Starting Early: Obesity Prevention during Infancy

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Abstract

Obesity prevalence among infants and young children has increased rapidly during the past 4 decades, a disturbing trend given early obesity’s association with later life obesity and its comorbidities. Fortunately, infancy is a period of great behavioral and metabolic plasticity offering numerous targets for preventive interventions. Modifiable factors that may affect early rapid weight gain and obesity risk include infant sleep duration, feeding to soothe infant distress, and the introduction of solid foods and transitional feeding. We discuss evidence linking these factors to weight outcomes, as well as results from behavioral obesity interventions in infancy, from our laboratory and others’. For example, in a recent pilot intervention, we focused on helping new mothers address three areas of infant behavior hypothesized to affect weight gain and early obesity risk: infant sleeping, crying, and feeding. First-time mothers were randomly assigned to receive either a Soothe/Sleep intervention, an Introduction of Solids intervention, both interventions, or no interventions. The interventions were delivered via home visits and showed positive effects on infant behaviors and weight outcomes at 1 year. Based on evidence from such pilot interventions, we assess the plausibility of targeting behavioral factors in infancy and suggest next steps for early prevention research.

The prevalence of obesity among young children has risen rapidly during the past 4 decades. Approximately 20\% of 2- to 5-year-olds are currently overweight, and approximately 10\% are obese. Similarly, 10\% of children under age 2 have a weight status at or above the 95th percentile for age and sex [1]. These statistics, combined with the limited success of obesity interventions targeting school-age children [2], highlight early obesity prevention as an important, emerging research area. Two growth trajectories can result in obesity early in
life [3]. First, through prenatal influences (e.g. maternal pre-pregnancy weight, gestational weight gain, smoking during pregnancy), babies can be born large and stay large during the postnatal period. Second, babies with normal or low birthweights can gain excessive weight during infancy. Rapid weight gain during infancy predicts obesity and its comorbidities later in the lifespan, even after adjustment for prenatal factors. These two distinct pathways suggest two avenues for intervention: prevention efforts beginning during the prenatal period and targeting the diet and behaviors of the mother, and postnatal prevention efforts targeting infant factors linked to early weight gain. In this paper, the latter is our focus. However, it is important to remember that birthweight affects subsequent growth, and in general, infants who are born heavier are more likely to regress toward the mean and grow more slowly than those born at the lower end of the birthweight distribution.

Rapid weight gain during infancy is associated with increased risks of obesity and its cardiovascular comorbidities from early childhood [4] through adulthood [5]. In addition to the epidemiological evidence, research with animal models reveals that early rapid weight gain can have epigenetic effects that may alter developing metabolic systems to increase risks of obesity, metabolic syndrome, cardiovascular disease, and diabetes [6]. This evidence indicates that, contrary to popular belief, a chubby baby is not necessarily a healthy baby who will ‘grow out of it’ but may be more likely to ‘grow into’ obesity later in life. Despite extensive evidence that early rapid growth increases obesity risk, until very recently, few obesity prevention efforts have been focused on infancy [7].

There are many reasons to consider obesity prevention during infancy. Obesity rates are high by early childhood, and epigenetic effects of obesogenic environments on early growth indicate that infancy is a period of behavioral and metabolic plasticity that can have life-long effects on health. The rapid dietary transition from an exclusive milk diet to a modified adult diet by age 24 months is one example of the flux and instability of infancy [8], highlighting this period as an opportunity to shape behaviors that affect growth and obesity risk. Basic research, in combination with a small number of pilot intervention studies, shed light on the efficacy of targeting behavioral factors linked to infant growth.

**Behavioral Factors Linked to Weight Outcomes during Infancy**

The current state of obesity research in early life suggests that moderating early rapid growth could be a successful first step in preventing obesity. What infant factors should be targeted in order to achieve this goal? In a recent review, Paul et al. [9] identified several modifiable factors, implicated by basic research as predictors of early rapid weight gain and obesity risk. These factors were infant feeding mode (breastfeeding or formula feeding), infant sleep duration, parental use of food to regulate infant distress, the timing of the introduction
of solid foods, sweetened beverage consumption, the age of weaning from the bottle, and the introduction of solids and table foods. Recently, the Institute of Medicine released a report on ‘Early Childhood Obesity Prevention Policies’, which focuses on the period from birth to age 5 and includes brief reviews of the evidence for some of these factors influencing early growth in infancy and early childhood [10].

A consistent and growing evidence base implicates infant sleep, parental regulation of infant distress, and the introduction of complementary foods and transitional feeding as promising early behavioral targets and suggests potential possibilities for interventions (table 1). What about breastfeeding? Breastfeeding is indisputably the ideal infant feeding mode for many reasons, including immunological benefits, but the evidence is not consistent regarding the extent to which breastfeeding protects against childhood obesity. Although meta-analyses show a modest, protective effect of breastfeeding [11], exclusively breastfeeding for long durations seems to confer the greatest benefit. While promoting exclusive and long durations of breastfeeding is a goal in the US, and rates of breastfeeding initiation have increased, with the majority of new mothers in the United States breastfeeding in the hospital, it is rare for an infant to be exclusively breastfed for durations that have been shown to result in reduced obesity risk. In addition, the effects of breastfeeding decrease in magnitude after adjusting for maternal and socioeconomic confounders that are also related to offspring obesity [12]. A recent study comparing longitudinal data on breastfeeding and later obesity across cultures in which the social patterning of breastfeeding differs adds to the evidence that part of breastfeeding’s apparent protective effect is due to residual confounding: In the UK, where breastfeeding is associated with a higher socioeconomic status, breastfeeding was inversely associated with child BMI, but in Brazil, where such social patterning of breastfeeding is not observed, breastfeeding was not associated with child BMI [13]. These findings do not support a causal effect of breastfeeding on BMI but do support possible causal links between breastfeeding and IQ and between breastfeeding and blood pressure as positive associations between breastfeeding and these outcomes were noted across samples differing in the social patterning of breastfeeding. Although breastfeeding is an important public health goal for multiple reasons, the lack of clear evidence that breastfeeding reduces obesity risk and the challenges of promoting exclusive breastfeeding for long durations have led us to focus on other factors.

Although evidence regarding causal mechanisms is still emerging, short sleep duration has been linked to a higher weight status in all age groups, including infants [e.g. 14], with only a few published studies failing to find this relationship [e.g., 15]. Short sleep may affect hormones regulating hunger and satiety and/or may lead to more feedings in infants who are awake for longer durations. To teach infants that hunger leads to feeding, feeding should be reserved for when the infant exhibits hunger cues. Feeding as an indiscriminate response to
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<th>Opportunity</th>
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| **Infant sleep**                                 | Educate parents on methods to lengthen sleep duration and soothe at night without feeding as a first response to nocturnal crying | + Intervention infants had greater increases in nocturnal sleep compared to controls, as well as greater reductions in settling time and night-time waking [23]  
+ Breastfed intervention infants showed increased nocturnal sleep duration [24]; effect not seen in infants transitioned to formula before 16 weeks |
| **Parental regulation of infant distress**       | Respond quickly to crying in early infancy, but use alternative methods to soothe than feeding | + Intervention infants were less likely to be given food as a reward [22]  
- Intervention did not affect maternal beliefs about using food to calm baby or responsiveness to satiety cues [23]  
+ In [24], fussing/crying episodes were more likely to be followed by awake/calm (as opposed to feeding; [27]) |
| **Introduction of solid foods**                 | Delay introduction of complementary foods until at least 4 months of age  
- Avoid placing cereal in a bottle  
- Use repeated exposure to healthy foods as a response to normal infant neophobia | + Intervention group introduced solid foods later [21, 22]  
+ Intervention group introduced solid foods later [23]  
+ Tended to introduce solids later (trend level) and were more likely to accept novel foods [24] |
| **Transitional feeding**                         | Emphasize healthy dietary choices  
- Use low-fat cow’s milk after introduction at 1 year  
- Do not any give juice to children <6 months; then, limit daily consumption of 100% fruit juice to <6 oz  
- Give juice only in a cup; do not allow children to easily transport juice  
- Completely avoid fruit drinks/soft drinks | + Earlier introduction of cup [21, 22] in intervention group  
+ Less juice feeding in intervention group [21]  
+ Less likely to be put to bed with a bottle [22]  
- No effects on maternal intake of healthy foods [23] |

1 Intervention targets selected from Paul et al. [9], based on the existing evidence base from pilot interventions targeting infants.
2 This column shows whether these variables were affected in the pilot studies of three groups whose studies were reviewed herein [21–24]. If one of the studies is not mentioned in a given row, then that behavior was not targeted in that study.
infant distress is another possible risk factor for obesity, and focus group data suggest that this practice is likely in low-income groups already at heightened obesity risk [16]. Fussier infants tend to be heavier, and researchers have speculated that this is because these fussy infants tend to be fed more as an attempt to soothe them. Recent research shows that highly negative infants and young children who are fed to soothe have increased BMI-for-age z-scores [17].

Fussier infants may also receive complementary foods sooner [18]. Early introduction of complementary foods has been linked to obesity risk, as have other inappropriate transitional feeding practices, such as offering sweetened beverages to young children [9]. While the evidence on early introduction of complementary foods is mixed, with many but not all studies indicating that early introduction increases obesity risk, there is also the possibility that the associations noted are the result of residual confounding or reverse causality (i.e. infants who grow faster are given solid foods earlier because they are hungrier). There is evidence that formula-fed infants receive complementary foods earlier than breastfed infants, and that early introduction of solid foods is associated with obesity risk in formula-fed but not breastfed infants [19].

As indicated above, there are many other differences between breastfed and formula-fed infants that make interpretation difficult. Causal manipulations of the timing and process of the introduction of solid foods can shed light on these issues, and initial evidence shows that the introduction of solids is an opportunity for infants to learn to like the foods that are offered and can have long-term effects on food acceptance [20]. Early periods of dietary transition offer unique opportunities to shape subsequent food selection and diet quality, an important goal given that the transition to the modified adult diet begins before the end of infancy, is relatively complete by 24 months [8], and is currently characterized by a high intake of sweets and grains and low intake of fruits and vegetables.

Taken together, sleep duration, feeding to soothe, and the timing and process of introducing new foods and beverages are all potentially modifiable behavioral factors that seem to predict weight status, providing the evidence base needed to attempt to causally manipulate these factors, alone or in combination, in pilot studies and efficacy trials aiming to prevent rapid growth during infancy and subsequent childhood obesity.

**Results of Initial Intervention Research during Infancy**

In a recent review of inventions designed to prevent obesity in 0- to 5-year-olds [7], most studies focused on preschoolers; only 6 of the 23 studies enrolled participants during the first year of life. Of these, only 2 enrolled participants in early infancy, when early measures of rapid growth could be obtained, and another was designed to focus on high-risk infants, based on infant weight status (≥95th percentile weight-for-age) or maternal obesity (BMI ≥30). Despite
the paucity of empirical evidence, this research area is growing, as evidenced by a number of publications describing protocols designed to prevent rapid growth and obesity during infancy. To date, many of these studies are in progress, and a few have published results.

In a feasibility pilot study conducted on an Australian sample, home visitors delivered an intervention that centered on feeding recommendations in the first year [21]. The intervention resulted in a lower proportion of mothers introducing solids before 4 months, a lower rate of juice feeding, and a higher proportion of cup use at infant age 12 months. The intervention group also had a higher proportion of mothers still breastfeeding at 12 months, but there were no differences between treatment and control on duration or proportion of exclusive breastfeeding. Nevertheless, these results are promising, and in a subsequent larger trial targeting socially and economically disadvantaged families, results were consistent with those from the pilot study [22].

Similarly, a pilot intervention in the US demonstrated promising effects on some early behaviors linked to rapid growth and obesity risk [23]. In this study, intervention messages were delivered to parents in primary care practices and via phone calls and targeted domains of sleep, TV viewing, feeding, and physical activity in infants and their mothers. Positive intervention effects were observed in the infants, including later introduction of solids and greater increases in reported night-time sleep duration from infant age 2 weeks to 6 months. There were no effects on breastfeeding duration, maternal beliefs about using food to soothe a crying baby, or on maternal responsiveness to infant fullness cues. Intervention and control infants did not differ on weight status at age 6 months, but there was a trend such that intervention infants were less likely to be in the highest weight status quartile.

In our own pilot research, we also reported promising effects on infant behaviors and weight status in a US sample [24]. We focused on helping new mothers to develop parenting skills to address three areas of infant behavior hypothesized to affect weight gain and early obesity risk: sleeping, crying, and feeding. First-time mothers who intended to breastfeed at infant birth were randomly assigned to receive either a Soothe/Sleep intervention, an Introduction of Solids intervention, both interventions, or no interventions. The interventions were delivered via home visits at ages 2–3 weeks and 4–6 months. One hundred and ten mostly White, higher income mothers residing in central Pennsylvania and their infants completed the one-year study. The Soothe/Sleep intervention focused on strategies to lengthen infant sleep and taught parents soothing strategies to use rather than indiscriminately feeding in response to infant fussing and crying. At age 2–3 weeks, dyads randomized to this intervention were instructed on alternate soothing responses, including swaddling, side or stomach position, shushing, swinging, and (non-nutritive) sucking. Parents were also taught to emphasize day/night differences and to respond to night waking with alternate soothing and care-taking responses. The Introduction of Solids intervention focused on
Infants who received both interventions [24] had lower weight-for-length percentiles at age 1 year (n = 110), relative to the WHO growth standards. No = No intervention; Feed = Introduction to Solids intervention; Sleep = Soothe/Sleep intervention; Both = both interventions.

‘when’, ‘how’, and ‘which’ foods to introduce to infants and provided systematic experiences with new foods between ages 4–6 months. All participants were given a standard infant parenting book, and nurses answered questions about general infant care. Mothers reported on infant behavioral states (sleeping, fussing/crying, awake/calm, and feeding) in 15-min intervals over 4 days at infant ages 3 and 16 weeks. At age 1 year, infant weight and length were measured.

Infants receiving both interventions had significantly lower weight-for-length percentiles at 1 year compared to other groups. This result is depicted in figure 1, where the y-axis depicts weight-for-length percentiles using the World Health Organization (WHO) growth charts, in accordance with the recent CDC recommendation to plot the growth of American children younger than 2 using these charts [25] and in contrast with our previously published results, which were plotted relative to the CDC growth charts [24]. The WHO charts depict optimal growth of breastfed infants living in families with adequate resources, so that infant growth was not limited by food availability. These growth standards are appropriate for our sample where all mothers intended to breastfeed.

Breastfed infants who received the Soothe/Sleep intervention also slept longer at night and had fewer nightly feedings from 3 to 16 weeks compared to infants who did not receive this intervention [24], and there was evidence that mothers in this group were less likely to indiscriminately use food to soothe...
infant distress. Because the Soothe/Sleep intervention aimed to help parents use adaptive soothing techniques, it was hypothesized that this intervention would increase infants’ likelihood of transitioning from a fussing/crying state to an awake/calm state, as opposed to transitioning from a fussing/crying state to feeding. To assess this aspect of the intervention, the data from the daily behavior diaries were analyzed using a statistical technique called Markov modeling [26], which enabled an examination of the transitions between behavioral states. Consistent with our hypotheses, the Soothe/Sleep intervention significantly increased the likelihood of transitioning from fussing/crying to awake and calm at 16 weeks. In other words, when intervention group infants were fussing and crying, it was more likely that they would move to an awake/calm state next, compared to controls. There was also evidence that transitions from fussing/crying to feeding predicted subsequent weight status [27].

These results provide initial evidence that behavioral interventions designed to modify parenting practices can decrease early weight gain through changes in parenting and in infant lifestyle, including sleeping, crying, and feeding. For the most part, these factors were parent reported, although the observed effects on measured weight status suggest that positive effects are not due to reporting biases. While this is an encouraging start, additional research is needed to determine the generalizability of these findings. Our pilot study showed effects on behaviors and weight outcomes, but our well-educated sample of mothers who intended to breastfeed at infant birth can be considered low risk. It is not clear if these results would be replicated in a more heterogeneous population or a population at increased risk of childhood obesity.

**Conclusions**

Obesity interventions in infancy can be viewed as controversial as traditional parenting and medical care have focused on ensuring sufficient growth rather than preventing its excess, and intervening with at-risk populations, although a natural next step brings its own controversial issues. One example that was mentioned is breastfeeding. Observational studies suggest that infants may be ‘protected’ from early obesity if they are exclusively breastfed for long durations. Breastfeeding also has demonstrated benefits in numerous other domains of child development; thus, it is the ideal infant feeding mode. Yet, there are marked sociodemographic differences in the prevalence of breastfeeding in many societies [see 12, 13], such that low-income and minority families are less likely to meet breastfeeding recommendations and also are at increased risk for obesity. Is it more practical to promote breastfeeding in these families, or is it more practical to give them information on the ‘best practices’ within the context of what they are already doing (formula feeding, and later, feeding solid foods and table foods)?
We have argued that there are a number of logical behavioral targets for early obesity prevention, but another caveat that must be added is that early obesity prevention efforts will not inoculate children against obesity. The initial evidence suggests that early behavioral interventions could help young children and their families to acquire healthy behaviors and growth healthfully, but in our current obesogenic environment, the efforts cannot stop there. Perhaps if coupled with early prevention efforts, school-based obesity interventions will be more effective. Perhaps early interventions will need to be supplemented with later family-based interventions. Perhaps some aspects of the broader environment will need to change. There are many questions and controversies to address as we build upon the existing pilot research.

In sum, current obesity rates suggest that prevention efforts are needed as early as infancy, a period of rapid transitions and developmental instability. Basic research implicates behavioral targets in different domains, including infant sleep, feeding to soothe, and the introduction of solids and transitional feeding, and there is initial evidence from pilot studies in home or pediatric contexts that it is possible to modify each of these. Next steps will be to expand upon this research by examining: (1) the pathways through which these efforts have their effects, (2) which factors seem to have the largest effects on weight, (3) whether effects are sustained in larger efficacy trials and effectiveness trials, (4) the generalizability of findings across different populations, including those at high risk, (5) the generalizability of findings within populations (e.g. are certain effects moderated by infant temperament?), (6) longitudinal data on the long-term effects of early interventions, and (7) ways to build on infancy interventions in childhood and beyond. The research on obesity prevention during infancy is off to a promising start, but this is only the beginning.

Disclosure Statement

The authors declare that no financial or other conflict of interest exists in relation to the content of the chapter.

References

Discussion

*Dr. Rosenbaum:* In my experience as a teacher and as a pediatrician, I find that a lot of the things you learn when you are young you forget in adolescence and then recall in adulthood. Is it possible that this is the case with early interventions? Perhaps the effects appear later on in life?

*Dr. Birch:* Yes, I think that’s quite possible, but longitudinal data in humans are limited. In addition, although evidence shows early effects on outcomes later in life, as in studies of ‘fetal programming’, there is typically no information about what occurs between the early life exposures and subsequent outcomes in adulthood. For example, with respect to the effects of breastfeeding on later obesity risk, no one has investigated whether diets during childhood and adolescence of breastfed children differ from those who were formula fed, although this seems likely.

*Dr. Goran:* I was wondering if you had done any analysis in your new data or other studies looking at the effect of other maternal exposures. When we have looked at our Hispanic cohorts, we found that breastfeeding is protective, but interestingly in kids who are exposed in utero to gestational diabetes that effect is practically wiped out. What might be responsible for this?

*Dr. Birch:* Animal model research has shown that maternal obesity, excessive gestational weight gain, and gestational diabetes can all interact with postnatal exposures to affect offspring growth and obesity risk. There are also data indicating that the composition of breast milk and success of breastfeeding are altered in women with diabetes. Finally, gestational diabetes is often accompanied by elevated maternal weight status, and excessive weight gain during pregnancy, factors that would predispose the infant to overweight and increase obesity risk, and these factors could offset any protective effect of breastfeeding.

*Dr. Ard:* This is anecdotal, but being a parent of young kids and having their friends around I am often struck by how parents project their liking or not liking of certain foods on their children. I wonder, in your studies, are you going to look at the introduction of new foods? If the mum doesn't like peas then she is not going to introduce the peas, and then the next time they are around someone eating peas she is probably going to say he doesn't like peas because he has never had peas and she doesn't like peas.

*Dr. Birch:* Your observations are consistent with some of the findings from our early research on the use of repeated exposure to promote acceptance of new foods. In general, foods that become familiar become preferred over those that are unfamiliar. If parents don't like a food, they are probably less likely to have it around, to eat it, or to offer it to the child, and early experience with tasting foods such as vegetables is essential to acceptance of these foods. With respect to mothers’ reports of children’s food preferences, nearly all of the very early research on children’s food preferences relied on maternal reports. The first thing I did when I began doing research in this area was to develop a procedure for obtaining preference data directly from young children. As a part of this work, we looked at the validity of children's food preferences, and as a part of this validation, we compared children's reported preferences with maternal reports of children's preferences. We also asked the mothers about their own food preferences and the results were consistent with your suggestion that mothers may project their own food likes and dislikes on the child. We found that mothers’ own food preferences correlated with mothers’ reports of their child’s preferences, but these maternal reports
of their children’ preferences were not related to children’s reports of their preferences. It was children’s reports of preferences, not mothers’ reports that predicted children’s food intake.

**Dr. Lovejoy:** I think that intervening in pregnancy is incredibly important, particularly given the epigenetic changes that can occur. But although pregnancy seems a great time to intervene because the woman is highly motivated and concerned about the health of her baby, the kinds of effects from behavior change interventions you’d expect to see are often not observed. For example, we have anecdotal evidence that since pregnant women know that smoking is bad for their baby, they may simply lie about their smoking behavior rather than actively seek cessation support. So, although I think we need to intervene early, I am concerned that if we provide information on food as well as on smoking and alcohol use during pregnancy, we are just going to get behavioral suppression, and lack of compliance.

**Dr. Birch:** You make an excellent point about compliance, and in recent discussions on the design of interventions, Tom Robinson suggested that to promote compliance, behavioral interventions need to be inherently motivating and include short-term incentives as well as more distal incentives, such as reducing obesity risk later in life. Robinson has had a lot of success in his research on obesity prevention and treatment in children using this approach. We are trying to do something similar in an RCT that we are beginning with first-time mothers and infants. Rather than talking about preventing obesity in their infants, we are promoting the intervention to new parents on the grounds that it can teach them the parenting skills they need to become effective, responsive parents. Short-term effects of responsive parenting can include positive effects on parents and infants. Based on the results of our pilot study, effects include increased parent self-efficacy, infants who tend to sleep longer, take fewer feedings at night, and who are less likely to gain excessive weight in the first year of life. The intervention teaches parents to be appropriately responsive to their baby’s needs, in particular, to learn to identify infant hunger and to use feeding to soothe only when the infant is hungry, and to use alternative soothing techniques in response to other distress. I do think that pregnancy and new parenthood are ‘teachable moments.’ However, although excessive weight gain in infancy is a risk factor for obesity, most new parents are not particularly concerned about their infant becoming obese. They have more immediate challenges to deal with! Most are motivated to be good parents, who are able to soothe and care for their infant, and we think this will help to motivate compliance; time will tell. There is a large body of evidence that responsive parenting is associated with positive cognitive, emotional, and health outcomes in children. We are hypothesizing that another benefit of responsive parenting will be to prevent excessive weight gain in infancy.

**Dr. Talamini:** You mentioned that your pilot study with mothers and infants provided mothers with soothing strategies. In your current study, will you offer age-appropriate soothing strategies for alternatives to food?

**Dr. Birch:** Yes, that’s right; the idea is during the first 3 months to teach them swaddling and use of white noise, which are effective approaches to soothing and calming young infants. However, for older infants and young children, swaddling is no longer effective and other strategies are needed. It’s easy and effective to use palatable foods to soothe infants and to use food to control older children’s behavior, and parents need guidance on effective alternatives to the use of food to soothe or control behavior.
Dr. Rolls: There must be huge cross-cultural differences in these early practices. Has anybody been exploring those and tried to tease out what effect they have on eating behavior?

Dr. Birch: There are a few classic anthropological studies that have described cultural differences in feeding practices, but they have not tended to focus on effects on eating behavior. I am not aware of current research on the topic. In his classic anthropological work, Robert LeVine reported on differences in parenting practices among cultural groups in Africa. One of the major points he makes is that parenting practices differ across groups to the extent that perceived threats to children's health and well-being differ. Parenting practices are attempts to protect children from perceived environmental threats to children's health. So, for example among groups who experience periodic famine or food scarcity, parents are concerned that children get enough to eat when food is available, and they may deliberately ignore hunger and fullness cues in their children, and overfeeding is common and may include offering food in response to any infant distress, force-feeding, and offering preferred foods when available. However, although a major threat to children's health these days is too much food or too much of the wrong foods, these traditional feeding practices persist, particularly among low-income groups at high risk for obesity. In ongoing research, we are finding that these traditional feeding practices are reported by Pennsylvania WIC mothers, many of whom have probably lived in environments where food is scarce, at least periodically. If parenting practices are a response to parents' perceived threats, then to change these traditional overfeeding practices, we need to change parents' perceptions. Simply telling them to use different strategies won't be sufficient.

Mrs. Wangsgaard: Have recommendations changed over the years concerning the order in which solid foods should be introduced? Does it matter in terms of their gut?

Dr. Birch: This is still an area of controversy, perhaps because guidance on order of introduction of solid foods is not evidence based. However, there is an ongoing multisite trial that should provide evidence soon.

Dr. Goran: Dr. Rolls, I think you mentioned a good point in terms of cultural differences. There is pretty good evidence, I think it's from a national longitudinal study of growth that the separation of obesity by ethnicity occurs early. We have shown in our WIC population that an increase in obesity is occurring by age 2 years in Hispanic children, whereas the increase occurs later in African-American populations.

Dr. Birch: The patterns of early obesity seen in NHANES data differ by gender between Hispanic and African-American children. To me, this suggests that differences between Hispanics and African-Americans in feeding practices may be responsible, but NHANES doesn't provide any direct evidence on differences in feeding practices. In particular, among African-Americans, girls are heavier than boys but among Hispanics, boys are heavier than girls. To me, this seems unlikely to be genetic; it's very likely that this difference is culturally driven.

Dr. Finegood: What is your sense about the impact of social media and the Internet on people's practices? Is it actually helping or is it creating more confusion? Are people adopting better practices?

Dr. Birch: In terms of impact, I don't really know. However, in doing our own search of what's out there, we found an amazing number of websites, blogs and YouTube videos related to infant care and feeding, and these varied greatly in information provided and in the extent to which they were evidence based. All this information could be very
confusing to new parents; being a new parent is challenging, and parents are looking for information. We found lots of information on some topics but little on others. For example, while there is conflicting guidance across sources about introducing solids, there is very little guidance on bottle feeding. We found limited guidance on how much to offer infants of various ages or on how to select appropriate bottles and nipples for infants of different ages/stages. Choosing appropriate bottles and nipples is important because although breastfeeding requires that the infant is an active participant, a bottle-fed infant can be more passive, and it is easy to overfeed a bottle-fed infant. Parents need guidance to recognize hunger and fullness in their infant, and to use these infant cues during feeding.