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[Archived] Early Behavioural, Familial and Psychosocial Predictors of Overweight and Obesity

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Introduction

The first five years of life are a critical period for the development of food and flavour preferences, the ability to self-regulate food intake, the transmission of cultural and familial beliefs about food and eating, and the susceptibility to overweight and obesity later in life. Many characteristics of the child, as well as factors related to the child's parents and home environment, may also influence the development of overweight and obesity during this early period. The early predictors of overweight and obesity are complex; thus, an exhaustive examination of the early predictive factors is beyond the scope of this review. Instead, several behavioural, familial and psychosocial influences that occur during the zero- to five-year-old period will be highlighted.

Subject

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In the United States, as well as worldwide, there have been dramatic increases in the rates of overweight and obesity.[1-2] The Pediatric Nutrition Surveillance System (PedNSS) reported that, in 2001, 13.1% of children from birth to age five were overweight (BMI-for-age at or above the 95th percentile). Recent results from the 1999-2000 National Health and Nutrition Examination Survey (NHANES) indicate that, among United States children aged six through 19 years, 31% were at risk for overweight or overweight, and 16% of that 31% were classified as overweight.[3] In adults, nearly two-thirds (65.1%) of the United States population was classified as overweight in 1999-2002.[3] Within this group, 30.4% were classified as obese and 4.9% as extremely obese.[3]

In both children and adults, there are several comorbidities associated with overweight and obesity.[4] Metabolic syndrome, type 2 diabetes mellitus, glucose intolerance, inflammation, orthopedic problems, cardiovascular disease, fatty liver disease, renal dysfunction and sleep apnea are just some of the adverse physical outcomes related to obesity during both childhood and adulthood.[4-5] Psychological problems, for example depression and reduced quality of life, are also serious correlates of obesity.[5] The mortality and multitude of adverse outcomes associated with obesity provide evidence of the need for a clear understanding of the predictors and causes of overweight and obesity during childhood to effectively guide early prevention and treatment efforts.

Key Research Questions

This review focuses on discussing the following three questions:

1. What are the impacts of infant feeding practices on the development of overweight and obesity?
2. What aspects of the introduction of and transition to solid foods are important for the development of overweight?
3. What are the parental and environmental influences on the development of dietary patterns and weight status during the toddler period (two to five years of age)?

Recent Research Results

Infant feeding practices and obesity

Breastfeeding is recommended as the optimal feeding method for the first six months of life, followed by the introduction of solid foods, with continued breastfeeding for a minimum of one

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year.[6] Although these recommendations are based on evidence for the protective effects of breast milk against chronic or infectious diseases and infant mortality, recent evidence has suggested breastfeeding may have additional protective benefits against overweight later in life. There are several hypotheses concerning the protective effects of breastfeeding against obesity; these effects may be attributable to biological and/or behavioural processes (for a review, see[7-9]).

Kramer[10] was the first to report an association between breastfeeding and protection against subsequent obesity. Since then, several other studies have attempted to elucidate the factors that confound and/or mediate the association between breastfeeding and weight status in later childhood. Although the present review is focused on psychosocial and behavioural predictors of overweight, it should be noted that much literature has suggested breast milk may have an effect on metabolic programming, which may provide later obesity protection. Breast milk has been shown to have positive effects on plasma insulin levels, lipoprotein profile and leptin sensitivity,[11-13] all of which are associated with body composition and health outcomes later in life.

With respect to behavioural effects of the breastfeeding experience, one possible protective factor is that breastfeeding may influence parental control of child consumption patterns. Fisher and colleagues found that mothers who had breastfed their infants for at least 12 months used less control over feeding when their infants were 18 months old.[14] This suggests that mothers who choose longer durations of breastfeeding may be less likely to use restrictive feeding practices, allowing their children to be more capable of learning effective self-regulation of food intake. Another possible mechanism by which breastfeeding may help prevent overweight and obesity is the experience breast milk provides for sensory development during the early postnatal period.[15] Before ever tasting solid food, a breastfed baby will experience the flavours of the mother's diet through breast milk, as the flavours in the diet of the mother are transmitted to the baby during feeding.[16] This experience is lacking for a formula-fed infant who receives a monotone flavour with each feeding. It is hypothesized that this experience allows breastfed infants to be more accepting of a broader variety of typically rejected foods (i.e. vegetables) than formula-fed infants, because these flavours are not novel. This may lead these individuals to consume a more varied, better-quality diet later in life, thus preventing overweight and obesity. Finally, it is also plausible that the associations seen between breastfeeding and later obesity risk are confounded by family characteristics, such as parent education levels, socioeconomic status or tendencies to lead healthier lifestyles. More studies controlling for these factors are needed to determine whether breastfeeding has effects over and above the characteristics of the

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parents and environment on the development of overweight and obesity.

Introduction of and transition to solid foods and obesity

Solid food introduction: As mentioned above, breastfeeding is recommended as the optimal feeding method for the first six months of life, followed by the introduction of solid foods between four and six months, when the child is developmentally ready. The guidelines also suggest that fruit juice is not a necessary part of an infant's diet and that, in any event, fruit-juice intake be limited to eight ounces per day after its initialintroduction at six months of age.[17] A study of two- and five-year-old children found that consumption of 12 fl oz/day of fruit juice was associated with obesity and short stature.[18] Similarly, Smith and Lifshitz found that excess juice consumption was associated with nonorganic failure to thrive, suggesting that large intakes of fruit juices may displace more calorie- and nutrient-dense foods.[19] However, longitudinal studies have failed to demonstrate an association between juice intake and anthropometric indices.[20-21]

Several studies have investigated the timing of adding supplementary foods and weight status. A study of infants from birth to one year of age revealed that breastfeeding and delayed introduction of solid foods were significant predictors of BMI and skinfold measurement at one year, but did not remain significant at two years.[22] Wilson and colleagues[23] found that feeding solid foods before 15 weeks was associated with an increased probability of wheezing and increased percentage of body fat in childhood compared to infants that were exclusively breastfed. Thus, the late introduction of solids may have a beneficial effect on childhood health. In contrast, a study investigating the effect of adding supplementary foods (cereal, fruit, juice, vegetables or meat) on infant growth at two to eight months and 12 to 24 months of age revealed that the timing of adding supplementary foods to the diet was not significantly associated with changes in weight or length for an infant's age. The only significant predictor of weight gain was weight prior to 12 months.[24] Similar results were observed in a study revealing that there was no difference in energy intake, growth and body composition between early (three to 12 months) introduction and late (six to 12 months) introduction of solids.[25] However, early introduction of solids may increase the risk of allergic reactions.[26]

Despite the AAP recommendations, the Feeding Infants and Toddlers Study (FITS), a national random sample of 3,022 four- to 11-month-olds revealed that two-thirds of infants were introduced to complementary foods between four and six months of age, 17% consumed juice prior to six months of age, and 22% of infants consumed cow's milk prior to 12 months of age.[27]

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The FITS data also suggests that four- to 24-month-old children are consuming significant amounts of developmentally inappropriate foods that are high in energy density and low in nutrients that are often sweet and salty.[28] For example, energy intakes among this age group exceed requirements by 20 to 30%.[29] Eighteen to 33% of infants and toddlers consumed no discrete servings of vegetables and 23% to 33% consumed no fruit. Also note that French fries were one of the three most common vegetables consumed by infants nine to 11 months of age, and 50% of seven- to eight-month-old infants consumed some type of dessert, sweet, or sweetened beverage.[28] Thus, it is likely that the availability of high-energy dense food is contributing to energy intakes that are in excess of energy requirements.[29]

Repeated exposure to and acceptance of fruits and vegetables: Food acceptance can be defined as food selection, food preference, and how much of a particular item is consumed. Children naturally prefer sweet and salty tastes and do not need to learn to like these foods.[30-32] Consuming these foods in excess can result in adiposity (fat accumulation) since they are usually energy-dense and have low nutrient values. In contrast, young children often initially reject healthy foods such as vegetables that are not sweet or salty. However, when given the opportunity to taste new foods repeatedly, without coercion, children learn to like new foods that they had once rejected.[33,34,35] Previous research has found that repeated exposure to new foods increased preference for the intake of those foods among two- to five-year-old children. The first study to investigate the differential levels of exposure (zero to 20 exposures) to unfamiliar foods on two-year-old children's food preference revealed that repeated exposure is an effective means of increasing preference.[35] Similar results were observed in four- to five-year-olds.[34] Furthermore, it may take 10 to 16 exposures before repeated exposure to a novel food is effective at increasing intake.[33,34] In addition, research suggests that tasting the novel food is imperative to promoting increased liking; looking at and smelling the novel foods is not enough.[33] Thus, providing repeated exposure to novel foods can increase children's preference for fruits and vegetables, increasing intake, which may prevent over-consumption of high energy-dense sweet and salty foods.

Parental influences and obesity

Parental modelling: It has been suggested that parents should model healthful eating behaviours in an effort to develop eating behaviours and lower the risk of obesity for their children.[36] While few studies have reported on this topic, the empirical evidence available tends to support this hypothesis. Results from a study of five-year-old girls indicated that mothers' fruit and vegetable

intake was positively associated with daughters' fruit and vegetable intake.[37] In another study of three- to five-year-old children and their parents, the frequency of consumption offamily meals, where adults tend to eat the most healthful foods, was associated with increased vegetable intake among young children.[38] Similar findings in the area of energy-dense foods (e.g. palatable, calorie-dense) have been reported, such that parental modelling of unhealthful foods and dietary practices are positively associated with young children's consumption of unhealthful foods.[39] Parental preferences and consumption of healthful or unhealthful foods may also be an indication of foods that parents make available for their children, thus influencing the foods children are most familiar with and more likely to accept.[32]

Parents' own eating behaviours are associated with children's eating behaviours and weight status. For example, in a study of three- to six-year-olds, Cutting and colleagues[40] reported that mothers' own disinhibition (eating in the absence of hunger) mediated the relation between mothers' BMI and their daughters' overweight status. In the same study,[40] it was also reported that mothers' dietary disinhibition independently predicted girls' overweight status and was positively associated with girls' food intake after the consumption of a meal. While this study did not examine whether dietary disinhibition was directly observed by children, given that mothers are primarily responsible for child- rearing duties, including meal preparation and child-feeding, it is possible that daughters may have adopted the maternal eating behaviours that they observed. Maternal modelling of disinhibition, which has been associated with binge eating and overweight status, [41] is of particular concern, as girls' adoption of mothers' disinhibited eating style may increase girls' risk for overweight.

Parental restriction over children's food intake: Children have a natural affinity for highly palatable foods. While most parents at some time or another restrict their children's intake in order to promote moderate consumption of these types of foods, excessive restriction over children's consumption of certain foods may have unintended negative effects on children's ability to self-regulate their food intake, and their weight status.[42] The practice of restriction, which involves parental control over the amount or type of food that children consume, may heighten children's interest in, preferences for and attempts to obtain the restricted food.[43] In a study of three- to five-year-old children, it was reported that maternal restriction of palatable foods (food high in fat and sugar) was positively associated with child consumption of palatable foods when given free access.[44]

Whether parental restriction is the cause of or result of child weight status is not fully understood. There may be a bidirectional relationship between these phenomena.[45] For example, child weight status may encourage parental restriction, which contributes to increased weight status among children, resulting in a cyclical pattern of child weight gain and parental restriction. The results of this cycle may disrupt children's ability to self-regulate their food intake, leading to disinhibition, or eating in the absence of hunger,[44] further contributing to excess weight gain. In sum, use of excessive restriction, while well-intended, may contribute to the disruption of children's ability to naturally regulate their food intake, and contribute to the consumption of restricted foods when they are readily available.

Pressure to eat (e.g. encouraging children to consume more food, especially fruit and vegetables) is another strategy that has been associated with child weight status. In a study of five-year-old girls, mothers who perceived their daughters as being underweight reported pressuring their daughters to eat more than mothers who perceived their daughters as being overweight.[45] Another prospective study reported that parental pressure to eat when children were five years of age was negatively associated with child BMI-for-age z-scores two years later.[46] Other studies have reported varying relations between child weight status and parental encouragement to eat, a construct closely related to pressure to eat. McKenzie and colleagues[47] found that parental encouragement to eat during meals was negatively associated with child BMI. However, during mealtime observations of 12- to 30-month-old infants with their parents, Klesges and colleagues[48] found that parental encouragement to eat was positively associated with infants' relative weight.

While results of the aforementioned studies suggest that in general, parental pressure and encouragement to eat may be in response to parents' perception of their child being underweight, it is possible that parents may use a combination of restrictive and pressure- to-eat feeding strategies in an effort to help their children manage or reduce their weight and to accept healthful foods. Parents may restrict their children's consumption of energy-dense snack foods, while pressuring them to eat healthy foods (e.g. fruit and vegetables), independent of their child's weight status.[49]Regardless of the motivation for using restrictive or pressure-to-eat feeding practices, excessive use of either method may have negative impacts on child food intake and weight status. Parental pressure to eat certain foods may in fact decrease children's preferences for the food, while restricting the intake of other foods may encourage over-consumption of the restricted foods when made available, increasing the child risk for overweight.

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Conclusions

The current literature provides much evidence that the first five years of life are an important period for the development of overweight and obesity. With respect to early feeding choices, both the decision to breast- or bottle-feed and the timing of the introduction of solid foods appear to have an impact on later weight status. Food-related parenting, such as repeated exposure to foods, modelling and use of restriction, also plays a key role in helping children develop healthy food preferences and self-regulation of intake. There is still a need for research to identify the specific factors that contribute to obesity during childhood and predict obesity later in adolescence and adulthood, but the knowledge presently available suggests that attention should be given to the feeding experience during the first five years of life.

Implications

Obesity is costing the United States billions of dollars in both medical costs and loss of productivity.[50] As the current ability to successfully treat obesity is low, a focus should be placed on prevention during early childhood.[51] Also, given that birth weight and childhood overweight are associated with adult obesity and obesity-related comorbities, these times of life may be prevention- and intervention-critical periods.[5] Research on early behavioural factors that predict subsequent overweight can provide needed evidence for the development and evaluation of behavioural interventions to prevent and/or treat obesity. The factors that contribute to overweight and obesity during early childhood, when children are more receptive to intervention and more pliable to habit development and change, need to be understood to aid in the design and success of effective prevention, intervention and treatment programs. If obesity can be targeted and prevented during the first years of life, many of the problems associated with obesity can be circumvented before they occur. As obesity is associated with both physical and mental impairments that are long-lasting, the need to prevent this problem is a high priority.

References

1. Lobstein T, Baur L, Uauy R, IASO International Obesity TaskForce. Obesity in children and young people: a crisis in public health. *Obesity Reviews* 2004;5 Suppl 1:4-104.
2. Popkin BM, Gordon-Larsen P. The nutrition transition: worldwide obesity dynamics and their determinants. International Journal of Obesity and Related Metabolic Disorders 2004;28 Suppl 3:S2-9.
3. Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999-2002. *JAMA - Journal of the American Medical Association* 2004;291(23):2847-2850.

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4. Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics* 1998;101(3 Pt 2):518-525.
5. Daniels SR, Arnett DK, Eckel RH, Gidding SS, Hayman LL, Kumanyika S, Robinson TN, Scott BJ, St Jeor S, Williams CL. Overweight in children and adolescents: pathophysiology, consequences, prevention, and treatment. *Circulation* 2005;111(15):1999-2012.
6. Breastfeeding and the use of human milk. American Academy of Pediatrics. Work Group on Breastfeeding. *Pediatrics* 1997;100(6):1035-1039.
7. Dewey KG. Is breastfeeding protective against child obesity? *Journal of Human Lactation* 2003;19(1):9-18.
8. Dietz WH. Breastfeeding may help prevent childhood overweight. *JAMA - Journal of the American Medical Association* 2001;285(19):2506-2507.
9. Arenz S, Ruckerl R, Koletzko B, von Kries R. Breast-feeding and childhood obesity--a systematic review. International Journal of Obesity and Related Metabolic Disorders 2004;28(10):1247-1256.
10. Kramer MS. Do breast-feeding and delayed introduction of solid foods protect against subsequent obesity? *Journal of Pediatrics* 1981;98(6):883-887.
11. Lucas A, Sarson DL, Blackburn AM, Adrian TE, Aynsley-Green A, Bloom SR. Breast vs bottle: endocrine responses are different with formula feeding. *Lancet* 1980;1(8181):1267-1269.
12. Singhal A, Cole TJ, Fewtrell M, Lucas A. Breastmilk feeding and lipoprotein profile in adolescents born preterm: follow-up of a prospective randomised study. *Lancet* 2004;363(9421):1571-1578.
13. Savino F, Nanni GE, Maccario S, Costamagna M, Oggero R, Silvestro L. Breast-fed infants have higher leptin values than formula-fed infants in the first four months of life. *Journal of Pediatric Endocrinology* 2004;17(11):1527-1532.
14. Fisher JO, Birch LL, Smiciklas-Wright H, Picciano MF. Breast-feeding through the first year predicts maternal control in feeding and subsequent toddler energy intakes. *Journal of the American Dietetic Association* 2000;100(6):641-646.
15. Mennella JA, Jagnow CP, Beauchamp GK. Prenatal and postnatal flavor learning by human infants. *Pediatrics* 2001;107(6):E88.
16. Mennella JA, Beauchamp GK. Early flavor experiences: research update. *Nutrition Reviews* 1998;56(7):205-211.
17. American Academy of Pediatrics. Committee on Nutrition, Kleinman RE, ed. *Pediatric nutrition handbook*. 4th ed. Elk Grove Village, Ill: The Academy; 1998.
18. Dennison BA, Rockwell HL, Baker SL. Excess fruit juice consumption by preschool-aged children is associated with short stature and obesity. *Pediatrics* 1997;99(1):15-22.
19. Smith MM, Lifshitz F. Excess fruit juice consumption as a contributing factor in nonorganic failure to thrive. *Pediatrics* 1994;93(3):438-443.
20. Skinner JD, Carruth BR. A longitudinal study of children's juice intake and growth: the juice controversy revisited. *Journal of the American Dietetic Association* 2001;101(4):432-437.
21. Alexy U, Sichert-Hellert W, Kersting M, Manz F, Schoch G. Fruit juice consumption and prevalence of obesity and short stature in German preschool children: results of the DONALD Study. Dortmund Nutritional and Anthropometrical Longitudinally Designed. *Journal of Pediatric Gastroenterology and Nutrition* 1999;29(3):343-349.
22. Kramer MS, Barr RG, Leduc DG, Boisjoly C, McVey-White L, Pless IB. Determinants of weight and adiposity in the first year of life. *Journal of Pediatrics* 1985;106(1):10-14.
23. Wilson AC, Forsyth JS, Greene SA, Irvine L, Hau C, Howie PW. Relation of infant diet to childhood health: seven year follow up of cohort of children in Dundee infant feeding study. *BMJ - British Medical Journal* 1998;316(7124):21-25.

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24. Carruth BR, Skinner JD, Houck KS, Moran JD. Addition of supplementary foods and infant growth (2 to 24 months). *Journal of the American College of Nutrition* 2000;19(3):405-412.

25. Mehta KC, Specker BL, Bartholmey S, Giddens J, Ho ML. Trial on timing of introduction to solids and food type on infant growth. *Pediatrics* 1998;102(3 Pt 1):569-573.

26. Ferguson A. Definitions and diagnosis of food intolerance and food allergy: consensus and controversy. *Journal of Pediatrics* 1992;121(5 Pt 2):S7-S11.

27. Briefel RR, Reidy K, Karwe V, Devaney B. Feeding infants and toddlers study: Improvements needed in meeting infant feeding recommendations. *Journal of the American Dietetic Association* 2004;104(1 Suppl 1):S31-S37.

28. Fox MK, Pac S, Devaney B, Jankowski L. Feeding infants and toddlers study: What foods are infants and toddlers eating? *Journal of the American Dietetic Association* 2004;104(1 Suppl 1):S22-S30.

29. Devaney B, Ziegler P, Pac S, Karwe V, Barr SI. Nutrient intakes of infants and toddlers. *Journal of the American Dietetic Association* 2004;104(1 Suppl 1):S14-S21.

30. Birch LL. Children's preferences for high-fat foods. *Nutrition Reviews* 1992;50(9):249-255.

31. Birch LL. Preschool children's food preferences and consumption patterns. *Journal of Nutrition Education* 1979;11(4):189-192.

32. Birch LL. Development of food preferences. *Annual Review of Nutrition* 1999;19:41-62.

33. Birch LL, McPhee L, Shoba BC, Pirok E, Steinberg L. What kind of exposure reduces children's food neophobia? Looking vs tasting. *Appetite* 1987;9(3):171-178.

34. Sullivan SA, Birch LL. Pass the sugar, pass the salt: Experience dictates preference. *Developmental Psychology* 1990;26(4):546-551.

35. Birch LL, Marlin DW. I don't like it; I never tired it: effects of exposure on two-year-old children's food preferences. *Appetite* 1982;3(4):353-360.

36. Ritchie L, Crawford P, Woodward-Lopez G, Ivey S, Masch M, Ikeda J. *Prevention of childhood overweight -- what should be done?* Berkerly, Calif: Center for Weight and Health, University of California at Berkeley; 2001. Available at: http://nature.berkeley.edu/cwh/PDFs/Prev_Child_Oweight_10-28-02.pdf. Accessed December 2, 2005.

37. Fisher JO, Mitchell DC, Smiciklas-Wright H, Birch LL. Parental influences on young girls' fruit and vegetable, micronutrient, and fat intakes. *Journal of the American Dietetic Association* 2002;102(1):58-64.

38. Cooke LJ, Wardle J, Gibson EL, Sapochnik M, Sheiham A, Lawson M. Demographic, familial and trait predictors of fruit and vegetable consumption by pre-school children. *Public Health Nutrition* 2004;7(2):295-302.

39. Fisher JO, Mitchell DC, Smiciklas-Wright H, Birch LL. Maternal milk consumption predicts the tradeoff between milk and soft drinks in young girls' diets. *Journal of Nutrition* 2001;131(2):246-250.

40. Cutting TM, Fisher JO, Grimm-Thomas K, Birch LL. Like mother, like daughter: familial patterns of overweight are mediated by mothers' dietary disinhibition. *American Journal of Clinical Nutrition* 1999;69(4):608-613.

41. Williamson DA, Lawson OJ, Brooks ER, Wozniak PJ, Ryan DH, Bray GA, Duchmann EG. Association of body mass with dietary restraint and disinhibition. *Appetite* 1995;25(1):31-41.

42. Faith MS, Scanlon KS, Birch LL, Francis LA, Sherry B. Parent-child feeding strategies and their relationships to child eating and weight status. *Obesity Research* 2004;12(11):1711-1722.

43. Fisher JO, Birch LL. Restricting access to palatable foods affects children's behavioral response, food selection, and intake. *American Journal of Clinical Nutrition* 1999;69(6):1264-1272.

44. Fisher JO, Birch LL. Restricting access to foods and children's eating. *Appetite* 1999;32(3):405-419.

45. Francis LA, Hofer SM, Birch LL. Predictors of maternal child-feeding style: maternal and child characteristics. *Appetite* 2001;37(3):231-243.

46. Faith MS, Berkowitz RI, Stallings VA, Kerns J, Storey M, Stunkard AJ. Parental feeding attitudes and styles and child body mass index: prospective analysis of a gene-environment interaction. *Pediatrics* 2004;114(4):e429-e436.

47. McKenzie TL, Sallis JF, Nader PR, Patterson TL, Elder JP, Berry CC, Rupp JW, Atkins CJ, Buono MJ, Nelson JA. BEACHES: An observational system for assessing children's eating and physical activity behaviors and associated events. *Journal of Applied Behavior Analysis* 1991;24(1):141-151.

48. Klesges RC, Coates TJ, Brown G, Sturgeontillisch J, Moldenhauerklesges LM, Holzer B, Woolfrey J, Vollmer J. Parental influences on children's eating behavior and relative weight. *Journal of Applied Behavior Analysis* 1983;16(4):371-378.

49. Lee Y, Mitchell DC, Smiciklas-Wright H, Birch LL. Diet quality, nutrient intake, weight status, and feeding environments of girls meeting or exceeding recommendations for total dietary fat of the American Academy of Pediatrics. *Pediatrics* 2001;107(6):e95.

50. Wolf AM, Colditz GA. Current estimates of the economic cost of obesity in the United States. *Obesity Research* 1998;6(2):97-106.

51. Wang LY, Yang QH, Lowry R, Wechsler H. Economic analysis of a school-based obesity prevention program. *Obesity Research* 2003;11(11):1313-24.

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