on minorities. Obesity at any stage is problematic, but childhood adiposity is of particular concern because of its significant impact on health and its associated long-term healthcare cost. Attributable consequences of adiposity in childhood include increased frequency of respiratory illnesses[1], persistence of obesity through adulthood, development of pediatric hypertension and juvenile onset diabetes,[1-3] development of psychological problems (such as eating disorders), body image disturbance,[3,4] and higher predisposition to the social problem of weight discrimination in later life[4].

A comprehensive review on the prevalence of childhood obesity conducted by Ogden and colleagues in 1997[5] revealed that overweight prevalence for infants—defined as weight for length above the 95th percentile of the NCHS growth chart—were 9.6% and 11% for U.S. infant boys and girls, respectively. Infant African-American boys had a rate of 10.2% and girls 15.0%, both of which were higher than the national prevalence. A follow-up study by the investigators showed that

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by 2000, 11.4% of all infants were overweight, and 18.5% of African-American infant boys and girls were overweight.[6] This increasing prevalence highlights the concerns about obesity in minority populations in view of the fact that it persists into adulthood, and a large proportion of African-American adults currently suffer from obesity and its related diseases.

In the course of human growth and development infancy is unique because it is the period of most rapid extra-utero growth. This rapid growth is manifested as an increase in both cell size and number and is directly a function of dietary intake. As such, overnutrition or undernutrition during this period adversely affects the growing individual and sets the stage for weight issues for a lifetime.[5-8] Parental misconceptions and health beliefs concerning what constitutes a normal body weight and normal diet for infants have been reported as the cause of inorganic failure to thrive in caucasians[9,10] and infant adiposity in minority populations in the United States.[3,11,12] Parental perceptions are important because they determine parental health actions.

The literature is replete with studies on infant feeding in almost all conceivable human social groups. However, not many studies have focused on the relationship between infant feeding and body image. Whereas body weight is the measure of the mass of an entity, body image is the perception of the distribution of that mass on the skeletal structure. It is measured normatively as positive or negative body image. Many studies have explored body image perceptions in adult populations, but fewer have focused on infants and children. In the literature, two of the few studies which have intentionally examined parental perception of their children's body image were conducted by Alexander et al. in 1991[3] and Kramer et al. in 1983[13]. Kramer's study focused on a Canadian population and discovered that women who preferred obese children later on ended up with chubbier children[13]. Alexander's study, which focused on a Mexican-American population, observed that obese mothers consistently preferred obese children[3]. Collectively, these two studies suggested that in early childhood, adiposity outcome may have more to do with parental weight preference for their children and less with other factors. No other study has yet been located that has intentionally targeted perceptions of adiposity during infancy in African-American mothers. Therefore. the objective of this prospective study was to contribute to this knowledge base by exploring, in a low-income African-American inner-city population, the relationship between maternal perceptions of infant body size (weight) and its relationship to infant feeding beliefs and practices and infant adiposity in the first six- to seven months of life. Additionally, this study endeavored to document whether Alexander's[3] and Kramer's[13] findings, that parental weight preference significantly influences the development of childhood adiposity, are applicable to an inner-city African-American population.

METHODS

The study was approved by the IRB department of Howard University and conducted in three privately managed clinics catering to low-income residents of Washington, DC. The clinics were selected for two reasons: 1) they had a large roster of African-American clients, and 2) each had a site office for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), which made it easier for clients to get their healthcare and WIC vouchers at the same time. The ultimate goal in selecting these clinics was to promote retention and to reduce attrition.

Beginning in April 1999, recruitment of 105 postpartum women who met the study's criteria was embarked upon. Each mother and infant dyad was followed up until the infant returned for the six-to-seven-month well-baby visit. After signing a consent form to participate, each mother completed several questionnaires with the assistance of the primary investigator. The first questionnaire completed was the Social Demographic Questionnaire, which contained variables, such as maternal age, parity, marital status, education, family income, number of household residents, and use of social services (such as WIC). At the first meeting, mothers were also asked to make verbal assessments of their perceptions of their infant's body size at birth and visual assessments by using a body silhouette scale. The African-American Infant Body Habitus Scale (AAIBHS) was used for the visual assessment and was developed and validated by the primary investigator prior to the study. It was tested for face validity to make sure that the images outlined represented the age group on which questions were being asked. When administered, 74% of the pilot test group agreed that the image represented infants at six months of age, and the remainder

thought the images were between five and seven months old. The AAIBHS was administered at the first and last well-baby visits and evaluated maternal perception of infant body size in four specific categories: typical infant size, healthy infant size, preferred infant size, and current infant size. The scale contained two sex-specific frames with five images ranging from #1—thin to #5—obese. It was administered by asking mothers the following four questions: 1) Which of these figures do you think represents a typical six-month-old African-American female/male in your neighborhood?, 2) Which of these figures represents a healthy body size for a six-month-old male/female infant in your neighborhood?, 3) Which of these figures would you prefer your baby to look like in six months?, and 4) Which of these figures represents the size of your baby at six months of age or currently? Whereas the first three questions were presented at the first meeting, the fourth question, which assessed mothers' current perception of their infant's body size, was asked at the infants' last well-baby visit.

Data on maternal attitudes and beliefs about infant feeding and infant fatness were gathered using the Maternal Infant Feeding Attitude Questionnaire (MIFAQ) and Maternal Infant Feeding Practice Questionnaires (MIFPQ)—both of which were developed from the broad infant literature specific to this population. Several of the questions were adapted from the study by Kramer,[13] which is one of the only two studies that dealt with body image in infancy. In addition to these two questionnaires, a supplemental semistructured interview schedule was administered to substantiate the contents of the MIFPQ and the MIFAQ. Additionally, a food frequency questionnaire was administered at the first and subsequent meetings with mothers to capture the introduction of nonmilk foods into the infants' diets.

Using the normative Body Parts Ranking Scale (BPRS), which consisted of six cards each labeled with the name of one of six body parts, mothers were asked to rank the cards according to their perceived importance in determining infant fatness. The six body parts individually listed were thighs, buttocks, arm, leg, face, and stomach. The rank order of the body parts was used to determine perceived importance in assessing infant fatness. Higher rank order meant greater importance in determining fatness.

Using the values for the images in Figure 1 (AAIBHS), the mean of each body size category was calculated by summing up the given value of all the images selected by mothers in response to the question specific to that category. For example, the numerical value of all the images selected by mothers in response to the question of "Healthy Body Size" was summed up and divided by the total number of respondents to acquire the mean for that category. The same procedure was followed for the remaining three categories. A larger mean meant that the mothers generally selected a larger body size in response to the corresponding question, and a smaller mean meant that a smaller size was selected. To assess whether the mean for each category was significantly different in this group, paired t-tests analysis was conducted.

Anthropometrical measures of the infant and mother were gathered at the first and subsequent clinic visits until the study was terminated. As the study progressed, infant feeding practices, specifically the introduction of solids and other nonmilk foods, were assessed monthly at each well-baby visit and periodically over the phone if mothers missed their well-baby visits.

Whenever a clinic visit was missed, mothers were called and their next clinic visits confirmed with both the mother and the pediatric nurse and the WIC dietitian, if applicable. All of this was to ensure that mothers were not lost to follow-up. In addition, mothers were also called on the telephone by the primary investigator, whenever possible, to remind them of their appointments and confirm changes in schedule if noted on the clinic appointment books. All participating mothers were compensated with token baby gifts for each clinic visit that they kept with the primary investigator in an effort to reduce loss to follow-up. It is important to note that all the clinics selected had a consistently high history of patients not showing up for their appointments, and this was being addressed at the time of the study by the managing entity selected by the District of Columbia.

RESULTS

In spite of the effort exerted to minimize loss to follow-up, complete data were available for 54 mother–infant dyads at the end of the study. Of all those lost to follow-up, over 90% had their phones cut off, had moved from their original place of residence, or had changed their clinic membership. For the remaining 10%, some stated that they were not

Table 1. Means of Maternal Perception of Infant Body Size by Category	
Perception Categories	**Mean ± SD**
Preferred body size	2.9±0.83
Healthy body size	2.9±0.78
Typical body size	3.2±1.18
Current body size	3.2±0.97

coming back to the clinic for personal reasons but would supply no other definitive reason for their refusal to come to the clinic. For this study, the greatest attrition occurred between the fourth- and sixth-month well-child visits. It is generally noted by researchers working in inner cities that certain characteristics inherent to inner city populations make attrition an ongoing challenge of research in this area.[14] Thus, the high attrition observed in this study was determined to not be unusual.

The mean age of the mothers at the end of the study was 25.3±0.6 years. The mean weight was 73.7±2.6 kg and the mean BMI was 28.1±1.0 kg/m^2. The majority of the participants were single (81%), and 94.7% were WIC participants. The mean number of children was 2.5±0.2; 38% of the women were first time mothers, and almost all the women (96%) had sought prenatal care during pregnancy. Thirty-three percent of the mothers had BMI >30, and 31.1% had a BMI between 25–30. Over 50% of the mothers in this sample were overweight using the IOM weight standards of 1990 which were in operation during the conduct of this study. These values were used and are still being used in this report, because they have been validated for use in pregnancy.[15,16] When the data is subjected to recent BMI standards where overweight is defined as BMI >25.0, then over 66% of the women in the study are overweight.

At the first meeting each mother was asked to verbally rate her infant according to whether she perceived him/her to be small, average, or large at birth. Twenty-one percent of the mothers rated their infants as small at birth, 56.2% as average and 22.9% as large. The numbers of males and females in each of the three rated groups were not significantly different. To assess the relationship between actual birthweight and maternal verbal rating of size at birth, spearman correlation was performed and resulted in a correlation coefficient of 0.58 and a p value of 0.0001. This means that overall mothers' verbal size ratings of their infants' correlated

Figure 1. African-American Infant Body Habitus Scale

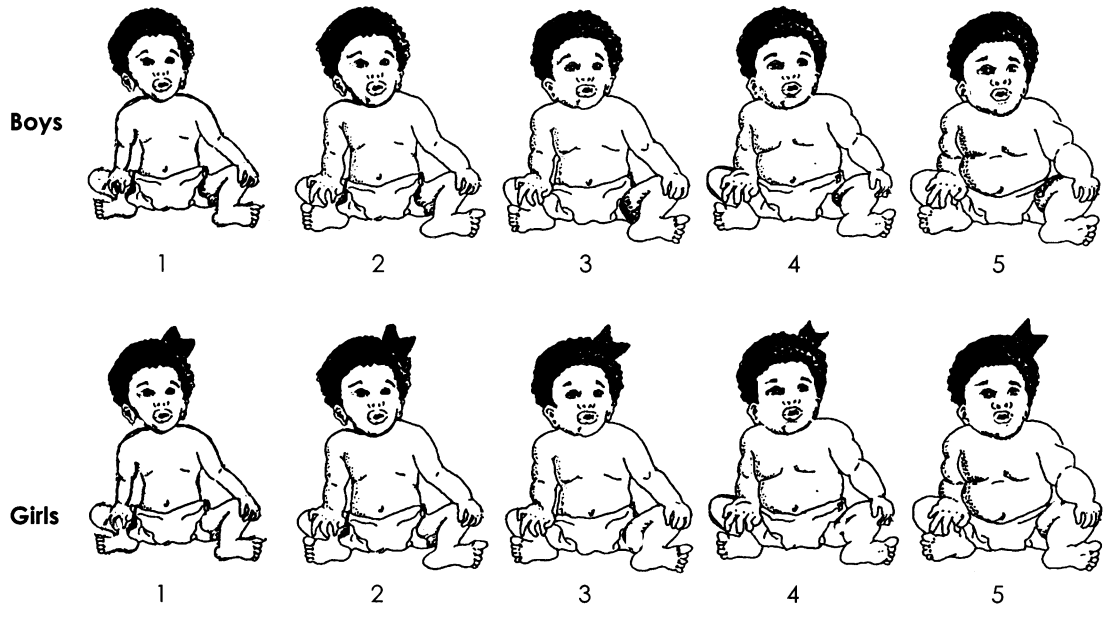

Table 2. Indices of Healthiness, Satisfaction, and Adequacy				
	Current Size Larger Than (a,b,c)	Current Size Same as (a,b,c)	Current Size Smaller (a,b,c)	Total in Percents
Healthiness	35.2[a]	40.1[a]	24.7[a]	100.0
Satisfaction	20.4[b]	48.1[b]	31.5[b]	100.0
Adequacy	43.0[c]	7.0[c]	50.0[c]	100.0
a = healthy size; b = preferred size; c = typical size				

positively with the infants' actual birth size category, and this observation was not due to chance.

Among the four body size perceptions assessed with the AAIBH Scale, the largest means observed was for Current and typical body sizes which were both 3.2. The smallest means were for preferred and healthy body sizes which were both 2.9 (Table 1). Significant mean group difference was found comparing typical body size and preferred body size, p=0.03, and marginal significance was found between typical and healthy body sizes, p=0.06. Overall, there were no significant gender differences in mean body sizes selected.

After examining the means of the different body sizes the question was asked, "Does the current body size value reflect what mothers selected as their preferred body size or does it conform to the typical Infant body size selected by mothers"? Secondly, were any of the means significantly different from each other? It was found that the mean Current body size was not significantly different from the mean typical infant body size, suggesting that mothers' selections of their infants' current body Size did not differ from that of the perceived typical size. However, there was a significant difference between preferred body size and typical body size, p=0.03.

To further explore the difference in means noted for each body size, indices were developed to assess maternal satisfaction with infant body size, maternal-perceived infant healthiness, and infant adequacy in reaching the body size norm of the community. The Satisfaction Index measured how satisfied mothers were with their infants' actual size by six months of age, and this was objectively measured by subtracting the numeric value of current body size from that of preferred body size. The Adequacy Index measured how adequately the mother's perceived infant current body size reflected her perceived size for a typical infant aged six months and was calculated by subtracting typical body size from current body size. The Healthiness Index was calculated by subtracting the value of current body Size from healthy body size and it measured the difference between the infant's current body size and the mother's perceived healthy size for that infant. The results of the calculations of these indices and their outcomes are presented in Table 2.

The most important finding in this table is that over 50% of the infants did not attain the preferred size that their mothers had selected. This means they were perceived to be either larger than or smaller than what their mothers preferred. Specifically, one-fifth of the infants were perceived to be larger than their maternal preferred size. Similarly, over 35% of the infants were perceived by their mothers to be larger than their perceived healthy size for infants of their ages. Noteworthy is that according to maternal selection, 43% of the children exceeded the perceived typical size of infants in the neighborhood, which means that these children seemed to their mothers to be larger than the typical infant in the neighborhood.

Maternal infant feeding beliefs and how they compared to the current feeding recommendations were assessed with the MIFPQ and MIFAQ questionnaires mentioned earlier. Listed in Tables 3 and 4 are the questions and the responses collected from the mothers. In the MIFPQ, the results reflect the percentage of women who selected the wrong answer for the questions asked in the four categories. This is denoted as "knowledge deficit" in the second column.

A striking finding in this sample of women was that over one-third believed that babies should not be breast fed from the first day of birth and just over a quarter thought colostrum was not beneficial to babies. Additionally, almost a third of the women believed babies needed to be introduced to other

foods before four months of age so that they could learn to accept new foods. Most significant was the finding that 48% of mothers believed that it was important to start their babies on the bottle early or else the baby might refuse it later. Summarizing the findings of the questionnaire, it was concluded that knowledge deficits regarding appropriate infant feeding range from 7.8% to a high of 48.0% in this study and was an area requiring intervention.

To capture actual maternal practice, the MIFPQ was administered, and the corresponding percentages of women answering each question are listed in Table 4. The purpose of this questionnaire was to capture actual practices to support findings in the interview schedule and the MIFAQ. Therefore, there were no right or wrong answers.

The questions in the MIFPQ focused on three major areas of infant feeding practices that have been identified as having an impact on infant adiposity: Food control behaviors, infant behavior management, and peer pressure. With regard to food control behaviors, there was high consistency

Table 3. Maternal Infant Feeding Attitude Questionnaire

Early Infant Feeding	**Percent With Knowledge Deficit**
Babies should be breastfed from the first day of birth.	35.3
Babies need formula because breast milk does not have all the ingredients they need for growth.	19.7
The first milk from the breast (colostrum) is good for the baby.	26.5
It is important to start the baby on the bottle early or else the baby might refuse it later.	48.0
Infant Satiety	
If a baby starts to cry after he has been fed, it ALWAYS means the baby is not full.	8.9
If a baby cries after feeding, it does not mean the baby is hungry.	14.5
Infant Health and Fatness	
Fatness is always the best way to tell how healthy a baby is.	20.6
Usually, thin babies are unhealthy babies.	14.8
Fat babies are always healthier than thin babies.	9.8
Infants who are given foods other than milk before they are two months old are always healthier than infants who receive other foods later.	17.6
Scheduling & Supplemental Feeding	
Babies need to be introduced to other foods before four months of age so that they can learn to accept new foods.	31.3
Foods, like mashed vegetables, cereal, and ground meats, should not be given to an infant before four months of age because it may make the baby sick.	20.6
Eggs and ground meats should be given to infants as soon as possible; that is, before they are four months old because it makes them healthy.	7.8
Foods that are good to give a baby before four months are mashed potatoes, mashed vegetables, and applesauce.	38.3

between women's response in all areas that measured food control. Approximately three-quarters of the respondents reported that they fed their babies whenever they perceived the infant to be hungry and, therefore, did not rely on fixed feeding schedules. Analysis of responses to the semistructured interview schedule which was used to supplement the questionnaires revealed that some of the cues that women used to determine infant hunger, infant satiety and feeding times were: 1) infant crying, 2)

Table 4. Maternal Infant Feeding Practices

Food Control Behavior	
There are two main ways people think infants should be fed. Some people feed their infants only when they look hungry, and others feed their infants any time they think the baby needs it. Which of these do you do?	
Feed my baby when she/he is hungry using certain signs (please give cues used to determine hunger)	77.5
Feed my baby whenever I think the baby needs it— that is, based on a schedule	21.5
Do something in between	1.0
Some women think that a baby's usual feeding time should not be delayed and will wake up their baby to feed it if it is past its feeding time. Which of these do you usually do?	
Allow the baby sleep and not pay attention to the time	76.5
Wake the baby up to feed him/her	22.5
Do something in between	1.0
Many times bottle-fed babies do not finish their bottles. If your baby does not finish the bottle do you usually...?	
Allow the baby to refuse the bottle	46.1
Encourage the baby to finish the bottle later	49.0
Do something in between	4.9
Behavior Management	
When your baby cries, if you check and it is not wet or hurting, do you usually...?	
Feed my baby to comfort it	31.3
Comfort my baby some other way	66.7
Do something in between	2.0
Suppose half an hour after feeding your baby, you notice it is fussy and unhappy. Would you usually...?	
Try to feed my baby to comfort him/her	22.5
Avoid feeding my baby so as not to mess up the baby's schedule	13.7
Do something in between	63.8
Peer and Relatives' Pressure	
Many times, friends or relatives who mean well may tell a mother that her baby is not gaining enough weight. If you were told this by a friend of family member, what do you think you would do?	
Encourage my baby to eat more	15.7
Continue with my usual feeding routine	72.5
Do something in between (be specific)	11.8

infant awakeness or length of sleep, 3) sucking on fingers or lips, and 4) fussiness. The most important cue reported was the infant's ability to sleep for long periods of time, which mothers stated was a reflection of satiety. This cue correlated highly with the reported practice of not waking the infant for feeding as assessed in question 2. In both questions 1 and 2, over 76% of the participants reported that they utilized infant cues and did not wake up their infants for feeding. Consequently, the percentage of women who reported a low reliance on the aforementioned cues to determine when to feed their infants corresponded almost exactly with the percentage of women who indicated that they did not wake their infants to feed them. Question 3 evaluated the potential for force-feeding, and based on the responses, it seems that 49% of the women exhibited a potential to force-feed their babies by insisting through their actions that their babies finish their bottles.

Regarding the influence of peers and relatives on infant feeding decisions as measured by question 6, 72.5% of the women responded that they would not change their feeding practices based on comments from others. However, when this question was probed further in the semistructured interview session, the majority of mothers said that if a comment was made about their child's growth, they would consult the child's physician for advice since "my friends and relatives do not know that much about babies anyway." Surprisingly, with the exception of the nurse practitioner, none of the subjects indicated that she would consult the nurse or the WIC dietitian on site for advice on the growth of the infant, even though the majority of contact was with these professionals.

The Food Frequency Questionnaire, which was administered at well-baby visits as well as through monthly telephone checks, revealed that cereal was the most frequent solid food introduced into the infant's diet. The reason given for this was that mothers believed that cereal promoted satiety and increased infant sleep time. This observation supports the earlier finding that over 76% of the women thought letting their baby sleep was more important than waking them to feed them. Another reason for the early introduction of cereal was that many mothers lamented that often they were not the first to give their infants cereal. Even when they desired to follow the recommendations of their healthcare providers, they felt thwarted because whenever they left their babies in the care of grandmothers and other older relatives, they returned to find that the children had been given cereal in the bottle to prevent them from crying and make them sleep.

Overall, 75.9% of the infants received nonmilk foods before four months of age and Table 5 shows the percentage of infants who received it before two months of age. This table was generated using maternal perception of their infants' size at birth as the analysis groups because we wanted to answer the question of whether maternal perception of size at birth had any influence on when infants were fed nonmilk foods. It was observed that women who perceived their infants as small introduced nonmilk foods earlier than women who perceived their infants as average. One-way ANOVA analysis revealed that the mean time of the introduction of nonmilk foods was significantly different between mothers who perceived their infants as small and those who perceived their infants as average, $p=0.03$.

The Body Parts Ranking Scale (BPRS), defined earlier, was used to assess maternal perception of infant fatness. Its purpose was to assess which parts of the body mothers rated as most important in determining if an infant was fat. It included six cards which mothers ranked in importance from most important to least important, from first place (#1) to last place (#6). Aggregates of the rankings showed that the body part perceived to be most important in determining fatness was the face, and the least important was the buttocks. Probing on

Table 5. Nonmilk Food Introduction Based on Body Size Perception at Birth

Maternal Verbal Perception of Infant Size at Birth	Nonmilk Foods Introduced Before Two Months	Nonmilk Foods Introduced After Two Months	Total Number/ Percent
Small baby	8/57	6/43	14/100%
Average baby	16/50	16/50	32/100%
Large baby	4/50	4/50	8/100%

the importance of the face in assessing fatness, it was determined that some mothers perceived that fatness in the face was indicative of overall infant health. Some of their comments to that regard were "the baby's healthiness is all in the face"; "if the face ain't healthy, the body ain't going to be healthy."

Infant length and weight measurements were converted to BMI or Quetelet indices and presented in Table 6. The most striking finding was that over 31% of the infants had BMI measures greater than the 95th percentile of the NCHS growth standards and were, therefore, overweight in this sample. In total, over 40% of the infants were over the 85th percentile.

To assess whether there was any relationship between early introduction of foods and infant adiposity outcomes, BMI was correlated with other variables, and the results are shown in Table 7. Negative correlations were observed for all pairs except BMI and cereal. In comparing the correlation statistic for each of the pairs, the data suggested that the earlier the introduction of nonmilk liquids and solids, the larger the infant's BMI by the age of six- to seven months.

Maternal weight and height data, which were collected at the last visit to allow for postpregnancy weight stabilization, were used in calculating maternal BMI. It was observed that 64% of the women had a BMI over 25, and 33% had a BMI over 30 by the time their infants were six months old. As previously reported in Table 6, 17 of the 54 infants were above the 95th percentile, according to the NCHS standards. Of the 17 infants, nine had mothers who were overweight or obese, and eight had mothers of normal BMI. Cross-tabulating maternal BMI, infant BMI, and maternal perception of infant current body size showed that 66.6% of the overweight women whose infants were above the 95th percentile selected the slim images on the AAIBH scale to represent the current body size of their babies. This was compared to 37.5% of normal BMI women who also were parents of obese infants and selected the slim images on the AAIBH scale to represent the current body size of their baby. Noting that some studies have found a relationship between parental obesity and preference for larger children,[3] we assessed the relationship between maternal final BMI and maternal perception of current infant body size at six months of infant age. Spearman correlation was conducted. The Spearman correlation statistic was 0.36 with a p value of 0.008. This means that there was a significant positive but mild correlation between maternal final BMI and the mother's perceived current infant body size.

DISCUSSION

Several important findings were observed in this study. It was determined that 57% of infants perceived to be small at birth received nonmilk foods before two months, compared to 50% of average and large infants, respectively (Table 5). There was no significant difference in means observed between large and small infants, but between average and small infants a significant difference in solid food introduction was observed (p=0.03). Though there was no significant difference found between large and small infants, percentage-wise, more large infants received nonmilk foods before four months, compared to those perceived to be average.

The high degree of early introduction of nonmilk foods observed in this sample of mothers support the reports of Bronner et al. (1999)[17], Bentley et al. (1999)[11], Baughcum et al. (1998)[12], and Underwood et al. (1997)[18], where a high percentage of the infants in their studies were observed to receive nonmilk foods early. Additionally, the findings also supports that of Crow and colleagues[19], where it was observed that maternal nurturing behaviors, such as

Table 6. Infant Weight for Height (Quetelet) Indices Using NCHS Standards

NCHS Standards	Percentages
Weight for height greater than 95th percentile	31.5
Weight for height greater than 85th percentile	9.3
Weight for height less than 85th percentile	59.2
Weight for height less than or equal to 50th percentile	42.6
Weight for height less than fifth percentile	3.0

feeding and pushing the nipple in a baby's mouth, were more prevalent among women with low birthweight babies. The negative correlation found between infant BMI (Quetelet index) and nonmilk foods introduction, as presented in Table 6, indicated that the earlier the introduction of nonmilk foods the larger the infants BMI by the end of the study. The finding fits the observations of other researchers regarding feeding and infant weight.[18-22] It was noted, however, that there was no correlation between the time of cereal introduction and infant BMI. Perhaps the reason cereals did not feature prominently is because the majority of babies received cereal early and, thus, the effect of cereal on adiposity could not be detected. Secondly, it was also noted in this study that the primary reason mothers gave cereal was not for growth but rather for sleep and convenience—so they did not aim to make their infants large per se but to keep them satisfied. Baughcum and colleagues[12] also observed this in their study in which some of their participants introduced cereal to help their babies sleep through the night. It also supports the findings of Bentley et al.,[11] in which it was observed that grandmothers played a significant role in deciding and offering nonmilk foods to infants.

Concerning infant feeding beliefs and practices, a significant finding was that infant satiety was determined by the length of time an infant slept. Consequently, feeding efforts which increased infants' sleep time, such as cereal feeding, were prevalent and viewed as positive by most mothers. The use of food for comfort and satiety was also observed to predispose infants to force-feeding, which is currently being debated in the literature as a possible factor in the development of childhood obesity. Forty-nine percent of the women were assessed as displaying the potential for force-feeding based on the responses given in the MIFPQ. It is intuitive that a counterargument here could be that perhaps mothers were trying to prevent waste and save money when encouraging their infants to finish the bottle. We submit that the subjects were WIC participants and, therefore, did not have to worry about the cost of infant formula. It seems something other than economics may be operating in the observation noted here and needs to be examined further.

One of the goals of this study was to examine how maternal weight affected body size perceptions. It was detected that overweight/obese women did underestimate their infants' sizes when compared with women of normal BMI, as evidenced by the fact that among the 17 infants who were above the 95th percentile for weight-for-height measures, those with overweight mothers were twice as likely to be classified as slim (#1) or average (#3) on the AAIBH scale, when their actual BMI placed them in the overweight category. Similarly, using the questionnaires, we found that about one-fifth of the mothers measured infant healthiness by fatness, supporting previously reported observations by Baughcum and colleagues.[12]

Finally, according to the Satisfaction Index in Table 2, over 52% of the infants did not attain their maternal preferred size. Most significant here was that one-fifth of these infants were perceived as larger than their maternal preferred size. This finding suggests that if maternal preference was one of the most important determinants of an infant's adiposity status, as suggested by Alexander[3] and Kramer,[13] and secondly, if it is assumed that parents consciously promote feeding actions that allow their children to attain their preferred size, then the majority of infants should have been observed to have attained their maternal preferred size. However, this was not what was observed in this study. The lack of significant correlation between maternal preference for infant size and actual infant size raises the question of whether Alexander[3] and Kramer's[13] findings are applicable to inner-city African-American mothers of newborns. Indeed,

Table 7. Correlation of Infant Quetelet Indices and Time of Nonmilk Food Introduction

Variable	Correlation Coefficient	P Value
BMI and noncereal solids	-0.59	0.001
BMI and nonmilk liquids	-0.59	0.02
BMI and cereal	-0.17	0.20
BMI and all foods before four months	-0.34	0.02

the data highlighted several other factors that may be responsible for the infants' weight outcomes. For example, the impact of the feeding and size preference of other significant child caregivers, such as grandparents, fathers, and other relatives, may be a contributing factor. It is intuitively understood that, regardless of the mother's size preference for her child, if other caregivers are responsible for feeding the infant for a significant period of time in the first six months, the child's weight outcome would be more strongly influenced by the caregivers' beliefs and corresponding feeding actions rather than the mothers' preference. This scenario would be especially true in this population in which mothers are more likely to leave their infants with their older female relatives who significantly influence feeding decisions, according to findings by Bentley et al.[11] Additionally, new mothers' need for a good night's sleep may also be a contributing factor. Women in the inner city, especially single mothers, who constituted 84% of this study population, face multiple demands on their daytime hours with little or no time for naps. Therefore, a baby who sleeps through the night can be an asset in making their lives manageable. Indeed, the findings of the food frequency questionnaire showed that many of the mothers believed that the introduction of cereal was useful in promoting infant satiety and sleep-time. Therefore, we suggest that for this study, intervening variables, such as the mother's need for adequate rest and the impact of other caregivers' beliefs and practices on the outcome of the infants weight status, need to be examined further before a definitive statement of refusal or support can be made of the findings by Alexander[3] and Kramer.[13]

IMPLICATIONS

Though these findings highlight an important and less-investigated sector of obesity research, there are still many unanswered questions. For example, we were unable to examine in depth the real reasons why each group of women introduced nonmilk foods early. A comparative analysis using in-depth interviews with each group of women to explore the reasons for early introduction could provide useful data in understanding why this high prevalence of early introduction of nonmilk foods exists and persists in this population.

The programmatic suggestions garnered from this study are that healthcare providers need to be vigilant in their assessment of obesity in children, particularly in the 0-to-two-year-old group. Recent recommendations from the Obesity Evaluation Expert Committee,[23] indicates that children under two years old who are obese need to be referred to an obesity expert for evaluation and treatment. As far as we could tell during this study, the only referrals made for the participants were to the WIC dietitian for counseling. Surprisingly, in this sample where the majority of the women had constant contact with the WIC dietitian, there was a high prevalence of overweight among children under six months of age—suggesting either problems with the type of counseling they were receiving or a lack of desire to implement what they were being taught. Like Bronner et al.,[17] our findings suggests there may be a need for improvement in the nutrition educational approaches utilized by WIC in motivating mothers to comply with national infant feeding recommendations. Some of the improvements that would be beneficial are a focused attempt to initiate intense prenatal education for women during the last trimester of pregnancy, alerting them to the effects of overnutrition on the infant's adiposity outcome. Messages to women should specifically inform them that infants gain most of their adipocytes in the last three months in-utero and the first six months postnatal, and during these periods, feeding practices which promote an increase in adipocytes' size and number will impact their children for a long time in diverse ways. These messages should also be delivered and reinforced consistently by all members of the healthcare team.

Finally, serious consideration should be given to focusing prenatal, infant nutritional education to first-time mothers who have little personal infant feeding experiences and who would, therefore, be less likely to have conflicts leading to noncompliance with the nutritional information given to them by healthcare providers. Specifically targeting first-time mothers would assist new mothers in their immediate infant feeding experience as well as prepare a foundation of feeding knowledge upon which they could draw to benefit subsequent children born to them. Additionally, this approach would also lay the foundation for a new generation of women who in later years would be able to provide sound nutrition counsel to their daughters and other female relatives.

CONCLUSION

The findings of this prospective study confirmed that maternal perception of infant body size does affect infant feeding decisions. Mothers who perceived their infants as small were more likely to introduce nonmilk foods before two months of age. However, the reasons for this practice were not always based on nutritional reasons.

By the end of the study, over 31% of the infants in the study had BMI ≥95th percentile, and a combined 40% were above the 85th percentile, according to NCHS weight-for-height standards. It was also observed that compared to women of normal weight, overweight mothers were twice as likely to underestimate the body size of their infants using the AAIBHS scale, even when the infants were overweight.

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REFERENCES

1. Wingard DL, Criqui MH, Edelstein SL, et al. Is breastfeeding in infancy associated with adult longevity? *Am J Public Health.* 1994;84:1458-1462.

2. Work Group on Cow's Milk Protein and Diabetes Mellitus. Infant feeding practices and their possible relationship to the etiology of diabetes mellitus. Pediatrics. 1994;94:752-753.

3. Alexander MA, Sherman BJ, Clark L. Obesity in Mexican-American Preschool Children—A Population Group at Risk. *Public Health Nurs.* 1991;8:53-58.

4. Thompson JK. Introduction: Body Image, Eating Disorders, and Obesity—An Emerging Synthesis. In: Thompson, JK, ed. Body Image, Eating Disorders, and Obesity. Washington, DC: American Psychological Association. 1996:1-22.

5. Ogden CL, Troiano R, Ronnette RB, et al. Prevalence of overweight among preschool children in the United States, 1971–1994. *Pediatrics.* 1997;99:1-7.

6. Ogden CL, Flegal KM, Carroll MD, et al. Prevalence and trends in overweight among U.S. children and adolescents, 1999–2000. *JAMA.* 2002;288:1728-1732.

7. Wishon PM, Kinnick VG. Helping infants overcome the problem of obesity. *Maternal Child Nurs.* 1986;11:118-121.

8. Butte NF, Wong WW, Smith EO, et al. Influence of early feeding mode on body composition of infants. *Biol Neonate.* 1995;67:414-424.

9. Castiglia PT. Obesity in infants and toddlers. *J Pediatric Health Care.* 1987;1:218-221.

10. Stordy BJ, Redfern AM, Morgan JB. Healthy eating for infants' mother's actions. *Acta Paediatr.* 1995;84:512-515.

11. Bentley M, Gavin L, Black MM, et al. Infant feeding practices of low-income, African-American adolescent mothers: an ecological, multigenerational perspective. *Soc Sci Med.* 1999;49:1085-1100.

12. Baughcum AE, Burklow KA, Deeks CM, et al. Maternal feeding practices and childhood obesity. *Arch Pediatr Adolesc Med.* 1998;152:1010-1014.

13. Kramer MS, Barr RG, Leduc DG, et al. Maternal psychological determinants of infant obesity: development and testing of two new instruments. *J Chr Dis.* 1983;36:329-335.

14. Research in the inner city can be challenging. Retrieved on March 20, 2003 from http://www.lstmichaelshospital.com/content/research/ichru/research_methodology.asp, 2003.

15. Siega-Riz AM, Adair LS, Hobel CJ. Instituted of medicine maternal weight gain recommendations and pregnancy outcomes in a predominantly Hispanic population. *Obstet Gynecol.* 1994;84:565-573.

16. Parker JD, Abrams B. Prenatal weight gain advice: an examination of the recent prenatal weight gain recommendations of the Institute of Medicine. *Obstet Gynecol.* 1992;79:664-669.

17. Bronner YL, Gross SM, Caulfield L, et al. Early introduction of solid foods among African-American participants in WIC. *J Am Diet Assoc.* 1999;99:457-461.

18. Underwood S, Pridham K, Brown L, et al. Infant feeding practices of low-income African-American women in a central city community. *J Community Health Nurs.* 1997;14:189-205.

19. Crow RA, Fawcett JN, Wright P. Maternal behavior during breast and bottle feeding. *J Behav Med.* 1980;3:259-277.

20. Neuman CG, Alpaugh M. Birthweight doubling time: a fresh look. *Pediatrics.* 1976;57:469-473.

21. Weil WB. Infantile obesity. In: Winick M. ed. Childhood Obesity. New York: John Wiley & Sons; 1975:61-71.

22. Yeung D, Pennell MD, Leung M, et al. Infant fatness and feeding practices: a longitudinal assessment. *J Am Diet Assoc.* 1981;79:531-535.

23. Barlow SE, Dietz WH. Obesity evaluation and treatment: expert committee recommendations. The Maternal Child Health Bureau, Health Resources and Services Administration, and the Department of Health and Human Services. *Pediatrics.* 1998;102:E29.