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Parental Influence on Eating Behavior:

Conception to Adolescence

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Introduction

Eating behaviors evolve during the first years of life as biological and behavioral processes directed towards meeting requirements for health and growth. For the vast majority of human history, food scarcity has constituted a major threat to survival, and human eating behavior and child feeding practices have evolved in response to this threat. Because infants are born into a wide variety of cultures and cuisines, they come equipped as young omnivores with a set of behavioral predispositions that allow them to learn to accept the foods made available to them. During historical conditions of scarcity, family life and resources were devoted to the procurement and preparation of foods, which are often low in energy, nutrients, and palatability. In sharp contrast, today in non-Third World countries children's eating habits develop under unprecedented conditions of dietary abundance, where palatable, inexpensive, ready-to-eat foods are readily available.

In this review, we describe factors shaping the development of children's food preferences and eating behaviors during the first years of life, in order to provide insight into how growing up in current conditions of dietary abundance can promote patterns of food intake which contribute to accelerated weight gain and overweight. In particular, we focus on describing children's predispositions and parents' child feeding practices. We will see that the feeding practices that evolved across human history as effective parental responses to the threat of food scarcity, can, when combined with infants' unlearned preferences and predispositions, actually promote overeating and overweight in our current eating environments. In addition to the relatively recent changes in our eating environments, concurrent reductions in opportunities for physical activity undoubtedly also contribute to positive energy balance and obesity, but are outside the scope of this article.

The first five years of life are a time of rapid physical growth and change, and are the years when eating behaviors that can serve as a foundation for future eating patterns develop. During these early years, children are learning what, when, and how much to eat based on the transmission of cultural and familial beliefs, attitudes, and practices surrounding food and eating. Throughout, we focus on the vital role parents and caregivers play in structuring children's early experiences with food and eating, and describe how these experiences are linked to children's eating behavior and their weight status.

The Current Eating Environment

These days, food and drink are available in most venues of everyday life. As of 2002, there were 514,085 food-service establishments in the United States and an additional 152,582 stores where food and beverages could be purchased.[1] In addition, a growing variety of inexpensive and energy-dense foods have become available in increasingly larger portions. A typical American supermarket carries 45,000 items[2] and consumer portions served by restaurants and fast-food establishments are often double the size of current recommended USDA serving size.[3]

In most families, women still have primary responsibility for feeding children.[4] Changes in employment patterns and family structure, however, leave women with less time to devote to this activity. From 1975 to 2004, labor force participation among mothers with children under eighteen years of age increased from forty-seven to seventy-one percent.[5] Moreover, both parents work in sixty-one percent of two-parent families with children under eighteen years of age.[6] Among single mothers, seventy-two percent are employed. Additionally, more women than men parent and feed their children without the assistance of a spouse: twenty-three percent of children under eighteen years of age live with their mother only.[7]

One consequence of these trends is that young children are routinely fed by someone other than a parent. In fact, thirty-one percent of preschool-age children receive out-of-home childcare which includes mealtime care from a grandparent or other relative, and forty-one percent participate in organized childcare.[8] In addition, families spend less time eating meals together. Only fifty-five percent of married parents and forty-seven percent of single parents eat breakfast daily with their preschool-age child.[9] Finally, an increasing proportion of food that children eat is prepared and consumed away from home.[10] About forty percent of family food dollars are now spent on food away from the home.[11] In these contexts children may be served particularly large portions[12] and consume more energy and fat than when eating at home.[13] Collectively, these trends suggest that today's young children spend less time eating at the family table and have routine exposure to large portions of palatable, energy dense foods than in previous generations.

Early Taste and Experience with Food Flavors in Amniotic Fluid

A growing body of evidence suggests that the food choices a mother makes during her pregnancy may set the stage for an infant's later acceptance of solid foods. Amniotic fluid surrounds the fetus, maintaining fetal temperature, and is a rich source of sensory exposure for infants. Many flavors in the maternal diet appear to be present in amniotic fluid. Adult sensory panels have detected odors and compounds of garlic,[14] cumin, and curry[15] in the amniotic fluid of pregnant women ingesting oil of garlic capsules and spicy foods, respectively. Because taste and smell are already functional during fetal life, and because the fetus regularly swallows amniotic fluid, the first experiences with flavor occur prior to birth. Exposure to these “transmittable” flavors influences the acceptance of these flavors by the infant postnatally.[16] Julie Mennella and colleagues examined the influence of repeated prenatal exposure to carrot juice and found that women who consumed carrot juice for three consecutive weeks during their third trimester of pregnancy had infants who exhibited fewer negative facial expressions when first introduced to carrot-flavored cereal as compared to plain cereal.[17] These findings reveal that experience with dietary flavors begins as the fetus is exposed to flavors from the maternal diet in utero, and that this early experience can provide a “flavor bridge” that can begin to familiarize the infant with flavors of the maternal diet. As we will see, familiarity plays a key role in the acquisition of food and flavor preferences.

The Impact of Breast Milk Feeding

Breastfeeding is recommended as the optimal feeding method for the first six months of life, followed by the introduction of solids and continued breastfeeding for a minimum of one year.[18] These recommendations are largely based on evidence that breast milk supports normal growth and also has immunological properties that provide some early protection from infection, and is associated with creating a lower risk of infant morbidity and mortality.[19] A growing body of literature also suggests that breastfeeding affords a small, yet consistent, protective effect against obesity. Specifically, Christopher Owen and colleagues conducted a systematic review of sixty-one studies, of which twenty-eight provided odds ratios to examine the influence of breastfeeding on obesity from infancy to adulthood. They found that breastfeeding was associated with a reduced risk of obesity among infants, young children, older children, and adults with an unadjusted odds ratio of 0.50, 0.90, 0.66 and 0.80, respectively.[20] Moreover, Stephan Arenz and colleagues reviewed twenty-eight studies investigating the association between breastfeeding and childhood obesity that met the following inclusion criteria: relative risk had to be reported, age at last follow-up had to be between five and eighteen years, feeding mode had to be reported, and obesity had to be defined using BMI. Of these twenty-eight studies, nine studies comprising more than 69,000 children were eligible for the meta-analysis. They found a significant adjusted odds ratio (AOR) for "ever breastfed" of 0.78, 95% CI (0.71-0.85) in the fixed model.[21] These odds ratios, which are significantly lower than 1.0, indicate a significantly lower risk for subsequent obesity among those who were breastfed, even when adjusting for other factors.

In one review of twenty-two high quality studies, fifteen found protective effects to be more consistently noted among school-aged children and adolescents than among younger children.[22] One possible explanation is that the impact of breastfeeding on subsequent weight status may be an example of metabolic or behavioral programming, in which the impact of breastfeeding on weight status only emerges later in development, and in this case, may not be clearly manifested until adolescence or adulthood. However, at this point, the mechanism(s) by which breastfeeding exerts protective effects are not understood. Specifically, breastfeeding is the ideal feeding method for the human infant and influences the developing anatomy and physiology of the gastrointestinal tract in ways that differ from formula feeding, such that breast-fed and formula-fed individuals may differ in the absorption and utilization of nutrients later in life.[23] In addition, there is some evidence for two complementary behavioral mechanisms that may explain the protective effects of breastfeeding. The first involves the effects of breastfeeding on food acceptance and the second involves the developing controls of energy intake.

The sensory properties of breast milk may facilitate the transition to the modified adult diet. Many flavors of the maternal diet appear in breast milk. For example, adult sensory panels can detect odors of garlic,[24] alcohol,[25] and vanilla[26] in milk samples of lactating women who ingested those flavors prior to providing milk samples. Flavors in human milk influence infant consumption. For example, breast milk flavored with garlic[27] and vanilla[28] increased infant sucking time at the breast compared to breast milk without garlic or vanilla flavor. Mennella and colleagues also tested the hypothesis that experience with flavor in breast milk modifies the infants' acceptance and enjoyment of those foods in a sample of forty-five mothers and their babies that were randomly assigned to one of three groups. The first group drank carrot juice during pregnancy and water during lactation; group two drank water during pregnancy and carrot juice during lactation, and the control drank water during both conditions.[29] Results revealed that repeated postnatal exposure to carrot flavors increased acceptance and enjoyment of carrot flavor in infant cereal. These findings indicate that flavors in breast milk, which vary with the maternal diet, provide the infant with a changing flavor environment. This early flavor experience appears to facilitate the infant's acceptance of foods of the modified adult diet,

especially those foods consumed by the mother during lactation.[30] In contrast to the varied flavor experience provided by breastmilk, formula provides the infant with the same consistent flavor experience.

There is limited evidence that these early differences in flavor experience provided by the breast and formula feeding also influence infants' subsequent acceptance of solid foods, especially those foods that might not otherwise be readily accepted, such as vegetables. For example, Susan Sullivan and Leann Birch conducted a short term longitudinal study of nineteen breastfed and seventeen exclusively formula fed four- to six-month-old infants and their mothers to examine the influence of milk feeding regimen and repeated exposure on acceptance of their first pureed vegetable. Participants were randomly assigned to be repeatedly fed one vegetable, either pureed peas or green beans. Results revealed infant feeding regimen moderated the effects of repeated exposure; the initial intake of vegetables did not differ between breastfed and formula-fed infants, but breastfed infants increased their intake more rapidly over days than formula fed infants, and continued to consume significantly more vegetables after ten exposures.[31] These findings are consistent with the view that breastfeeding can more easily facilitate the acceptance of solid foods compared to formula feeding.

A second hypothesis regarding the protective effect of breastfeeding on later risk of overweight is that breastfeeding provides the infant with greater opportunity for self-regulation of intake. A limited body of evidence suggests that infants have some ability to self-regulate caloric intake by adjusting the volume of milk consumed,[32] although this can be influenced by maternal feeding practices. In bottle feeding, the infant can obtain milk with less effort than from the breast, so the formula-fed infant is more passive in the feeding process and has fewer opportunities to control the amount consumed, making it easy to over-feed the infant. In contrast, the breastfed infant must take an active role in order to transfer milk from the breast. The higher levels of maternal control that are possible with bottle feeding reduce infants' opportunities to control the amount consumed at a feeding.[33] Limited evidence indicates that bottle-fed infants consume more milk and gain weight more rapidly than breastfed infants, increasing their risk for childhood obesity.[34] Moreover, research suggests the difference in milk intake between breastfed and formula-fed infants becomes greater with age.[35] In short, while evidence is limited, breast feeding and formula feeding provide very different opportunities for early self-regulation of energy intake, and additional research is needed to assess how these differing feeding methods influence the developing controls of energy intake, weight gain, and risk for childhood obesity.

Whether and how infants exert control during feeding to regulate energy intake are not new questions. Clara Davis conducted seminal research in the late 1920s and 1930s, providing the first evidence of an unlearned ability to self-regulate energy intake in infancy. In Davis' studies, infants and toddlers grew well and had few illnesses when given the opportunity to select and consume a variety of simply prepared foods at each meal.[36] As previously mentioned, Samuel Fomon and colleagues revisited the issue of self-regulation of energy intake by systematically varying the energy density of infant formula.[37] By six weeks of age, full-term infants who were fed a concentrated formula (100 kcal/mL) consumed smaller volumes than did those infants who were fed a diluted formula (54 kcal/mL), such that total daily energy intake did not differ between the two groups. In 1977, observational data from Sharon Pearcey and John De Castro complemented these experimental findings, revealing that individual variability in energy consumed at meals among twelve-month-old infants was close to forty-seven percent, while variability in daily energy intake was seventeen percent.[38] Similarly, Roberta Cohen and colleagues[39] found no difference in daily energy intake among infants four to six months of age who were fed only breast milk versus those who were fed breast milk along with complementary foods, suggesting that infants were adjusting their intake of breast milk in response to the addition of solid foods.

The ability to regulate energy intake has also been described in preschool-age children. Children responded to covert manipulations in the energy content of foods served as first courses by adjusting their subsequent intake, such that their total energy intake for the meal and energy consumed over a thirty-hour period[40] was maintained across conditions in which low- or high-energy foods were provided as a first course. Differences among preschool-age children in their ability to self-regulate energy intake have been associated with differences in weight status. For example, Susan Johnson and Leann Birch examined the influence of weight status on regulation of energy intake in seventy-seven three- to five-year-old children. Each child participated in two treatments, differing only in whether children received a low- or high-calorie preload of fruit flavored drinks of equal volume before lunch. After twenty minutes, children self-selected intake from a familiar lunch menus (i.e., turkey hot dogs, American cheese, unsweetened applesauce, carrot sticks, fruit bars, and 2% milk) to assess their ability to adjust food intake in response to changes in energy density of the preload drinks. They found that children who showed little evidence of adjusting their lunch intake in response to the energy differences in the preloads were significantly heavier.[41] Leann Birch and Jennifer Fisher used a similar protocol to investigate the association between weight status and children's caloric compensation in a sample of 197 non-Hispanic white five-year-old girls. Data were used from two separate lunches which differed in whether a low- or high-energy preload drink was consumed prior to lunch. Again, after a brief delay, participants ate a self-selected lunch (i.e., sandwich, carrots, applesauce, cookies, and milk) *ad libitum*. Results indicated substantial individual differences in the extent to which girls adjusted their energy intake at lunch in response to the differences in preload energy content. On average the girls only compensated for about half of the energy in the preloads. In this case, greater maternal restriction in feeding was associated with poorer compensation and higher weight status in daughters.[42] While infants show a predisposition to respond to differences in energy density early in life, the child's early experience, including child feeding practices, shape the development of individual differences in self-regulation abilities.[43] That infants and young children are capable of self-regulating energy intake under laboratory conditions, in the absence of adult intervention, and in the presence of only simply prepared healthy foods, does not speak to the extent to which this ability can be exercised in current family environments.

The Influence of Genetic Predispositions and Repeated Exposure on Food Acceptance during Infancy and Childhood

Infants do not have to learn preferences for the basic tastes (sweet, salty, sour, bitter, and umami). Rather, they are predisposed to pleasing flavors. Shortly after birth infants express preferences for sweet tastes and reject those that are sour and bitter.[44] Preferences for salt are apparent at approximately four months.[45] These predispositions are thought to have evolved to serve a protective function, by encouraging the consumption of energy-rich foods (often signaled by the sweet taste) and discouraging ingestion of toxins (signaled by bitter and sour tastes).[46] These taste preferences are unlearned, and become very apparent to parents once infants begin the transition from exclusive milk feeding to a modified adult diet. In general, sweet foods such as fruits, flavored yogurts, and juices are readily accepted by infants, while foods such as vegetables, which are not sweet, and may contain bitter components, are initially rejected. Laboratory studies have confirmed that young children readily form preferences for flavors associated with energy rich foods.[47] Even the fruits and vegetables most preferred by children (e.g., bananas, apples, potatoes, and peas) tend to be those that contain the most energy.[48] Innate preferences for energy dense foods may be one catalyst acting to promote energy intake among children in abundant dietary environments.

Alternatively, children's acceptance of foods that have less intrinsic hedonic appeal to children (such as vegetables) are shaped by their experience with those foods. Children decide their food likes and dislikes by eating, and associating food flavors with the social contexts and the

physiological consequences of consumption. The tendency for children to initially reject novel foods is often just a case of neophobia. Several studies have demonstrated that children's preferences for and acceptance of new foods are enhanced with repeated exposure to those foods in a non-coercive setting. New foods may need to be offered to preschool-aged children ten to sixteen times before acceptance occurs. At the same time, simply offering new foods will not necessarily produce liking; having children taste new foods is a necessary part of the process.[49] Awareness of this normal course of food acceptance is important because approximately one quarter of parents with infants and toddlers prematurely drew conclusions about their child's preference for foods after two or fewer exposures.[50]

Transition to the Modified Adult Diet: Food and Beverage Consumption

During the first year of life, eating patterns undergo rapid evolution. Initially, infants obtain all nutrition from a single fluid source (i.e. milk) consumed approximately every two to four hours. By the end of the first year, however, the infant has moved to a modified meal and snack pattern, consuming many foods found in their culture's adult diet. The American Academy of Pediatrics (AAP) recommends breastfeeding for the first four to six months of life, followed by the introduction of complementary foods once the child is developmentally ready.[51] At this point, the evidence regarding the impact of early complementary feeding on the development of obesity is inconsistent. Only four located studies examined the association between the timing of complementary food introduction and weight gain in longitudinal studies. Two of these studies linked the early introduction of solid foods and obesity at twelve months[52] and eighteen months[53] of age, independent of breastfeeding. However, the other studies, using similar designs, failed to note associations between the early introduction of solid foods and childhood obesity at twenty-four months[54] and seven years of age.[55] Therefore, there is a need for well designed prospective, longitudinal studies examining this association in order to better understand the influence of the early introduction of solids on the development of childhood obesity.

Results from a recent survey, the Feeding Infants and Toddlers Study, which provides data on the dietary patterns of 3,022 infants and toddler four to twenty-four months of age, has also raised concerns regarding excessive energy intake as well as the quality of young children's diets.[56] Barbara Devaney and colleagues found that mean reported energy intakes exceeded estimated energy requirements by ten percent for infants four to six months, twenty-three percent for infants seven to twelve months, and thirty-one percent for toddlers twelve to twenty-four months.[57] Analyses also revealed that children consumed significant amounts of energy-dense but nutrient poor foods.[58] For example, french fries were the most common vegetable consumed among fifteen- to eighteen-month-olds, and approximately fifty percent of seven- to eight-month-olds consumed some type of dessert, sweet, or sweetened beverage. Results also revealed that eighteen to thirty-three percent of infants and toddlers consumed no servings of vegetables, and twenty-three and thirty-three percent consumed no fruits. Moreover, fewer than ten percent of infants and toddlers consumed dark green, leafy vegetables.[59] Thus, it appears that parents and caregivers need encouragement to repeatedly offer nutrient dense age-appropriate foods (e.g., fruits, dark green and yellow vegetables, and yogurt) as opposed to convenient energy dense foods and snacks.

The large amounts of fruit juice and sweetened beverages that begin to appear in young children's diets have also been cause for concern. The AAP recommends no more than four to six ounces a day of fruit juice for children one- to six-years old. By nineteen to twenty-four months of age, however, mean intake of children who consumed 100% fruit juice was 9.5 ounces a day, with ten percent of toddlers consuming over fourteen ounces a day.[60] One cross-sectional study of two- and five-year-old children found that consumption of twelve fluid ounces per day of fruit juice was associated with obesity and short stature.[61] The findings of

this study have not been replicated, however, and several longitudinal studies report no association between fruit juice consumption and over-weight.[62] In fact, Melanie Smith and Fima Lifshitz reported an association of excess juice consumption with nonorganic failure to thrive, suggesting that large intakes of fruit juices may displace more calorie and nutrient dense foods.[63]

Alternatively, Jean Welsch and colleagues used a retrospective longitudinal design to evaluate juice intake and the persistence of overweight among two- to three-year-old children.[64] Children identified as at risk for overweight who consumed sweet drinks (e.g., vitamin C containing juices, other juices, fruit drinks, and soda) as infrequently as one to two times daily increased their odds of becoming overweight by sixty percent. Consumption of sweetened beverages (i.e. fruit drinks, soda) has also been associated with excessive weight and weight gain among eleven- to twelve-year-old and nine- to fourteen-year-old children.[65]

Parents as Providers and Models

Parents powerfully shape children's early experiences with food and eating, providing both genes and environments for children. Children's eating patterns develop in the early social interactions surrounding feeding. As young omnivores, they are ready to learn to eat the foods of their culture's adult diet, and their ability to learn to accept a wide range of foods is remarkable, especially given the diversity of dietary patterns across cultural groups. Several decades of research inside and outside of the laboratory have revealed that, as in other areas of children's development, caregivers act as powerful socialization agents.[66] Parents select the foods of the family diet, serve as models of eating that children learn to emulate, and use feeding practices to encourage the development of culturally appropriate eating patterns and behaviors in children.

Caregivers as Providers

Studies conducted outside the laboratory support the notion that children's preference and intake patterns are largely a reflection of the foods that become familiar to them. Research indicates that the extent to which fruits and vegetables are present and readily available and accessible in the home correlates positively with the level of consumption in school-age children.[67] For example, Karen Cullen and colleagues examined the relationships among availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables in a sample of eighty-eight fourth through sixth graders and their parents. Results revealed that availability was the only significant predictor of intake for children reporting high preferences, whereas for children reporting low preferences, availability and accessibility were significantly related to consumption of fruits, vegetables, and 100% fruit juice. Thus, accessibility appears to be particularly important for children with low preferences for fruit, 100% fruit juice, and vegetables.[68] Similarly, Polly Kratt, Kim Reynolds, and Richard Shewchuk examined the role of availability of fruits and vegetables in the home and found that homes with greater availability had a stronger set of motivational factors (e.g., self efficacy and behavioral capability/knowledge of parents) for fruit and vegetable consumption compared to homes with low fruit and vegetable availability. Furthermore, the availability of fruits and vegetables was a moderating variable for intake by both parents and children.[69] The findings are much the same for milk drinking. In a study of beverage intake among girls during middle childhood, milk consumption among girls almost always or always served milk at meals and snacks was two times higher than it was for girls rarely or never served milk. Similarities in milk intake quantities among mothers and daughters were also attributable to the extent that milk was served at meals.[70]

Children's intake of particular foods is influenced not only by the types of foods *present* in the home but also by the *amount* of those foods available to them. Recent laboratory studies provide

causal evidence that large food portions promote greater energy intake by children as young as two years of age. When age-appropriate portions of an entrée were doubled in size, preschool-age children ate approximately twenty-five to twenty-nine percent more than the age-appropriate portions of those foods, even though they consumed only two thirds of the smaller portions of the entrée and were not aware of increases in the portion size.[71] These effects were attributable principally to increases in the average size of children's bites. Children did not adequately reduce their intake of other foods to compensate for their intake of larger portions of the entrée. As a result, energy intake was nine to fifteen percent higher at meals during which larger portions were served.

Adults, like children, eat more when served large portions.[72] However, for children and adults, the intake of large portions is not associated with weight status, suggesting that the relevance of large portions to weight gain is not a function of *exposure* to large portions; rather, it is a particular susceptibility of the overweight adult individual to overeating large portions when available. Evidence from laboratory studies suggests that larger portions served to consumers at restaurants, in convenience and grocery stores, and in other retail settings are driving increases in the average size of portions consumed both at home and away from home,[73] as well as increasing the daily energy intake of children.[74]

Caregivers as Models

Children learn about food through the direct experience of eating *and* by observing the eating behavior of others. Leann Birch found that the selection and consumption of vegetables by preschool-age children were influenced by the choices of their peers.[75] When preschool-age children observed the eating behavior of adults, it had a similar effect. For example, Helen Hendy and Bryan Raudenbush found that children's intake of a novel food increased at those meals during which they observed a teacher enthusiastically consuming the food. Interestingly, enthusiastic modeling by a teacher was not as effective when children were seated with peers who exhibited different food preferences than did their teachers.[76] While one might expect modeling by parents to have a similar if not stronger influence on children's preference and choices, experimental evidence is lacking.

Studies conducted outside the laboratory also provide indirect evidence for the role of social modeling. For example, low-income adolescent girls who reported seeing their fathers consume milk had higher calcium intakes than did those girls who did not see their fathers drink milk.[77] Parental modeling has also been associated with greater fruit juice and vegetable intake among school-age children.[78]

Parenting Styles and Children's Eating Behavior

Parenting, by definition, involves the task of care and feeding one's children. Subsequently, child feeding practices have evolved as parental responses to perceived environmental threats to children's well being.[79] For nearly all of human history, the major threats to child health have been food scarcity and infectious disease. Feeding practices developed to address these threats have been passed from one generation to the next, and have become traditional practices routinely used by parents without question. However, in today's environment, we must ask, “Are these child feeding practices, evolved to address the threats posed by food scarcity and infectious disease, effective in dealing with the current threats to child health posed by too much food, obesity, and its comorbidities?” The simple answer to this question is “no.”

Traditional feeding practices used with infants and young children include feeding children frequently and quickly in response to distress, offering foods designed especially for infants and young children, offering preferred foods if possible, and encouraging children to eat as much as possible when food is available, often involving the use of coercion and force feeding.

There are, of course, differences across cultures in the specifics of these practices and in the particular foods offered to children. There are also differences within cultures among parents' feeding practices. These differences are caused by cultural differences among parents and by their goals for their children. In addition, parents' feeding practices are influenced by children's individual characteristics, including age, sex, weight status, and eating behavior.

Parenting practices and parent-child interaction during feeding vary in the degree to which children are allowed some degree of autonomy in eating.[80] These interactions can have a powerful influence on children's developing food preferences, intake patterns, diet quality, growth, and weight status. However, it is important to note that child feeding practices may have unintended effects on children. For example, parents' feeding practices often include attempts to increase children's intake of nutrient dense foods (e.g., “eat your vegetables”) or restrict children's access to and intake of “unhealthy” or “junk” foods (e.g., “no, you can't have any cookies now”). Parents using these practices may intend to promote healthier diets in children, and perhaps even prevent obesity, but the results of research reveals such attempts can have negative effects on children's food preferences and their self-regulation of energy intake.[81]

In general, parental control of feeding practices, especially restrictive feeding practices, tends to be associated with overeating and poorer self-regulation of energy intake in preschool-age children.[82] The manner in which eating behavior is affected depends on the nature of the directive. For example, using food as reward for good behavior increased preschool-age children's preferences for those foods,[83] and because sweet, palatable foods are often used as rewards, this practice can have the unintended consequence of promoting children's preferences for energy dense palatable foods that are often unhealthy. Parents may also reward children for consuming healthy foods in hopes of increasing children's intake of foods such as vegetables; but research has demonstrated that this practice can actually result in children learning to dislike and avoid those foods.[84]

Restricting children's access to “forbidden” foods also has a paradoxical effect on food preference and energy intake. Research reveals that placing a preferred food in sight, but out of reach, decreases children's ability to exhibit self-control over obtaining the food.[85] As a result, when restriction is lifted, and “forbidden” foods are present, children often have difficulty controlling the amount of food eaten, resulting in overeating and eating in the absence of hunger. For example, Fisher and Birch investigated the effects of restricting three-to five-year-old children's physical access to foods (i.e. apple or peach bar cookies) within their environment. Each child was observed on ten occassions over five weeks. During the restricted-access procedure, children had free access to a control food throughout the twenty minute procedure. In contrast, the restricted food was kept in a large transparent jar in the center of the table. After ten minutes, chidren were granted access to the restricted food for two minutes, followed by the removal of the restricted food from the table. Results revealed that the restricted food elicited more positive comments, more requests, and when it was made available, children took larger portions and ate more, compared to freely accessable control food.[86] These findings indicate that restricing access to palatable foods may be counterproductive in that it may promote their intake. Research with animal models produced a similar pattern when access to a preferred food source was given daily to some rats and on alternating days to others.[87] Furthermore, longitudinal research reveals that at least among middle class white families with daughters, maternal use of restrictive feeding practices predicts uninhibited overeating and greater weight gain.[88]

Excessive parental control and pressure to eat may also influence dietary intake and disrupt children's short-term behavioral control of food intake. For example, longitudinal studies have reported that higher levels of parental control and pressure to eat were associated with lower

fruit and vegetable intakes[89] and higher intake of dietary fat[90] among young girls. Moreover, in a study of children's feeding practices, encouraging children to eat by focusing their attention on the amount of food on the plate promotes greater consumption and makes children less sensitive to the caloric content of the foods consumed.[91] Thus, pressuring children to eat their vegetables in order to leave the table or as a contingency to receiving dessert may ultimately lead to the dislike of those vegetables.

Controlling feeding practices are not likely used in isolation, but rather represent the caregiver's broader approach to child feeding. Indeed, parents of preschoolers who reported placing greater restrictions on their children's eating also reported using higher levels of pressure or coercion in feeding.[92] These practices are thought to typify an authoritarian style of feeding in which eating demands placed on the child are relatively high, but responsiveness to the child's needs or behavior is relatively low.[93] Unlike specific practices, feeding styles are believed to be stable over time and characterize parent-child interactions across a wide range of situations. Several studies have observed that authoritarian parents have fewer fruits and vegetables available in the home and their children consume smaller amounts of those foods.[94] Specifically, Heather Patrick and colleagues examined the association between parent feeding styles and children's food consumption patterns of Head Start preschoolers and their parents. Results indicated that authoritative feeding was positively associated with the availability of fruits and vegetables and attempts to get their child to eat those foods. In contrast, authoritarian feeding was associated with lower availability of fruits and vegetables. In addition, actual consumption of these foods varied by feeding style; authoritative feeding was positively associated with the consumption of dairy and vegetables, in contrast, authoritarian feeding was negatively associated with vegetable intake.[95]

Authoritative styles of feeding are also characterized by the high demands or expectations placed on the child while eating. Unlike authoritarian parents, however, those with authoritative styles tend to be highly responsive to the child's eating cues and behaviors. Authoritative parenting has been associated with greater home availability of fruits and vegetables as well as greater child consumption of dairy, fruits, and vegetables and lower consumption of junk foods.[96] The balance of setting limits and clear expectations with consideration of the child's needs is thought to promote appropriate nutrition and growth. In fact, empirical data on feeding styles and their influence on weight and weight gain are quite limited. Recent findings from the National Institute of Child Health and Human Development *Study of Early Child Care and Youth Development* revealed a protective association of authoritative parenting style with risk of overweight among five-year-old children. Among a national sample of 872 socio-economically and ethnically diverse families with young children, authoritarian parents were almost five times as likely to have an overweight child as authoritative parents, after statistically adjusting for potentially confounding effects of race and income.[97] These findings reveal that the consistent use of authoritative feeding practices, which set clear expectations for children's eating behavior and are responsive to children's needs, can reduce the risk of obesity.

Finally, feeding styles involving low demand and low responsiveness to the child are considered neglectful whereas those with low demand and high responsiveness to the child are indulgent. These permissive styles of feeding would logically appear to engender overnutrition and overweight among those children exposed to the current dietary environment of abundance. However, this assertion remains unproven. In one study, neglected children, possibly reflecting permissive parenting styles, had a greater risk of adult obesity.[98] However, feeding styles and their effects on dietary intake were not considered. In a more recent study of low-income African-American and Hispanic families, children of parents using indulgent feeding styles had higher weight status scores compared to children with authoritarian parents.[99]

Differing Perceptions of Healthy Weight: Socioeconomic and Cultural Contexts

Parents' approach to feeding their children reflects their goals for their children's eating and health,[100] and these goals are influenced by culture and socioeconomic status. For example, among middle-income, non-Hispanic white families, mothers who employed greater restrictions in feeding their daughters had greater concerns about their daughters becoming overweight.[101] Overweight, however, is not universally perceived as a detriment to health, especially for infants and very young children. For example, low-income mothers have reported that a heavy infant is viewed as a sign of a healthy child and successful parenting. Parents who view a child large for their age as healthy are unlikely to be concerned about child overweight, or to use restrictive feeding practices to prevent overweight. Given such values, caregivers may interpret infant behavior in terms of potential hunger and take specific care to prevent that state. Indeed, low-income mothers often interpret nonspecific behaviors such as frequent crying as signs of hunger. Consequently, feeding practices that are at odds with current recommendations, including concentrating formula or adding cereal to formula, or introducing solid foods before four months of age may be adopted by mothers who value having bigger babies.[102]

Cultural, socioeconomic and psychological factors also may shape parents' perceptions of a healthy weight for their children. Data from the Third National Health and Nutrition Examination Survey (1988-1994) indicate that nearly one third of mothers with overweight children do not perceive their children as being over-weight.[103] Among low-income populations, seventy to eighty percent of mothers perceive their overweight child to be of normal weight or even underweight.[104] In addition, low-income mothers of young children have reported that social stigmatization, physical limitations, and lack of a healthy diet are more relevant indicators of problematic weight than are objective measurements.[105] These findings indicate that low-income parents desire their children to be at a healthy weight, but differ from health care professionals in their view of just what constitutes a “healthy” weight.

Summary and Suggestion for Intervention

Experiences with food flavors begin very early; the fetus becomes familiar with the flavors of the maternal diet during pregnancy, and the breastfed infant experiences the flavors of the maternal diet in breast milk. This early experience provides a “flavor bridge,” which can promote the infant's acceptance of the foods from the maternal diet. As children make the transition to the modified adult diet of their culture, children's food preferences and their diets reflect the foods that are available and accessible to them; parental modeling and familiarity plays an important role in their developing food preferences.

These findings suggest a number of potential early intervention approaches that could be used during infancy and very early childhood to promote healthier intake patterns. The implication of the research findings is that if we want children to learn to like and eat healthy foods such as vegetables, they need early, positive, and repeated experiences with those foods, as well as opportunities to observe others consuming those foods. The natural tendency of children to prefer sweet or salty, caloric rich foods over energy-poor but micronutrient-rich alternatives highlights the need for adult intervention to provide a varied and healthful diet. As such, caregivers play a critical role in determining which kinds of foods will become familiar to their children – from the foods kept routinely in the cupboard to those served regularly at the family table and even those consumed away from home. Caregivers also act as important gatekeepers to the social influences surrounding children's eating, including access to media and modeling. Because observing the eating behavior of others influences children's acceptance of foods, decisions about how often families eat together, who is present during family meals, as well

as what is served, will dictate what is consumed and what children learn to like and eat. Evidence regarding the poor nutritional quality of table foods infants and toddlers are consuming as they transition to the adult diet reveals a need for parental guidance regarding the importance of offering healthy foods, avoiding restrictive and coercive feeding practices and serving as positive models of eating behavior for their infants and young children.

Although children possess an innate ability to self-regulate their energy intake, the extent to which they exercise this ability is determined by environmental conditions: for example, offering large food portions, calorically rich, sweet or salty palatable foods; the use of controlling feeding practices that pressure or restrict eating; and the modeling of excessive consumption can all undermine self-regulation of energy intake in children. As indicated previously, these current manifestations of traditional child feeding practices, which involve promoting children's intake, can be maladaptive in the current food environment where food surfeit, obesity, and chronic disease have replaced food scarcity and infectious disease as major threats to children's health.

A major theme of this review is that the strategies parents use to feed their children and the effects of those strategies on children's eating and health are influenced by the broader context in which feeding is embedded. As such, culture, tradition and context reveal what is valued and what actions are taken to achieve feeding goals. As a part of culture, by definition, these feeding practices are not readily subject to change. However, since the threats provided by current eating environments have changed, changes in traditional feeding practices are needed. A first step in initiating change in traditional feeding practices is to provide parents with information to change parents' perceptions and concerns regarding the threat that obesity poses to their children's growth and health.

In the current context, feeding strategies that are responsive to children's hunger and satiety cues and which encourage children's attention to hunger and fullness are needed to support self-regulation. However, these approaches to child feeding are a clear departure from the traditional feeding practices, which have evolved to promote children's intake whether or not they are hungry. Influential parenting factors reveal that in order to change parenting practices, we need to alter parent's beliefs regarding current threats to children's health. In this instance, parents need to learn that a large, rapidly growing child who is crossing percentiles on the growth chart is not a sign of successful parenting, but a cause for concern, and that guidance may be needed regarding alternative approaches to feeding. The challenge will be providing parents with information that will alter their concerns and perceptions regarding overweight as a threat to child health, and with guidance on alternative feeding strategies, which can be effective in promoting healthy weight in an environment that encourages excessive consumption.

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